Risk Premia Harvesting Through Momentum

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Abstract

Momentum is the premier market anomaly. It is nearly universal in its applicability. Rather than focus on momentum applied to particular assets or asset classes, this paper explores momentum with respect to what makes it most effective. We do this first by introducing a hurdle rate filter before we can initiate long positions. This ensures that momentum exists on both an absolute and relative basis and allows momentum to function as a tactical overlay. We then explore the factor most rewarded by momentum - extreme past returns, i.e., price volatility. We identify high volatility through the paired risk premiums in foreign/U.S. equities, high yield/credit bonds, equity/mortgage REITs, and gold/Treasury bonds. Using modules of asset pairs as building blocks lets us isolate volatility related risk factors and use momentum to effectively harvest risk premium profits.

[1] http://optimalmomentum.com An earlier version of this paper with a different title was the first place winner of the 2012 NAAIM Wagner Awards for Advancements in Active Investment Management.

Introduction

Momentum is the tendency of investments to persist in their relative performance. Assets that perform well over a 6 to 12 month period tend to continue to perform well into the future. The momentum effect of Jegadeesh and Titman (1993) is one of the strongest and most pervasive financial phenomena. Researchers have verified its existence in U.S. stocks (Fama and French (2008)), industries (Moskowitz and Grinblatt (1999), Asness, Porter and Stevens (2000)), styles (Lewellen (2002), Chen and DeBondt (2004)), foreign stocks (Rouwenhorst (1998), Chan, Hameed and Tong (2000), Griffen, Ji and Martin (2005)), emerging markets (Rouwenhorst (1999)), country indices (Bhojraj and Swaminathan (2006), Fama and French (2011)), commodities (Pirrong (2005), Miffre and Rallis (2007)), currencies (Menkoff, Sarno, Schmeling, and Schrimpf (2011), Okunev and White (1993)), international government bonds (Asness, Moskowitz and Pedersen (2009)), corporate bonds (Jostova, Nikolova and Philipov (2010)), and residential real estate (Beracha and Skiba (2011)). Since its first publication, momentum has been shown to work going forward in time (Grundy and Martin (2001), Asness, Moskowitz, and Pedersen (2009)) and back to the Victorian age (Chabot, Ghysels and Jagannathan (2009)).

There has also been considerable study of exogenous factors that influence momentum. In a recent paper, Bandarchuk, Pavel and Hilscher (2011) reexamine

some of the factors that have previously been shown to impact momentum in the equities market. These include analyst coverage, illiquidity, price level, age, size, analyst forecast dispersion, credit rating, r squared, market-to-book, and turnover. The authors show that all these factors are proxies for extreme past returns, or high volatility. Greater momentum profits simply come from more volatile assets.

With respect to fixed income, Jostova, Niklova and Philipov (2010) show that momentum strategies are highly profitable among non-investment grade corporate bonds. High yield, non-investment grade corporate bonds have, by far, the highest volatility among bonds of similar maturity. This may indicate that credit default risk is also a proxy for volatility risk.

The real estate market and long-term Treasury bonds are also subject to high volatility due to their sensitivity to interest rate risk and economic conditions. Gold is subject to high volatility as well, due to its response to economic stress and uncertainty. In this paper, we will examine momentum with respect to high volatility associated with all four markets - equities, bonds, real estate, and gold.

Before proceeding, we need to distinguish between relative and absolute momentum. When we consider two assets, momentum is positive on a relative basis if one asset has appreciated more than the other has. However, momentum is negative on an absolute basis if both assets have declined in value.

Most momentum researchers use long and short positions to examine both the long and short side of a market simultaneously. They are therefore only concerned with relative momentum. It makes little difference whether the studied markets go up or down, since short momentum positions hedge long ones and vice versa. Relative momentum can help one identify when assets will remain strong relative to others, but if a market as a whole is in a downtrend, then all related assets are likely to sustain loses.

When looking only at long side momentum, however, it is desirable to be long only when both absolute and relative momentum is positive, since momentum results are highly regime dependent. Fortunately, there is a way to put the odds in one's favor with respect to momentum profits from long positions. Positive momentum means an asset that has outperformed over the past twelve months is likely to continue doing so. To determine absolute momentum, we see if an asset has outperformed Treasury bills over the past year. Since Treasury bills are expected to always remain positive, if our chosen asset shows positive relative strength with respect to Treasury bills, then it too is likely to continue showing a positive return. In our momentum match ups, if our selected assets do not show positive relative strength with respect to Treasury bills, then we select Treasury bills as an alternative investment until our other assets are stronger than Treasury bills. Treasury bill returns thus serve as both a hurdle rate before we can invest in

other momentum assets, as well as a safe, alternative investment until our assets show both relative and absolute positive momentum.

Besides incorporating a safe alternative when market conditions are not favorable, our module approach has another important benefit. It imposes diversification on our momentum portfolios. If one were to throw all assets into one large pot, as is often the case with momentum investing, and select the top few momentum candidates, there is a good chance some of the selected assets would be highly correlated with one another. Asset pair modules help ensure that different asset classes (and risk factors) receive portfolio representation.

2. Data and Methodology

All monthly return data begins in January 1974, unless otherwise noted, and includes interest and dividends. For equities, we use the MSCI US, MSCI EAFE, and MSCI ACWI exUS indices. These are all free float adjusted market capitalization weightings of large and midcap stocks. The MSCI EAFE Europe, Australasia and Far East Index includes twenty-two major developed market countries, excluding the U.S. and Canada. The MSCI ACWI exUS, i.e., MSCI All Country World Index ex US, includes twenty-three developed market countries (all but the U.S.) and twenty-one emerging market countries. MSCI ACWI exUS data begins in January 1988. We create a composite data series called EAFE+ that is

comprised of the MSCI EAFE Index until December 1987 and the MSCI ACWI exUS after that time.[2]

The Bank of America Merrill Lynch High Yield Cash Pay Bond Index that we use begins in November 1984. Data prior to that is from Steele System's Corporate Bond High Yield Average. All other bond indices are from Barclays Capital. REIT data is from the National Association of Real Estate Investment Trusts (NREIT).

Gold returns using the London PM gold fix are from the World Gold Council. Treasury bill returns are from newly issued 90-day auctions as reported by the U.S. Treasury. No deductions have been made for transaction costs. The average number of switches per year for our modules is 1.4 for foreign/U.S.equities, 1.2 for high yield/credit bonds, 1.6 for equity/mortgageREITs, and 1.6 for gold/Treasuries, making momentum transaction costs negligible. The average annual expense ratio for a representative group of exchange-traded funds corresponding to the indices we use is .25%, and their annual transaction costs are .05%.

The most common metric for evaluating investment strategies is the Sharpe ratio. It is most appropriate when you have normally distributed returns or quadratic preferences. Yet the returns from financial assets usually are not normally distributed. Tail risk may be much greater than one expects under an

[2] Since these indices are based on capitalization, the MSCI ACWI exUS receives only a modest influence from emerging markets. Our results do not change significantly if we use only the MSCI EAFE Index.

assumption of normality. Quadratic utility implies that as wealth increases, you become more risk averse. Such increasing absolute risk aversion is not consistent with rational investor behavior.

Yet despite its limitations, the Sharpe ratio is based on expected utility theory, while most alternative performance measures lack a theoretical underpinning. Therefore, we use the Sharpe ratio as a risk adjusted metric, but also present skewness and maximum drawdown as additional risk factors.[3] Maximum drawdown here is the greatest peak to valley equity erosion on a month end basis.

Most momentum studies use either a six or a twelve-month formation period. Both perform well, but since twelve months is more common and has lower transaction costs, we will use that timeframe.[4] One often skips the most recent month during the formation period in order to to disentangle the momentum effect from the short-term reversal effect returns that may be related to liquidity or microstructure issues with equity returns. Momentum results for non-equity assets are actually better if one does not skip a month, since they suffer less from liquidity issues. Because we are dealing with gold, fixed income and real estate, as well as equities, we adjust our positions monthly but without skipping a month.

[3] Skewness relates directly to the symmetrical characteristics of the return distribution. Positive skewness implies the potential for greater variance of positive returns than negative returns. Risk averse investors generally prefer positive skewness over negative skewness.

[4] The four disclosed momentum products available to the public use twelve-month momentum. They are AQR Funds, Russell Investments, QuantShares, and Summerhaven Index Management.

We first apply momentum broadly to the MSCI U.S. and EAFE+ stock market indices in order to create a baseline equities momentum portfolio. In bonds, we incorporate credit risk volatility using the High Yield Bond Index, which has an average duration of just over four years. We match High Yield Bonds with the Barclays Capital U.S. Intermediate Credit Bond Index, the next most volatile intermediate term fixed income index.

Real estate has the highest volatility over the past five years of the eleven U.S. equity market sectors tracked by Morningstar. Real Estate Investment Trusts (REITs) make up most of this sector. The Morningstar real estate sector has both mortgage and equity based REITs. We similarly use both.

Our final high volatility risk factor focuses on economic stress and uncertainty. For this, we use the Barclays Capital U.S. Treasury 20+ year Bond Index and gold. Investors generally hold these as safe haven alternatives to equities and fixed income securities subject to credit default risk.

3. Equity/Sovereign Risk

Equities are the mainstay of momentum investing. Therefore, our first momentum module is composed of the MSCI U.S. and EAFE+ indices. It gives us broad exposure to the U.S. equity market, as well as international diversification. Volatility comes from the equity risk premium, as well as from sovereign risk. Table 1 presents the summary statistics from January 1974 through December

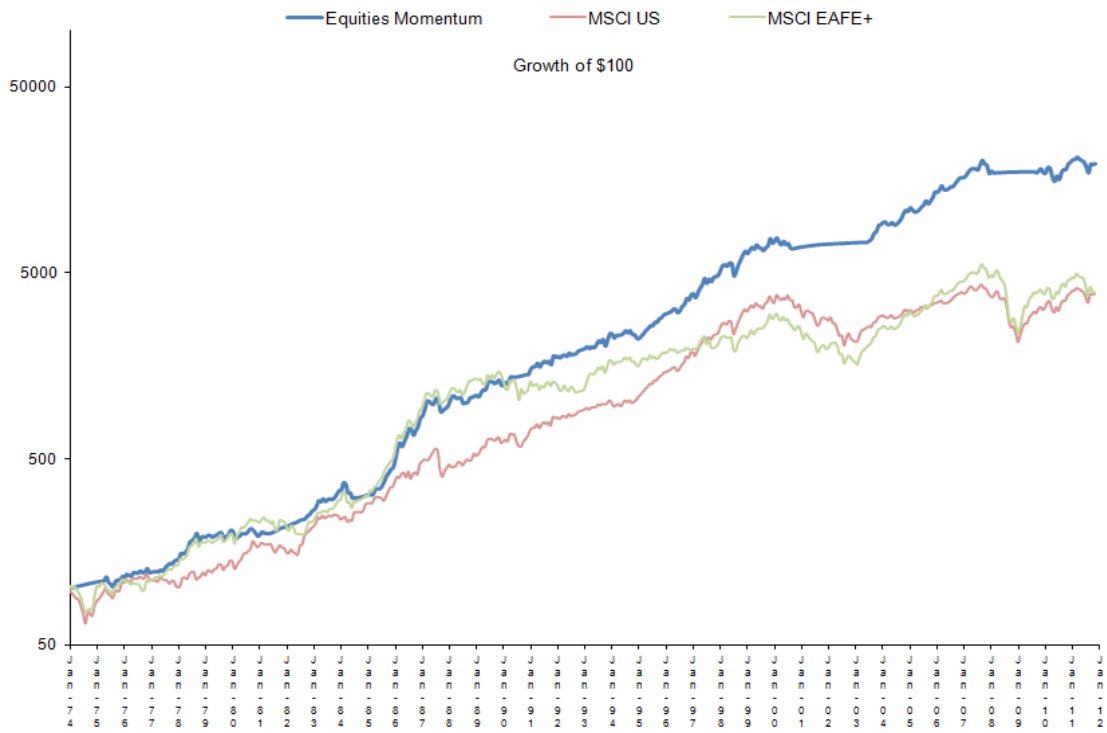
2011 for the equity indices, our momentum strategy, and momentum excluding the use of Treasury bills as a hurdle rate and alternative.

Table 1 Equities 1974-2011

	Momentum	Momentum exT Bills	US	EAFE+
Annual Return	15.79	13.46	11.49	11.86
Annual Std Dev	12.77	16.17	15.86	17.67
Annual Sharpe	.73	.45	.35	.33
Max Drawdown	-23.01	-54.56	-50.65	-57.37
Skewness	-.24	-.34	-.38	-.32

The average of the annual return of both equity indices is 11.68%, and their average annual standard deviation is 16.77%. The annual return and standard deviation of our momentum strategy are 15.79% and 12.77%. This is a remarkable 400 basis point increase in return and 400 basis point reduction in volatility from the market indices. Momentum doubles the Sharpe ratio and cuts the drawdown in half. Momentum results without the use of Treasury bills are better than the index averages', but not nearly as good as the results that come from using momentum with Treasury bills as a trend filter and alternative asset.

Figure 1 Equities Momentum 1974-2011



Most momentum research on equities looks at individual securities sorted by momentum. All three of the fully disclosed, publically available momentum equity programs use momentum applied to individual stocks. It might be useful therefore to see how our module approach stacks up against individual stock momentum.

The AQR momentum index is composed of the top one-third of the Russell 1000 stocks based on twelve-month momentum with a one-month lag. Positions are adjusted quarterly. The AQR small cap momentum index follows the same procedure with the Russell 2000. Table 2 shows the AQR results, as well those of our Equity module, from when the AQR indices began in January 1980.

Table 2 AQR Index versus Equity Module 1980-2011

	AQR Large Cap	AQR Small Cap	US MSCI	Equity Module
Annual Return	14.75	16.92	12.42	16.43
Annual Std Dev	18.68	22.44	15.60	13.13
Annual Sharpe	.45	.46	.41	.75
Max Drawdown	-51.02	-53.12	-50.65	-23.01
Skewness	-.55	-.61	-.61	-.22

The AQR indices show a modest advantage over the broad US market index. However, our Equity module results are considerably better. The differences here are understated, since AQR estimates that their index results should be reduced by transaction costs of .7% per year.

4. Credit Risk

Table 3 lists the average credit rating, average bond duration, and annualized standard deviations over the past five years for the most common intermediate term fixed income indices maintained by Barclays Capital.

The U.S. High Yield Bond Index has by far the highest volatility. Its standard deviation over the past five years is 14.0, compared to 5.4 for the next highest one belonging to the U.S. Intermediate Credit Bond Index. Since their average bond durations are about the same, the main cause of their volatility difference is the

credit default risk of their respective holdings, as reflected in their average credit ratings.

Table 3 Intermediate Fixed Income

Index	Rating	Duration	Volatility
Treasury	AA	4.0	3.7
Government	A	5.3	3.3
Government/Credit	A	3.9	3.4
Aggregate Bond	A	4.4	3.6
Credit	A	4.4	5.4
High Yield	B	4.1	14.0

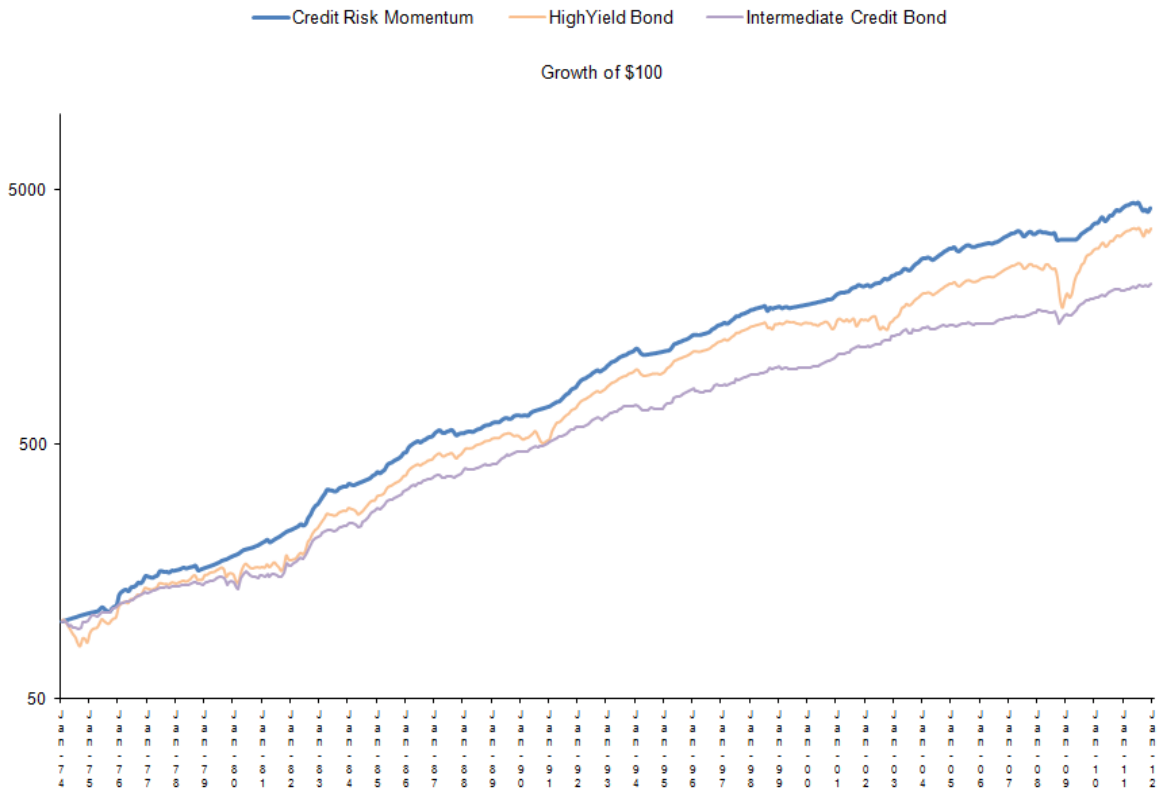
In Table 4, we see that applying momentum to both bond indices produces almost a doubling of the indices' individual Sharpe ratios, from .51 and .54 to .97.

Table 4 Intermediate Term Fixed Income 1974-2011

	Momentum	Momentum exTBills	High Yield	Credit Bonds
Annual Return	10.49	10.39	10.29	8.53
Annual Std Dev	4.74	6.13	8.67	5.19
Annual Sharpe	.97	.74	.51	.54
Max Drawdown	-8.20	-12.08	-33.17	-11.35
Skewness	-.10	.15	-.49	-.45

Momentum gives the same profit as from high yield bonds alone, but with less than half the volatility, one-quarter the drawdown, and one-fifth the negative skewness. Our momentum strategy even has a lower standard deviation and drawdown than the investment grade, credit bond index. Momentum without the use of Treasury bills does not give nearly as much improvement in reducing volatility or drawdown. Although investors most often apply momentum to equity investments, fixed income investors should take note of the potential here for extraordinary momentum returns of an extra 196 basis points per year over intermediate term credit bonds, and with less volatility.

Figure 2 Credit Risk Momentum 1974-2011



One possible explanation for this impressive performance is that the credit default risk associated with high yield bonds may be less when these bonds are in a positive relative and absolute momentum situation. Their risk premium is still able to flow to investors under favorable market conditions identified through momentum, when their actual risks may not be very high.

5. Real Estate Risk

We next look for additional asset classes with risk factors related to high volatility. Table 5 is a list of the eleven Morningstar equity sector indices with their annualized standard deviations over the five years ending 12/31/11.

Table 5 Morningstar Sectors

Sector	Volatility
Real Estate	33.9
Basic Materials	29.7
Financial Services	29.4
Energy	27.2
Consumer Cyclicals	24.4
Industrials	24.1
Technology	22.6
Communication Services	21.0
Health Care	15.9
Utilities	14.8
Consumer Defensive	12.6

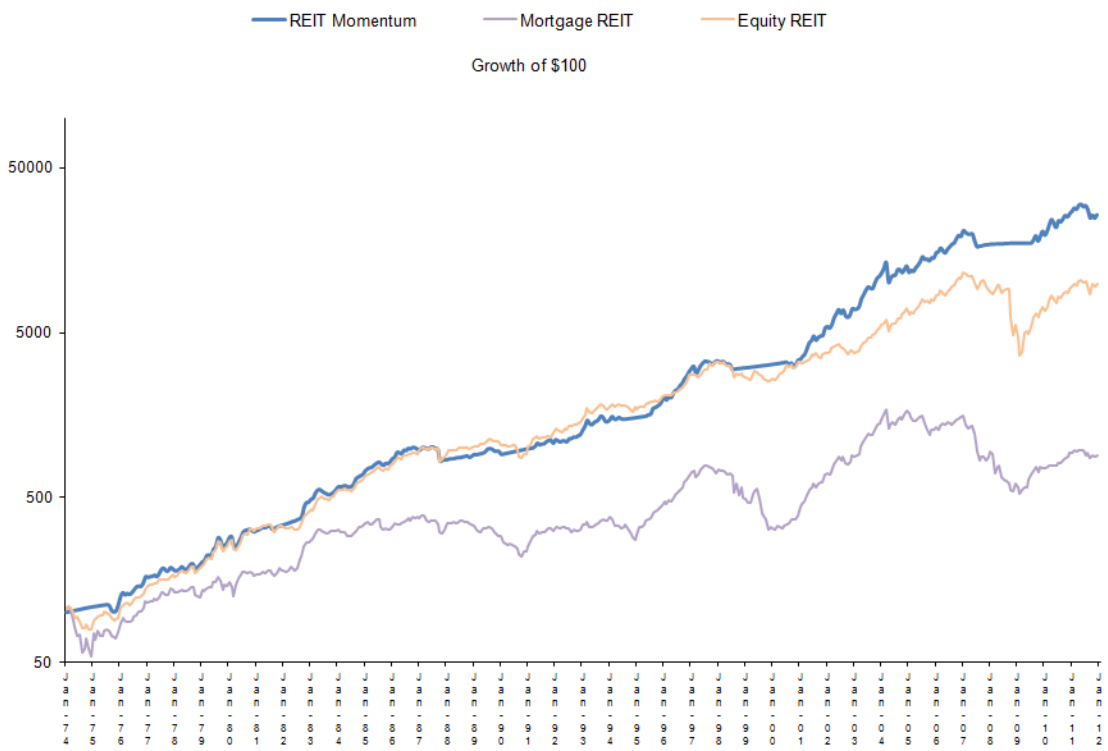
At the top of the list is real estate with a standard deviation of 33.9%. The Morningstar Real Estate sector includes both equity and mortgage REITS. We will also use both to give us some separation and differentiation for momentum selection purposes.

Table 6 shows an annual rate of return of 16.78% from our momentum strategy applied to REITs. This is the highest return of our momentum modules so far. It is also significantly higher than the returns of the individual equity and mortgage REIT indices of 14.6% and 8.28%. The momentum standard deviation and drawdown are substantially lower than the indices themselves. The momentum Sharpe ratio is .77, compared to .48 and .13 for the REIT indices. As with our other modules, the Sharpe ratio and volatility of momentum without Treasury bills are less than the Sharpe ratio and volatility of the portfolio with Treasury bills.

Table 6 REITs 1974-2011

	Momentum	Momentum exTBills	Equity REIT	Mortgage REIT
Annual Return	16.78	16.80	14.60	8.28
Annual Std Dev	13.24	16.56	17.39	20.71
Annual Sharpe	.77	.62	.48	.13
Max Drawdown	-23.74	-48.52	-68.30	-42.98
Skewness	-.75	-1.13	-.72	-.22

Figure 3 REIT Momentum 1974-2011



6. Economic Stress

Economic stress is another volatility-based risk factor. Gold and long-term Treasury bonds respond to that stress. Both often react positively to weakness in the economy. Economic weakness tends to produce falling nominal interest rates, which raises bond prices. Gold is usually strong when long-term Treasury yields fall. There is some differentiation and separation for momentum purposes, since gold responds more favorably to inflationary expectations, while Treasuries respond positively to deflationary pressures.

Gold is not highly correlated with most other assets, which makes it particularly useful from a portfolio point of view. Gold, like Treasuries, is not only

a good hedge and diversifier; it is also a safe haven during times of economic turmoil (Bauer and McDermot (2010)). A safe haven is an asset that remains uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil.

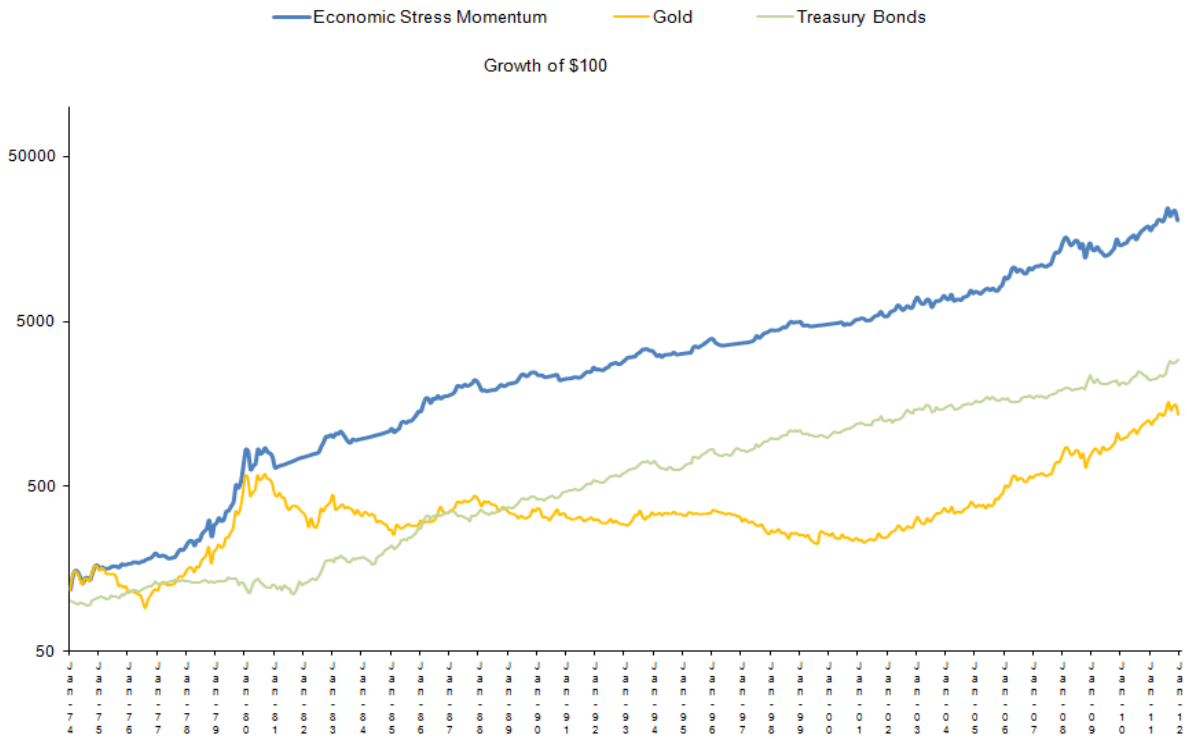
Table 7 shows the economic stress module results. Gold's average annual standard deviation of 20.00 since 1974 is almost the same as the 20.71 volatility of mortgage REITs, which is the highest of all our assets. Treasury bond annual volatility of 10.54 is higher than the 8.67 volatility of the High Yield Bond Index.

Table 7 Economic Stress Momentum 1974-2011

	Momentum	Momentum exTBills	Gold	Treasury Bonds
Annual Return	16.65	16.31	9.22	9.90
Annual Std Dev	17.04	17.65	20.00	10.54
Annual Sharpe	.59	.56	.17	.39
Max Drawdown	-24.78	-36.82	-61.78	-20.08
Skewness	.68	.62	.60	.38

Momentum raises annual profits substantially to 16.65%, from a return of 9.22% with gold and 9.90% with Treasuries. The Sharpe ratio increases from .17 and .39 to .59.

Figure 4 Economic Stress Momentum 1974-2011



7. Robustness Checks

We can divide our 38 years of data into two equal sub-periods. Table 8 shows performance from January 1974 through December 1992 and from January 1993 through December 2011.

Table 8 Performance 1974-1992 and 1993-2011

	Equities 1974-1992	Equities 1993-2011	Credit 1974-1992	Credit 1993-2011	REIT 1974-1992	REIT 1993-2011	Stress 1974-1992	Stress 1993-2011
Annual Return	17.82	13.79	12.97	8.06	14.74	18.85	21.39	12.09
Annual Std Deviation	13.0	12.54	4.77	4.63	11.34	14.91	19.41	14.23
Annual Sharpe	.68	.79	.96	1.00	.54	.96	.61	.59
Maximum Drawdown	-17.81	-11.33	-4.94	-8.20	-17.91	-23.74	-24.27	-24.78
Skewness	-.11	-.39	.98	-1.31	-.20	-1.01	.99	-.36

Sharpe ratios remain high for all the modules during both sub-periods. They are very consistent across both sub-periods for the equities, credit risk, and economic stress modules.

Table 9 compares performance using twelve month and six month formation periods.

Table 9 Formation Periods - 12 and 6 Month

	Equities 12 Mo	Equities 6 Mo	Credit 12 Mo	Credit 6 Mo	REIT 12 Mo	REIT 6 Mo	Stress 12 Mo	Stress 6 Mo
Annual Return	15.79	14.67	10.49	10.95	16.78	16.67	16.65	11.79
Annual Std Deviation	12.77	12.33	4.74	4.98	13.24	13.61	17.04	16.35
Annual Sharpe	.73	.68	.97	1.01	.77	.74	.59	.35
Maximum Drawdown	-23.01	-22.54	-8.20	-7.65	-23.74	-34.59	-24.78	-24.27
Skewness	-.24	-.13	-.10	-.17	-.75	-.76	.68	.87

Performance is very good for both periods. The stress module does better with a twelve-month formation period, while equities, credit bonds, and REITs perform about the same using either six or twelve months.

8. Momentum Return versus Weighted Average Return

Table 10 shows momentum return along with average return weighted by each asset's percentage usage within a module.

Table 10 Returns and Volatility 1974-2011

		Volatility	Return	Utilization Rate	Weighted Avg Return	Momentum Return
Equities						
	U.S.	15.86	11.49	37.7%		
	EAFE+	17.67	11.86	39.7%		
	TBill	1.19	5.89	22.6%	10.41	15.79
Credit Risk						
	Credit	5.19	8.53	19.5%		
	Hi Yield	8.67	10.29	55.3%		
	TBill	1.19	5.89	25.2%	7.66	10.49
REITs						
	Equity	17.38	14.60	46.9%		
	Mortgage	20.71	8.28	26.8%		
	TBill	1.19	5.89	26.3%	10.63	16.78
Stress						
	Gold	20.00	9.02	39.0%		
	Treasuries	10.54	9.90	43.2%		
	TBill	1.19	5.89	17.8%	8.84	16.65
Average					**9.39**	**14.93**

By comparing momentum returns to weighted average returns, we see that momentum and our timing filter create 59% higher profits.

9. Module Characteristics

The modules are in Treasury bills from 17.8% of the time with the economic stress module to 26.2% of the time with the REIT module. Singular match ups of Treasury bills with each asset, rather than with paired combinations of assets, would lead to higher Treasury bill utilization and lower expected profits. On the other hand, more than two assets within a momentum module could make it more difficult to isolate singular risk factors.

We might find higher volatility by further segmenting a market or asset class. For example, we could split equities into individual countries and find additional volatility. However, this granularity would come at the cost of individual country risks dominating our desired risk factor of high volatility from sovereign markets. Greater segmentation might also reduce the benefits we get from diversification by using multiple rather than singular assets.

Table 11 is a results summary of each asset and risk module, as well as the equally weighted composite of all four modules. As a benchmark, we also present the equal weighted portfolio of all nine assets (two per module plus Treasury bills) without the use of momentum.

The composite momentum portfolio gives an annual return of 14.90% with a standard deviation of 7.99%. The Sharpe ratio of this portfolio is 1.07, versus Sharpe ratios of .73, .97, .77, and .59 for the individual equity, credit risk, REIT,

and economic stress modules. The return of this composite momentum portfolio is 50% higher than the return of the equal weight, all asset benchmark portfolio. The momentum portfolio has double the Sharpe ratio (1.07 vs. 0.50) and less than half the drawdown (-10.92 vs. -26.77). These are impressive results using just twelve-month momentum, a simple trend following filter, and a balanced portfolio of U.S and foreign equities, credit and high yield bonds, REITs, gold and Treasury bonds.

The risk profile of our dynamic asset mix bears some resemblance to those of static risk parity portfolios. Successful risk parity programs can offer 300-400 basis points of additional annual return when leveraged to the same level of risk (10.6 annual standard deviation) as a conventional balanced portfolio (See Dalio (2011)). Our composite momentum portfolio, leveraged to the same level of risk as a conventional balanced portfolio, shows a remarkable 950 basis points of incremental return, while avoiding derivatives, counterparty risk, and tracking error.

Table 11 Results Summary 1974-2011

	Annual Return	Annual Std Dev	Annual Sharpe	Maximum Drawdown	Skewness	Kurtosis
Equities						
• **US**	11.49	15.86	.35	-50.65	-.38**	4.83**
• **EAFE+**	11.86	17.67	.33	-57.37	-.32**	4.21**
Credit Risk						
• **High Yield**	10.29	8.67	.51	-33.17	-.49**	10.01**
• **Credit Bond**	8.53	5.19	.54	-11.35	.45**	9.53**
REITs						
• **Equity REIT**	14.60	17.39	.48	-68.30	-.72**	11.57**
• **Mortgage REIT**	8.28	20.71	.13	-42.98	-.22*	8.29**
Economic Stress						
• **Gold**	9.22	20.00	.17	-61.78	.60**	6.72**
• **Treasuries**	9.90	10.54	.39	-20.08	.38**	4.81**
Momentum Modules						
• **Equities**	15.79	12.77	.73	-23.01	-.24*	4.83**
• **Credit Risk**	10.49	4.74	.97	-8.20	-.10	8.96**
• **REITs**	16.78	13.24	.77	-23.74	-.75**	8.33**
• **Economic Stress**	14.27	16.60	.48	-24.78	.73**	11.86**
Composite – Equal Weight						
• **Momentum**	**14.90**	**7.99**	**1.07**	**-10.92**	**-.45****	**6.56****
• **Non-Momentum**	9.95	8.19	.50	-26.77	-.54**	7.00**
**p<.01 * p<.05 for normality						

Figure 5 Momentum versus Benchmarks 1974-2011

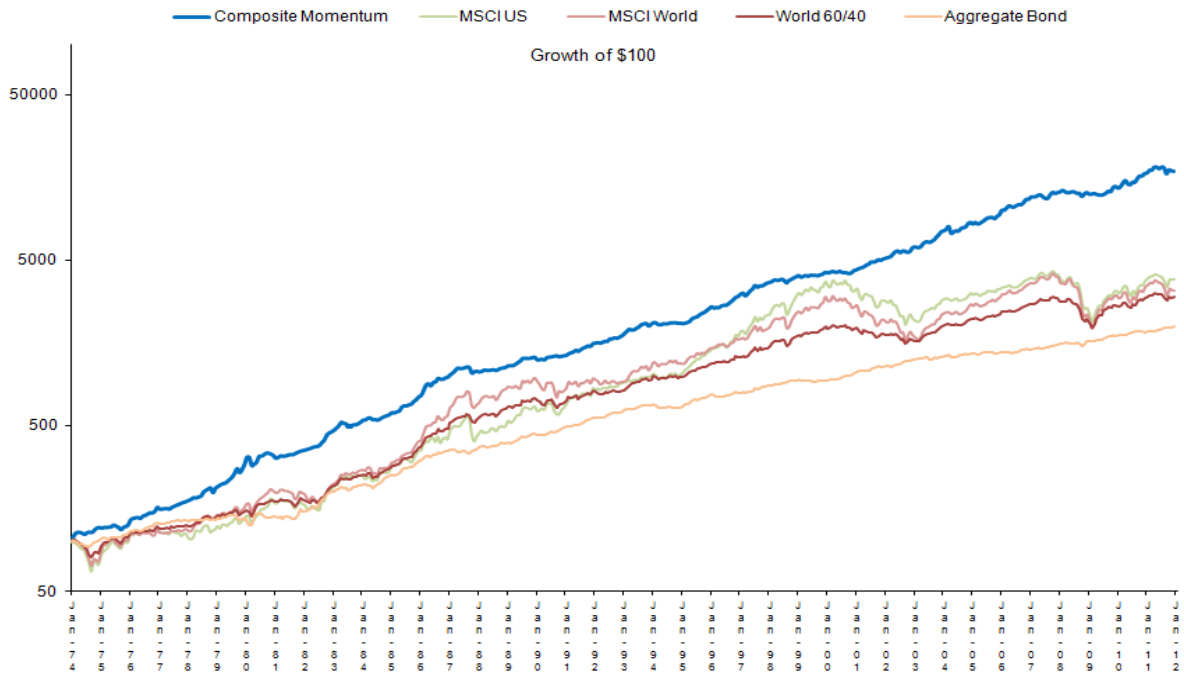


Figure 6 Composite Momentum 1974-2011

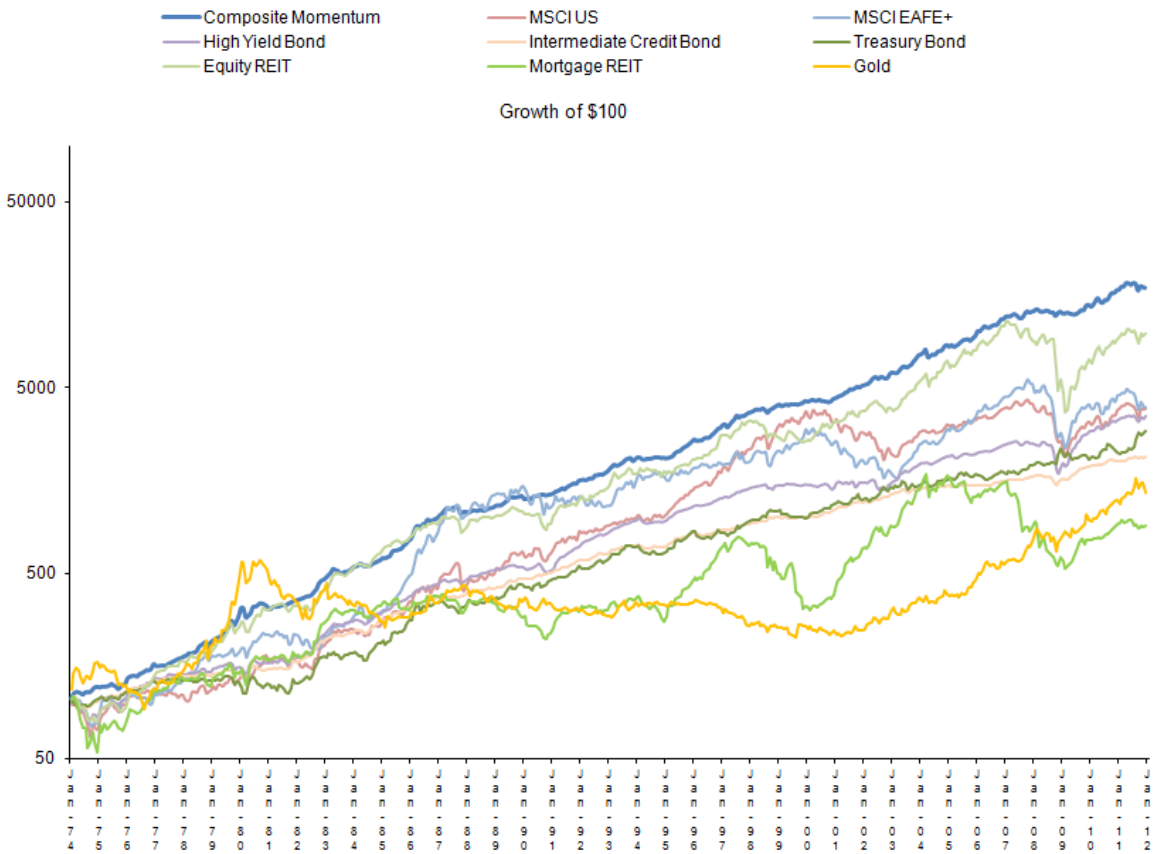


Table 12 shows the Sharpe ratios of each of our assets and modules, as well as the composite momentum portfolio.

Table 12 Sharpe Ratios

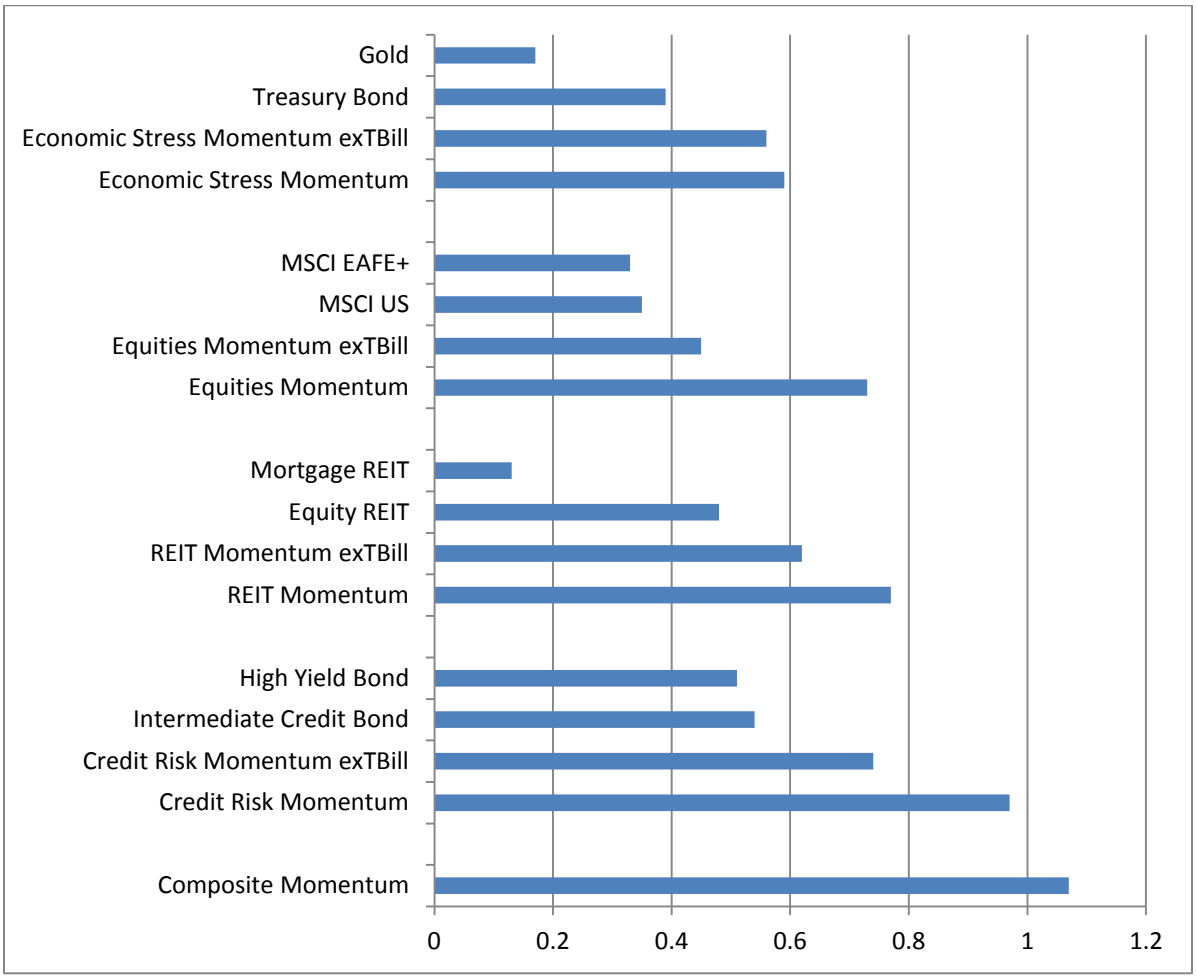


Table 13 shows performance versus several benchmarks during the three worst periods of equity erosion over the past 38 years of data. We see that the

composite momentum portfolio, through its trend following characteristics, is itself a safe haven from market adversity.

Table 13 Largest Equity Drawdowns

Date	MSCI US	MSCI WORLD	WORLD 60/40	COMPOSITE MOMENTUM
3/74-9/74	-33.3	-30.8	-21.5	2.1
4/02-9/02	-29.1	-25.6	-13.2	7.5
11/7-2/09	-50.6	-53.6	-34.7	-2.8

World 60/40 is composed of 60% MSCI World Index and 40% US Aggregate Bond Index.

10. Correlations

Table 14 shows the correlations of the modules, as well as the correlations if Treasury bills are not included in the risk modules. We have already seen that Treasury bills are very helpful in raising return and lowering volatility. Now we see that they also are beneficial from a portfolio point of view, since they lower most correlations. According to PIMCO (Page (2010)), risk factor correlations are lower than asset class correlations. They are also more robust with respect to regime shifts. Our lower risk module correlations support those findings.

Table 14 Correlation Coefficients 1974-2011

with Treasury Bill Hurdle Rate			
	Credit Risk	**REITs**	**Stress**
Equities	.35	.29	.17
Credit Risk		.40	-.05
REITs			.10
without Treasury Bill Hurdle Rate			
	Credit Risk	**REITs**	**Stress**
Equities	.40	.45	.13
Bonds		.46	.06
REITs			.12

11. Portfolio Considerations

Given the inequalites in the Sharpe ratios and correlations of our four modules, we may not want to allocate capital equally to all of them. The traditional way to allocate varying amounts of capital across different asset classes is via Markowitz mean variance portfolio optimization. This uses quadratic programming algorithms to determine efficient portfolios that offer the highest potential return at any given level of expected volatility, or, conversely, the lowest volatility at any given level of expected return. There are, however, several potential pitfalls with this approach. First, the process is very sensitive to the inputs used. These are the

assets' past returns, volatilities, and correlations. Second, the optimization process depends on the same simplifying assumptions as the Sharpe ratio, i.e., that returns are normally distributed or that one has quadratic utility preferences. It is because these assumptions are unrealistic and/or the inputs are unpredictable, that there have been many attempted fixes to the Markowitz approach. These include shrinkage of the estimated inputs, constraining the portfolio weights, estimating expected returns from an asset-pricing model, bootstrapping outputs to correct for bias, and imposing shifts toward lower variance portfolios with less uncertainty. Yet the math can still go wrong and create allocation mistakes because of input instability.

Expected returns are the least predictable of the inputs. Yet momentum makes returns more consistent and predictable. It may be tempting then to use Markowitz optimization for momentum portfolio construction. However, we need to keep in mind the non-normality of our momentum return distributions.[5]

Fortunately, our momentum modules can guide us to an attractive alternative to Markowitz mean variance optimization. Modules reduce the number of portfolio inputs from eight (two assets per module) to four. One can analyze possible portfolio allocations using nothing more than a simple spreadsheet. One can search for a high Sharpe ratio, a targeted level of volatility, or other objective functions.

[5] The Jarque-Bera, Shapiro-Wilk, Lilliefors and Anderson-Darling tests all have p values <.0001 for each of our modules, which strongly rejects normality.

There is no need for matrix inversions, Lagrange multipliers, or other complicated procedures associated with Markowitz optimization.

12. Conclusions

We have seen how risk factors indicating high volatility contribute to momentum profitability. We also introduced the hurdle rate/alternative asset concept to help ensure that momentum is positive on an absolute, as well as a relative, basis. Our final contribution is the introduction of risk factor oriented momentum modules that facilitate portfolio diversification and enable the construction of effective momentum portfolios for harvesting risk premium profits.

Using thirty-eight years of past performance data, momentum modules show significant performance improvements in all four areas we have examined - equities, credit risk, real estate, and economic stress, as represented by gold and Treasuries. The Fama-French three-factor annual alphas of these four modules are 8.9, 4.2, 8.7, and 10.64 respectively. The ancillary conclusions we reach are as follows:

1) Investors should consider momentum investing based on diversified risk factors rather than solely by asset class.

2) Long side momentum works best when used with a hurdle rate and safe alternative asset, such as Treasury bills, that can neutralize market risk. This puts momentum on an absolute, as well as a relative, basis. Momentum can and should

be used tactically, as well as a strategically, in order to take advantage of regime persistence.

3) Investors generally wish to avoid high volatility. There is now, in fact, a propensity toward low volatility investment portfolios. Yet momentum profits are greater when using high volatility assets. Momentum can help investors harness this volatility and convert it into extraordinary returns.

4) Focused risk modules that isolate and target specific risk factors are an efficient way to incorporate volatility into momentum- based portfolios. They also facilitate the effective use of a hurdle rate/safe alternative asset. Modules provide flexibility, making it simple and easy to implement momentum-based portfolios. Otherwise, portfolio construction could be problematic given the strong non-normality of momentum income streams.

5) Despite an abundance of momentum research, no one is sure why it works so well. The most common explanations have to do with behavioral factors, such as anchoring and the disposition effect. An alternative explanation is that investor risk aversion is wealth dependent. Investors are more risk averse under adverse conditions and less risk averse under favorable conditions. This causes prices to go to extremes beyond their reasonable values. Volatility makes bad conditions seem worse and good conditions seem better, which leads to overextension of price trends and higher momentum profits.

Diversification is the closest thing to a free lunch in the investment world. This is because investors using intelligent diversification can earn the same returns with less risk than those holding undiversified portfolios. Momentum investing, which is still in its infancy, may offer even better opportunities for higher returns with less risk, if done intelligently. Just as the benefit of diversification diminishes when applied indiscriminately, the value of long side momentum also diminishes if applied too broadly, or without trying to differentiate downside from upside market conditions. When applied effectively, momentum makes diversification more efficient by selectively utilizing assets only when their momentum is strong, and they are therefore more likely to appreciate. A focused momentum approach bears market risk only when it makes the most sense, i.e., when there is positive absolute as well as relative momentum. Momentum, serving as an alpha overlay, can capture risk the high premia from volatile assets while defensively adapting to regime change.

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