Risk Management Advisor

The impact of currency correlation on asset returns

FX Strategy | Global
12 October 2010

G10 FX Strategy +1 646 855 9342
MLPF&S
G10FX.Strategy@ml.com

Moisés Romero Morales +1 415 622 3784
FX Strategist
MLPF&S
moises.r.morales@baml.com

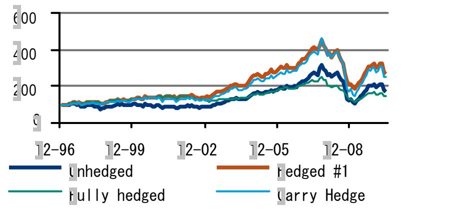
John Hopkinson +1 646 855 6246
FX Strategist
MLPF&S
john.hopkinson@baml.com

This installment of Risk Management Advisor was originally published 08 July 2010.

The decision to hedge FX

Investors owning assets denominated in foreign currencies are subject to fluctuations in the dollar value of their investments due to currency movements. An important factor in the decision to hedge FX is the carry of the currency. Hedging a long position in a currency with high interest rates implies the acceptance of an FX loss reflected by the difference in foreign and domestic rates. High carry currencies are therefore much more likely to remain un-hedged, yet they tend to be positively correlated with equities as well, which create volatile returns when expressed in US dollar terms. We analyze the impact of correlation on hedged and un-hedged returns, and determine the appropriate hedge ratios to use for a given utility function. Figure 1 reflects an example of indexed portfolio returns using our calibration method with 12/96=100.

Figure 1: Performance of ASX 200

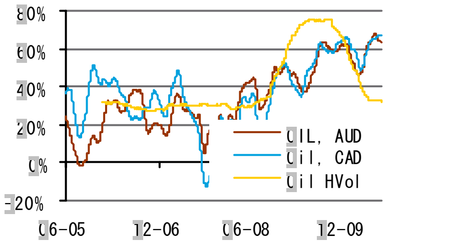


Hedge #1: Hedge to maximize returns – vol squared
Source: BofA Merrill Lynch Global Research

High oil and currency correlations continue strongly

Figure 2 displays the upward trending correlation between the price of crude oil and two major commodity currencies, AUD and CAD. Doubts regarding the sustainability of China's growth path and the momentum of the U.S. recovery, on top of the continuing concerns over European debt crisis, have started to weigh on investors' global economic outlook. Deceleration in the recovery (or worse) may lead to a return of elevated volatilities in oil/commodity, and heightened volatility in commodity currencies. Therefore, firms with positions in CAD or AUD may wish to consider hedging with collars, since the structures offer bottom side protection and a window of optionality, at zero cost. If currency volatility works in the firm's favor before expiry, the hedger may restructure the hedge to lock the rate.

Figure 2: Oil and Currency Correlations

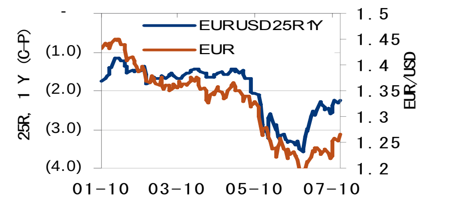


Source: BofA Merrill Lynch Global Research

July jump in EUR signals opportunity to hedge.

In June, as the recovery of the U.S. economy showed signs of sputtering, the EUR rebounded from its low of 1.1923 EUR/USD to close the month at 1.2238 EUR/USD; and by the early July publication date of this monthly, the currency had risen further to 1.2615. The down trend in the 25-delta risk reversal also broke in June, suggesting a lightening in the bearish demand for EUR puts. Nevertheless, consensus forecasts for the EUR remain bearish, suggesting that the recent rebound may be fleeting. Firms with EUR sales, therefore, might be well served to seize the favorable hedging opportunities offered by the recent move and enter into forwards or OTMF EUR put options. Forwards would lock in the recent favorable move, while ATMF EUR puts would allow participation in additional EUR appreciation at lower cost, given the recent easing in implied volatility – ATMF EUR vols, for instance, are currently trading at about 14%, down from highs near 15.5% in early June.

Figure 3: EUR strengthens during June 2010



Source: BofA Merrill Lynch Global Research

Refer to important disclosures on page 12 to 13. Link to Definitions on page 11.

Correlation and FX Hedging

We consider the point of view of an investor who has bought $100 worth of foreign equity, and is interested in the future dollar value of his investment. Our objective here is to analyze the impact of correlation between the performance of the equity and the currency in which it is denominated.

Carry and the decision to hedge FX

When domestic interest rates are low, investors may seek to find returns by either investing in stocks, or putting their cash in high carry currencies. As a result, the performance of high yielding currencies is often positively correlated with equity returns. In times of risk aversion, this correlation can be exacerbated by the repatriation of funds from un-hedged, poorly performing foreign equities, adding to the selling pressure of the pure FX carry positions being unwound. The result is that un-hedged foreign equities typically experience greater volatility of returns in USD terms than in the local currency.

Figure 4: USD denominated vol vs. correlation (12% Currency vol and 20% Equity Vol)

Correlation of equity and currency	Volatility of equity in USD
90.0%	31.2%
50.0%	28.0%
0.0%	23.3%
-50.0%	17.4%
-90.0%	10.6%

Source: BofA Merrill Lynch Global Research

What hedging strategy should be adopted?

A forward currency hedge on $100 might create a large FX position if the asset were to increase or decrease in value significantly. This can be effectively eliminated if the hedge amount is adjusted periodically to reflect the changing value of the asset. This apparently small difference can actually change the return distribution significantly however. Even with rebalancing, there is still gap risk on the equity returns. For example, if the company is subject to a takeover, the stock price might jump 50% overnight. To eliminate this risk would require the use of an exotic “quanto” forward, with notional linked to the equity price.

Positive correlation introduces positive drift

The reason for the positive drift when the currency is positively correlated with equity is an asymmetry between hedging gains and losses, and FX gains and losses on the underlying. To see this, suppose that the FX and underlying are perfectly correlated, and that the initial currency exchange rate is 1. We use a static hedge on a notional of $100 = FC 100 (FC: foreign currency). If the asset appreciates to FC 120, the currency will appreciate by about 12%, to 1.12, making it worth 120*1.12 = $134.40. At the same time, our FX hedge on FC 100 will lose $12, so our net gain is $22.40. This compares favorably to the FC 20 gain on the asset. Conversely, if the asset declines to FC 80, then the currency will decline to around $0.88, then our asset is worth 0.88*80 = $70.40. Our hedge gains $12 so our net loss is $17.60, which again compares favorably to the FC 20 loss on the asset.

Rebalancing hedges can be unhelpful

If we rebalance our hedges in the case when the currency is positively correlated to the equity, we increase our hedging losses as we increase the notional to match the asset, while we reduce our hedging gains by reducing our hedges as the asset depreciates. Viewing the currency trades in isolation, we are following a poor trading strategy of cutting short our winnings, and increasing our losses.

Haven currencies and negative correlation

Occasionally equity markets are negatively correlated to the currency. This is typically when the currency is one with consistently low interest rates. Examples are the Japanese Yen, and the Swiss Franc. In the case of the Swiss Franc, the negative correlation between equity and currency is most apparent when converting to Euros. In this instance our analysis would be relevant to a European investor investing in the Swiss stock market. The particular case of CHF versus EUR is interesting in that the cross rate experiences very low volatility. A manager may look at the positive carry to be gained by hedging, and given the low volatility expect little effect from the transaction. However, this may be a missed opportunity, as all the positive benefits of hedging with positive correlation, become negative with negative correlation.

Lower correlation suggests lower hedge percentages

If the currency is sufficiently negatively correlated with the asset, then in USD terms the volatility of the asset will be lower than it is in foreign currency terms. This suggests that lowering hedge ratios when the correlation is lower may be advantageous. Specifically, if we expect an equity volatility of σ_E, a currency volatility of σ_C, and a correlation of ρ, then if we leave q% un-hedged, our volatility of returns will be $\sqrt{(\sigma_E^2+q^2\sigma_C^2+2\rho q\,\sigma_E\,\sigma_C)}$. We can combine this formula with our estimated return μ, and carry cost x to determine the value of q which maximizes our utility function. Note that all parameters here are annualized.

Utility Function	Percentage Un-hedged to maximize utility
Return / Volatility	$((\mu-x)\,\rho\,\sigma_E\,\sigma_C-\sigma_E^2\,x)/((x-\mu)\,\sigma_C^2+x\,\rho\,\sigma_E\,\sigma_C)$
Return – Volatility^2/2	$(x-\rho\,\sigma_E\,\sigma_C)/\sigma_C^2$

For example, with σ_E = 20%, σ_C = 12%, ρ = 0, μ = 10% and x = 1% (meaning we have 1% negative carry), we find that return / volatility is maximized with a hedge percentage of 69.14% (un-hedged 30.86% in the formula), while return - Volatility^2/2 is maximized with a hedge percentage of 30.56%. It is worth mentioning that the latter measure doesn't depend on the unreliable return estimate μ. The second formula is particularly intuitive. It suggests reducing the hedge amount if the correlation is lower, if the carry cost is higher, and also if the currency volatility is lower. The first formula requires a double check that it really is a maximum and not a minimum. If the carry cost is sufficiently high, the true maximum Sharpe ratio is achieved going fully un-hedged, but the formula gives a spurious negative answer (which we would normally interpret as zero).

Introducing Optionality can be helpful

If a manager is required to remain 100% hedged, the positive skew seen when the currency is positively correlated with the equity becomes a negative skew for negative correlation. To mitigate this undesirable consequence, a manager can purchase some optionality. A simple strategy would be to use a participating forward. In this case, the hedge notional is smaller when the hedge loses money, and larger when the hedge gains money. The more negative the correlation, the greater the amount of optionality that is appropriate.

FX should be part of the asset allocation decision

Efficient portfolio construction usually involves calculating the covariance matrix of the various assets, and using this in combination with the vector of return estimates to determine which allocation produces the best ratio of risk to return. If the FX component of assets is hedged out then the co-variances can be assumed to be that of the underlying assets, and so FX can be removed from this part of the calculation. A more subtle point is that valuing the asset in USD terms does enter into the expected return calculation though the quanto correlation drift ($\rho\,\sigma_E\,\sigma_C$). Assuming that we have positive correlation when the currency is a high yielder, this correlation drift reduces the impact of the negative carry on our hedge. One caveat is that given the difficulty in estimating expected return vectors, this adjustment likely falls well inside the margin of error.

Implied vs. realized G10 correlations

Figure 5: Implied vs. realized correlations of G10 crosses

1M Implied Correlations Against USD

	EUR	JPY	GBP	CHF	AUD	CAD	NOK	NZD	SEK
EUR	--	--	--	--	--	--	--	--	--
JPY	-3.7	--	--	--	--	--	--	--	--
GBP	67.7	-15.3	--	--	--	--	--	--	--
CHF	60.2	14.5	55.2	--	--	--	--	--	--
AUD	60.5	-28.0	55.5	38.0	--	--	--	--	--
CAD	55.0	-30.0	52.0	46.8	77.0	--	--	--	--
NOK	76.3	-9.1	66.1	59.2	72.0	63.3	--	--	--
NZD	61.4	-24.6	58.2	46.1	87.0	72.3	63.7	--	--
SEK	79.7	-11.7	64.8	57.4	68.2	67.6	87.1	67.8	--

1M Realized Correlations Against USD

	EUR	JPY	GBP	CHF	AUD	CAD	NOK	NZD	SEK
EUR	--	--	--	--	--	--	--	--	--
JPY	-15.3	--	--	--	--	--	--	--	--
GBP	65.6	15.7	--	--	--	--	--	--	--
CHF	56.4	19.3	68.0	--	--	--	--	--	--
AUD	74.5	-55.4	51.0	39.4	--	--	--	--	--
CAD	64.6	-61.9	34.2	30.2	83.0	--	--	--	--
NOK	81.1	-40.8	53.4	51.7	85.5	73.7	--	--	--
NZD	73.6	-41.9	54.2	35.7	94.1	67.3	83.2	--	--
SEK	90.5	-27.8	64.5	61.9	82.9	71.5	89.9	81.2	--

3M Implied Correlations Against USD

	EUR	JPY	GBP	CHF	AUD	CAD	NOK	NZD	SEK
EUR	--	--	--	--	--	--	--	--	--
JPY	5.3	--	--	--	--	--	--	--	--
GBP	68.6	-7.3	--	--	--	--	--	--	--
CHF	68.6	18.2	56.9	--	--	--	--	--	--
AUD	59.3	-24.8	55.0	37.4	--	--	--	--	--
CAD	54.0	-25.5	52.0	44.2	77.5	--	--	--	--
NOK	80.1	-0.4	68.1	65.4	69.1	66.5	--	--	--
NZD	59.1	-24.7	56.4	42.9	86.8	72.0	63.5	--	--
SEK	81.9	-2.4	66.2	64.9	65.7	67.3	88.3	64.9	--

3M Realized Correlations Against USD

	EUR	JPY	GBP	CHF	AUD	CAD	NOK	NZD	SEK
EUR	--	--	--	--	--	--	--	--	--
JPY	-30.3	--	--	--	--	--	--	--	--
GBP	60.1	-29.3	--	--	--	--	--	--	--
CHF	71.3	-6.0	51.1	--	--	--	--	--	--
AUD	49.9	-64.4	49.3	37.9	--	--	--	--	--
CAD	51.2	-73.6	50.2	34.6	84.0	--	--	--	--
NOK	71.2	-61.5	62.5	56.8	82.3	77.4	--	--	--
NZD	54.2	-47.8	46.1	43.5	89.6	66.7	75.2	--	--
SEK	81.5	-61.2	61.9	62.5	72.7	75.5	88.9	66.8	--

6M Implied Correlations Against USD

	EUR	JPY	GBP	CHF	AUD	CAD	NOK	NZD	SEK
EUR	--	--	--	--	--	--	--	--	--
JPY	8.3	--	--	--	--	--	--	--	--
GBP	67.4	-2.2	--	--	--	--	--	--	--
CHF	70.5	17.1	55.0	--	--	--	--	--	--
AUD	59.0	-22.0	55.0	37.5	--	--	--	--	--
CAD	53.0	-20.0	52.0	42.3	77.0	--	--	--	--
NOK	81.6	3.2	67.6	66.7	68.0	66.9	--	--	--
NZD	58.6	-22.2	56.1	42.8	86.5	71.5	63.8	--	--
SEK	83.4	0.1	65.4	67.5	65.4	66.7	89.0	63.9	--

6M Realized Correlations Against USD

	EUR	JPY	GBP	CHF	AUD	CAD	NOK	NZD	SEK
EUR	--	--	--	--	--	--	--	--	--
JPY	-12.4	--	--	--	--	--	--	--	--
GBP	61.6	-15.0	--	--	--	--	--	--	--
CHF	80.5	5.3	57.1	--	--	--	--	--	--
AUD	55.1	-46.2	47.9	44.9	--	--	--	--	--
CAD	54.2	-52.9	44.4	42.0	83.9	--	--	--	--
NOK	78.3	-34.9	62.6	67.8	80.1	73.9	--	--	--
NZD	59.1	-34.1	47.8	51.1	88.0	68.8	75.6	--	--
SEK	81.9	-41.4	58.9	67.4	73.6	75.1	88.3	70.6	--

1Y Implied Correlations Against USD

	EUR	JPY	GBP	CHF	AUD	CAD	NOK	NZD	SEK
EUR	--	--	--	--	--	--	--	--	--
JPY	8.7	--	--	--	--	--	--	--	--
GBP	66.0	-0.7	--	--	--	--	--	--	--
CHF	73.8	15.2	53.8	--	--	--	--	--	--
AUD	59.0	-19.0	55.0	38.0	--	--	--	--	--
CAD	53.0	-14.0	52.0	42.0	76.0	--	--	--	--
NOK	82.5	4.2	67.2	68.5	66.9	67.9	--	--	--
NZD	58.7	-19.4	56.2	43.1	86.5	70.5	64.2	--	--
SEK	84.1	0.5	64.6	69.6	65.0	66.4	89.4	64.6	--

1Y Realized Correlations Against USD

	EUR	JPY	GBP	CHF	AUD	CAD	NOK	NZD	SEK
EUR	--	--	--	--	--	--	--	--	--
JPY	1.2	--	--	--	--	--	--	--	--
GBP	61.1	-7.3	--	--	--	--	--	--	--
CHF	86.0	16.4	57.6	--	--	--	--	--	--
AUD	63.9	-25.7	51.8	55.2	--	--	--	--	--
CAD	57.2	-31.9	42.5	47.8	78.4	--	--	--	--
NOK	80.5	-17.3	62.2	72.7	79.1	72.6	--	--	--
NZD	63.0	-18.0	51.6	56.1	86.5	68.3	74.1	--	--
SEK	81.1	-23.9	58.7	72.5	73.9	70.1	85.6	69.6	--

Source: BofA Merrill Lynch Global Research

The implied correlations are calculated from observed implied volatility prices. Realized correlations are computed from daily log changes of end-of-day spot.

Asset class correlations

Figure 6: 1-month asset correlations using daily data

		Currencies								10Y Swaps (SA)				US Credit		Global Equities					Comm.		
		DXY	GBP	EUR	JPY	EURJPY	EURGBP	AUDJPY	Vol	USD	GBP	EUR	JPY	Baa	HY	VIX	SP 500	FTSE 100	MSCI Eur	NIK 225	Gold	Oil	CRB
Currencies	DXY	+100	-78	-88	-1	-65	-6	-49	+35	-55	-56	-43	-33	+2	+59	+52	-54	-35	-48	-48	-12	-54	-66
	GBP	-78	+100	+61	+14	+37	-49	+31	-1	+44	+59	+34	+22	+9	-30	-31	+37	+11	+27	+21	+3	+33	+32
	EUR	-88	+61	+100	-14	+83	+39	+62	-43	+65	+36	+44	+33	-31	-69	-70	+70	+31	+42	+57	+17	+64	+68
	JPY	-1	+14	-14	+100	-67	-30	-74	+48	-47	+8	-17	-54	+27	+51	+61	-64	-61	-55	-50	-6	-56	-44
	EURJPY	-65	+37	+83	-67	+100	+47	+88	-59	+76	+22	+43	+56	-38	-81	-87	+88	+58	+63	+71	+17	+80	+76
	EURGBP	-6	-49	+39	-30	+47	+100	+31	-45	+21	-27	+10	+10	-43	-41	-40	+33	+20	+14	+40	+14	+33	+38
	AUDJPY	-49	+31	+62	-74	+88	+31	+100	-65	+68	+15	+40	+69	-44	-81	-88	+92	+65	+67	+63	+17	+75	+67
	Vol	+35	-1	-43	+48	-59	-45	-65	+100	-31	-4	-18	-59	+8	+49	+60	-57	-71	-70	-62	+3	-43	-52
Swaps	USD	-55	+44	+65	-47	+76	+21	+68	-31	+100	+42	+60	+34	-35	-58	-61	+70	+31	+38	+55	+3	+62	+57
	GBP	-56	+59	+36	+8	+22	-27	+15	-4	+42	+100	+44	+20	+19	-36	-19	+24	+22	+33	+32	-4	+23	+25
	EUR	-43	+34	+44	-17	+43	+10	+40	-18	+60	+44	+100	+41	-25	-61	-52	+59	+36	+41	+52	+18	+46	+41
	JPY	-33	+22	+33	-54	+56	+10	+69	-59	+34	+20	+41	+100	-8	-59	-55	+60	+81	+80	+34	+31	+42	+57
Credit	Baa	+2	+9	-31	+27	-38	-43	-44	+8	-35	+19	-25	-8	+100	+40	+40	-43	-4	+0	-12	-3	-21	-5
	HY	+59	-30	-69	+51	-81	-41	-81	+49	-58	-36	-61	-59	+40	+100	+82	-87	-53	-55	-66	-11	-70	-61
Equities	VIX	+52	-31	-70	+61	-87	-40	-88	+60	-61	-19	-52	-55	+40	+82	+100	-96	-55	-61	-83	-21	-80	-66
	SP 500	-54	+37	+70	-64	+88	+33	+92	-57	+70	+24	+59	+60	-43	-87	-96	+100	+59	+65	+77	+13	+81	+63
	FTSE 100	-35	+11	+31	-61	+58	+20	+65	-71	+31	+22	+36	+81	-4	-53	-55	+59	+100	+96	+51	+14	+50	+62
	MSCI Eur	-48	+27	+42	-55	+63	+14	+67	-70	+38	+33	+41	+80	+0	-55	-61	+65	+96	+100	+59	+16	+57	+67
	NIK 225	-48	+21	+57	-50	+71	+40	+63	-62	+55	+32	+52	+34	-12	-66	-83	+77	+51	+59	+100	-1	+63	+50
Comm.	Gold	-12	+3	+17	-6	+17	+14	+17	+3	+3	-4	+18	+31	-3	-11	-21	+13	+14	+16	-1	+100	+23	+37
	Oil	-54	+33	+64	-56	+80	+33	+75	-43	+62	+23	+46	+42	-21	-70	-80	+81	+50	+57	+63	+23	+100	+81
	CRB	-66	+32	+68	-44	+76	+38	+67	-52	+57	+25	+41	+57	-5	-61	-66	+63	+62	+67	+50	+37	+81	+100

Source: BofA Merrill Lynch Global Research

Figure 7: 1-year asset correlations using daily data

		Currencies								10Y Swaps (SA)				US Credit		Global Equities					Comm.		
		DXY	GBP	EUR	JPY	EURJPY	EURGBP	AUDJPY	Vol	USD	GBP	EUR	JPY	Baa	HY	VIX	SP 500	FTSE 100	MSCI Eur	NIK 225	Gold	Oil	CRB
Currencies	DXY	+100	-69	-91	-14	-51	-20	-36	+24	-15	-14	-27	-14	-2	+38	+30	-44	-41	-40	-25	-33	-54	-60
	GBP	-69	+100	+61	-7	+46	-48	+41	-31	+19	+26	+24	+14	-4	-34	-37	+42	+25	+30	+23	+22	+49	+49
	EUR	-91	+61	+100	+1	+66	+40	+45	-23	+22	+12	+32	+11	-9	-43	-36	+51	+39	+37	+33	+31	+54	+54
	JPY	-14	-7	+1	+100	-74	+10	-72	+39	-64	-41	-42	-29	+22	+41	+43	-44	-36	-39	-42	-3	-30	-23
	EURJPY	-51	+46	+66	-74	+100	+19	+84	-44	+63	+38	+53	+29	-22	-59	-56	+67	+53	+54	+54	+23	+59	+53
	EURGBP	-20	-48	+40	+10	+19	+100	+1	+10	+3	-17	+7	-4	-5	-8	+4	+7	+13	+6	+10	+9	+3	+3
	AUDJPY	-36	+41	+45	-72	+84	+1	+100	-50	+60	+41	+46	+33	-27	-64	-68	+78	+62	+61	+55	+26	+62	+57
	Vol	+24	-31	-23	+39	-44	+10	-50	+100	-22	-25	-18	-28	+12	+38	+51	-37	-44	-47	-29	-16	-29	-32
Swaps	USD	-15	+19	+22	-64	+63	+3	+60	-22	+100	+51	+64	+29	-24	-47	-41	+51	+37	+37	+37	+11	+38	+34
	GBP	-14	+26	+12	-41	+38	-17	+41	-25	+51	+100	+64	+31	-7	-33	-29	+33	+42	+43	+31	+12	+30	+29
	EUR	-27	+24	+32	-42	+53	+7	+46	-18	+64	+64	+100	+23	-7	-41	-37	+43	+41	+40	+39	+16	+36	+32
	JPY	-14	+14	+11	-29	+29	-4	+33	-28	+29	+31	+23	+100	-15	-29	-22	+27	+36	+36	+12	+8	+26	+30
Credit	Baa	-2	-4	-9	+22	-22	-5	-27	+12	-24	-7	-7	-15	+100	+29	+26	-31	-16	-15	-17	+1	-15	-9
	HY	+38	-34	-43	+41	-59	-8	-64	+38	-47	-33	-41	-29	+29	+100	+66	-76	-58	-60	-43	-25	-53	-52
Equities	VIX	+30	-37	-36	+43	-56	+4	-68	+51	-41	-29	-37	-22	+26	+66	+100	-83	-56	-60	-39	-22	-50	-44
	SP 500	-44	+42	+51	-44	+67	+7	+78	-37	+51	+33	+43	+27	-31	-76	-83	+100	+68	+71	+53	+26	+65	+59
	FTSE 100	-41	+25	+39	-36	+53	+13	+62	-44	+37	+42	+41	+36	-16	-58	-56	+68	+100	+95	+45	+33	+52	+58
	MSCI Eur	-40	+30	+37	-39	+54	+6	+61	-47	+37	+43	+40	+36	-15	-60	-60	+71	+95	+100	+45	+28	+52	+57
	NIK 225	-25	+23	+33	-42	+54	+10	+55	-29	+37	+31	+39	+12	-17	-43	-39	+53	+45	+45	+100	+14	+37	+36
Comm.	Gold	-33	+22	+31	-3	+23	+9	+26	-16	+11	+12	+16	+8	+1	-25	-22	+26	+33	+28	+14	+100	+36	+40
	Oil	-54	+49	+54	-30	+59	+3	+62	-29	+38	+30	+36	+26	-15	-53	-50	+65	+52	+52	+37	+36	+100	+86
	CRB	-60	+49	+54	-23	+53	+3	+57	-32	+34	+29	+32	+30	-9	-52	-44	+59	+58	+57	+36	+40	+86	+100

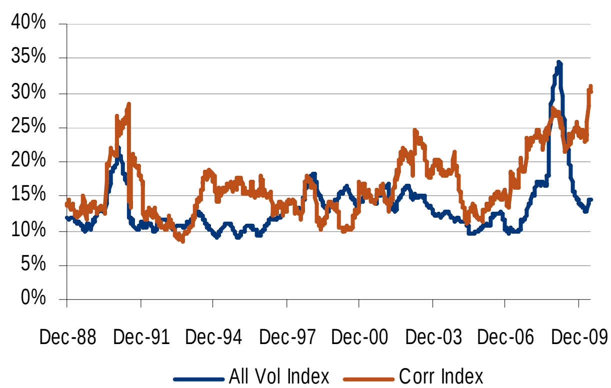
Source: BofA Merrill Lynch Global Research

Correlations in the table are based off the most recent daily log percentage movements of the asset classes. Currency crosses are quoted from BBG. DXY is the US Dollar Index. Currency volatility is the average 1-month implied volatility of the USD against GBP/EUR/JPY. Swaps are 10-year semi-annual swap rates. The Baa index listed under credit is defined as Moody's Corporate Baa Bond Index. HY is defined as the Bank of America High Yield Credit Default Swap Index. VIX is the CBOE SPX Volatility Index. The equity indices used are the S&P 500, FTSE 100, MSCI Euro, and Nikkei-225. The gold index is defined as the London Gold Market Fixing. The oil index is defined as Brent crude. CRB is the Reuters/Jefferies-CRB Index.

Sum of cross-asset correlations

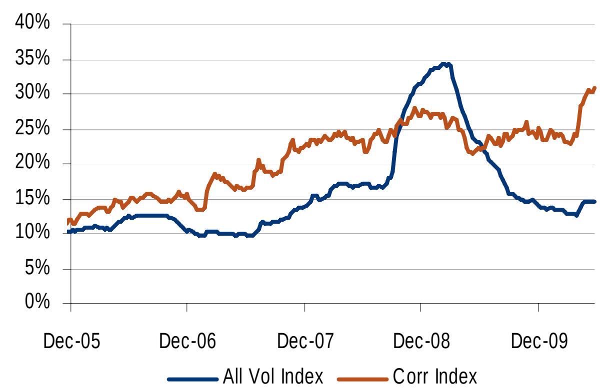
In periods of elevated volatility, cross-asset correlations tend to rise alongside increases in volatility. In the following graphs, we show the sum of correlations between 11 assets covering four asset classes: equities (MSCI indices for US, Europe, and Asia), fixed income (US, German, and Japanese 7-10Y Datastream bond indices), commodities (Brent crude and gold bullion from Datastream) and currencies (EUR/USD, AUD/JPY and EUR/GBP from WM Company). Correlations are calculated using 6-month moving windows.

Figure 8: Sum of asset correlations since 1989



Source: BofA Merrill Lynch Global Research, MSCI, Thomson Reuters Datastream, WM Company

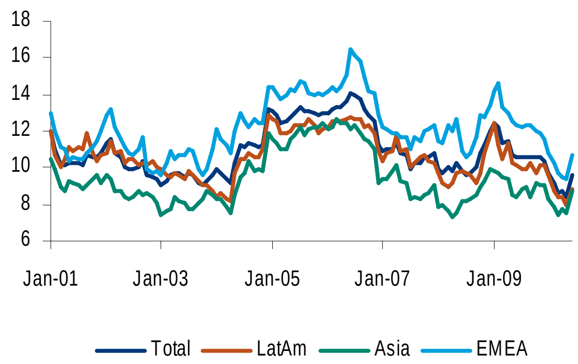
Figure 9: Sum of asset correlations since 2006



Source: BofA Merrill Lynch Global Research, MSCI, Thomson Reuters Datastream, WM Company

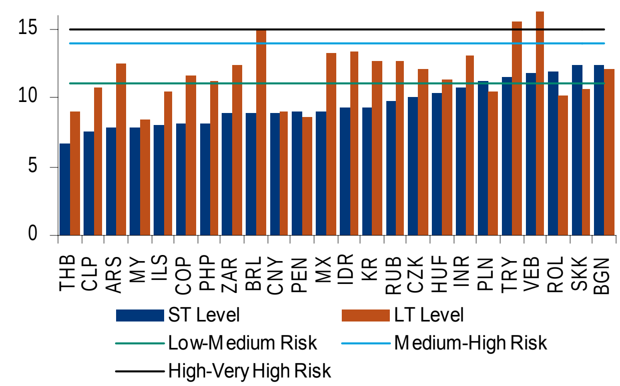
Currency Crisis Indicator

Figure 10: Historical CCI levels



Source: BofA Merrill Lynch Global Research

Figure 11: Current CCI Levels



Source: BofA Merrill Lynch Global Research

Click here for CCI Documentation

The **Currency Crisis Index** assigns risk scores to the prevailing value of 11 macroeconomic variables that are likely to be good gauges of economic and financial health. CCI attempts to anticipate exchange rate moves over a 3-month horizon.

CCI-Long Term attempts to provide an earlier risk signal than the CCI using weight variables to maximize predictive power over the 3-15 month horizon.

CCI Scores

- 15+ very high risk
- 14-15 high risk
- 11-14 medium risk
- 5-11 low risk

CCI and CCI-L levels are calculated every month-end.

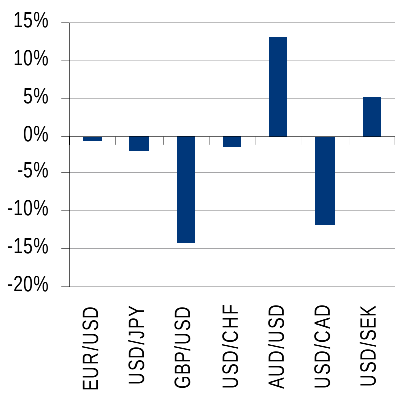
Figure 12: Current CCI and CCI-L risk levels and changes

	CCI	Max Value, Last 6 Mths	1 Mth Change	6 Mth Change	CCI-L	CCI-L, 1 Mth Change
Thailand	6.7	7.6	0.7	-0.9	9.0	0.0
Chile	7.6	8.3	1.0	0.0	10.7	-0.3
Argentina	7.8	9.7	0.4	-1.9	12.5	-0.1
Malaysia	7.8	8.7	1.1	-0.9	8.4	0.0
Israel	8.1	8.1	1.6	0.1	10.4	0.0
Colombia	8.1	9.4	0.8	-1.3	11.6	0.0
Philippines	8.2	9.1	0.8	-0.9	11.1	0.6
S. Africa	8.8	8.8	1.6	0.7	12.3	0.0
Brazil	8.8	10.2	0.8	-1.4	15.0	0.0
China	8.9	8.9	0.8	0.3	9.0	0.0
Peru	9.0	9.6	1.1	-0.6	8.6	0.6
Mexico	9.1	10.0	0.5	-0.9	13.2	0.6
Indonesia	9.2	9.8	1.7	-0.6	13.4	0.0
Korea	9.4	9.4	2.0	1.1	12.6	1.3
Russia	9.8	11.6	1.6	-1.8	12.6	-0.6
Czech	10.0	11.4	1.8	-1.3	12.1	1.3
Hungary	10.4	10.6	1.9	-0.3	11.4	-0.6
India	10.7	11.2	1.1	-0.5	13.1	0.0
Poland	11.2	11.8	0.1	-0.6	10.5	0.0
Turkey	11.5	12.7	0.3	-0.8	15.6	-0.1
Venezuela	11.7	14.1	1.4	-2.3	17.2	0.0
Romania	11.9	15.2	1.6	-3.2	10.2	0.0
Slovakia	12.4	13.5	1.6	-1.2	10.5	0.0
Bulgaria	12.4	13.2	1.1	-0.8	12.1	-0.1

Source: BofA Merrill Lynch Global Research

Fair valuation misalignments

Figure 13: Bilateral misalignment from median fair value



Note: Negative misalignment means that the fixed currency is undervalued with respect to the variable currency.
Source: BofA Merrill Lynch Global Research

Research suggests that exchange rates are too volatile relative to changes in economic fundamentals. However, there is value in fundamental models. Fair value levels are useful for multi-year planning and for risk budgeting. Equilibrium values can also provide guidance for evaluating cyclical and shorter-term market movement. Mean reversion and contrarian strategies are typical short-term currency misalignment trades, often established relative to long-term, equilibrium currency values.

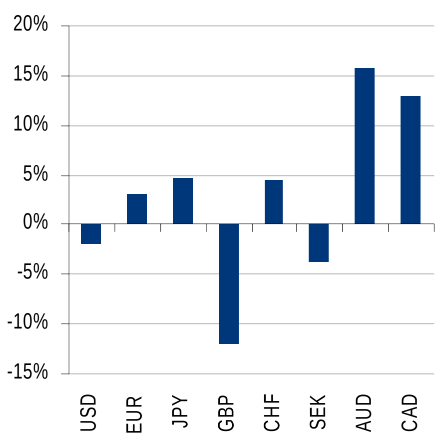
Factors that generate currency misalignments typically change across economic cycles and across currency pairs. Our approach to long-term currency valuation uses five models (purchasing power parity, real interest rate differentials, monetary, balance of payments, and behavioral real exchange rate models) applied across twelve macroeconomic variable sets. The models are designed to monitor long-term misalignments from fundamental value over time and for long-term directional forecasting purposes. They consider equilibrium in goods markets, capital markets, monetary sector, external sector, and account for long-run shifts in real equilibrium exchange rate through productivity, terms of trade and fiscal shocks.

Figure 14: Median bilateral misalignments by currency pair

EUR/USD	USD/JPY	GBP/USD	USD/CHF	AUD/USD	USD/CAD	USD/SEK
-0.8%	-1.9%	-14.1%	-1.4%	13.3%	-11.7%	5.1%
EUR/JPY	EUR/GBP	EUR/CHF	EUR/AUD	EUR/CAD	EUR/SEK	
-7.8%	12.8%	-3.3%	-14.2%	-13.3%	4.4%	
GBP/JPY	CHF/JPY	AUD/JPY	CAD/JPY	SEK/JPY		
-15.2%	0.8%	13.5%	3.0%	-10.9%		
GBP/CHF	GBP/AUD	GBP/CAD	GBP/SEK			
-15.8%	-22.6%	-15.9%	-5.0%			
AUD/CHF	CHF/CAD	CHF/SEK				
12.4%	-4.6%	12.0%				
AUD/CAD	AUD/SEK					
3.1%	27.1%					
CAD/SEK						
23.6%						

Source: BofA Merrill Lynch Global Research

Figure 15: TWI misalignment from median fair value



Source: BofA Merrill Lynch Global Research

Figure 16: Bilateral misalignments by model

	USD	EUR	JPY	GBP	CHF	SEK	AUD	CAD
PPP - CPI	-4.8%	5.2%	9.5%	-16.4%	2.4%	-2.1%	22.6%	19.6%
PPP - PPI	3.2%	7.4%	0.2%	-15.8%	1.6%	-0.7%	15.1%	-3.4%
BoP - CPI/Long	-1.7%	3.9%	6.6%	-17.0%	2.0%	0.2%	24.7%	19.8%
BoP - CPI/Short	-4.0%	5.2%	8.0%	-16.4%	2.4%	-1.2%	23.3%	18.3%
BoP - PPI/Long	4.4%	6.6%	-0.6%	-16.1%	1.3%	1.6%	15.0%	-3.1%
BoP - PPI/Short	3.2%	7.3%	-0.2%	-15.8%	1.6%	0.3%	15.2%	-3.0%
MM - Flex	-16.7%	1.3%	40.6%	-6.6%	5.0%	-11.3%	9.0%	19.3%
MM - Sticky	-14.3%	-3.3%	36.8%	0.5%	3.7%	-13.0%	9.3%	19.5%
RID - Long	1.4%	-1.1%	1.2%	-7.3%	14.0%	-10.1%	14.2%	14.0%
RID - Short	-2.4%	2.3%	-0.1%	-6.9%	10.7%	-8.7%	15.3%	13.9%
BEER I	0.0%	-1.8%	5.8%	-5.3%	13.4%	-7.0%	10.9%	4.7%
BEER II	4.4%	-5.1%	2.9%	-2.9%	12.2%	-7.3%	9.3%	5.6%
Median	-1.8%	3.2%	4.7%	-12.0%	4.4%	-3.8%	15.9%	12.9%

Source: BofA Merrill Lynch Global Research

PPP: Equilibrium exchange rate is consistent with goods market equilibrium in the domestic and foreign economies

BOP: While this approach considers current account equilibrium through relative price developments, it uses interest rate differentials to capture capital account movement.

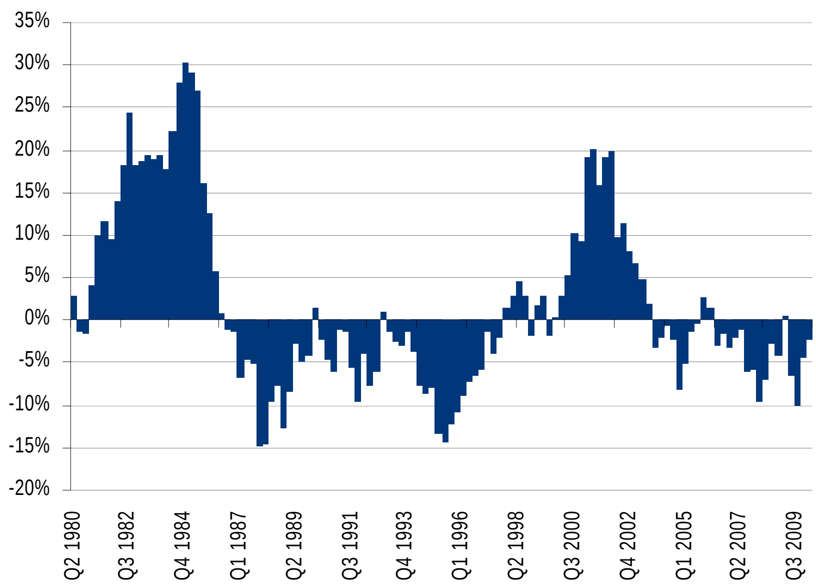
MM: These models estimate the equilibrium exchange rate that should equate the relative money demand/supply conditions between economies.

RID: In these models, real equilibrium exchange rates are determined by real interest differentials through capital markets arbitrage.

BEER: Models exchange rate swings using relative productivity, terms of trade, and fiscal shocks.

Current fair value estimates

Figure 17: Major USD index misalignments from median fair value over time



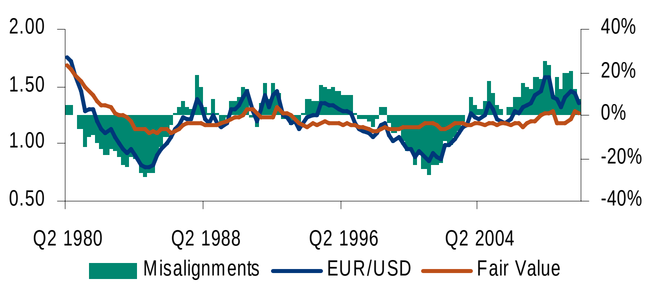
Source: BofA Merrill Lynch Global Research

Figure 18: Fair value estimates by model

	EUR/USD	USD/JPY	GBP/USD	USD/CHF	AUD/USD	USD/CAD	USD/SEK	EUR/GBP	EUR/CHF	EUR/SEK
PPP - CPI	1.26	95.2	1.81	1.08	0.68	1.27	7.30	0.70	1.36	9.21
PPP - PPI	1.26	86.5	1.81	1.06	0.75	1.02	7.36	0.69	1.34	9.25
BoP - CPI/Long	1.31	91.2	1.88	1.04	0.69	1.26	7.22	0.70	1.36	9.48
BoP - CPI/Short	1.27	93.8	1.82	1.07	0.68	1.26	7.34	0.70	1.36	9.29
BoP - PPI/Long	1.28	85.2	1.84	1.04	0.76	1.02	7.42	0.69	1.34	9.49
BoP - PPI/Short	1.26	86.2	1.81	1.06	0.75	1.03	7.43	0.69	1.34	9.34
MM - Flex	1.17	127.4	1.51	1.21	0.68	1.30	7.26	0.77	1.41	8.47
MM - Sticky	1.23	122.0	1.46	1.15	0.69	1.30	6.90	0.84	1.41	8.47
RID - Long	1.35	86.2	1.73	1.13	0.77	1.20	6.43	0.78	1.53	8.69
RID - Short	1.26	87.5	1.63	1.17	0.74	1.21	6.90	0.77	1.47	8.69
BEER I	1.32	91.1	1.65	1.16	0.77	1.11	6.83	0.80	1.53	8.98
BEER II	1.41	86.2	1.70	1.09	0.81	1.11	6.47	0.83	1.53	9.09
Median Fair Value	1.26	89.31	1.77	1.08	0.75	1.20	7.24	0.73	1.38	9.15
St. Dev.	0.06	14.35	0.14	0.06	0.04	0.11	0.36	0.06	0.08	0.37

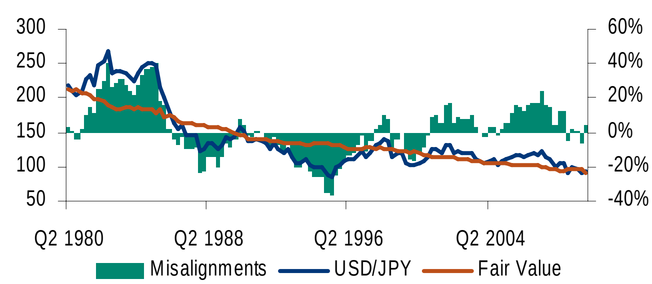
Source: BofA Merrill Lynch Global Research

Figure 19: EUR/USD median fair value misalignment



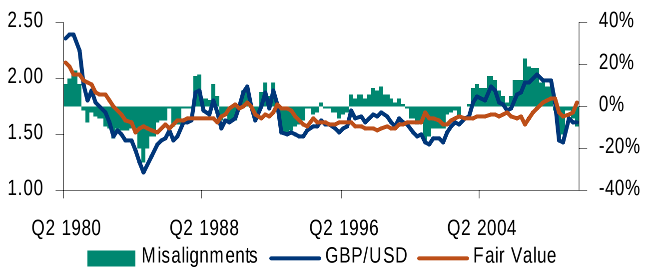
Source: BofA Merrill Lynch Global Research

Figure 20: USD/JPY median fair value misalignment



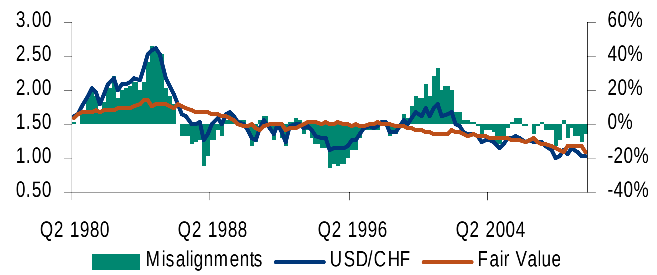
Source: BofA Merrill Lynch Global Research

Figure 21: GBP/USD median fair value misalignment



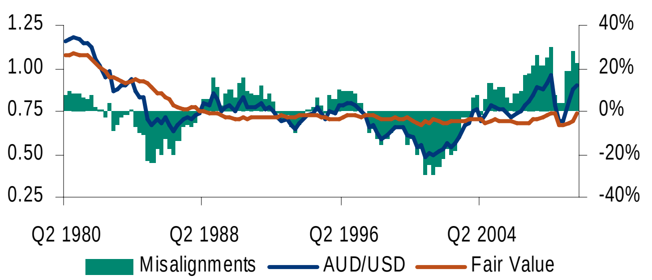
Source: BofA Merrill Lynch Global Research

Figure 22: USD/CHF median fair value misalignment



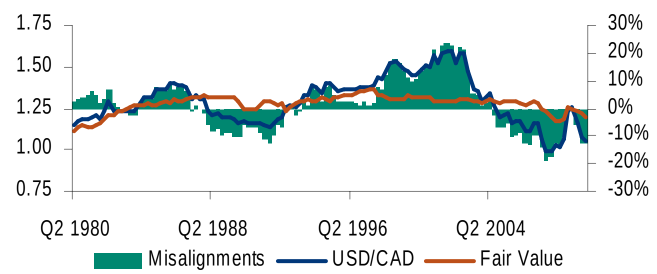
Source: BofA Merrill Lynch Global Research

Figure 23: AUD/USD median fair value misalignment



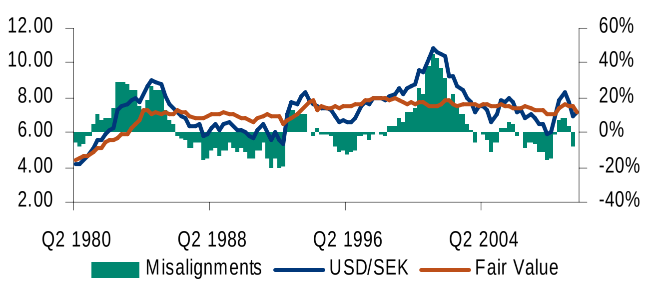
Source: BofA Merrill Lynch Global Research

Figure 24: USD/CAD median fair value misalignment



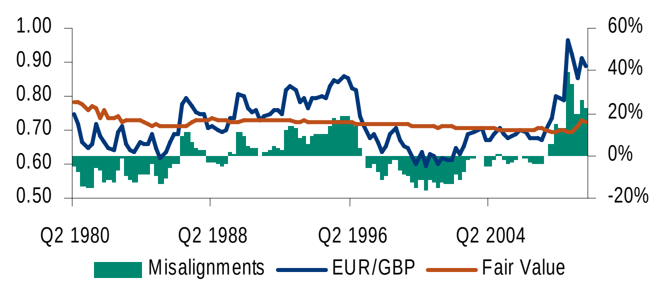
Source: BofA Merrill Lynch Global Research

Figure 25: USD/SEK median fair value misalignment



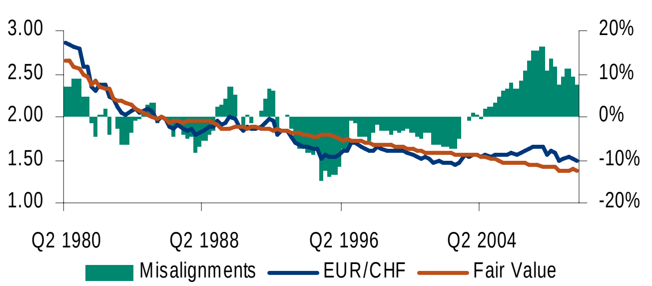
Source: BofA Merrill Lynch Global Research

Figure 26: EUR/GBP median fair value misalignment



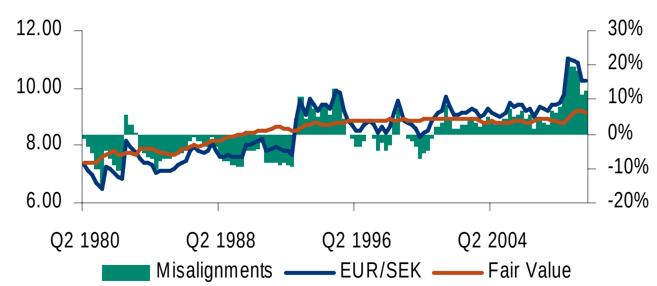
Source: BofA Merrill Lynch Global Research

Figure 27: EUR/CHF median fair value misalignment



Source: BofA Merrill Lynch Global Research

Figure 28: EUR/SEK median fair value misalignment



Source: BofA Merrill Lynch Global Research

Link to Definitions

Macro

Click here for definitions of commonly used terms.

Important Disclosures

Due to the nature of strategic analysis, the issuers or securities recommended or discussed in this report are not continuously followed. Accordingly, investors must regard this report as providing stand-alone analysis and should not expect continuing analysis or additional reports relating to such issuers and/or securities.

BofAML fixed income analysts regularly interact with sales and trading desk personnel in connection with their research, including to ascertain pricing and liquidity in the fixed income markets.

Other Important Disclosures

BofA Merrill Lynch (BofAML) Research refers to the combined Global Research operations of Merrill Lynch and BAS.

Recipients who are not institutional investors or market professionals should seek the advice of their independent financial advisor before considering information in this report in connection with any investment decision, or for a necessary explanation of its contents.

Officers of MLPF&S or one or more of its affiliates (other than research analysts) may have a financial interest in securities of the issuer(s) or in related investments.

Merrill Lynch Research policies relating to conflicts of interest are described at http://www.ml.com/media/43347.pdf.

"Merrill Lynch" includes Merrill Lynch, Pierce, Fenner & Smith Incorporated ("MLPF&S") and its affiliates, including BofA (defined below). "BofA" refers to Banc of America Securities LLC ("BAS"), Banc of America Securities Limited ("BASL") and their affiliates. Investors should contact their Merrill Lynch or BofA representative if they have questions concerning this report.

Information relating to Non-US affiliates of Merrill Lynch and Distribution of Affiliate Research Reports:

MLPF&S, BAS, and BASL distribute, or may in the future distribute, research reports of the following non-US affiliates in the US (short name: legal name): Merrill Lynch (France): Merrill Lynch Capital Markets (France) SAS; Merrill Lynch (Frankfurt): Merrill Lynch International Bank Ltd, Frankfurt Branch; Merrill Lynch (South Africa): Merrill Lynch South Africa (Pty) Ltd; Merrill Lynch (Milan): Merrill Lynch International Bank Limited; MLPF&S (UK): Merrill Lynch, Pierce, Fenner & Smith Limited; Merrill Lynch (Australia): Merrill Lynch Equities (Australia) Limited; Merrill Lynch (Hong Kong): Merrill Lynch (Asia Pacific) Limited; Merrill Lynch (Singapore): Merrill Lynch (Singapore) Pte Ltd; Merrill Lynch (Canada): Merrill Lynch Canada Inc; Merrill Lynch (Mexico): Merrill Lynch Mexico, SA de CV, Casa de Bolsa; Merrill Lynch (Argentina): Merrill Lynch Argentina SA; Merrill Lynch (Japan): Merrill Lynch Japan Securities Co, Ltd; Merrill Lynch (Seoul): Merrill Lynch International Incorporated (Seoul Branch); Merrill Lynch (Taiwan): Merrill Lynch Securities (Taiwan) Ltd.; DSP Merrill Lynch (India): DSP Merrill Lynch Limited; PT Merrill Lynch (Indonesia): PT Merrill Lynch Indonesia; Merrill Lynch (Israel): Merrill Lynch Israel Limited; Merrill Lynch (Russia): Merrill Lynch CIS Limited, Moscow; Merrill Lynch (Turkey): Merrill Lynch Yatirim Bankasi A.S.; Merrill Lynch (Dubai): Merrill Lynch International, Dubai Branch; MLPF&S (Zürich rep. office): MLPF&S Incorporated Zürich representative office; Merrill Lynch (Spain): Merrill Lynch Capital Markets Espana, S.A.S.V.; Merrill Lynch (Brazil): Banco Merrill Lynch de Investimentos S.A.

This note has been approved for publication in the United Kingdom by Merrill Lynch, Pierce, Fenner & Smith Limited and BASL, which are authorized and regulated by the Financial Services Authority; has been considered and distributed in Japan by Merrill Lynch Japan Securities Co, Ltd and Banc of America Securities – Japan, Inc., registered securities dealers under the Financial Instruments and Exchange Law in Japan; is distributed in Hong Kong by Merrill Lynch (Asia Pacific) Limited and Banc of America Securities Asia Limited, which are regulated by the Hong Kong SFC and the Hong Kong Monetary Authority; is issued and distributed in Taiwan by Merrill Lynch Securities (Taiwan) Ltd.; is issued and distributed in India by DSP Merrill Lynch Limited; and is issued and distributed in Singapore by Merrill Lynch International Bank Limited (Merchant Bank), Merrill Lynch (Singapore) Pte Ltd (Company Registration No.'s F 06872E and 198602883D respectively) and Bank of America Singapore Limited (Merchant Bank). Merrill Lynch International Bank Limited (Merchant Bank), Merrill Lynch (Singapore) Pte Ltd and Bank of America Singapore Limited (Merchant Bank) are regulated by the Monetary Authority of Singapore. Merrill Lynch Equities (Australia) Limited (ABN 65 006 276 795), AFS License 235132 provides this note in Australia in accordance with section 911B of the Corporations Act 2001 and neither it nor any of its affiliates involved in preparing this note is an Authorised Deposit-Taking Institution under the Banking Act 1959 nor regulated by the Australian Prudential Regulation Authority. No approval is required for publication or distribution of this note in Brazil.

This research report has been prepared and issued by MLPF&S and/or one or more of its non-US affiliates. MLPF&S is the distributor of this research report in the US and accepts full responsibility for research reports of its non-US affiliates distributed to MLPF&S clients in the US. Any US person (other than BAS and its respective clients) receiving this research report and wishing to effect any transaction in any security discussed in the report should do so through MLPF&S and not such foreign affiliates.

BAS distributes this research report to its clients and accepts responsibility for the distribution of this report in the US to BAS clients. Transactions by US persons that are BAS clients in any security discussed herein must be carried out through BAS.

General Investment Related Disclosures:

This research report provides general information only. Neither the information nor any opinion expressed constitutes an offer or an invitation to make an offer, to buy or sell any securities or other financial instrument or any derivative related to such securities or instruments (e.g., options, futures, warrants, and contracts for differences). This report is not intended to provide personal investment advice and it does not take into account the specific investment objectives, financial situation and the particular needs of any specific person. Investors should seek financial advice regarding the appropriateness of investing in financial instruments and implementing investment strategies discussed or recommended in this report and should understand that statements regarding future prospects may not be realized. Any decision to purchase or subscribe for securities in any offering must be based solely on existing public information on such security or the information in the prospectus or other offering document issued in connection with such offering, and not on this report.

Securities and other financial instruments discussed in this report, or recommended, offered or sold by Merrill Lynch, are not insured by the Federal Deposit Insurance Corporation and are not deposits or other obligations of any insured depository institution (including, Bank of America, N.A.). Investments in general and, derivatives, in particular, involve numerous risks, including, among others, market risk, counterparty default risk and liquidity risk. No security, financial instrument or derivative is suitable for all investors. In some cases, securities and other financial instruments may be difficult to value or sell and reliable information about the value or risks related to the security or financial instrument may be difficult to obtain. Investors should note that income from such securities and other financial instruments, if any, may fluctuate and that price or value of such securities and instruments may rise or fall and, in some cases, investors may lose their entire principal investment. Past performance is not necessarily a guide to future performance. Levels and basis for taxation may change.

Futures and options are not appropriate for all investors. Such financial instruments may expire worthless. Before investing in futures or options, clients must receive the appropriate risk disclosure documents. Investment strategies explained in this report may not be appropriate at all times. Costs of such strategies do not include commission or margin expenses.

BofA Merrill Lynch is aware that the implementation of the ideas expressed in this report may depend upon an investor's ability to "short" securities or other financial instruments and that such action may be limited by regulations prohibiting or restricting "shortselling" in many jurisdictions. Investors are urged to seek advice regarding the applicability of such regulations prior to executing any short idea contained in this report.

Foreign currency rates of exchange may adversely affect the value, price or income of any security or financial instrument mentioned in this report. Investors in such securities and instruments effectively assume currency risk.

UK Readers: The protections provided by the U.K. regulatory regime, including the Financial Services Scheme, do not apply in general to business coordinated by Merrill Lynch entities located outside of the United Kingdom. These disclosures should be read in conjunction with the BASL general policy statement on the handling of research conflicts, which is available upon request.

Officers of MLPF&S or one or more of its affiliates (other than research analysts) may have a financial interest in securities of the issuer(s) or in related investments.

Merrill Lynch is a regular issuer of traded financial instruments linked to securities that may have been recommended in this report. Merrill Lynch may, at any time, hold a trading position (long or short) in the securities and financial instruments discussed in this report.

Merrill Lynch, through business units other than BofAML Research, may have issued and may in the future issue trading ideas or recommendations that are inconsistent with, and reach different conclusions from, the information presented in this report. Such ideas or recommendations reflect the different time frames, assumptions, views and analytical methods of the persons who prepared them, and Merrill Lynch is under no obligation to ensure that such other trading ideas or recommendations are brought to the attention of any recipient of this report.

In the event that the recipient received this report pursuant to a contract between the recipient and MLPF&S for the provision of research services for a separate fee, and in connection therewith MLPF&S may be deemed to be acting as an investment adviser, such status relates, if at all, solely to the person with whom MLPF&S has contracted directly and does not extend beyond the delivery of this report (unless otherwise agreed specifically in writing by MLPF&S). MLPF&S is and continues to act solely as a broker-dealer in connection with the execution of any transactions, including transactions in any securities mentioned in this report.

Copyright and General Information regarding Research Reports:

Materials prepared by Merrill Lynch research personnel are based on public information. Facts and views presented in this material have not been reviewed by, and may not reflect information known to, professionals in other business areas of Merrill Lynch, including investment banking personnel. Merrill Lynch has established information barriers between BofAML Research and certain business groups. As a result, Merrill Lynch does not disclose certain client relationships with, or compensation received from, such companies in research reports.

To the extent this report discusses any legal proceeding or issues, it has not been prepared as nor is it intended to express any legal conclusion, opinion or advice. Investors should consult their own legal advisers as to issues of law relating to the subject matter of this report. Merrill Lynch research personnel's knowledge of legal proceedings in which any Merrill Lynch entity and/or its directors, officers and employees may be plaintiffs, defendants, co-defendants or co-plaintiffs with or involving companies mentioned in this report is based on public information. Facts and views presented in this material that relate to any such proceedings have not been reviewed by, discussed with, and may not reflect information known to, professionals in other business areas of Merrill Lynch in connection with the legal proceedings or matters relevant to such proceedings.

This report has been prepared independently of any issuer of securities mentioned herein and not in connection with any proposed offering of securities or as agent of any issuer of any securities. None of MLPF&S, any of its affiliates or their research analysts has any authority whatsoever to make any representation or warranty on behalf of the issuer(s). Merrill Lynch policy prohibits research personnel from disclosing a recommendation, investment rating, or investment thesis for review by an issuer prior to the publication of a research report containing such rating, recommendation or investment thesis.

Any information relating to the tax status of financial instruments discussed herein is not intended to provide tax advice or to be used by anyone to provide tax advice. Investors are urged to seek tax advice based on their particular circumstances from an independent tax professional.

The information herein (other than disclosure information relating to Merrill Lynch and its affiliates) was obtained from various sources and we do not guarantee its accuracy. This report may contain links to third-party websites. Merrill Lynch is not responsible for the content of any third-party website or any linked content contained in a third-party website. Content contained on such third-party websites is not part of this report and is not incorporated by reference into this report. The inclusion of a link in this report does not imply any endorsement by or any affiliation with Merrill Lynch. Access to any third-party website is at your own risk, and you should always review the terms and privacy policies at third-party websites before submitting any personal information to them. Merrill Lynch is not responsible for such terms and privacy policies and expressly disclaims any liability for them.

All opinions, projections and estimates constitute the judgment of the author as of the date of the report and are subject to change without notice. Prices also are subject to change without notice. Merrill Lynch is under no obligation to update this report and Merrill Lynch's ability to publish research on the subject company(ies) in the future is subject to applicable quiet periods. You should therefore assume that Merrill Lynch will not update any fact, circumstance or opinion contained in this report.

Certain outstanding reports may contain discussions and/or investment opinions relating to securities, financial instruments and/or issuers that are no longer current. Always refer to the most recent research report relating to a company or issuer prior to making an investment decision.

In some cases, a company or issuer may be classified as Restricted or may be Under Review or Extended Review. In each case, investors should consider any investment opinion relating to such company or issuer (or its security and/or financial instruments) to be suspended or withdrawn and should not rely on the analyses and investment opinion(s) pertaining to such issuer (or its securities and/or financial instruments) nor should the analyses or opinion(s) be considered a solicitation of any kind. Sales persons and financial advisors affiliated with BAS, MLPF&S or any of their affiliates may not solicit purchases of securities or financial instruments that are Restricted or Under Review and may only solicit securities under Extended Review in accordance with firm policies.

Neither Merrill Lynch nor any officer or employee of Merrill Lynch accepts any liability whatsoever for any direct, indirect or consequential damages or losses arising from any use of this report or its contents.