

The changing face of correlation?

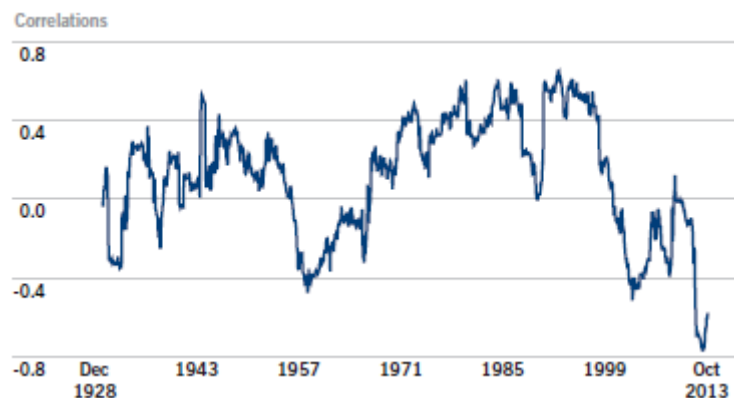
State Street Global Investors | 02 April 2014

Preaching the benefits of diversification is rather like extolling the virtues of motherhood – self-evidently good ideas that everyone can buy into. The challenge for investors over the past several years is that diversification did not work, or more correctly stated, it did not work as expected. Questions are raised then around how investors should think about diversification going forward, how they can ensure that true diversification is achieved, and how best to consider this when modeling portfolios.

REPORTS OF DIVERSIFICATION'S DEATH ARE GREATLY EXAGGERATED

As investors exited the Global Financial Crisis (GFC), there was disappointment from many segments that the diversification that they expected to experience in their portfolio did not manifest. The fact that correlations across risky assets spiked close to 1.0 (i.e. perfectly correlated) was the proof point to some that modern portfolio theory and optimisations did not work anymore. The reality, however, was that correlations between risky asset classes almost always spike in times of crisis and that, overall, correlation among different asset classes is always a variable thing.

Figure 1: Rolling 36-Month correlation S&P 500 & US long-term government bonds



Sources: Factset, SSgA. Past performance is not a guarantee of future results.

At a very broad equity/bond level, we can see long-term, cyclical trends in correlations between these two asset classes. For example, since 1926, the correlation between the S&P 500 Index and US Long-Term Government Bonds has averaged 0.09, but has been highly variable in that period, ranging from a high of 0.65 to a low of -0.76, a low which occurred

during the most recent crisis.

Post-GFC correlations across all of the asset classes have increased (Figure 2, 3, and 4), except for US Treasuries, where correlations have turned more negative. We also see a significant increase in commodities' correlation to developed equities, from 0.11 pre GFC to 0.59 post-GFC. Similarly, the correlations of German bunds to equities turned from negative to positive post-GFC.

CORRECTIONS OVER, BEFORE AND AFTER THE GLOBAL FINANCIAL CRISIS

Figure 2: Correlations matrix
(Jan 1994 – Aug 2013)

	S&P 500	MSCI Europe	MSCI Pacific	MSCI EM	DJ UBS Commodity	S&P Case Shiller 10	CS Hedge Fund	Barcl High
S&P 500	1.00							
MSCI Europe	0.83	1.00						
MSCI Pacific	0.64	0.68	1.00					
MSCI EM	0.73	0.76	0.72	1.00				
DJ UBS Commodity	0.33	0.42	0.45	0.46	1.00			
S&P Case Shiller 10	0.03	0.02	0.12	0.01	0.05	1.00		
CS Hedge Fund	0.57	0.57	0.43	0.62	0.42	0.04	1.00	
Barclays VLI High Yield	0.63	0.63	0.51	0.63	0.33	0.03	0.49	1.00
Barclays US Treasury	-0.18	-0.20	-0.15	-0.22	-0.07	-0.10	-0.04	-0.04
Barclays German Treasury	0.09	0.34	0.22	0.15	0.31	-0.03	0.03	0.03

Figure 3: Correlations matrix pre-financial crisis
(Jan 1994 – Dec 2007)

	S&P 500	MSCI Europe	MSCI Pacific	MSCI EM	DJ UBS Commodity	S&P Case Shiller 10	CS Hedge Fund	Barcl High
S&P 500	1.00							
MSCI Europe	0.78	1.00						
MSCI Pacific	0.52	0.53	1.00					
MSCI EM	0.67	0.66	0.63	1.00				
DJ UBS Commodity	0.11	0.14	0.32	0.27	1.00			
S&P Case Shiller 10	0.02	0.03	0.11	0.02	0.16	1.00		
CS Hedge Fund	0.49	0.48	0.28	0.54	0.22	0.03	1.00	
Barclays VLI High Yield	0.55	0.47	0.32	0.49	0.13	-0.01	0.37	1.00
Barclays US Treasury	-0.11	-0.17	-0.12	-0.21	0.01	-0.06	0.08	-0.04
Barclays German Treasury	-0.14	0.13	0.05	-0.09	0.18	-0.04	-0.13	-0.04

Figure 4: Correlations matrix post financial crisis
(Jan 2008 – Aug 2013)

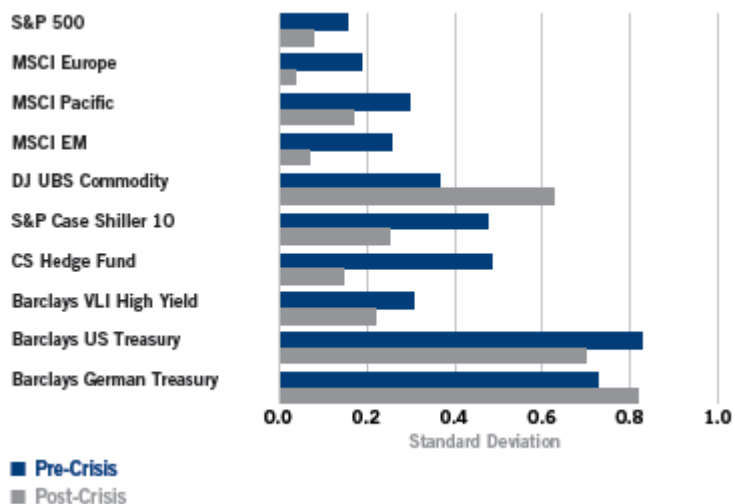
	S&P 500	MSCI Europe	MSCI Pacific	MSCI EM	DJ UBS Commodity	S&P Case Shiller 10	CS Hedge Fund	Barcl High
S&P 500	1.00							
MSCI Europe	0.91	1.00						
MSCI Pacific	0.85	0.90	1.00					
MSCI EM	0.84	0.90	0.88	1.00				
DJ UBS Commodity	0.59	0.66	0.63	0.70	1.00			
S&P Case Shiller 10	0.03	0.01	0.15	0.02	-0.05	1.00		
CS Hedge Fund	0.76	0.79	0.79	0.82	0.76	0.08	1.00	
Barclays VLI High Yield	0.75	0.78	0.78	0.83	0.54	0.06	0.77	1.
Barclays US Treasury	-0.31	-0.28	-0.22	-0.26	-0.19	-0.15	-0.36	-0
Barclays German Treasury	0.43	0.60	0.54	0.54	0.48	-0.03	0.40	0.

Sources: Factset, SSgA. Past performance is not a guarantee of future results. The correlation coefficient measures the strength and direction of a linear relationship between two variables. It measures the degree to which the deviations of one variable from its mean are related to those of a different variable from its respective mean.

In addition to changes in the absolute values of correlations, the variability and volatility of the measure itself has increased. For example, comparing the correlation of MSCI ACWI equity (Figure 5) and Citigroup WGBI bond index (Figure 6) to various other asset classes, we observed that the post-GFC correlation volatility across all of the equities relative to MSCI World has decreased, and that the correlations themselves have increased. Correlation between real estate, hedge fund and high yield to equities also increased and correlation volatility decreased.

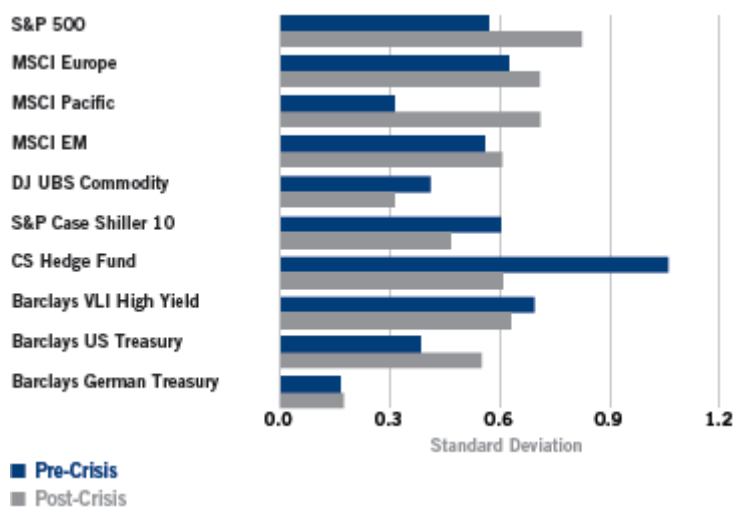
Additionally post-GFC, correlation volatility has increased between equity and fixed income assets. The changing nature of these correlations and the differing rates by which they change are important for investors to address if they wish to be diversified effectively.

Figure 5: Volatility of correlations with MSCI ACWI



Sources: Factset, SSgA. Past performance is not a guarantee of future results.

Figure 6: Volatility of correlations with Citi WGBI



Sources: Factset, SSgA. Past performance is not a guarantee of future results.

The period since August 1997 is interesting to note as there have been steady declines in the correlations between equity and bonds. This period is also one of significantly low inflation, and has led to falling, and ultimately negative, correlations between the two asset classes.

While our immediate expectation is for inflation to continue to be low in the near term, it does highlight an important consideration for portfolio construction – which is that when inflation does reverse and increase, the strong diversification between stocks and bonds is

likely to be reduced.

SO, WHERE TO FIND REAL DIVERSIFICATION?

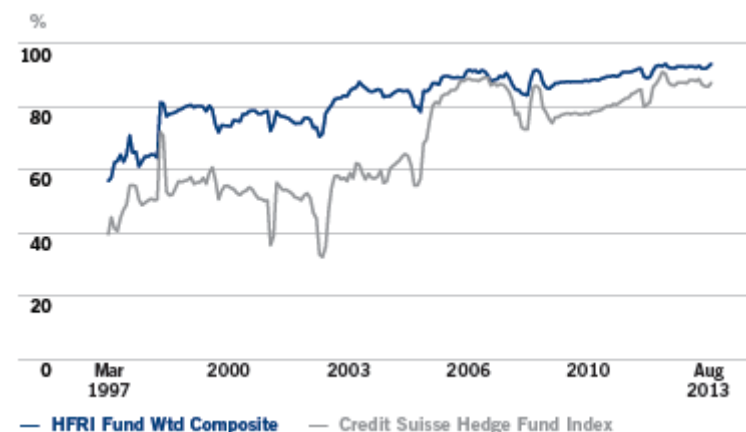
This variable nature of correlation raises the question of where investors can find effective diversification. Comparing *normal* environments to *crisis*, different asset classes will play different roles at different times. For example, commodities average a 0.3 correlation with US large cap equities over time, but post-GFC the relationship was 0.6.

Alternatives assets have been used to provide diversification but, on the surface at least, their potential benefits appears to be diminished. The short-term correlation between composite hedge fund index returns and global equity returns has been on a fairly steady rise over the past 20 years, and is currently hovering around 90% (Figure 7). This is largely due to increased strategy and specific fund diversification within the broad indices. This is apparent with the asset-weighted Credit Suisse Hedge Fund Index converging to the HFRI Fund Weighted (equal weighted) Composite (Figure 7).

From a longer-run perspective, some specific hedge fund strategies still offer a reasonable amount of potential diversification benefit, however, both relative to global equities and to global bonds (Figure 8).

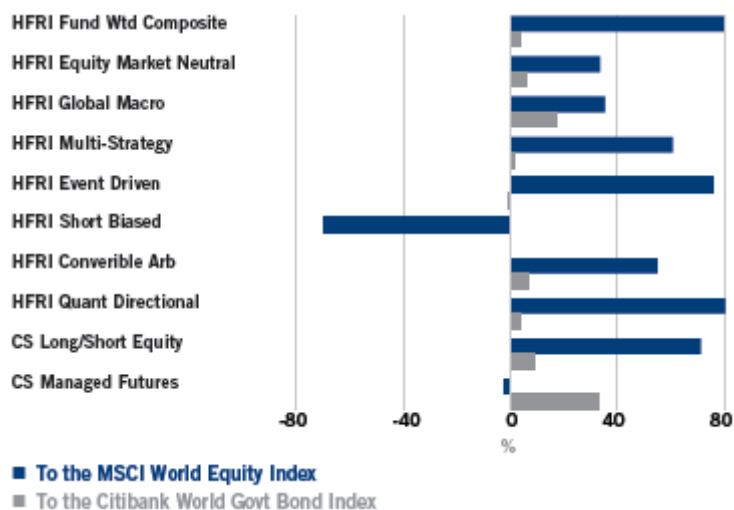
Figure 7: Broad hedge fund indices

Trailing 36-month correlation to the MSCI World



Sources: Factset, SSgA. Notes: Past performance is not a guarantee of future results.

Figure 8: Long-run hedge fund index correlations



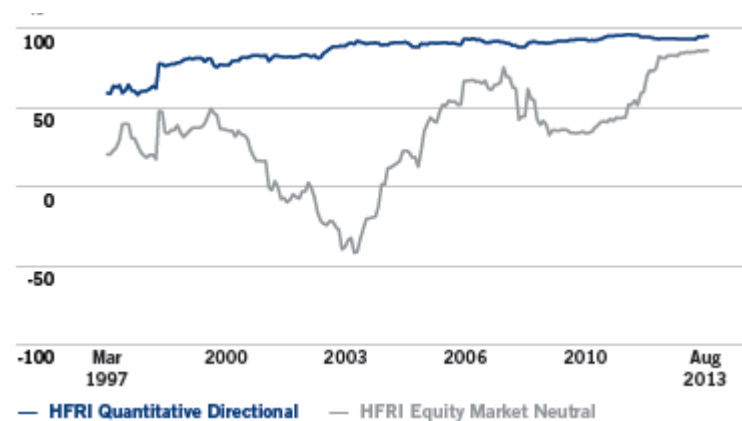
Sources: Factset, SSgA. Past performance is not a guarantee of future results.

As one drills further into the broad category of hedge funds, the details begin to tell a slightly different story on the shorter-term basis. With the benefit of different exposures and investment processes, the interaction with other asset classes will vary both in terms of absolute value and volatility. While some strategies offer relatively stable correlations through time, others are quite variable. Unfortunately, those with the lowest correlations to global equities will tend to have the highest correlation variability through time.

The result from a hedge fund perspective: it's key to understand the role that any given strategy plays in the portfolio. Strategies such as short-biased and managed futures can provide the diversification desired. Other strategies can help to provide necessary returns, but their contribution to diversification is limited.

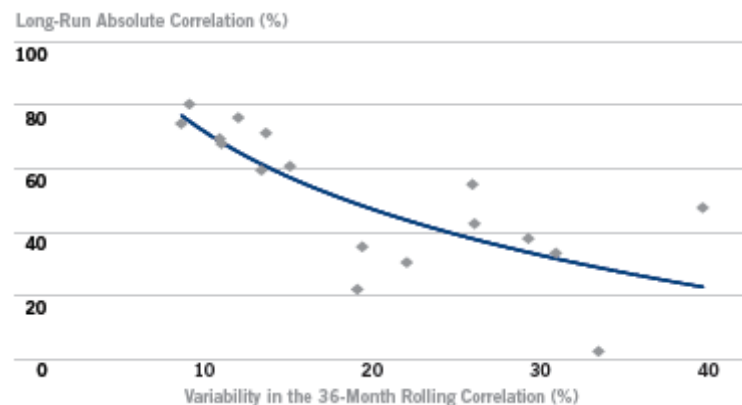
Figure 9: Strategy-specific hedge fund indices

Trailing 36-month correlation to the MSCI World



Sources: Factset, SSgA. Past performance is not a guarantee of future results.

Figure 10: Specific hedge fund strategies



Sources: Factset, SSgA. Past performance is not a guarantee of future results.

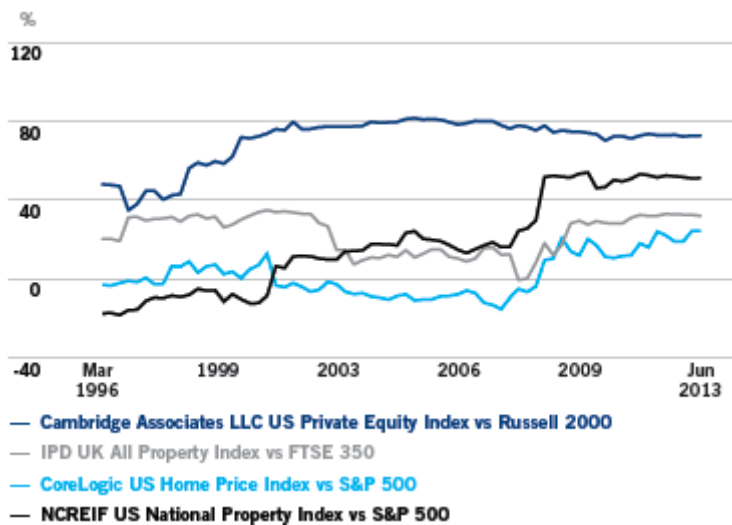
Moving past hedge funds to other investments in the alternatives space, assets such as direct real estate and private equity tell varied stories. To fully understand the impact of holding these assets, investors must first adjust the return streams to account for the phantom volatility and correlation reduction benefit derived from quarterly accounting and the use of stale price information. Unlike the public market, where price discovery happens minute by minute, in private markets, things are more difficult. With typical quarterly pricing, the overall risk – as measured by the standard deviation of returns – looks more attractive than public market holdings, and correlations with other assets are lower. The reality is that this is not a good measure, and adjustments must be made to de-smooth asset returns.

These adjustments help to remove auto-correlation (correlation with prior returns from the same source) that arises from 'sticky' pricing as a result of the heavy use of prior comps

during both appraisals and transactions. While still not a complete measure of risk, it does create more comparable return streams. The result is that real estate can provide a true level of diversification relative to equities (Figure 11) while private equity is on the opposite roll, with the correlation to equities increasing since the trough in correlation in 1997.

Figure 11: Private equity and UK & US real estate returns

Trailing 36-Quarter Correlation with MSCI World Equities



Sources: Factset, SSgA. Past performance is not a guarantee of future results.

IMPLICATIONS FOR PORTFOLIO CONSTRUCTION

These observations create very important implications for portfolio construction and selection of assets within a portfolio. The variable nature of correlation requires an understanding of how and when normal diversification will be effective and how stress markets impact those relationships.

Certain asset classes such as US Treasuries or managed futures may not provide a particularly attractive return stream in a normal market, and their role as a diversifier might be limited. However, in crisis events, we see that they respond well relative to other asset classes.

To help deal with these issues, there are a variety of steps investors can use to improve their modeling and outcomes.

- One simple step will be to use both long-term and crisis correlations as inputs to optimisations and modeling. This will give a broader picture of potential outcomes.
- Another potential adjustment would be to exponentially weight historical returns to get a correlation calculation that is more impacted by recent market activity. This is

important because more secular correlation shifts can be persistent.

As we see in Figure 1, the patterns of correlation can be quite cyclical. Even over an 87-year span of three-year rolling correlations, we see long time periods of steady correlation that are much different than the long-term average. By factoring in the higher impact of recent times through the exponential-weighted calculation, investors may be able to better identify these shifts and react to them in this more variable environment.

The ability to consider potential regimes – and their impact on correlation and diversification – could also help with dynamic shifts to proactively adjust in order to maximise the positioning and potential risk management. These regimes could be based on forward views of overall risk aversion or could be based on factors of economic growth such as GDP or inflation.

THE IMPORTANCE OF INFLATION

The consideration of different inflation regimes is a critical one at this juncture. While near-term inflation remains low, it is an issue at the forefront of many investors' minds given the level of stimulus provided by central banks around the globe. There are a variety of impacts that inflation will have on returns of stocks and bonds, but the impact to discount rates and correlation is important to understand for diversification expectations.

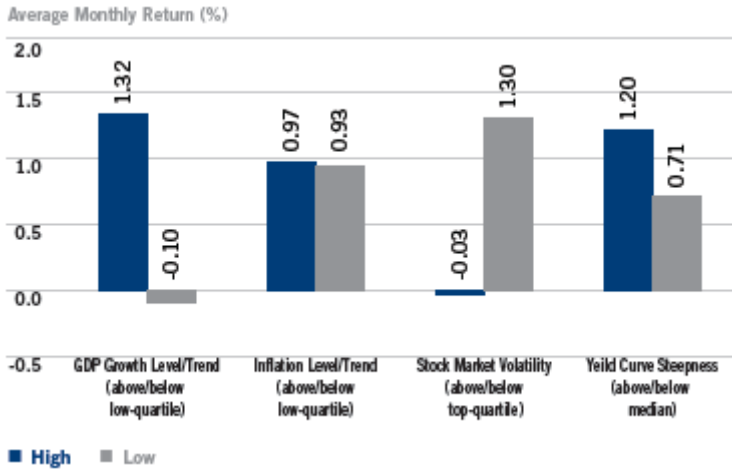
Common up- and downtrends in real bond yields and earnings yields during inflationary and disinflationary phases appear to have made the stock-bond correlation high from the mid-1960s to the mid-1990s.

Antti Ilmanen, *Stock Bond Correlation*, *Journal of Finance*, September 2003.

As markets shift to a phase where real growth increases and inflation eventually increases, nominal yields will shift higher and the correlation between stocks and bonds increase. As noted by Ilmanen above, as inflation moves from below trend to above, stock-bond correlation shifts from 0.09 to 0.19. With the fixed income market (and therefore interest rates) in transition, it is likely that investors will continue to see sharp adjustments.

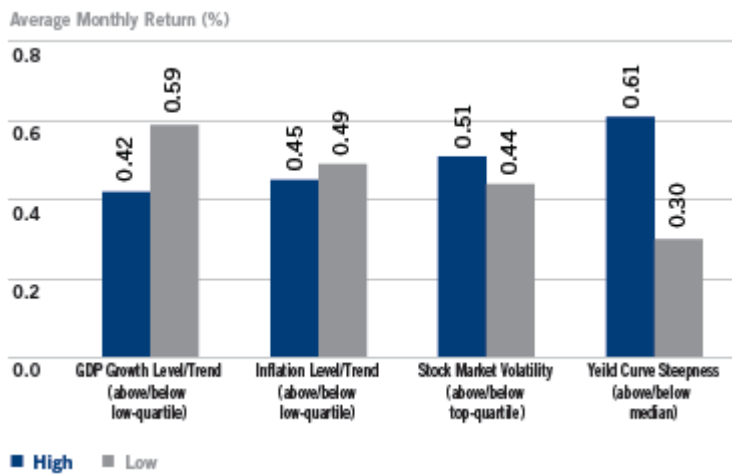
In this environment, a more nimble approach – such as tactical asset allocation – can be more appropriate, as well as diversifying into strategies that seek to provide real diversification and stable low correlations such as cash and divergent strategies like macro hedge funds, CTAs and volatility.

Figure 12: Stock market return



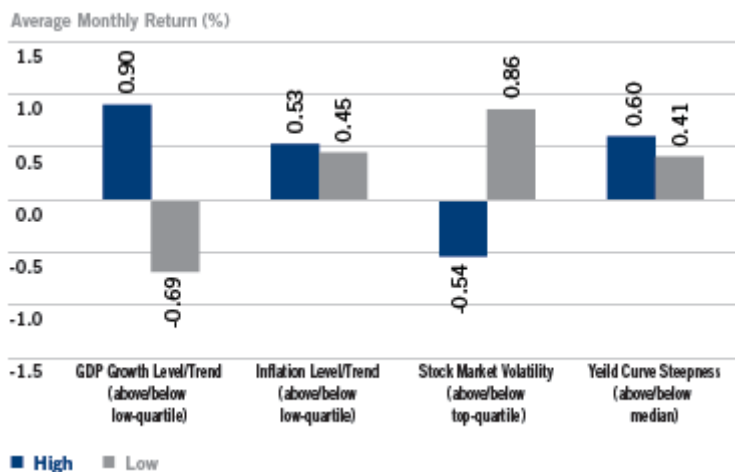
Sources: Ibbotson Associates and Schroder Salomon Smith Barney. Past performance is not a guarantee of future results.

Figure 13: Government bond return



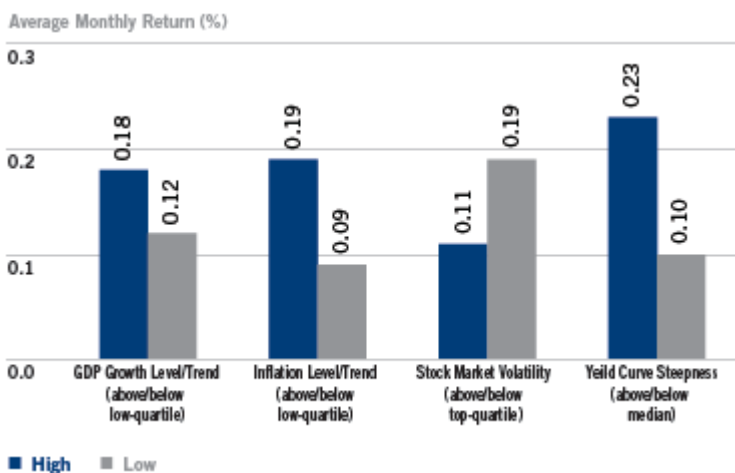
Sources: Ibbotson Associates and Schroder Salomon Smith Barney. Past performance is not a guarantee of future results.

Figure 14: Excess stock–bond return



Sources: Ibbotson Associates and Schroder Salomon Smith Barney. Past performance is not a guarantee of future results.

Figure 15: Stock–bond correlation



Sources: Ibbotson Associates and Schroder Salomon Smith Barney. Past performance is not a guarantee of future results.

THE IMPACT OF INVESTOR RISK PREFERENCE

In addition to inflation regimes creating variable correlations, investor risk preference will also drive the relationships between asset classes. This relationship is especially important as it can provide some insight into periods where correlations may shift quickly and the realised diversification is not what is expected.

Using SSgA's Market Regime Indicator (MRI)¹ as a proxy for investors' risk aversion, we see interesting changes in the correlation relationship as risk preference shifts (Figures 12–16) .

In some cases, such as the shift from normal regime to crisis, a spike in correlation across risky assets is expected. We see some asset classes such as commodities, where their diversification to US equities is best under a normal environment (0.16) but increases in both crisis (0.65) and euphoria (0.28).

We see a similar relationship for hedge funds. The implication is that in addition to being aware that correlations are variable and adjusting expectation accordingly, investors may benefit by having a forward-look expectation on environments and the impact on correlation structures. With that information, portfolio mixes can be adjusted.

CONCLUSION

The 2014 market environment continues to pose a challenge for asset allocators looking to build portfolios with the proper level of diversification. The dynamic nature of this measure has been a historical challenge, made only the more challenging since the GFC.

It is important to ensure that allocations are made to assets that are truly diversifying, as this is a critical step towards managing overall risk. Introducing steps to be more reactive and dynamic relative to changes in risk or economic regime can provide a way to help protect portfolios and manage risk.

- Correlations are dynamic and that should be factored into portfolio modeling to ensure proper expectations. Shifts in market regimes also create opportunities to shift portfolios to take advantage of this variability.
- Strategies such as government bonds, managed futures, short-biased hedge funds and volatility can potentially provide the diversification desired.
- Real estate may also provide a true level of diversification relative to equities.

Figure 16: MRI Regime – Crisis

	S&P 500	MSCI Europe	MSCI Pacific	MSCI EM	DJ UBS Commodity	S&P Case Shiller 10	CS Hedge Fund	Barcl High Yield
S&P 500	1.00							
MSCI Europe	0.94	1.00						
MSCI Pacific	0.86	0.90	1.00					
MSCI EM	0.95	0.95	0.94	1.00				
DJ UBS Commodity	0.65	0.57	0.65	0.70	1.00			
S&P Case Shiller 10	0.04	0.07	0.04	0.00	-0.15	1.00		
CS Hedge Fund	0.80	0.79	0.81	0.79	0.77	-0.03	1.00	
Barclays VLI High Yield	0.94	0.85	0.78	0.85	0.71	-0.01	0.88	1
Barclays US Treasury	0.02	0.18	0.33	0.29	0.38	-0.21	0.16	0
Barclays German Treasury	0.64	0.72	0.74	0.78	0.86	0.07	0.67	0

Figure 17: MRI Regime – High Risk Aversion

	S&P 500	MSCI Europe	MSCI Pacific	MSCI EM	DJ UBS Commodity	S&P Case Shiller 10	CS Hedge Fund	Barcl High
S&P 500	1.00							
MSCI Europe	0.89	1.00						
MSCI Pacific	0.72	0.79	1.00					
MSCI EM	0.71	0.81	0.84	1.00				
DJ UBS Commodity	0.26	0.47	0.46	0.51	1.00			
S&P Case Shiller 10	-0.16	-0.15	-0.10	-0.22	-0.11	1.00		
CS Hedge Fund	0.62	0.66	0.65	0.71	0.33	-0.23	1.00	
Barclays VLI High Yield	0.62	0.59	0.59	0.62	0.13	-0.15	0.54	1
Barclays US Treasury	-0.18	-0.05	0.16	-0.03	0.11	0.20	-0.19	-0
Barclays German Treasury	0.20	0.51	0.51	0.41	0.42	0.09	0.27	0

Figure 18: MRI Regime – Normal

	S&P 500	MSCI Europe	MSCI Pacific	MSCI EM	DJ UBS Commodity	S&P Case Shiller 10	CS Hedge Fund	Barcl High
S&P 500	1.00							
MSCI Europe	0.81	1.00						
MSCI Pacific	0.60	0.64	1.00					
MSCI EM	0.72	0.79	0.71	1.00				
DJ UBS Commodity	0.16	0.35	0.48	0.42	1.00			
S&P Case Shiller 10	0.06	-0.02	0.14	0.00	0.14	1.00		
CS Hedge Fund	0.32	0.58	0.48	0.59	0.46	0.13	1.00	
Barclays VLI High Yield	0.45	0.47	0.42	0.55	0.21	0.07	0.28	1
Barclays US Treasury	-0.31	-0.29	-0.13	-0.26	-0.09	-0.06	-0.05	-0
Barclays German Treasury	0.06	0.32	0.26	0.20	0.35	-0.13	0.32	0

Figure 19: MRI Regime – Low Risk Aversion

	S&P 500	MSCI Europe	MSCI Pacific	MSCI EM	DJ UBS Commodity	S&P Case Shiller 10	CS Hedge Fund	Barcl High
S&P 500	1.00							
MSCI Europe	0.74	1.00						
MSCI Pacific	0.51	0.51	1.00					
MSCI EM	0.60	0.58	0.56	1.00				
DJ UBS Commodity	0.38	0.36	0.41	0.38	1.00			
S&P Case Shiller 10	-0.14	-0.12	0.15	-0.04	-0.14	1.00		
CS Hedge Fund	0.65	0.49	0.55	0.63	0.40	-0.08	1.00	
Barclays VLI High Yield	0.45	0.54	0.30	0.45	0.18	-0.15	0.29	1
Barclays US Treasury	-0.26	-0.20	-0.06	-0.13	0.04	-0.10	-0.13	0
Barclays German Treasury	0.16	0.57	0.22	0.20	0.19	-0.01	0.11	0

Figure 20: MRI Regime – Euphoria

	S&P 500	MSCI Europe	MSCI Pacific	MSCI EM	DJ UBS Commodity	S&P Case Shiller 10	CS Hedge Fund	Barclays High Yield
S&P 500	1.00							
MSCI Europe	0.91	1.00						
MSCI Pacific	0.80	0.79	1.00					
MSCI EM	0.72	0.69	0.74	1.00				
DJ UBS Commodity	0.28	0.39	0.39	0.51	1.00			
S&P Case Shiller 10	0.47	0.48	0.68	0.47	0.59	1.00		
CS Hedge Fund	0.71	0.70	0.49	0.61	0.02	-0.14	1.00	
Barclays VLI High Yield	0.66	0.60	0.32	0.55	0.16	-0.07	0.79	1.00
Barclays US Treasury	0.01	0.16	-0.29	-0.25	-0.20	-0.57	0.42	0.01
Barclays German Treasury	0.39	0.61	0.33	0.38	0.38	0.03	0.54	0.01

Source: SSgA. The correlation coefficient measures the strength and direction of a linear relationship between two variables. It measures the degree to which the deviations of one variable from its mean are related to those of a different variable from its respective mean.

ENDNOTES

1. The Market Regime Indicator is a proprietary, forward-looking blend of equity implied volatility, currency implied volatility and risky debt credit spreads used to give an indication of investor risk aversion. For more details, see ssga.com

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