

Rise of Cross-Asset Correlations

Asset Class Roadmap for Equity Investors

Summary

- Cross-Asset Correlations:** Over the past ten years, cross-asset correlations roughly doubled. Globalization of capital markets, and new risk-management and alpha-extraction techniques have driven the secular increase of cross-asset correlations. The recent cyclical increase is a result of elevated macro volatility. We believe that understanding the fundamentals and technicals of cross-asset correlation will be an increasingly important task for investors.
- Currencies:** The increasing share of EM equities, US and Japan debt, and the declining share of US equities in Global market capitalization is an important driver of correlation between currencies and equities. Risk-on/off trading, currency carry trades, and cross-asset arbitrage are further strengthening this correlation.
- Interest Rates:** Investors who decrease risk exposure usually sell equities to buy Treasury bonds. These risk flows cause a positive rate/equity correlation. Positive rate/equity correlation and a breakdown of the so-called “Fed Model” occurred in 1997 when three successive crises caused global de-risking and a flight to Treasuries. Risk of a correlation reversal is posed by severe stagflation or treasury/equity contagion.
- Commodities:** Historically, diversification benefits resulted in significant investment interest for commodities. The traditionally negative correlation to equities reversed sharply in 2008, as a result of delevering and demand destruction. About 40% of current commodity/equity correlation is a spillover from FX/equity correlation. Despite diversification benefits, commodities are not immune to tail events such as the one recently exhibited by silver.
- Credit:** With current correlation of ~80%, credit, equities, and equity volatility are the most correlated assets. Correlation of credit and equities is logical as both are priced based on the value and volatility of company assets. In practice, correlation is driven by capital structure arbitrage and hedging of credit with equity instruments.
- Equities:** Due to the globalization of capital markets, cross-regional equity correlation rose steadily over the past 20 years. Recent high levels have diminished the benefits of cross-regional diversification. Macro volatility is a more significant driver of sector and stock correlation. Specific risk-management and alpha-extraction trends impacting correlation were discussed in our report: [“Why we have correlation bubble.”](#)
- Alternative Assets:** Low correlation between strategies and ability to generate alpha make hedge funds an attractive asset class. Over the past ten years, hedge fund assets increased notably relative to the size of global equity markets. Disciplined risk-management techniques and alpha extraction employed by hedge funds likely contributed to the secular increase of correlations.
- Hybrid Derivative Trades:** In this section we highlight several trade ideas that take advantage of current levels of cross-asset correlations. Equity hedges contingent on interest rates, currencies, or commodities can significantly reduce the cost of equity hedging and be tailored for specific scenarios such as US stagflation or a debt crisis.

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Drivers of Cross-Asset Correlations

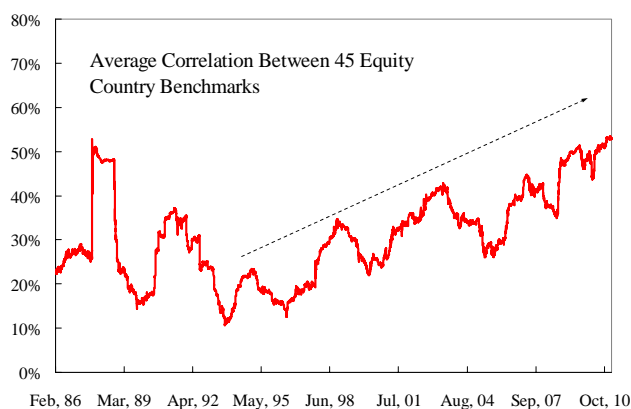
Rise of Cross-Asset Correlations

Correlation measures the degree to which prices of assets move together. Over the past decade, investors witnessed a significant increase of correlation between equities as well as an increase of correlation between other risky assets such as credit, foreign exchange, interest rates, and commodities.¹ High levels of correlation usually point to a common source of risk for asset prices. In times of high macro uncertainty, the prices of equities, risky bonds, oil, gold, and emerging market currencies are largely driven by changes in the macroeconomic outlook. In addition to a recent increase due to macro volatility, cross-asset correlation has been on a secular rise due to changes in market structure. Integration of global economies, increased efficiency and globalization of financial markets, and new risk-management and alpha-extraction techniques have all contributed to a rise in cross-asset correlation levels. In this report we discuss trends in cross-asset correlations and their impact on investors.

Figure 1 shows the average correlation between 45 developed world and emerging market country equity benchmarks contained in the MSCI All Country World Index. Over the past 20 years, the average correlation between these country benchmarks roughly doubled. This secular increase of cross-regional equity correlation is a result of the integration of global economies and capital markets. Liberalization of flows of goods between economies (free trade, outsourcing of labor), the rise of Emerging Markets (e.g., BRICS), and globalization of the financial industry (e.g., global banks and hedge funds) all contributed to the increase of cross-regional correlations. While the globalization of capital markets reduced diversification and cross-market arbitrage opportunities, the benefits of globalization are immense – the rapid growth of emerging economies has led to improved economic well-being for billions.

Similar to cross-regional equity correlation, the correlation between equities, credit, foreign exchange, interest rates, and commodities all increased over the past two decades. Figure 2 shows the average levels of cross-asset correlations for the 1990-1995 time period, and compares them to the average correlation levels over the past five years. On average, correlations between different asset classes more than doubled. Each of these cross-asset correlations will be discussed in the rest of the report.

Figure 1: Globalization – Rise of Correlation Between Equity Market Benchmarks for 45 Emerging and Developed Economies



Source: J.P. Morgan Equity Derivatives Strategy.

Figure 2: Cross-Asset Correlation Levels Increased for Equities, Credit, Foreign Exchange, Interest Rates, and Commodities

Asset Class	Correlation Between	1990-1995*	Past 5Y	Change
Equity	DM Country Indices	31%	47%	17%
Equity	EM Country Indices	23%	45%	23%
Equity	DM and EM Indices	38%	74%	36%
Equity	Economic Sectors	57%	69%	12%
Equity	Individual Stocks	25%	41%	16%
Credit	High Yield and Equities	46%	64%	19%
Credit	High Yield and VIX	37%	60%	24%
Foreign Exch.	DM Currencies and Equities	-1%	28%	29%
Foreign Exch.	EM Currencies and Equities	6%	42%	36%
Interest Rates	10Y Rate and Equities	-38%	29%	67%
Commodity	All Commodities	5%	25%	21%
Commodity	Commodities and Equities	-5%	12%	17%
Average		19%	45%	26%

* For Credit 2002-2005. All Currencies vs. USD

Source: J.P. Morgan Equity Derivatives Strategy.

¹ For a detailed study of equity correlations and their drivers, please see our report: [“Why we have a correlation bubble.”](#)

Correlation Risk/Reward

A common list of asset classes includes: equities, credit, interest rates, foreign exchange, commodities, and alternative assets. *Asset class* is generally defined as “a group of securities that exhibit similar characteristics, behave similarly in the marketplace, and are subject to the same regulations.”² In other words, the correlation between assets plays an important role in the defining of an asset class itself. In the early 1990s, correlation between Emerging Market (EM) stocks and Developed Markets (DM) stocks was ~30% and the two sets of equities were considered separate asset classes. Over the past three years, EM/DM correlation was ~80% and the two asset classes morphed into one. Similarly, the recent correlation of High Yield credit spreads to equities of ~75% is higher than the current average correlation between S&P 500 stocks of ~45%.

Below we consider the impact of cross-asset correlation on the risk and reward of multi-asset portfolios. The volatility of a multi-asset portfolio increases with the level of cross-asset correlation and the volatility of the assets in the portfolio.³ Hence, the higher the cross-asset correlation, the higher the portfolio volatility. If the portfolio volatility is reduced by lower cross-asset correlation, investors can free up risk capital that can be employed to generate additional returns.

Consider a portfolio of the following risky assets: emerging and developed market stocks, high yield bonds, commodities, and currencies. As shown in Figure 2, these assets are highly correlated. Over the past 15 years, the correlation between these assets increased from ~20% to ~45%, increasing by 25 correlation points. Assuming an average annualized asset volatility equal to that of equities (14.3% US equity volatility since 1871), this increase of cross-asset correlation would cause portfolio risk to increase by more than a third (35% increase in risk). Assuming that tied risk capital could have been employed to generate the average return of equities (8.9% annualized total return for US equities since 1871), the implicit cost of this cross-correlation increase is estimated at 312 basis points per annum.⁴

Figure 2 also shows a dramatic increase in equity/rates correlation. An increase of equity/rate correlation reduces the risk of a portfolio of equities and Treasury bonds. Consider a portfolio with equal weights invested in equities and US Treasury bonds. The increase of more than 60 points in rates/equity correlation over the past 15 years reduced the risk of an equity/treasury portfolio by a quarter. Assuming that the freed risk capital could have been employed to generate the average return of equities and treasuries (6.8% annualized total return since 1871), the implicit benefit of the cross-correlation increase is an estimated at 180 basis points per annum.⁵

In addition to the described impact on a multi-asset portfolio, cross-asset correlation can have a significant impact on equity-only portfolios. For instance, the most recent FX and Oil price movements have impacted the performance of equities. Equity investors can also trade cross-asset correlation directly through derivative products such as rate/equity, FX/equity, or commodity/equity hybrid options (described in the last section of this report). We believe that understanding the fundamentals and technicals of cross-asset correlation will be an increasingly important task for all portfolio managers.

Volatility, Risk Management, and Alpha as Drivers of Correlation

In times of elevated macro uncertainty, investors and risk managers look at equities, risky bonds, commodities, and currencies as sources of portfolio risk. As portfolio risk is adjusted up or down in a risk-on/off trading style, the prices of all risky assets tend to move in sync. In this rigid investment approach, any asset is viewed as having an exposure or ‘beta’ to the macro risk and some asset-specific ‘alpha’. Given the level of macro risk and the magnitude of ‘alpha’ available in the asset class, a risk-on/off trading approach determines the market level of cross-asset correlations.

² Investopedia website.

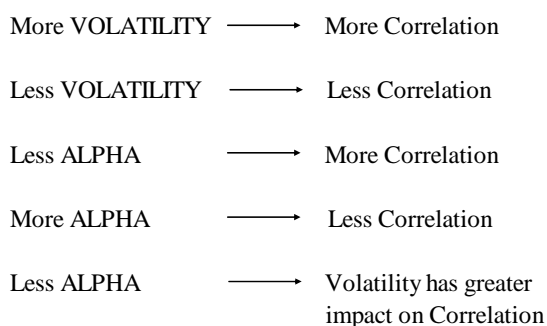
³ For a more exact expression, see the Appendix.

⁴ For a portfolio of Equities, High Yield Bonds, Commodities, and Currencies, the portfolio’s risk increased 1.4% for each cross-asset correlation point increase. The equivalent performance opportunity cost was 12bps for each point increase in cross-asset correlations.

⁵ For a portfolio of Equities and US Treasuries, the portfolio’s risk decreases 0.5% for each point increase in rates/equity correlation. The equivalent performance benefit is 3bps per point increase in equity/rate correlation.

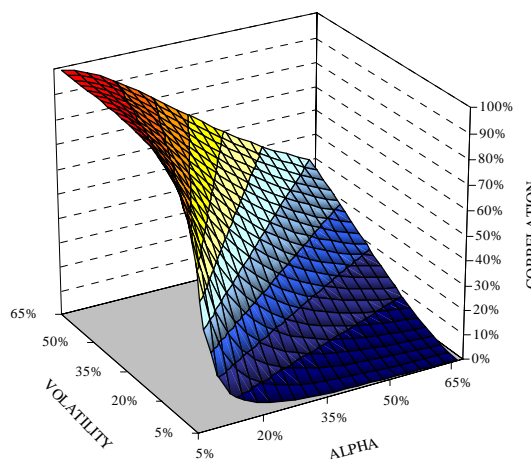
This relationship between cross-asset correlation, macro volatility, and availability of alpha in markets is summarized in Figure 3 (for a more formal explanation, see the Appendix). Essentially, a high level of macro volatility causes high cross-asset correlation. In addition, a lack of alpha also causes an increase of correlations. Interestingly, in a high-alpha environment spikes in macro volatility have a muted impact, while in a low-alpha environment macro volatility can cause a dramatic spike in cross-asset correlation. Figure 4 shows theoretical levels of cross-asset correlation (vertical axis) as a function of alpha and macro volatility. In order to have a large spike in cross-asset correlation, not only is macro volatility needed, but the level of alpha in the markets needs to be depleted.

Figure 3: Relationship Between Cross-Asset Correlation, Macro Volatility, and the Magnitude of Alpha Opportunities in the Market



Source: J.P. Morgan Equity Derivatives Strategy.

Figure 4: Graphical Representation of the Relationship Between Cross-Asset Correlation, Macro Volatility, and Magnitude of Alpha



Source: J.P. Morgan Equity Derivatives Strategy.

In the rest of this report, we explain the fundamentals of cross-asset correlation between currencies, rates, commodities, credit, equities, and alternative assets. **We also link the increase of cross-asset correlation to the current high macro volatility and to developments in risk-management and alpha-extraction techniques.**

US Treasuries and Risk Management

Disciplined risk management and portfolio diversification can contribute to an increase of cross-asset correlations. For instance, when investors increase their equity risk exposure by purchasing US, Developed World, and Emerging Markets equities in proportion to market capitalization, this leads to a net selling of USD and buying of foreign currencies. In addition, when the additional risk capital is obtained by reduction of holdings of government bonds (in proportion to current government bond market capitalization), it causes selling of US Treasuries. This type of risk-on/off flows is causing the current negative correlation between USD and global equities, and the positive correlation between equities and treasury yields (see the Currencies and Interest Rates sections). Over the past few years, many investors started increasing commodity allocation due to their low historical correlation to other risky assets and resistance to inflation. ‘Risk-on’ flows into commodities, along with USD/Equity correlation (note that commodities are priced in USD), recently gave rise to a strong positive correlation between equities and commodities.

Risk hedging with liquid derivative products can also have an impact on correlations. However, derivatives are not the cause of correlation but just facilitate the previously described risk-management techniques. For instance, hedging of equity exposure is typically implemented via index futures on liquid, capitalization-weighted indices such as the S&P 500. Trading of these instruments can mechanically increase correlation between large-cap stocks. Similarly, hedging credit portfolios with VIX or S&P 500 products can result in increased credit-equity correlation.

Alpha Extraction

A decrease of asset-specific alpha increases the level of cross-asset correlations. An example of alpha capture that causes correlation increase is statistical arbitrage. In a simple pair strategy, an arbitrageur is trading two correlated assets – buying the underperforming asset and selling the outperforming one. The trade increases the correlation between the pair and captures (diminishes) the alpha. This type of arbitrage can be implemented between pairs of stocks, sectors, and regional markets, between indices and their constituents, and more generally between different assets such as currencies, rates, and equities.

Similar to statistical arbitrage, alpha is extracted by various relative-value trading strategies. Capital structure arbitrage is a relative-value approach of trading equity versus credit. It can be employed on an individual security as well as an index level (e.g., trading CDX against S&P 500). Capital structure arbitrage can cause an increase of credit/equity correlations. Currency carry trades involve selling low-yielding currencies (e.g., USD and JPY) and buying high-yielding currencies, or more generally risky assets denominated in these currencies. This ‘generalized’ currency carry trade can cause an increase of FX/equity correlation, and even an increase in commodity/equity correlation.

An increase in the amount of assets invested in alpha-extraction strategies may have a secular impact on cross-asset correlations. Hedge funds assets, currently at ~\$2T, experienced significant growth over the past ten years. While not all hedge funds can consistently generate alpha, the increase of hedge fund assets likely had a net effect of alpha reduction and thus increase of correlation.

The described market changes that contributed to a secular increase of cross-asset correlations also brought some benefits. For example, cross-regional capital flows provide capital to emerging economies, electronic trading can improve liquidity for all market participants, and credit/equity arbitrage equally distributes risk and reward between bondholders and shareholders. Cross-asset correlations will likely decrease alongside macro volatility. However, the described market developments should persist and reset correlation levels to a new, higher, norm.

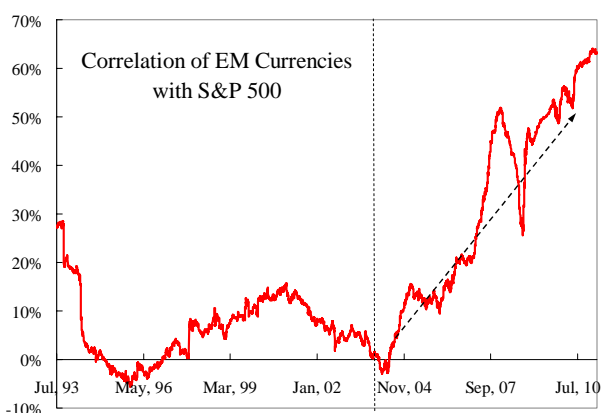
Currencies

Risk On/Off and Global Currency Flows

It is well known that an increased risk appetite of investors results in an inflow of capital into Emerging Market stocks. In order to purchase these stocks, funds need to be converted into local EM currencies. Given the liquidity of EM stocks and currencies, these inflows typically cause both assets (EM stocks and currencies) to appreciate at the same time, giving rise to positive correlation between equities and EM currencies. Increased interest for EM equities and the risk-on/off trading style caused a remarkable increase of EM Currency/Equity correlation over the past seven years (Figure 5). In fact, the current average correlation between the S&P 500 and EM Currencies is higher than the average correlation between large-cap US stocks even at the peak of the financial crisis in 2008.

Similar risk flows drive the correlation between equities and currencies of major developed economies such as USD, EUR, and JPY. Of particular interest for equity investors is the strong negative correlation between equities and USD. Developments in global equity markets over the past ten years can help us understand this relationship. Figure 6 shows the market capitalization of US, Developed World ex US, and Emerging Equity Markets since 1998. The figure shows the relative rise of EM, and decline of US market capitalization. Ten years ago, US equity markets represented ~60% of global equity market capitalization, with emerging markets only 6%. In the decade from 2001 to 2011 the US equity market halved to ~35% of global market capitalization, Developed Markets ex US increased to 41%, and Emerging Markets expanded to 24% of global equity capitalization.⁶ The relevance of capitalization changes to currency/equity correlation is that, while ten years ago the 'risk-on' trade into global equities (in proportion to global market capitalization) involved net buying of USD, since 2004 (and in particular over the past three years) the global 'risk-on' trade involves net selling of USD in order to purchase EM and Developed World ex US equities.

Figure 5: Correlation of EM Currencies (vs. USD) and S&P 500



Source: J.P. Morgan Equity Derivatives Strategy.

Figure 6: Global Equity Market Capitalization Since 1998

Year	Market Capitalization (\$Bn)			US	DMxUS	EM
	US	DM ex US	EM	%	%	%
1998	7,800	5,000	200	60%	38%	1%
1999	9,900	6,300	200	60%	38%	1%
2000	12,300	7,800	400	60%	38%	2%
2001	11,800	7,500	1,200	57%	37%	6%
2002	10,500	6,100	1,000	60%	35%	6%
2003	8,100	6,100	1,000	53%	40%	7%
2004	10,300	8,600	1,700	50%	42%	8%
2005	11,300	10,500	2,200	47%	44%	9%
2006	11,300	11,900	3,300	43%	45%	12%
2007	12,800	14,700	4,700	40%	46%	15%
2008	12,900	16,900	7,800	34%	45%	21%
2009	7,900	9,500	3,600	38%	45%	17%
2010	9,900	12,300	6,500	34%	43%	23%
2011	11,400	13,400	8,000	35%	41%	24%

Source: J.P. Morgan Equity Derivatives Strategy.

⁶ The period includes 9/11/2001, wars in Iraq and Afghanistan, emergence of BRICs, and strengthening of European Monetary Union.

Equally important is to look at the capitalization of global government debt markets shown in Figure 7. Currently, US and Japanese government bonds represent 62% of the market. US Treasuries and Japan government bonds are the largest, most liquid, and broadly held ‘riskless’ assets. US Treasuries alone represent almost 30% of all government bonds, and almost 60% of all AAA-rated bonds. In other words, US Government debt is most broadly used as a liquid store of ‘risk-free’ assets. A ‘risk-on’ trade involves shifting allocation from ‘riskless’ into ‘risky’ assets, and will therefore involve net selling of US (or Japan) debt and selling the USD (or JPY) to buy risky assets such as equities – two-thirds of which are denominated in non-US currencies.⁷ The ‘risk-on/off’ impact to asset allocation between government bonds and more risky assets will also cause correlation between interest rates and equities discussed in the next section.

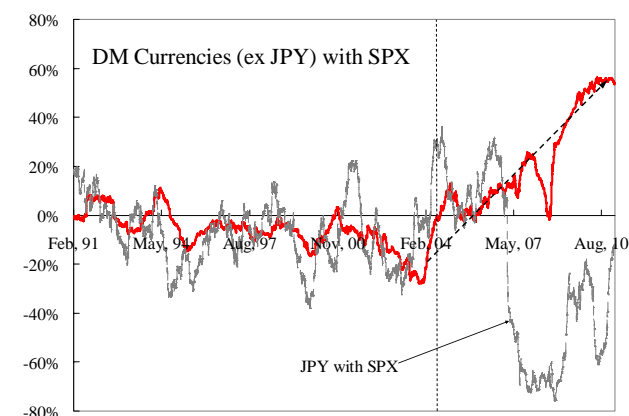
Figure 8 shows the correlation of DM currencies (excluding JPY) and equities over the past 20 years. We note that correlation started significantly increasing in 2004, which is roughly the time US equity market capitalization dropped below half of the global market capitalization. As the US capitalization dropped to roughly a third, correlation between DM currencies (excluding JPY) and equities further increased. The same chart shows correlation of JPY/USD and equities. Given the role of Japan’s government bond market (the largest liquid ‘risk-free’ asset pool), correlation of JPY/USD to equities is negative, in clear contrast to the rest of DM currencies.

Figure 7: Global Government Debt Market Capitalization

Country	Debt (\$Bn)	% of Total	S&P Rat.	% of GDP
Japan	10,779	34%	AA-u	226
USA	9,077	28%	AAAu	59
Italy	2,299	7%	A+u	118
France	1,869	6%	AAAu	84
Germany	1,761	5%	AAAu	79
UK	1,726	5%	AAAu	77
Spain	939	3%	AA	63
Canada	633	2%	AAA	34
Greece	479	1%	BB-	144
Belgium	451	1%	AA+u	99
Netherlands	449	1%	AAAu	65
Austria	276	1%	AAA	70
Portugal	206	1%	BBB-	83
Australia	203	1%	AAAu	22
Next 10	1,025	3%	--	--

Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg.

Figure 8: Correlation of DM Currencies (vs. USD) with S&P 500 (Solid); Correlation of JPY (vs. USD) with S&P 500 (Dashed)



Source: J.P. Morgan Equity Derivatives Strategy.

We have shown how secular changes in global equity and bond market capitalization as well as risk-management techniques (namely asset allocation between risky and riskless assets) impact the correlation between currencies and equities. Next we address the role of alpha-extraction techniques such as currency carry trades and cross-asset statistical arbitrage.

Currency carry trades involve borrowing in low-yielding currencies, and selling the currency to invest in higher-yielding currencies or other higher-yielding assets such as equities. Historically, low-yielding currencies were the JPY, and more recently the USD. Higher-yielding currencies were typically riskier EM currencies or commodity-driven developed world currencies. In both cases the currency carry trade is a ‘risk-on’ trade that involves selling USD or JPY while buying currencies (or assets) positively correlated with equity or commodity risk. Through this mechanism, the currency carry trade strengthens the USD/equity correlation, as well as correlation between equities, currencies, and commodities.

Cross-asset statistical arbitrage involves simultaneous trading of currencies, equities, and commodities. A computer model establishes and forecasts covariance between these assets, then algorithmically trades based on discrepancies between the expected relative moves of assets and observed moves. This type of statistical trading can provide liquidity and sap the market impact from trades in each asset class. However, the result is an increase of cross-asset correlation. We can find

⁷ Or alternatively buying riskier corporate or non-US government debt from countries such as Italy, Spain, and Greece.

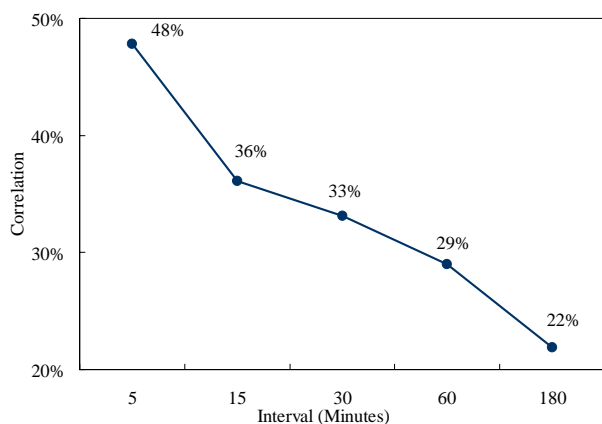
potential evidence of high-frequency statistical cross-asset trading activity in the behavior of currency/equity correlation calculated over different time horizons. Asset allocation flows typically occur over long-term time horizons. For instance, a portfolio manager may decide to review the allocation to risky assets vs. riskless bonds on a weekly basis, but will not adjust risk exposure minute-by-minute.

Figure 9 below shows EUR/USD correlation to equities calculated based on 5-, 15-, 30-, 60-, and 180-minute returns over the past six months. We note that EUR/USD to equity correlation is highest for the shortest time interval (5 minutes) and decreases for longer time periods. This suggests that some form of cross-asset trading, most likely of a statistical nature, does take place at high frequency.

High correlation between currencies and equities has a variety of implications for equity investors. The negative correlation between USD and equities increases the volatility of foreign assets (e.g., ADRs) to US investors. Similarly, for foreign investors this makes US equities less volatile as equity and USD risks partially offset each other.

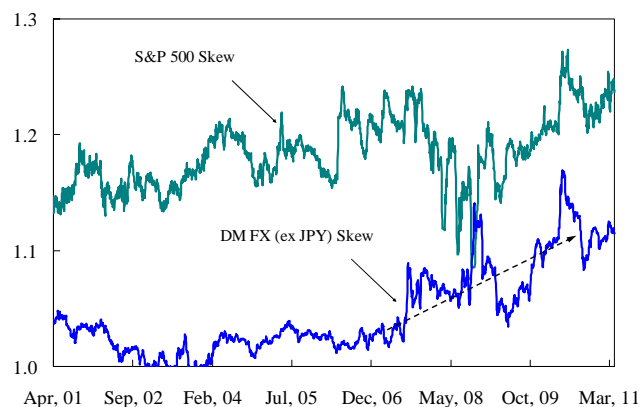
Another interesting application of currency/equity correlation is the possibility of cross-asset hedging. If FX options are cheaper than equity index options, investors could hedge equity exposure with FX options. In this approach the investor relies on the stability of correlation between currencies and equity, and seeks FX options that are ‘cheaper’ than S&P 500 options. Figure 10 below shows the six-month downside skew for the S&P 500 and the average skew for FX options of DM currencies against USD.⁸ Skew is expressed as a ratio of out-of-the-money (OTM) put implied volatility to at-the-money (ATM) implied volatility. We note that S&P 500 skew is trading persistently higher than FX skew. The reason for this is the supply/demand imbalance for equity index put options (more buyers than sellers of downside protection). Meanwhile, FX skew was fairly low prior to 2004, but given the steady increase of currency/equity correlation (Figure 8), FX skew has been rising as well. Despite this increase, FX skew for certain currency pairs may still be cheaper than S&P 500 skew, making FX puts an attractive alternative hedge for equities.⁹

Figure 9: EUR/USD Correlation to S&P 500, Calculated from 5-, 15-, 30-, 60-, and 180-Minute Returns



Source: J.P. Morgan Equity Derivatives Strategy.

Figure 10: S&P 500 and DM Currencies vs. USD Downside Skew



Source: J.P. Morgan Equity Derivatives Strategy.

⁸ Skew measures the difference between the price of OTM downside puts to at-the-money puts. High levels of skew imply a high probability of a large downside move, which increases the price of downside put options.

⁹ For specific examples of currency/equity hedging, see J.P. Morgan publications: “Tail-Risk Hedging with FX Options” and “VIX, Equities, and Dollar Carry Trade.”

Interest Rates

End of Fed Model and Use of US Treasuries as Global ‘Risk-Free’ Asset

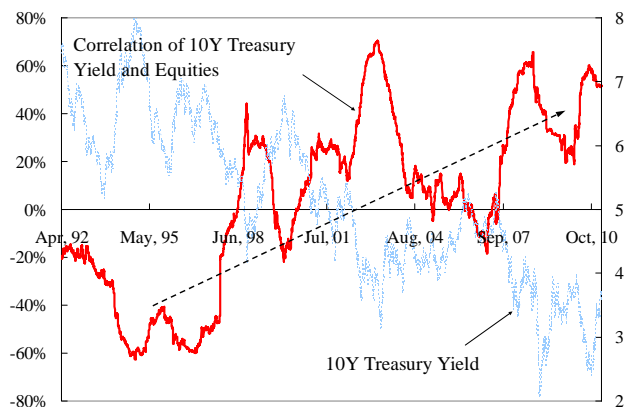
In the previous section, we explained the role of US and Japan government debt as a liquid, ‘riskless’ storage of assets. When investors increase risk exposure, they typically sell some government debt, and invest the proceeds in DM and EM equities, risky debt, or commodities. Reducing risk exposure involves selling risky assets and buying treasuries (flight to quality). This ‘risk-on/off’ asset allocation approach has caused a positive correlation between equities and interest rates over the past ten years. Positive correlation between rates and equities adds significant diversification benefits to a portfolio of risky assets and treasury bonds – as risky assets decline in value, treasury bonds appreciate and vice versa (e.g., see ‘Correlation Risk/Reward’ section).

Another reason for use of Treasuries as a ‘risk-free’ asset and a positive equity/rate correlation is an active monetary policy. If the economy is overheating and risky assets rally, the central bank may increase rates to cool down the economy. Conversely, if risky assets are selling off, the Fed may cut rates to support growth and avoid recession (Greenspan/Bernanke Put). Given the positive nominal yield of treasury bonds and negative correlation to equities, treasuries are considered to be a superior ‘riskless’ asset to cash deposits. The widespread usage of US Treasuries as ‘riskless’ storage has caused an increase of equity/rate correlations and decrease of treasury yields over the past 15 years, as shown in Figure 11.

Historically, the correlation between equities and rates was not always positive. Moreover, there are theoretical reasons why this correlation should in fact be negative. The so-called “Fed Model” states that treasury yields should be roughly equal to equity earnings yield (E/P or simply the inverse of the P/E ratio).¹⁰ The so-called “Fed Model” therefore implies direct negative correlation between treasury yields and equities – the higher the stock price, the lower the equity yield and hence the lower the treasury yield. The rationale behind the “Fed Model” is that investors compare the yield generated by holding treasuries to equity earnings yield, and invest their cash deposits into the one that looks more attractive (until treasury yield and earnings yield become equal). Market data over the past ten years have proved this reasoning to be flawed. Figure 12 shows a 30-year history of rate/equity correlation. We note that prior to 1997, rate/equity correlation was indeed negative, as predicted by the so-called “Fed Model.” This changed virtually in one day, when the Asian crisis caused risk contagion across global markets on 10/27/1997.

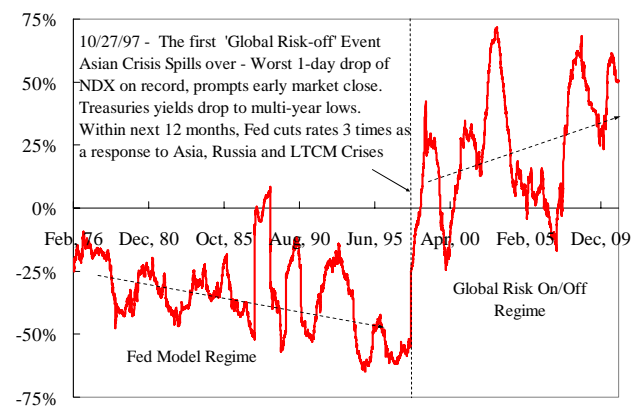
¹⁰ Ed Yardeni, “Fed’s stock market model finds overvaluation,” Topic Study #38, US Equity Research, Deutsche Morgan Grenfell, 1999.

Figure 11: Correlation of 10Y Treasury Yield and S&P 500



Source: J.P. Morgan Equity Derivatives Strategy.

Figure 12: Regime Change of Equity/Rate Correlation Occurred in 1997/1998



Source: J.P. Morgan Equity Derivatives Strategy.

Investors across the globe sold risky assets and piled into Treasury bonds, driving yields lower. The first global “Risk-off” event resulted in the worst one-day returns for the Nasdaq and Dow Jones, and caused Treasury yields to drop to two-year lows. Over the next 12 months and as a response to the crisis, the Fed postponed one rate increase, and subsequently cut rates three times thereby reinforcing the positive correlation between equities and yields. Similar equity selloffs and Treasury rallies occurred twice more in the next year during the LTCM and Russia debt crises. Risk-off events have become truly global affecting all asset classes (EM and DM Equities in the Asia crisis, Emerging Market Debt in the Russia crisis, Equity Volatility, Interest Rate Swap Spreads, and M&A Spreads in the LTCM crisis). These events established treasury bonds as the ‘riskless’ asset of choice and reversed the levels of equity/rates correlation for years to come.

Despite our view that equity/rate correlations will stay positive, there are certain scenarios that could cause a weakening or reversal of this relationship. While the return of an outdated “Fed Model” investment approach does not pose a risk for correlation, the occurrence of Stagflation or even full-fledged US bond/equity contagion could reverse the equity/rate correlation. In the case of Stagflation, treasury yields are expected to increase as a result of increased inflation expectations. A low or negative growth outlook and increased inflation expectations could cause an equity selloff. In this way, the occurrence of Stagflation could cause equity/rate correlations to drop or even turn negative.

The most dramatic reversal of equity/rate correlations could happen in the event of full-fledged US bond/equity contagion. This could occur as a result of a US fiscal crisis, prompting foreign investors to abandon US Treasuries as the ‘risk-free’ asset of choice. A sharp increase in rates would be followed by a broad selloff of all dollar assets. This type of tail event could result in equity/rate correlation dropping towards -100%. In addition, this event would likely trigger a dramatic reversal of equity/currency and equity/commodity correlations, likely weakening cross-regional equity correlations (e.g., US equities underperforming).

Investors wary of a potential US fiscal crisis and the tail-risk scenario described above could use an equity/rate correlation view in order to inexpensively hedge their equity exposure. An example trade would be to buy an out-of-the-money put option on the S&P 500 index, with a payoff that is contingent on treasury yields rising above a certain level. Given the current positive correlation between rates and equities, the cost of this type of hybrid would be significantly cheaper (as compared to the simple S&P 500 put option). For more details on this trade, see the last section of this report (Hybrid Derivative Trades).

Commodities

Silver Bullet for Asset Allocation

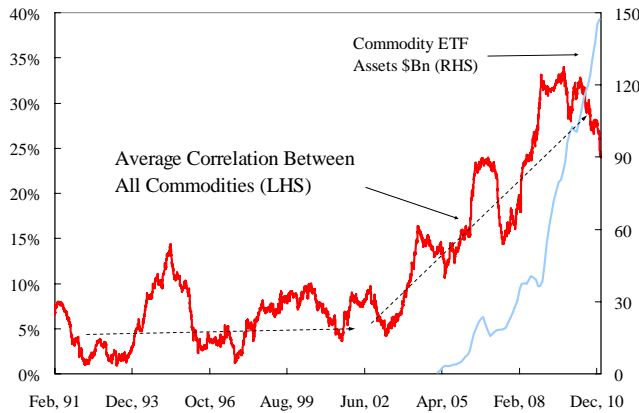
Prior to the financial crisis in 2008, commodities were essentially uncorrelated to equities and bonds, and were relatively weakly correlated among themselves. These attractive features were highlighted in numerous studies in the mid-2000s. For instance, a 2006 Ibbotson Associates study concluded that including commodities would have improved performance by 133bps, and suggested that an optimal asset allocation should include a significant proportion of commodities.¹¹ In addition to diversification benefits, commodities are considered to be a store of value and a hedge for inflation. These findings were largely based on historical analyses and did not take into account the potential price and correlation impact of widespread commodity allocations.

These attractive historical properties of commodities caught investors' attention and significant funds started flowing into the asset class. The demand for commodities from China and other emerging economies, the benign monetary policies of central banks, and increased geopolitical tensions caused large price increases, further fueling interest in the asset class. For instance, assets invested in Commodity ETFs roughly doubled every year since their launch in 2005 and currently stand at ~\$150bn. In addition to individual commodities, broad commodity indices such as GS, DJ UBS, and TR/J CRB attracted significant investment assets. Figure 13 shows the growth of commodity ETF assets, as well as the steady increase in correlation between various commodities over the past ten years. Correlation between individual commodities was weak in the 1990s, but started increasing steadily in the 2000s. This is likely the result of increased investment allocation to commodities and commodity indices.

Correlation between commodities and equities was on average negative in the 1990s and early 2000s. However, following the collapse of Lehman Brothers, commodity/equity correlation turned positive (Figure 14). There are several reasons that caused this quick reversal. Firstly, commodities sold off alongside equities and other risky assets in the big 'risk-off' event of 2008/2009. As investors de-levered and de-risked, any speculative premium built into commodities was erased. Alongside de-risking, the recession that followed the crisis reduced demand for commodities, causing a positive correlation between equities and commodities (e.g., a drop in GDP expectations translates into reduced demand for oil and lower equity valuations at the same time). Another significant driver of positive commodity/equity correlation is the negative correlation of USD to equities described in the Currencies section of this report (see Figures 5 and 8). As commodities are priced in USD, currency/equity correlation spills over to commodity/equity correlation. For instance, a 1% increase in equities will, on average, coincide with a 20bps drop in USD. As commodities are priced in USD, this will mechanically lead to a 20bps increase in commodity prices on account of USD/equity correlation. Currently, about 40% of the positive commodity/equity correlation can be attributed to the (negative) correlation of USD to equities. The increase of commodity/equity correlation since 2008 and the commodity/equity correlation adjusted for USD pricing of commodities is shown in Figure 14.

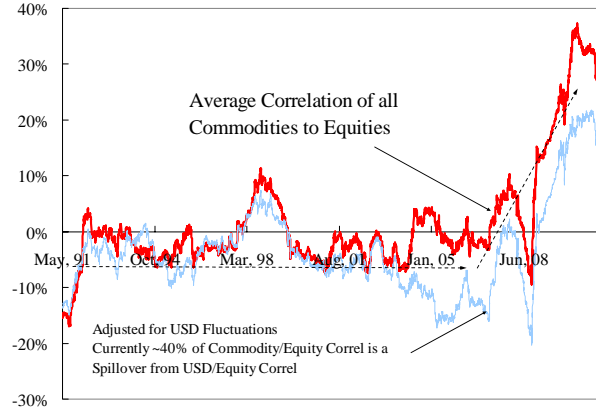
¹¹ "Strategic Asset Allocation and Commodities," Ibbotson Associates, 2006.

Figure 13: Correlation Between Various Commodities and Growth of Commodity ETFs



Source: J.P. Morgan Equity Derivatives Strategy.

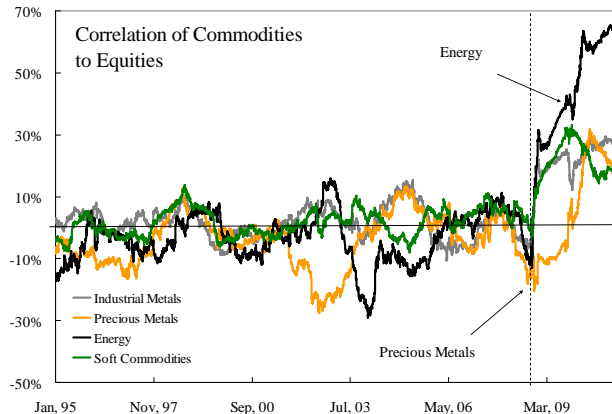
Figure 14: Commodity/Equity Correlation and the Spillover of Equity/FX Correlation



Source: J.P. Morgan Equity Derivatives Strategy.

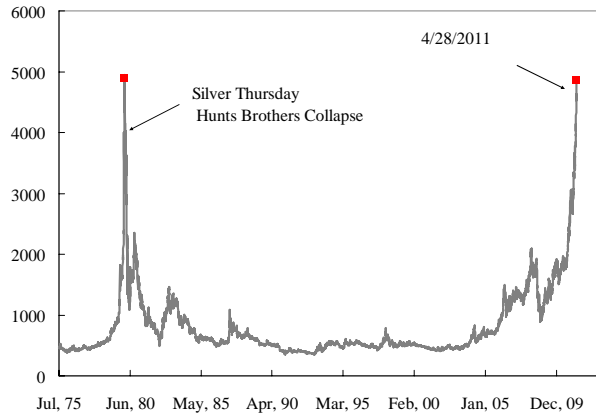
Figure 15 provides more details on the shift in commodity/equity correlation that occurred in 2008. The biggest reversion was experienced by Oil/Equity correlation which spiked from roughly -10% to current levels of over 60%. Industrial metals and soft commodities experienced similar correlation shifts. Gold/Equity correlations initially dropped as investors sold equities and rushed into the perceived relative security of gold. However, correlation quickly turned positive fueled by speculative demand and strong negative correlation of USD to equities.

Figure 15: Commodity/Equity Correlation for Energy, Precious Metals, Industrial Metals, and Soft Commodities



Source: J.P. Morgan Equity Derivatives Strategy.

Figure 16: Some Commodities Are Prone to the Creation of Bubbles



Source: J.P. Morgan Equity Derivatives Strategy.

The increase of commodity/equity correlation since 2008 diminished some of the diversification value to a cross-asset portfolio. At least part of the correlation increase can likely be attributed to the investment demand for commodities. As investors increase or decrease exposure to all risky assets (including commodities and equities), commodities/equity correlation increases.

More precarious than the reduced diversification benefit is the risk of creation and bursting of speculative bubbles. The burst of an asset bubble can reduce returns and erase diversification benefits achieved over time. Figure 16 shows the price of Silver over the past 35 years. There are two prominent features of the chart. The first one is the speculative bubble engineered by the Hunt Brothers and its burst on “Silver Thursday” in March 1980, and the second one is the price of silver at the time of writing of this report.

Aside from market risk, there are intriguing social and macroeconomic aspects of commodity investing. Some of these issues were publicly discussed following a decision by California State Teachers' Retirement System against a large investment into commodities. In the run-up of silver prices during the Hunt Brothers' scheme, Tiffany published a full-page add in *The New York Times* stating: "We think it is unconscionable for anyone to hoard several billion, yes billion, dollars worth of silver and thus drive the price up so high that others must pay artificially high prices for articles made of silver." Replacing "Silver" with "Food" or "Gas" reveals the socioeconomic risk of potential commodity bubbles.

In addition to asset allocation, commodity/equity correlation plays an important role in valuations and volatility estimates for Materials and Energy sector stocks.¹² As discussed in the Rates section, investors trade hybrid options based on equity and commodity prices. Two examples of such hybrid option trades are explained in the 'Hybrid Derivatives Trades' section.

¹² For further discussion of Oil/Equity correlation, and its impact on Energy Sector Volatility, please see our paper "Energy Sector Volatility – Fundamentals of Volatility and Relative Value Ideas" from 2008.

Credit

Capital Structure Arbitraged

Correlation between credit spreads and equities has been steadily increasing over the past ten years. Figure 17 shows the correlation of changes in 5-year High Yield credit spreads and S&P 500 returns, as well as the correlation between changes in HY credit spreads and changes in VIX levels. With correlation of ~80%, credit, equities, and equity volatility are currently the most closely correlated assets.

There are many theoretical reasons behind the strong credit/equity correlation. Structural models of credit provide prices for both bonds and the stock of a company based on the value and volatility of the company's assets. If the value of the assets drops below the level of debt, the equity price is zero. For higher levels of assets, equity is priced as a call option on assets struck at the debt level. J.P. Morgan Equity Derivatives Research maintains a simple structural model that can identify divergences between credit, equity volatility, and equity levels for individual stocks.¹³

Aside from the theoretical relationship, a high correlation between credit and equities is realized through relative-value trading. Capital structure arbitrage trades and cross-asset hedging tend to closely align these three assets. An example of a capital structure arbitrage trade is a relative-value trade between CDS and equity put options.¹⁴ Perhaps more important drivers of credit and equity correlation are cross-asset hedges which are usually implemented at an index level. Due to the liquidity and transparency of the equity options market, many investors hedge their credit exposure via equity index options and volatility products (e.g., put spreads and put-spread collars on equity indices, VIX futures, calls/call spreads and index variance).

In addition to liquidity and transparency, an advantage of using equity instruments for credit hedging is hedge diversification. Investors diversify their hedges to avoid potentially crowded positions in credit hedges (such as outright shorting, or buying puts on CDX price index). If a hedge is 'crowded', investors that rush to monetize the payoff may impact the price of the hedging instrument and thus reduce the effectiveness of the hedge. For this reason it may be prudent to have hedges diversified across liquid instruments and thus minimize the impact of hedge unwinds. Another advantage of using equity hedges for credit is the potential pricing advantage. Due to high levels of equity skew, pricing of equity put-spreads and put-spread collars in some instances may be more attractive than outright purchases of CDX options or shorting CDX.

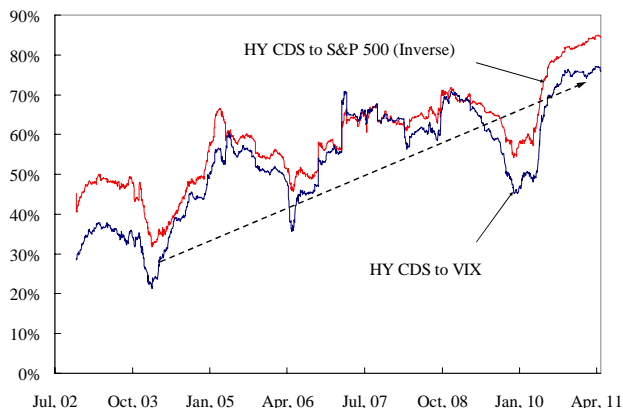
An obvious risk of credit/equity hedges (and more generally cross-asset hedges) is the tracking error between the two assets. The size of this tracking error is typically comparable to or greater than potential savings in the option pricing.

However, the tracking risk can also provide great opportunities for investors hedging credit with equity (or vice versa). The reason is that credit and equity prices can exhibit significant divergence in the short term. Investors who can correctly identify a divergence can buy protection on the 'expensive' asset to hedge the one that appears 'lagging'. Figure 18 shows the cumulative divergence of HY Credit spreads over equities and volatility (S&P 500 and VIX) based on a simple multiple regression model. This simple approach can help investors identify hedging relative-value opportunities. For instance, the figure shows a widening of credit relative to equities in the aftermath of GM's downgrade in the spring of 2005. Another episode of credit/equity divergence occurred when the VIX declined to multi-year lows at the end of 2005.

¹³ "A Framework for Credit-Equity Investing," 2007.

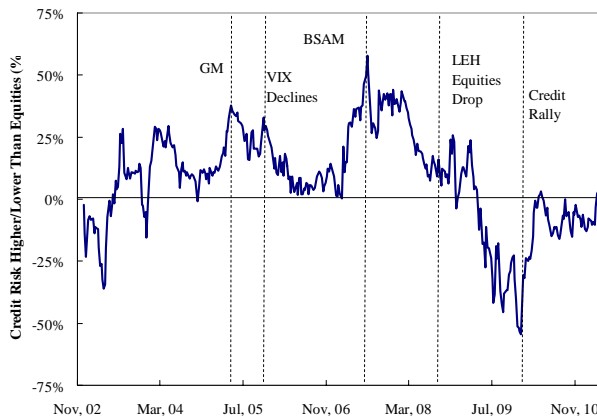
¹⁴ "Credit and Equity Volatility – Relative Value Opportunities," 2006.

Figure 17: Correlation of 5Y HY Credit Spreads to S&P 500 and VIX



Source: J.P. Morgan Equity Derivatives Strategy.

Figure 18: Credit/Equity Divergences over the Past Ten Years



Source: J.P. Morgan Equity Derivatives Strategy.

Perhaps the biggest divergence and hence credit/equity hedging opportunity occurred in the summer of 2007, following the collapse of BSAM credit hedge funds. During this episode, equity markets failed to react to the deterioration in credit markets leading into the 2008 financial crisis. In all of these cases, holding equity hedges would have been more profitable than holding credit hedges, as credit either widened ahead of equities or equity volatility was lower than credit spreads. However, equity hedges are not always more attractive. At the end of 2009, credit spreads tightened more than what would have been expected based on the regression against equities and the VIX (buying credit protection may have been more effective leading into the market correction that happened in May 2010). Despite the recent widening of credit spreads relative to equity volatility, currently we do not see a large discrepancy between the two assets.

Equities

Why We Have a Correlation Bubble

As with other asset classes, correlation between various equity markets and sectors has been trending higher over the past 20 years.¹⁵ The equity correlations most interesting to investors are the correlation between different regional markets (e.g., the correlation between developed world indices), the correlation between various industry sectors, and the correlation between individual stocks.

Figure 19 shows the correlation between developed and emerging markets and the correlation between different emerging market country benchmarks (in addition, Figure 1 shows the regional correlation between all country benchmarks). We note that the increase of cross-regional equity correlation is largely a secular trend (and only to a smaller extent driven by macro volatility). As explained in the first section of the report, this trend has been caused by the globalization of economies and financial markets. We believe this globalization, and hence the high cross-regional correlation trend, is not reversible. While region-specific events such as the recent earthquake in Japan may soften cross-regional correlations, markets are not likely to revert to the levels observed in the mid-1990s, when the average correlation between EM benchmarks was close to zero and EM/DM correlation was only ~25%. This trend of rising cross-regional correlation significantly diminished the once important diversification benefit of investing across emerging and developed markets. It appears that in the case of cross-regional investing, ‘the only free lunch in finance’ (a common reference to diversification) has been eaten.

The correlations between industry sectors are currently at their highest levels. Figure 20 shows a trend of increasing sector correlations over the past ten years, in particular the increase due to market volatility in 2008. Aside from market volatility, sector-specific market trends can have a large impact on cross-sector equity correlation. The most prominent is the large drop in sector correlation during the creation and burst of the internet bubble in 2001 as Technology stocks first rallied and then crashed relative to ‘old economy’ sectors.¹⁶

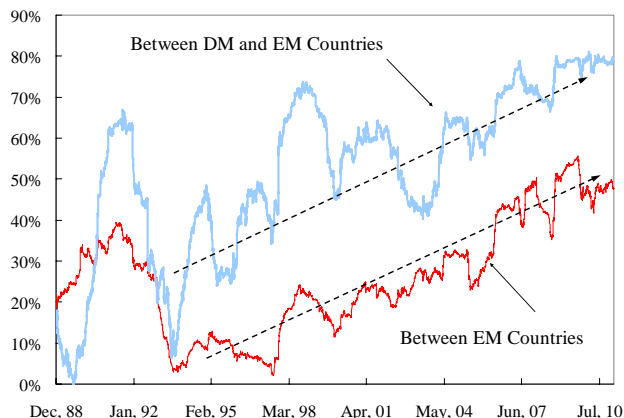
Figure 20 also shows average correlation between S&P 500 stocks. The recent increase of equity correlation has largely been driven by the increased macro volatility since 2007. However, other structural reasons contributed to increased levels of equity correlation. The widespread use of index products (e.g., futures) and high-frequency trading strategies, such as statistical arbitrage and index arbitrage, are likely contributing to increased levels of correlation.¹⁷ While the levels of correlation should decrease with reduced macro volatility (correlation has already significantly decreased over the past six months), the new normal for equity correlation will likely be higher due to the aforementioned structural developments. The historical average level of correlation was 28%, and our estimate for the future long-term average is ~35% (significantly lower than correlation during the peak of market crisis, but higher than the historical average). In addition to increased long-term average levels, correlation will probably be more prone to spikes due to the alpha depletion discussed in the first section.

¹⁵ For a detailed discussion of equity correlations see our report “Why we have a correlation bubble,” 2010.

¹⁶ For a more detailed discussion of sector correlations and their impact on market volatility, see our report “New Framework for Trading Correlation,” 2010.

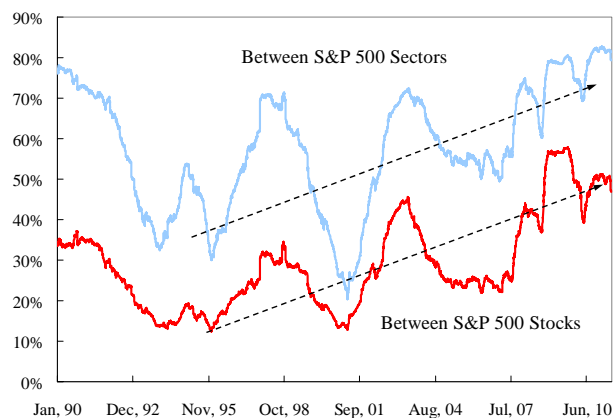
¹⁷ This was discussed in detail in our report “Why we have a correlation bubble.”

Figure 19: Secular Increase of Cross-Regional Equity Correlation



Source: J.P. Morgan Equity Derivatives Strategy.

Figure 20: Sector and Stock Equity Correlation



Source: J.P. Morgan Equity Derivatives Strategy.

Equity correlations are an important input to manage the risk of a multi-asset portfolio or an equity-only long-short portfolio. More directly, equity correlations are used to price various derivatives instruments as described below.

Correlation between markets in different regions is used to price options on baskets of global indices. These ‘World Basket’ options are used by both retail and institutional investors. An example is a put option on the best-performing index out of the S&P 500, EuroStoxx 50, and Nikkei. The buyer of a ‘Best-of’ put is buying correlation, i.e., counting that if the markets go down, correlation between these indices will increase, causing them all to fall by a similar amount. ‘Best-of’ options can significantly reduce the cost of hedging as they cost less than the cheapest put option on one index. Another popular instrument is outperformance options. An example is an option on the outperformance of Emerging Markets (e.g., MSCI EM index) over DM (e.g., S&P 500). Pricing of this option depends on the projected correlation between EM and DM, and the instrument can provide a relatively secure and levered exposure to strong EM performance (see Hybrid Derivative Trades section).

Both sector and average stock equity correlations can be traded through relative-value trading of index, sector (e.g., ETF), and stock options. Selling equity correlation entails selling index options and buying options on the individual index constituents (stocks) in a specific ratio. Sophisticated investors should be aware of the price of correlation (implied correlation) they are paying when buying index options (e.g., buying index puts). Due to excessive demand and a lack of supply of index options, equity correlation typically trades above its fair value. In many cases, investors may be better off buying options on individual stocks or sectors than index options. When the price of equity correlation is much higher than levels realized by stock prices, arbitrage investors step in and sell index correlation.¹⁸

¹⁸ For more details see “Why we have Correlation Bubble,” “Tail Risk Relative Value,” and “New Framework for Correlation Trading.”

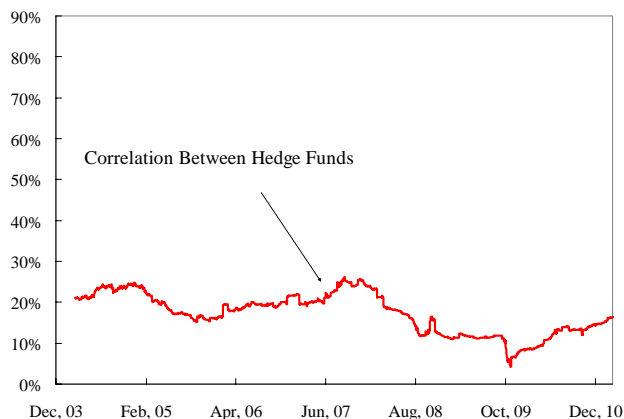
Alternative Assets

Hedge Funds and Correlation

Throughout this report we showed examples of increasing cross-asset correlation levels. One may ask if there is an asset class that did not experience a secular increase of correlation during recent years. An asset that could consistently generate positive alpha (outperformance) and not have a significant exposure to market risk (beta) would be uncorrelated to market risk. Many hedge funds seek to generate pure alpha through an absolute return mandate and should therefore be less correlated to other risky assets. Hedge funds are usually classified as ‘Alternative Assets’, alongside private equity and venture capital. There are various types of hedge funds including Merger Arbitrage, Global Macro, Distressed, Equity Market Neutral, Convertible Arbitrage, and others. These hedge fund strategies show relatively low correlation between one another. Figure 21 shows the average correlation between Hedge Fund Research Indices over the past eight years.¹⁹ Correlation between various hedge fund strategies has been low, and is not showing a secular increasing trend as we see with equities, commodities, and currencies.

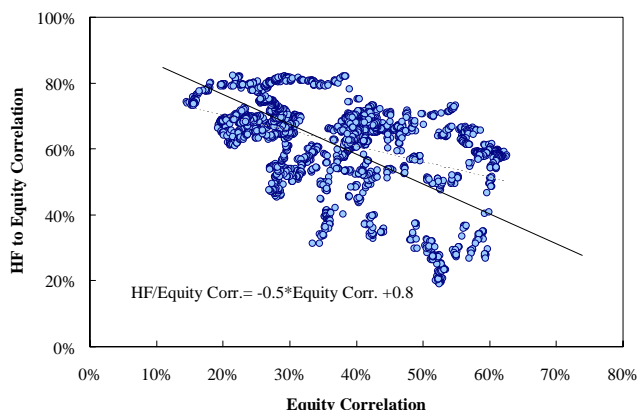
Correlation between the average performance of hedge funds (as measured by the HFRXGL Index) and the S&P 500 has been in a 20-80% range. This shows that, on average, hedge funds do have a significant exposure to equity markets. An attractive feature of hedge fund/equity correlation is that it tends to decline with an increase of market risk. In other words, on average, hedge funds show the ability to scale down market exposure in periods of high macro volatility. This is shown in Figure 22 which plots hedge fund/equity correlation vs. levels of equity correlation.

Figure 21: Correlation Between Hedge Fund Indices



Source: J.P. Morgan Equity Derivatives Strategy.

Figure 22: Hedge Fund/Equity Correlation Declines in Times of High Macro Volatility



Source: J.P. Morgan Equity Derivatives Strategy.

The low correlation between hedge fund strategies and lower correlations to other risky assets in periods of stress make hedge funds an attractive asset class. Over the past ten years, hedge fund assets increased significantly, both in absolute terms as well as in terms of percentage of global equity market capitalization. This is shown in Figure 23.

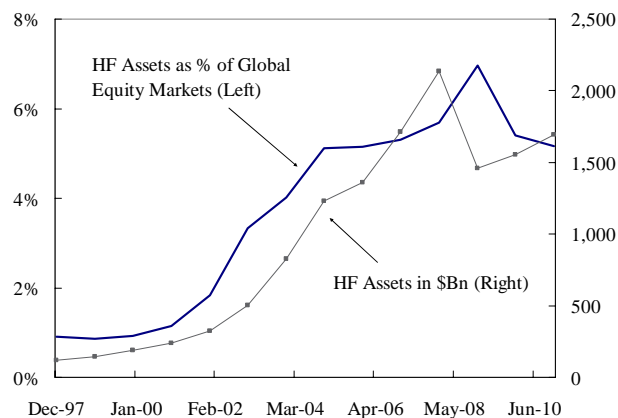
Hedge fund managers usually have a disciplined approach to risk management and neutralize risk exposures with the use of index-based and leveraged products such as futures and options. These risk-management techniques, alongside higher-than-average turnover, can contribute to increased levels of correlation.²⁰ Additionally, hedge funds seek to extract alpha through relative-value (hedged) trading. In the first section of this report, we showed that diminished levels of alpha increase the

¹⁹ 12M average pair-wise correlation between the following Hedge Fund Research indices: HFRXMA, HFRXDS, HFRXEI, HFRXCA, HFRXRVA, HFRXGL, HFRXM, HRXEMN, HFRXCOM, HFRXCRED, and HFRXTEM.

²⁰ See “Why we have correlation bubble,” 2010.

level of correlation and make markets more susceptible to correlation spikes. It is a possibility that the growth of hedge fund assets (shown in Figure 23) contributed to the secular increase of correlations over the past ten years (e.g., global macro and emerging market strategies may have contributed to an increase of cross-regional correlations, capital structure arbitrage strategies to credit/equity correlation, statistical arbitrage strategies to equity correlation, etc.).

Figure 23: Growth of Hedge Fund Assets Over the Past 15 Years



Source: J.P. Morgan Equity Derivatives Strategy, BarclayHedge LTD – Alternative Investments database.

In this report we have discussed structural changes in the market that have led to an increase of correlation levels. While the increase of correlations over the past three years is largely driven by macro volatility, secular market changes are causing a rising trend in cross-asset correlations. These changes include the integration of global economies and capital markets, and innovations in the financial industry. Advancement of risk-management techniques, such as hedging and dynamic asset allocation, use of US Treasuries as ‘risk-free’ storage, as well as more intensive extraction of alpha, have likely contributed to a secular increase in cross-asset correlations. Compared to 20 years ago, markets are currently more correlated and there is more pronounced “Alpha/Beta” separation. General market risk or ‘beta’ is managed more efficiently and at significantly lower cost (e.g., liquid derivative instruments and electronic trading), while large pools of assets are seeking ‘alpha’ via relative-value and arbitrage trading necessary for the proper functioning of capital markets.

Hybrid Derivative Trades

Implementing Cross-Asset Views

There are a number of trading strategies that can take advantage of cross-asset views. A common approach is to look for a closely correlated pair of assets and proxy hedge one with the other. This was briefly discussed in the Credit and Currencies sections. The main premise of proxy hedging is that the correlation between the two assets will remain stable. Cross-asset hedging makes the most sense when the price of one asset appears to be out of line relative to the other (e.g., equity volatility too low relative to credit spreads), or when the cost of protection in one asset class is significantly cheaper than in the other (e.g., FX volatility cheaper than equity index volatility). Investors can also focus on various tail-risk scenarios and look at the cost of tail protection across a range of assets. The expected benefits of cross-asset hedging (either coming from the cheapness of protection, or expected reversion of price divergence) are then compared to the tracking risk.

In this section we present several trades to implement cross-asset views directly through over-the-counter “Hybrid” derivatives. Hybrid derivatives have a payoff that is conditional on the price of more than one asset class. An advantage of using hybrid derivatives is that investors can significantly cheapen the cost of a hedge by buying protection against a particular cross-asset scenario. An example is buying a put option on the S&P 500 with a payoff conditional on the gold price rising above a certain level. If an investor believes that a market crash will coincide with a run of investors into the relative security of gold, buying this hybrid option could be significantly cheaper than buying a plain put on the S&P 500. In some cases, hybrid derivatives can have an added cost benefit if there is a natural supply of cross-asset risk (e.g., from retail structured product issuance or insurance industry demand). Below we list several cross-asset hybrid trades based on cross-asset relationships discussed in this report.

Rate/Equity

S&P 500 5-Year 90% Put Option contingent on 10-Year Swap Rate above 6% at maturity. The cost of this rate/equity hybrid option is ~3.5%. **This represents a discount of ~75%** compared to the cost of a vanilla S&P 500 5Y 90% put costing ~14.7%.

As discussed in Interest Rates section, rates are currently exhibiting positive correlation to equities (Figures 11 and 12). This means that if the S&P 500 drops, rates are likely to drop as well. The reason for this correlation relates to risk flows out of (into) equities and into (out of) US treasury bonds. Given the current positive correlation, the probability that the market will drop and rates go up is relatively small. For this reason the cost of this hybrid option is significantly lower than a plain S&P 500 put. However, there are two scenarios in which rate/equity correlation could sharply reverse. The first one is severe stagflation in which rates would go up and the market decline, and the second one is a tail event resulting in a sharp selloff of bonds and stocks (see Interest Rates section). Investors hedging against these two scenarios can significantly cheapen the cost of the hedge by purchasing this hybrid option.

Moreover, there are structural forces that are cheapening the price of this hybrid. Insurance companies that sell variable-annuity products with embedded guarantees are most vulnerable to falling equities (reducing the value of the assets used to provide guaranteed returns) and lower long-term interest rates (lowering the discount rate and therefore increasing the present value associated with future liabilities). These companies typically buy structured and hybrid investments that are long equity/rate correlation in order to hedge against the most unfavorable scenario of equities and interest rates falling simultaneously. Dealers that sell these structures are therefore left short equity/rate correlation and frequently seek to trade products with other clients that permit them to buy equity/rate correlation in order to reduce their own exposure. S&P 500 puts contingent on higher interest rates is an example of such a product. Investors that are willing to make their equity protection contingent on an increase in long-term interest rates can significantly reduce the cost of this protection by exploiting dealers’ desire to buy this equity/rate correlation.

Commodity/Equity

S&P 500 1-Year 95% Put Option contingent on Crude Oil above 105%. This option costs ~3.3% compared to plain S&P 500 1-year 95% put at ~6.6%. **This represents a ~50% lower premium.**

As discussed in the Commodities section, the current correlation between equities and oil is strongly positive (Figure 15). This positive correlation is caused by the link between expected economic activity and demand for oil, investment inflows/outflows into commodities as a portfolio risk asset, and a negative relationship between equities and USD – the currency in which oil is priced. Investors who believe that this high correlation between crude oil and equities could reverse may reduce the cost of their equity protection by making it contingent on a rising oil price.

A potential reversal of correlation could be triggered by a supply shock such as escalation of MENA crisis (e.g., a blockade of oil shipments through the Persian Gulf). In such a scenario oil prices may sharply increase and equities sell off. Another scenario in which oil/equity correlation may reverse is a potential US fiscal crisis – a sharp selloff of USD could mechanically push commodity prices higher.

S&P 500 1-Year 95% Put Option contingent on Spot Gold above 105%. The cost of this option is ~2.9% compared to vanilla put at ~6.6%. This **reduces the premium by ~55%** compared to the cost of a vanilla S&P 500 1-year 95% put.

The current correlation between gold and equities is mildly positive (Figure 15). This is caused by the investment demand for gold and a negative relationship between equities and USD – the currency in which gold is priced. The positive correlation between equities and gold is significantly cheapening the price of this option (which is contingent on gold and equities moving in the opposite direction).

Despite the fact that gold and equities are now positively correlated, in the times of escalating macro volatility (e.g., see Figure 15, September 2008), gold prices are known to exhibit negative correlation with equities. This is driven by the use of gold as a relatively secure ‘store of value’. In addition, an inflationary shock could prop up the prices of gold while negatively impacting equities. Investors who believe that gold/equity correlation may reverse either due to macro volatility shocks or US inflation may consider cheapening the cost of their equity protection by making it contingent on a rising gold price.

Currency/Equity

S&P 500 September 2011 ATM Put Option contingent on the Euro rising 3.5% against the USD at maturity. The cost of this option is 1.15% compared to a vanilla S&P 500 put that costs 4.8%. **This represents a ~75% lower premium.**

The S&P 500 recently exhibited a strong positive correlation to the Euro/USD (Figure 8). Therefore, a decline of the S&P 500 is expected to coincide with a decline in the Euro. However, if dollar assets show weakness as a result a potential large selloff in treasury bonds (e.g., triggered by the end of QE2), the Euro may strengthen despite a market selloff. Investors who believe that a potential decline of equities may be accompanied by a selloff of USD assets can significantly reduce the cost of their equity protection by making it contingent on the EUR rising. In this trade, an investor is selling currently record-high levels of equity/FX correlation and counting on a correlation reversal.

S&P 500 December 2011 95% Put Option contingent on the Canadian Dollar strengthening 3.5% against the USD. The cost of this option is 0.55% vs. a vanilla put cost of ~4.6%. **This represents a ~85% lower premium.**

The current correlation between CAD and equities is an astounding 80%. As with other DM currencies (Figure 8), as equities rise, the USD weakens causing appreciation of the CAD. In addition, the CAD is highly correlated to gold, and the positive correlation of equities and gold further increases the correlation of the CAD to equities. For these reasons the S&P 500 put option contingent on CAD rising is ~85% cheaper than the vanilla S&P 500 put.

However, there are several scenarios that could cause this correlation to reverse. If an equity selloff is caused by a selloff in US assets triggered by end of QE2, the occurrence of stagflation in the US, or a dollar crisis, the CAD could strengthen relative to the USD. In addition, in case of escalation of macro risk, gold/equity correlation would be expected to reverse

(Figure 15, September 2008) further supporting the CAD. Investors who believe that either equity/USD correlation or equity/gold correlation may reverse (causing the USD to weaken relative to the CAD in a negative equity environment) could significantly benefit from selling S&P 500/CAD correlation at record levels.

Cross-Regional

Outperformance of MSCI EM over S&P 500 1-Year Call Option. The cost of this option is ~6.4%. If the option is made contingent on the S&P 500 being above its current level at expiry, the cost is further reduced to ~3.9%. **This represents ~35% and ~60% premium reductions, respectively,** relative to a vanilla 1-year MSCI EM ATM call option (currently at ~9.6%).

An EM/DM outperformance option provides a relatively secure and levered exposure to strong EM performance, as the loss is limited to premium invested and the cost is lower than an outright option on EM. The correlation between EM and DM equities is currently at record levels (Figure 19). High levels of EM/DM correlation are cheapening the price of this option, as investors who purchase the option are effectively selling EM/DM correlation.

Investors who think that Emerging Markets may outperform US equities (e.g., due to risk of US fiscal crisis), causing a reversal of EM/DM equity correlation, would find an outperformance option attractive. For investors with a bullish outlook on equities, the additional contingency on the S&P 500 being above the current price represents an attractive feature. MSCI EM has a beta of ~1.25 to S&P 500, and the positive payoff of EM/DM outperformance is expected to coincide with the S&P 500 rising in absolute terms.

3-Month 95% Strike Best-of Put on a basket of S&P 500, FTSE 100, and ASX 200. The cost of this option is 1.2%. **This represents a 31% discount** compared to the cheapest vanilla put on any of the indices (premium of 1.75%).

One way to cheapen the cost of protection is buying best-of puts on a basket of indices. A best-of put has the same payoff as a standard 'vanilla' put, but the underlying instrument is the best-performing index within the selected basket. By conditioning the payoff on the best performer out of a basket of three indices, investors can cheapen the cost of protection significantly. The price of the best-of put is driven by the correlation between the constituents, the number of constituents, and their implied volatilities. A best-of put is typically cheaper when correlation is low. Moreover, best-of puts benefit from an increase in correlation and volatility, which both typically occur during a market selloff. Thus, if equities sell off sharply, investors are likely to have purchased these options at a lower correlation and volatility level than what is subsequently realized. All major global indices sold off together during the Q4 2008 credit crisis and the May 2010 Euro area sovereign debt crisis, suggesting the best-of put structure would have been effective in protecting a global portfolio during these sharp sell-offs.²¹

²¹ See European Equity Derivatives Weekly Outlook – Revisiting tail risk hedging, 1-Mar-2011.

Appendix: Simple Correlation Model

Volatility of a multi-asset portfolio is proportional to the average correlation between asset classes (cross-asset correlation) and the weighted-average volatility of asset classes in the portfolio.

$$\sigma_{Portfolio}^2 = \sum_{i,j} w_i w_j \rho_{ij} \sigma_i \sigma_j = \sum_i w_i^2 \sigma_i^2 + \rho \sum_{i \neq j} w_i w_j \sigma_i \sigma_j$$

$$\sigma_{Portfolio}^2 \approx \rho \sum_{i,j} w_i w_j \sigma_i \sigma_j = \rho \sum_i w_i \sigma_i \sum_j w_j \sigma_j = \rho \langle \sigma \rangle^2$$

In a simplified risk-on/off world, one can model each asset as having an exposure or ‘beta’ to the performance of macro risk and some asset-specific ‘alpha’. Cross-asset correlation is then a function of macro volatility σ_r , exposure of assets to macro volatility (beta), and asset-specific risk (i.e., magnitude of individual asset’s alpha). For two assets (labeled with indices x and y), correlation is calculated from their returns as:

$$r_x = \beta_x r + \alpha_x \quad r_y = \beta_y r + \alpha_y$$

$$\rho_{xy} = \frac{\sum_i r_x r_y}{\sigma_x \sigma_y} = \frac{\beta_x \beta_y \sigma_r^2}{\sqrt{(\beta_x^2 \sigma_r^2 + \alpha_x^2)(\beta_y^2 \sigma_r^2 + \alpha_y^2)}}$$

For assets with a similar exposure to macro risk (beta) and similar magnitude of asset-specific ‘alpha’, cross-asset correlation further simplifies to the following expression:

$$\rho_{xy} \approx \frac{1}{1 + \frac{\alpha_\sigma^2}{\beta^2 \sigma_r^2}}$$

Risks of Common Option Strategies

Risks to Strategies: Not all option strategies are suitable for investors; certain strategies may expose investors to significant potential losses. We have summarized the risks of selected derivative strategies. For additional risk information, please call your sales representative for a copy of “Characteristics and Risks of Standardized Options.” We advise investors to consult their tax advisors and legal counsel about the tax implications of these strategies. Please also refer to option risk disclosure documents.

Put Sale. Investors who sell put options will own the underlying stock if the stock price falls below the strike price of the put option. Investors, therefore, will be exposed to any decline in the stock price below the strike potentially to zero, and they will not participate in any stock appreciation if the option expires unexercised.

Call Sale. Investors who sell uncovered call options have exposure on the upside that is theoretically unlimited.

Call Overwrite or Buywrite. Investors who sell call options against a long position in the underlying stock give up any appreciation in the stock price above the strike price of the call option, and they remain exposed to the downside of the underlying stock in the return for the receipt of the option premium.

Booster. In a sell-off, the maximum realised downside potential of a double-up booster is the net premium paid. In a rally, option losses are potentially unlimited as the investor is net short a call. When overlaid onto a long stock position, upside losses are capped (as for a covered call), but downside losses are not.

Collar. Locks in the amount that can be realized at maturity to a range defined by the put and call strike. If the collar is not costless, investors risk losing 100% of the premium paid. Since investors are selling a call option, they give up any stock appreciation above the strike price of the call option.

Call Purchase. Options are a decaying asset, and investors risk losing 100% of the premium paid if the stock is below the strike price of the call option.

Put Purchase. Options are a decaying asset, and investors risk losing 100% of the premium paid if the stock is above the strike price of the put option.

Straddle or Strangle. The seller of a straddle or strangle is exposed to stock increases above the call strike and stock price declines below the put strike. Since exposure on the upside is theoretically unlimited, investors who also own the stock would have limited losses should the stock rally. Covered writers are exposed to declines in the long stock position as well as any additional shares put to them should the stock decline below the strike price of the put option. Having sold a covered call option, the investor gives up all appreciation in the stock above the strike price of the call option.

Put Spread. The buyer of a put spread risks losing 100% of the premium paid. The buyer of higher ratio put spread has unlimited downside below the lower strike (down to zero), dependent on the number of lower struck puts sold. The maximum gain is limited to the spread between the two put strikes, when the underlying is at the lower strike. Investors who own the underlying stock will have downside protection between the higher strike put and the lower strike put. However, should the stock price fall below the strike price of the lower strike put, investors regain exposure to the underlying stock, and this exposure is multiplied by the number of puts sold.

Call Spread. The buyer risks losing 100% of the premium paid. The gain is limited to the spread between the two strike prices. The seller of a call spread risks losing an amount equal to the spread between the two call strikes less the net premium received. By selling a covered call spread, the investor remains exposed to the downside of the stock and gives up the spread between the two call strikes should the stock rally.

Butterfly Spread. A butterfly spread consists of two spreads established simultaneously. One a bull spread and the other a bear spread. The resulting position is neutral, that is, the investor will profit if the underlying is stable. Butterfly spreads are established at a net debit. The maximum profit will occur at the middle strike price, the maximum loss is the net debit.

Pricing Is Illustrative Only: Prices quoted in the above trade ideas are our estimate of current market levels, and are not indicative trading levels.

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