

Discovering Risk Indicators in the FX Markets

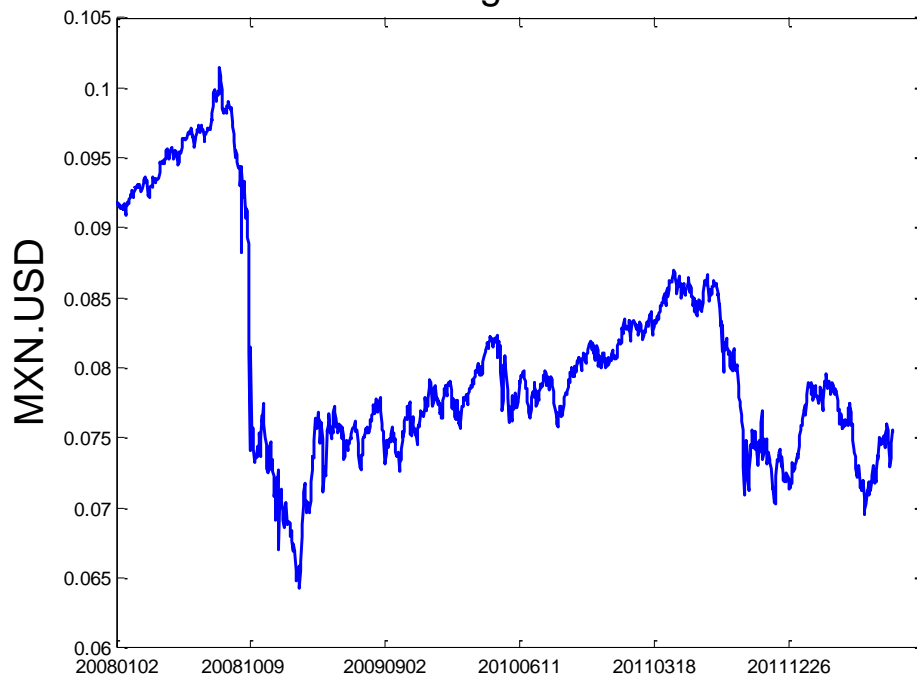
Ernest Chan¹, Ph.D.

MANAGING MEMBER, QTS CAPITAL MANAGEMENT, LLC.

The Forex market had not been kind to Forex fund managers in 2011. These managers lost 6.2% on average, and assets under management at these funds are at 60% of the level at the start of 2011². The main culprit? The sell-off in emerging market currencies due to the US federal debt downgrade and the Eurozone debt crisis.

We have seen this movie before. Figure 1 shows the value of Mexican Peso (MXN) in US dollars since 2008. We focus on MXN.USD

Figure 1



¹ Contact: ernest@epchan.com, www.epchan.com

² Neil Shah, "As Markets Soar, Currency Funds Miss the Bus", Wall Street Journal, February 7, 2012.

because it is the most liquid of all emerging market currencies, and traders have been treating it as a proxy for emerging market risk. Many of its steepest daily drops occurred during the 2008-9 financial crisis and the 2011 debt crisis. But for currency strategies, steep rise in a currency's value can be just as damaging as a steep drop, and all of the steepest one-day rises in MXN.USD³ also occurred during those crises.

Extreme moves in currencies are in fact much more problematic than extreme moves in equities or futures. The reason is that the "normal" volatility of currencies is typically smaller than that of equities or futures. For example, the volatility of MXN.USD is about 17% per annum, while that of the S&P 500 index E-mini future (ES) is 25%. Because of this lower volatility, currency strategies are typically traded at higher leverages than equity or futures strategies in order to earn the same returns. Yet the extreme moves in currencies are no smaller than the extreme moves in an equity index future. The most extreme move in either direction of MXN.USD from 2008/1/2 to 2012/7/30 is 10.1% (on 2008/10/9), while that of ES is -9.6% (on 2008/12/1). Even more revealing are the respective kurtoses of their daily returns distributions over the same period: 22 for MXN.USD, and only 7 for ES. The fat tails of a currency can be much fatter than that of an equity index! When coupled with high leverage, a few days of these extreme currencies move can account for a large part of the drawdown of a currency fund, as indeed happened in 2008-9 and 2011. Avoid trading or holding currency positions on those days would be highly advantageous. But can we tell whether the next day will be the day with an extreme move? In other words, do leading risk indicators for currencies exist?

VIX as a Leading Risk Indicator

Frequently, the first thought that comes to mind in the context of risk indicators is the VIX volatility index. But equally frequently, practitioners would dismiss VIX as a contemporaneous risk indicator, worthy only of casual chatter on the BNN or the CNBC. We have found, however, that VIX is a surprisingly good leading indicator for extreme risk, not only of MXN, but of ES as well. In comparison, it works slightly less well for another risky asset, HYG, the high yield corporate bond ETF.

One quick way to demonstrate the efficacy of VIX is to look at the best and worst 5 daily moves of MXN.USD from 2008/1/2-2012/7/30. The best returns range from 3.9% to 10.1%. If we exclude those days where the previous day's VIX value is greater than or equal to 35, a commonly used threshold, then all but

³ Typically, USD.MXN will be the quoted currency pair. We study the inverse MXN.USD because our focus is on the value of MXN.

of one those moves disappear. The worst daily returns range from -5.1% to -8.7%. If we apply the same VIX filter, all but of one those worst daily moves will also disappear. Additionally, the average volatility of MXN decreases from 16.6% to 11.1%, and the kurtosis decreases from 22 to 18. Applying the same filter to ES and HYG have similar effects. Some of the results are summarized in Table 1.

It is also useful to study leading risk indicators in the context of a concrete strategy. This is because a treacherous period for one strategy may well be a very profitable period for another – risk indicators are not universal. After all, we are typically not buy-and-hold investors in currencies, or even ES or HYG. In particular, we will focus on mean-reverting strategies only. It is well-known that mean-reverting strategies are most susceptible to tail-risk, since there is no natural stop loss. (If we are in a long position, and the price goes lower, a mean-reverting strategy may ask us to buy more in spite of mounting losses.) On the other hand, momentum strategies do have natural stop losses, so tail-risk is effectively cut off. (If we are in a long position, and the price goes lower, a momentum strategy may ask us to sell the long position and go short.) In fact, there is some evidence that a generic momentum strategy benefits from kurtosis in a returns series⁴.

The mean-reverting strategy that I studied is a version of a strategy that our currency fund is actively trading, and it involves the arbitrage between MXN and various other commodity currencies. Most of its tail risk originates from MXN. The backtest Sharpe ratio of this strategy is 2.25. But we prefer the maximum drawdown as a measure of the non-Gaussian tail risk. It has a rather large maximum drawdown of -15%. After applying the VIX filter, the maximum drawdown drops to -10%, a significant improvement.

	MXN.USD		ES		HYG	
Volatility (p.a.)	17%	11%	25%	19%	17%	10%
Best daily move	10%	6%	8%	4%	12%	3%
Worst daily move	-9%	-6%	-10%	-8%	-8%	-8%
Max Drawdown	-37%	-25%	-57%	-32%	-34%	-28%
Kurtosis	22	18	7	8	28	32

Table 1: Comparison of currency, equity index future, and high yield bond risks. Numbers in **bold** are obtained after applying the VIX \geq 35 filter. Period of study is 2008/1/2-2012/7/30.

⁴ Ernest Chan, “Algorithmic Trading: Strategies and Their Pitfalls”, to be published by John Wiley & Sons, 2013.

Other Research

The study I presented above is open to the criticism that it may suffer from data-snooping or hindsight bias. We have focused on only 5 best or worst days in the sample period, or one measure of risk: the maximum drawdown. It is hard to evaluate the statistical significance of whether the VIX indicator is truly predictive of extreme events, due to the scarcity of such events. Furthermore, it is not clear whether “false positives” identified by the VIX filter will remove highly profitable trades even as it removes losing trades. Fortunately, our positive conclusion is supported by other academic research.

There are many academic studies to find out if VIX or other implied volatility measures are good predictors of future realized volatility. For example, Andersen and Bonarenko⁵ concluded that VIX is indeed predictive, but less so than other measures such as the CIV and MFIV, which make use of broader range of options strike prices than VIX. Other research⁶ indicated that implied volatility measures generally outperform historical volatility measures such as the GARCH model in predicting future volatility. However, our focus is not just prediction of realized volatility on average – we are only interested in the predictability of extreme events. For this purpose, Alex Paulsen⁷ studied the prediction of extreme returns of ES based on the changes of the level of VIX, and he reached the same positive conclusion as Andersen and Bonarenko. In contrast, we did not find changes in VIX levels to be as predictive of risk as the levels themselves for both VIX and ES.

One may also ask whether options on US stocks are the best predictor of volatilities for emerging market currencies. Won't the JPMorgan Emerging Market Volatility Index (EM-VXY) be more appropriate? Based on some preliminary research we have performed, we found that it is actually less predictive of future MXN volatility, perhaps because the Mexican Peso is more closely tied to the health of the US economy than other emerging market currencies.

There are other candidate leading risk indicators to explore. One favorite is the TED spread, which measures the difference between the 3-month LIBOR and T-bill rate. A more recent invention is the pair of ETFs ONN and OFF. ONN goes up when the market is in a “risk-on” mood, *i.e.* when the prices of risky assets are

⁵ Torben G. Andersen and Oleg Bondarenko, 2007. “Construction and Interpretation of Model-Free Implied Volatility”. NBER Working Paper No. 13449.

⁶ Jinhong Shu and Jin E. Zhang, 2003. “The relationship between implied and realized volatility of S&P 500 index”. Wilmott Magazine.

⁷ Alex Paulsen, 2008. “Predictive Risk Modeling and Applications”. Ph.D. thesis, University of Washington.

bid up. ONN is basically a basket of risky assets. OFF is just the mirror image of ONN. So a high value of OFF may be a good leading risk indicator. There are also risk indicators that are very specific to a strategy. For example, oil price is a good leading risk indicator for the arbitrage between gold and gold miners stocks⁸.

Since all of these risk indicators are also tradable instruments, the role of the risky asset and the risk indicator can often be reversed. It is equally valid to ask if MXN is a good leading indicator for ES, or if HYG is a good leading indicator for ONN.

There is one final leading risk indicator that operates on a short-term time scale that can be very powerful. As research conducted by Richard Lyons⁹ indicates, order flow is a leading indicator of price change, at least in the FX market. Order flow is signed transaction volume. For example, if an order is executed at the ask price, the order flow is positive. If it is executed at the bid price, the order flow is negative. Order flow information is a good predictor of price movements because market makers can distill important fundamental information from order flow information, and set the bid-ask prices accordingly. For example, if a major hedge fund just learns about a major piece of breaking news, their algorithms will submit large market orders of the same sign in a split second. Market maker monitoring the order flow will deduce, quite correctly, that such large one-directional demands indicate the presence of informed traders, and they will immediately adjust their bid-ask prices to protect themselves. This large change in order flow is negative if the asset in question is risky, such as stocks, commodities, or risky currencies; it is positive if the asset is low risk, such as US treasuries or USD, JPY, or CHF.

Since most of us are not large market makers or operators of an exchange, how can we access such order flow information? For stocks and futures markets, we can monitor and record every tick (*i.e.* every change in best bid and ask prices, and every transaction price and size), and thus determine whether a transaction took place at the bid (negative order flow) or at the ask (positive order flow). For currencies market, this is difficult because most dealers do not report transaction prices. We may have to monitor currency futures instead in order to construct this risk indicator. Once the order flow per transaction is computed, we can easily compute the cumulative or average order flow over some lookback period and use that to predict whether the price will move up or down.

⁸ Ernest Chan, *op. cit.*

⁹ Lyons, Richard. 2001. *The Microstructure Approach to Exchange Rates*. The MIT Press.

Conclusion

Our study of the VIX index suggests that it is predictive of extreme moves in various risky assets including an emerging market currency (MXN), an equity index future (ES), and a high yield corporate bond ETF (HYG). Our conclusion was bolstered by other academic research as well. A variety of other possible leading indicators of risk was suggested, including EM-VXY, the TED spread, and the ETFs ONN and OFF. One of the more interesting indicator may be order flow, which allows us to monitor risk at high frequency.

If a leading risk indicator identifies a future period to be highly risky, it is not always necessary to liquidate positions and shut down trading ahead of that period. We can often incorporate the higher expected volatility as an input to our mean-reverting trading models so that positions are not entered until a higher threshold is met, thus capturing more of the profits when prices mean-revert while decreasing the drawdown during the risky period. The various ways to utilize leading risk indicators are highly model-dependent, and are omitted from this brief report.

Of course, no financial indicators can predict events such as terrorist attacks or natural disasters that can have catastrophic consequences on the financial markets. However, in combination with other risk management techniques such as the Kelly formula, Constant Proportion Portfolio Insurance¹⁰, and the use of derivatives, the use of these indicators can reduce the magnitude of painful drawdowns.

¹⁰ Ernest Chan, *op. cit.*