CFM
INSIGHT.DATA.CLARITY.

1 November 2018

ALTERNATIVE BETA MATTERS

Quarterly Newsletter - Q4 2018

Introduction

Welcome to CFM's Alternative Beta Matters Quarterly Newsletter.

Within this report we recap major developments in the Alternative Industry, together with a brief overview of Equity, Fixed Income/Credit, FX and Commodity markets as well as Trading Regulations and Data Science and Machine Learning news. All discussion is agnostic to particular approaches or techniques, and where alternative benchmark strategy results are presented, the exact methodology used is given. It also features our 'CFM Talks To' segment, an interview series in which we discuss topical issues with thought leaders from academia, the finance industry, and beyond.

We have included an extended academic abstract from a paper published during the quarter, and one white paper. Our hope is that these publications, which convey our views on topics related to Alternative Beta that have arisen in our many discussions with clients, can be used as a reference for our readers, and can stimulate conversations on these topical issues.

Contact details

Call us +33 1 49 49 59 49
Email us cfm@cfm.fr

Quarterly review

Quantitative overview of key developments in Q3 2018

Alternative industry performance

Global markets witnessed a major divergence between developed and emerging market (EM) equities, the former very much pulled higher by the flourishing US economy, the latter hauled lower by a slump in EM FX rates and concerns about their stock of dollar-denominated debt. The S&P 500 steamed to a string of record highs, breaching the 2930 level on September 20, finishing the quarter 0.4% higher. Interest rates also crept higher on a somewhat hawkish US Federal Reserve (Fed) that lifted rates for a 7th time in two years on September 26. With a rise having largely been priced in, reaction on bond markets was muted, but bond prices kept slipping as the benchmark US 10-year yield broke through, and remained above the 3% level.

The HFRX Global Hedge Fund Index, a common shorthand for performance amongst hedge funds, lost 0.4% during the quarter – most of the losses accruing in September. The final month of the quarter was particularly challenging for both the HFRX Equity Hedge and the Macro/CTA Indices, both posting declines of -1.63% and -0.63% respectively. The HFRX EH Equity Market Neutral Index ended in line with the other indices in the equity hedge stable, registering a decline of -0.83% in September (and -0.69% for the quarter). With EM suffering through a tumultuous period, the HFRX Emerging Markets Composite Index delivered the most negative returns: -2.64% through the quarter. On the other end of the scale, the HFRX ED Distressed Restructuring Index fared best, gaining 0.79%.

Commodity Trading Advisors (CTAs) registered decent gains, with the SG CTA[1] index returning 1.3% in Q3. As with the Barclay CTA Index[2] (+0.7% over the period), the largest gains for managed futures were recorded in August, where they profited from an accelerated downtrend in notably emerging market currencies – with the Turkish lira the worst performing currency (apart from the Argentinian peso) over the month (-25.01%) and ultimately the quarter (-24.2%). Mostly long exposure in Brent as well as the S&P 500 – both contracts of which made strong gains during the quarter – was also a boon for some trend followers. A moreover substantial increase in their long Brent positioning also developed after August 15 according to Commitment of Traders (CoT) data.

The average absolute correlation between futures contracts, often taken as an indicator of CTAs' ability to diversify, continued to trend up from Q2 2018, approaching 14%. The negative correlation between bonds and equities have increased slightly in Q3, rising from ~20% to ~25% on average, while the correlation between Commodities (Crude as proxy) and Equities increased beyond 20% – up from 10% since the start of 2018.

Total return for Equity Market Neutral (EMN) and CTA hedge fund indices over the past year[3]

The principal implied volatility indices across four asset classes over the past year[4]

The log of the dollar risk weighted average daily volume across futures on the four asset classes over the past year[5]

[1] The Société Générale CTA index is an equal-weighted index of the twenty largest (as measured by assets under management) trend following CTAs, who are recognized as such within the industry and are, amongst others, open to new investment. For construction methodology and a full list of constituents, see: https://cib.societegenerale.com/en/prime-services-indices/

[2] The BarclayHedge CTA Index provides monthly performance data for a large selection of manged future managers, going back to 1980. Constituents and methodology can be obtained on the BarclayHedge website: https://www.barclayhedge.com/research/indices/btop/

[3] The EMN index is that calculated by HFR, while the CTA index is calculated by Société Générale

[4] For the EUR/USD exchange rate we use the Bloomberg defined EURUSDV1M ticker. The VIX, TYVIX, and OIV indices are calculated and published by the CBOE

[5] We estimate effective FX volumes to be a factor of 5-10 more than this due to the extra liquidity available through the spot markets

The return of the generic trender[6] referenced in the text over the past year

Equity indices

The collapse in demand for EM equities continued from Q2, with a whole raft of concerns continuing to pester these markets. While the MSCI EM Index (MXEF) only lost 2% during the period, the realised volatility (daily 3-month) moved up considerably, especially during the second week of August as the release of an American pastor, held by Iran, became a diplomatic flashpoint. The US threatened more sanctions, fanning a weekly drop of 3.7% in the MXEF. Geopolitics were a constant companion, with trade war anxieties becoming a humdrum accompaniment to every EM story. Despite limited evidence of contagion fears beyond Turkey, Russia and Argentina (except perhaps European Banks with large lending operations in Turkey), markets seemed to keep a cautious approach to EM exposure. This policy might seem sensible, since there are real concerns such as the vulnerability of some economies' reliance on external funding during a period of tighter US monetary policy. The Fed has continued to raise rates and unwind its balance sheet, with the US dollar index (DXY) strengthening 3.14% YTD through September.

A potential slowdown in the Chinese economy is also weighing on risk appetite, especially with many EMs' reliance on Chinese demand becoming exposed. External headwinds from US tariffs are, it seems, already having an effect: the Caixin Manufacturing PMI printed down three months out of three during Q3, reaching 50 for September (the threshold between contraction and expansion). Higher oil prices are exacerbating the scenario, with large EM importers succumbing to both higher prices, and local currencies that have fallen against the greenback – further increasing the cost. The Australian bourse, subject to a heavy reliance on Chinese demand for natural resources, had a testing quarter, down 2% and recorded the highest RSI[7] of 61 on July 10 (the S&P 500 had a comparable RSI level on September 21). The FTSE China A50 meanwhile, had the lowest RSI of 40 on July 3.

Developed markets (DM) had a more upbeat run, with the MSCI World Index (MXWO) gaining 4.5%. The rise in DM markets was however mostly thanks to the US (the largest constituent of the MXWO – carrying a weight of 62% in the index), the economy of which has been on a tear. Buttressed by, at first glance, robust economic metrics (impressive GDP figures, strong business confidence, low unemployment supporting consumer spending) along with good earnings, made markets ostensibly immune to the trade spat and other geopolitical turmoil. Industrial activity measures moreover seem to support this sentiment, as the Markit US Purchasing Managers' Index (PMI) has been stable and recorded a rise in September to 55.6, well into expansionary territory. It is, however, worth noting that most economic releases during the quarter nevertheless came in below economists' expectations, with Citigroup's Economic Surprise Index showing that expectations have missed by the most since 2017.[8] US equity benchmarks, nevertheless, steamed ahead, with the S&P 500 reaching a new record high (and ending the quarter up 7.2%). The S&P 500 was also the best performing contract when applying our generic trender. Implied volatility was subdued, with the CBOE VIX range bound between 11 and 15 points, while realised 10, 30, and 50 day volatility all reached or approached lows for the year during the last two weeks of September. Meanwhile, the CBOE Skew index, a widely tracked measure to gauge investors' sensitivity to skew risk, i.e. the likelihood of large 'outlier' returns in the S&P 500, reached an all-time high of 159 on August 13.[9]

The Nasdaq (up 7.14% over the quarter) equally reached record highs at the end of August as Technology stocks continued to outperform peers. The S&P 500 GICS 1 Technology sector gained 8.49% in Q3 (19.5% YTD) with Morgan Stanley upgrading the price target of both Amazon and Alphabet.

The UK's FTSE, down 2.8% for the quarter, suffered a tumultuous cycle, first hamstrung by EM worries as commodity prices slumped, and towards the end of the period, as the pound found support on optimistic Brexit negotiations. The FTSE found a four-month low on August 15, led by the large Basic Material constituent within the index as commodity prices fell on weaker Chinese, and

[6] Our generic trender is calculated as laid out in our 'Two centuries of trend following' paper, which is available on our website: https://www.cfm.fr/insights/two-centuries-of-trend-following. The trend signal is calculated as the difference of the last price and an exponential moving average of the past 5 months' prices, divided by the volatility: $S_n(t) = \frac{p(t-1) - \langle p \rangle_{n,t-1}}{\sigma_n(t-1)}$. The instruments are equally risk weighted in the portfolio

[7] Defined according to https://en.wikipedia.org/wiki/Relative_strength_index using 100 day exponentially weighted moving averages. The RSI varies between 0 and 100 with 70 implying an instrument is overbought and 30 implying the instrument is oversold

[8] The Citi Economic Surprise Indices measure the discrepancy between actual and predicted economic data. A positive reading means that economic data releases have been stronger than economists' forecasts, and a negative reading that the data has been worse than expected

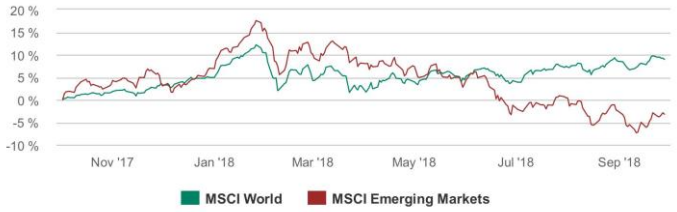
[9] "A SKEW value of 100 means that the perceived distribution of S&P 500 log-returns is normal, and the probability of outlier returns is therefore negligible. As SKEW rises above 100, the left tail of the S&P 500 distribution acquires more weight, and the probabilities of outlier returns become more significant." For more information on the CBOE Skew Index, please refer to the official documentation and methodology on the official website: http://www.cboe.com/products/vix-index-volatility/volatility-indicators/skew

EM growth outlook. The index recovered slightly as the EU negotiation team suggested that a Brexit deal could be reached within 6-8 weeks, before falling to a five-month low on September 11. The index recovered towards month-end, supported by a strong oil-price.

On the European continent, the Eurostoxx index, only losing slightly less than half a percent over the quarter, was subjected to large swings, falling 6.6% from the high on July 27, to a low on September 7. The implied and realised volatilities both climbed, with fears over a trade war escalation affecting the large, export sensitive components of the index. BMW, notably, issued a profit warning citing trade headwinds, dragging itself, and two of its Eurostoxx 50 peers – VW and Daimler – down. The Eurostoxx 50 was, consequently, the worst performing index when applying our generic trender. In comparison, the Stoxx 600 – tracking a much larger set of underlying stocks – gained a modest 0.3%.

Rounding up the bulletin on DM equities, are Japanese stocks that reached a new high, with the Nikkei index gaining 5.5% on yen weakness on continued loose monetary policy signals coming from the Bank of Japan.

The return of the MSCI World and the MSCI Emerging Markets indices for the past year



Stocks and equity factors

Factor-based investment strategies yet again experienced a challenging quarter. Employing the HFRX Equity Neutral Index as a proxy, these strategies lost 0.69% over the quarter. The underperformance with the broader HFRX Global Hedge Fund Index was more modest than in Q2, trailing by a marginal 30 basis points.

The MSCI World Indices employing a factor tilt, i.e. Momentum, Size, Quality, and Value showed largely a continuation from Q2, with Momentum maintaining the crown as best performing factor YTD. The MSCI World Momentum Total Return Index gained 7.87%, while the S&P 500 Momentum Index gained 9.48%, reflective of the strong surge in, and outperformance of US equities over the quarter. The MSCI Momentum Index for Europe underperformed its US peer, the gap having reached 10% at the end of Q3.

Value factors continued to underperform, the MSCI World Value Index gaining only slightly over the period, and remaining near-flat for the year. Multi-factor approaches continue to be stymied by the poor performance of Value, with anti-correlated Growth and Momentum not offsetting sufficiently.

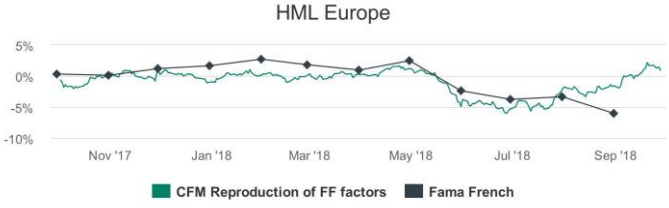
Investors seem to show a strong preference for Growth stocks, especially as seen by the remarkable gains registered by the Technology sector in the US. Technology sector names also contribute, in addition to Growth (having shown solid growth in sales and earnings) to a sizeable amount of stocks in Quality factors (featuring high profitability and low levels of debt). The divergence between sectors is as such stark, with the S&P 500 Information Technology sector having outperformed the worst performing sector, Consumer Staples, by 24% YTD.

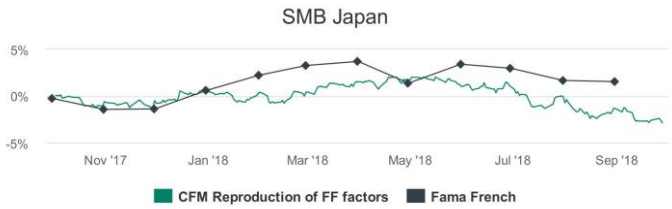
During the month of September, the spread between the Russel 1000 value and Russel 1000 growth indices narrowed slightly, with defensive Value stocks – those stocks that have lower price-to-earnings ratios for example, and tend to pay regular dividends, starting to look much more attractive than their growth counterparts.

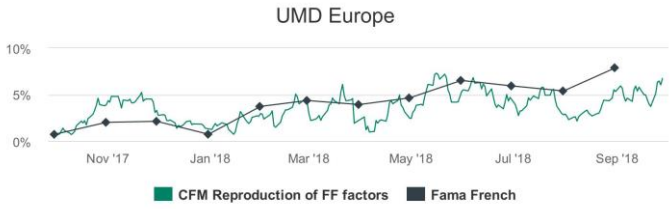
Regional performance has also shown a pronounced divergence. Factors traditionally exhibit similar trends across markets, but a geographical universality is being challenged by starkly diverging central bank policies and idiosyncratic geopolitical risks.

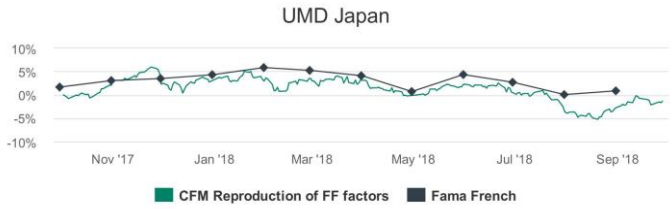
In a reproduction of the Fama-French-Carhart factors, European equities underperformed in the Small Minus Big (SMB), or Size factor, along with Japanese stocks that have been trending down since March. US SMB stocks remained flat, yet positive YTD. In the High Minus Low (HML) factor, European Value stocks gained, while US stocks suffered losses (Japanese securities flat). Momentum stocks in the Up Minus Down (UMD) factor continued to perform well across all regions (with US stocks maintaining their lead YTD), despite a slump at the end of July.

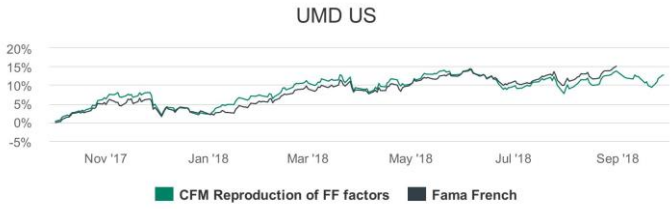
The Fama-French factors for the last year in Europe, Japan and US











High Minus Low (HML) corresponds to a market neutral (MN) portfolio long the high book to price stocks and short the low book to price stocks. Small Minus Big (SMB) corresponds to a MN portfolio long the small market cap stocks and short the large market cap stocks. Up Minus Down (UMD) corresponds to a MN portfolio long the historical winners and short the historical losers. In each case, the grey line is downloaded from Kenneth French's website, while the green line is the CFM reproduction of the Fama-French portfolios. The methodology can be attributed to Eugene Fama and Kenneth French and is not explicitly used in any CFM product.

Fixed income and credit

Core sovereigns registered losses, with the FTSE World Government Bond Index ending the quarter down 1.6% as bond yields rose. A rise in interest rates have been sustained, largely supported by the Fed overseeing the wind-up of QE and monetary policy tightening in an environment of record unemployment (and inflationary pressure showing signs of life). The Fed, as expected, hiked rates unanimously (9-0) by 25 basis points at their September 26 meeting, with markets expecting at least one more increase before the end of this year: the CME FedWatch Tool[10] puts the probability for a December 19 rate hike at 80%, which will bring the Fed Funds rate to 2.25-2.50% (up from the 1-1.25% in December 2017). Having attained their dual mandate, the Fed is having to choreograph a delicate manoeuvre of tightening monetary policy, without choking the booming US economy.

The US yield curve shifted up, much more on the short end. While the benchmark 10-year yield gained 20 basis points – closing the period well above the 3% level – the 2-

[10] The probabilities of the CME Group FedWatch Tool are calculated on 30-day Fed Fund futures contract prices, with further details and methodology to be found on their website: https://www.cmegroup.com/trading/interest-rates/countdown-to-fomc.html

year yield jumped 29 basis points. Interest rate differentials between the US and other major economies continue to increase, with the spread between the US and German 2-year bonds, for example, continuing to diverge. The spread stood at 3.34% at the end of Q3, up from the 3.19% at the end of Q2. The fact that investors have to pay the German government to borrow their money is largely a result of the European Central Bank (ECB) who have reiterated a commitment to keep interest rates on hold "at least through the summer of 2019".

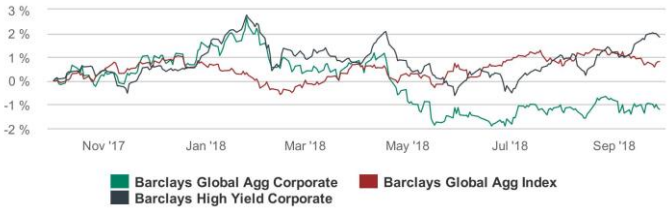
The Bank of Japan (BoJ) held a highly anticipated monetary policy meeting on July 31, with speculation swirling that the Bank would announce a shift in their QE framework. They ultimately disappointed markets, remaining committed to "powerful continuous easing" and only fine-tuning the range in which it will allow the 10-year JGB to move. The yield on the 10-year JGB fell promptly, with the yen also sinking against the dollar. After yields spiked on August 1 (reaching 0.13%), and the RSI hitting a low of 40 points on August 2 (the lowest amongst the sovereigns), the 10-year JGB promptly traded higher with yields slumping to 0.08% on August 21. This rollercoaster made the 10-year JGB the worst performing bond when applying our generic trender.

Meanwhile, the Bank of England (BoE), as was widely anticipated, raised interest rates to 0.75% (a 25 basis points hike and establishing the highest level in a decade). The pound found no support, ending the session on August 2 down against the US dollar. While the BoE move stimulated a rise in UK Gilts, the real impetus came courtesy of Michel Barnier – lead Brexit negotiator for the EU – when he affirmed, on August 29, a willingness to offer the UK a concession deal. The 10-year Gilt jumped to 1.49% and ended the month at 1.56% (up 29½ basis points from the end of Q2).

The German Bund attained the highest RSI of 59 points on July 16, with the Australian 90-day bank bill rate and the Euroyen having recorded the lowest and highest RSI amongst Short Term Interest Rate contracts: 35 points on July 11, and 63 points on 28 September respectively.

The benchmark Barclays Global Aggregate suite of indices offered mixed returns: the Total Return Index (Unhedged) returned -0.9% over the period, while the sister Global Aggregate Corporate Total Return Index gained 0.41%.

The return of Barclays Global Aggregate Bond Indices for the last year



Commodities

With uncertainty surrounding sustained global growth, and the trade war a perennial accompaniment in markets' calculations, commodities came under pressure. Moreover, the strength of the US dollar, an important factor when it comes to commodity prices (it tends to have an inverse value relationship with raw material prices) was an additional element in poor performance.

Some fear that the tariffs being piled up by the US on China are already having an effect, with Chinese softer PMI figures, and Industrial Production numbers lower than economists' expectations – three months on the trot. Copper, a shorthand gauge of global growth, sunk into official bear-market territory on August 15 as the outlook for demand waned. This bellwether, already under pressure from the general EM rout, got a further knock as supply prospects increased when workers and management of BHP at Escondida in Chile (the largest copper mine in the world) neared a deal in order to avoid industrial action.

The S&P Goldman Sachs Commodity Index, while unremarkably flat over the period (-0.2%), dipped to a low on August 15, before recovering. The recovery was, nonetheless, almost entirely thanks to a surge in oil price from mid-August, reflective by way of the sister S&P Goldman Sachs Non-energy Commodity Index (which strips out oil, gasoil and other energy sector contracts) being down 4%. Bringing us neatly to the news that grabbed most commodity headlines: the benchmark Brent and Crude contracts that both surged, fanned by a fear that world supply would fall short of demand as the first round of sanctions against Iran were introduced. With a concern that the loss of barrels from Iran (and Venezuela) will not be made up by additional supplies from Saudi Arabia or Russia, Brent broke through the $80 per barrel threshold on September 21, and capping off the period with a rise of 4.42% – a fifth straight quarterly rise (and not seen since 2008). Furthermore, a claim by U.S. Energy Secretary Rick Perry that a release from the Strategic Petroleum Reserve would have "a fairly minor

and short-term impact" might have further stoked fears of no stopgap supply measures being introduced. Many commodity brokerage houses predicted a rise to above $100 per barrel. Crude attained the highest RSI of 60 points on 2 July – slightly below, but close to the threshold of 70 that is considered overbought territory. Soybeans registered the lowest RSI of 32 points on July 6, well into oversold territory.

Furthermore, the spike in Brent in mid-August coincided with a reduction in the correlation between this contract and WTI Crude as US energy manufacturers ramped up production and Crude trading a slightly higher discount.

Soft commodities, on the other hand, had a rotten quarter: the Bloomberg Softs Subindex tanked by 13%. Coffee, one of the worst performing commodities, dropped 13.5% over Q3 – making it the sixth consecutive negative quarter for the beleaguered good as bumper crops are expected from amongst others, Brazil (where the national supply agency, Conab, predicted a record crop with a 33.2% rise in production from 2017). Coffee, as such, was the best performing contract when our generic trender was applied, having been on a long, continuous slide since the middle of 2017. Wheat, contrarily, was the worst performing contract in applying the generic trender as prices fluctuated by 20% over the period.

The one year return of the S&P GSCI, GSCI Non-Energy, and Bloomberg Commodity Spot indices

FX

The dollar index (DXY) turned higher and posted a 0.7% gain over the quarter and was 3.2% higher YTD. Non-commercial traders added to their long position in the index, with the dollar benefitting, principally, from an ever-widening interest rate gap with other major G7 currencies as an outwardly hawkish Fed is picking up the pace of rate hikes as the ECB and BoJ leave short-term rates in negative territory.

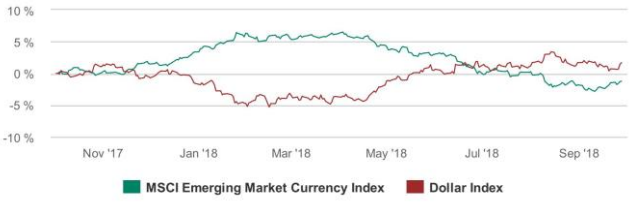
Implied volatility was most pronounced in the Cable rate, as the pound got riled between Brexit negotiations and monetary policy hikes. The 1-month at-the-money implied volatility lurched from a low of 6.5 points on August 3, to 9.6 on September 24. The greenback gained 1.4% against sterling over the quarter, and 0.7% against the euro.

Emerging market currencies stumbled on a cocktail of a stronger US dollar (increasing their riskiness along with questioning their ability to repay a large cache of dollar denominated debt); fears of contagion spreading beyond Turkey, Iran and Russia; as well as a general risk-off attitude with trade tariffs that may choke global growth and trade. The Turkish lira, along with the Argentinian peso, were the two main stragglers. The Turkish lira collapsed 42% YTD by the end of August as geopolitical tensions with the US exacerbated ongoing concerns over its wide current account deficit – along with above-target inflation and a worry about central bank independence. The MSCI EM Currency Index, having lost 5.1% YTD through August, regained some footing and gained 0.6% in September. The index found some reprieve especially during the final weeks of the quarter as a host of EM central banks tightened their monetary policy stance. The Turkish lira strengthened by 8.2% against the dollar during the month, on, amongst others, a 625 basis point hike in the benchmark interest rate on September 1.

When we apply our generic trender, the Indian rupee was the best performing currency on a short position (the rupee has lost 14% of its value against the dollar YTD, and registered losses every month since February). The loonie was the worst performer on a choppy quarter for the Canadian currency.

The Mexican peso attained the highest RSI of 58 points on August 9, while the lowest RSI was registered by the Chinese yuan – 33 points on August 16.

Dollar Index (DXY) vs MSCI Emerging Market Currency Index



Trading news and regulation

"Forex rule book closes window on 'last look' practice"[11]

We have previously reported on the efforts of the Bank of International Settlement (BIS) Markets Committee to promote adherence to the Global FX Code, a voluntary set

[11] https://www.ft.com/content/552f2fb0-e3ec-11e7-97e2-916d4fbac0da

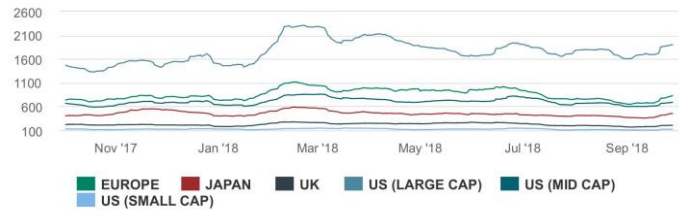
of guidelines regarding execution and transparency. The document now has well over 100 signatories, and received a revision at the end of 2017. The new wording strongly opposes the use of "last look", a practice whereby dealers may refuse client orders during a short holding period after reception. Last look can have an adverse effect on clients' execution quality, if the broker were to use the holding period to selectively reject client trades on which it would lose money, and accepting those that are profitable.

Clients are increasingly aware of this issue, and their collective pressure on dealers is leading to hold times now reduced to only a few tens of milliseconds, or their deactivation altogether. In line with this trend CBOE FX (formerly Hotspot) – one of the major public FX platforms - adopted a similar change in its matching engine in September. While dealers still have the possibility to use last look, client orders (given that prices are equivalent) are preferentially routed to dealers offering firm, guaranteed liquidity.

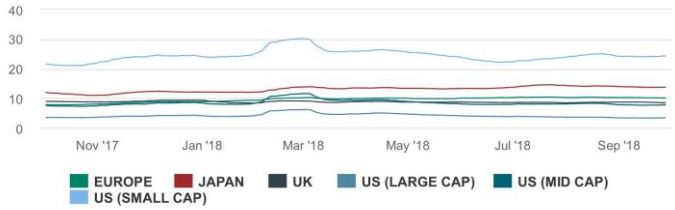
"Beyond Interactive: Notebook Innovation at Netflix"[12]

The development of strategies at CFM leverages many tools of data science, most often originating from outside finance. In August, on its blog, Netflix published an article giving insights into the functioning of their workflow, and their different data-related roles. The article, beyond giving an in-depth list of useful (and often free) software, proposes several good practices. In a fast, data-driven environment time-to-market is key, and there is a strong emphasis on efficiency, and the ability to turn a simple idea into a production solution while expending the minimum of resources. Easy to deploy interactive tools, cloud computing (Netflix' data analysis is hosted by Amazon) and leveraging open source projects are among the crucial components that make their platform efficient.

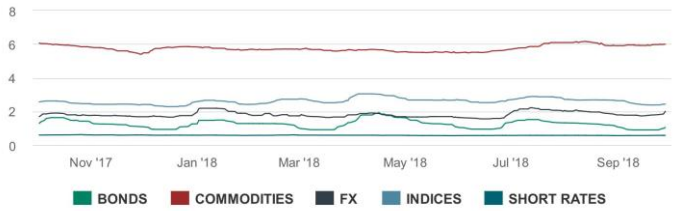
Average monthly dollar equity market volume in billion USD



Typical bid-ask spread in six major groups of equities in basis points



Average bid-ask spread on five future asset classes in basis points



Data Science & Machine Learning

The latest CFM White Paper on Artificial Intelligence, *A new hype or a new hope? Neural networks applied to live market data*, is now available on our website.[13] It explains, in simple terms, how neural networks can improve the predictability of stock returns and lead to significantly better trading costs.

Countless data analysts and scientists use notebooks for their calculations: much like a traditional printing calculator, they show both the programming instructions and their result (graphs, tables, etc.), which is very convenient for data exploration. Yet, their more graphical nature is likewise a hindrance, especially when it comes to tracing the history of changes made to the notebook, or when merging changes made by multiple collaborators simultaneously. CFM's Marc Wouts has developed a new tool to tackle this shortcoming: Jupytext. It allows for a seamless conversion between notebooks and a text version that makes the above tasks tractable. This project is hosted on Github, the leading open-source repository, where it has received widespread acclaim and reached more than a 1,000 likes ("stars") in a matter of only a few days. CFM is proud to support the development of important, cross-industry open-source tools for data science.

We also continue to support the local data science ecosystem by organising Meetups. The most recent, PyData Paris, was on the Python language and Data

[12] https://medium.com/netflix-techblog/notebook-innovation-591ee3221233

[13] The paper is available on our website and can be found here: https://www.cfm.fr/insights/a-new-hype-or-a-new-hope-neural-networks-applied-to-live-market-data/

science. We welcomed Jessica Hamrick, a researcher from Google DeepMind, who presented 'nbgrader', a tool that allows professors to give assignments as Jupyter notebooks and speed up the grading process. We also had a professor from the University of Paris, Nicolas Thiéry, who presented Sage, a tool for manipulating mathematical concepts through programming. Both of these tools are open source and thus easily usable by anybody.

We also had the opportunity to learn about MLBox, an open source automated machine learning python library, developed by Axel de Romblay. MLBox is the kind of tool that holds the promise for faster data analysis by automatically exploring a whole range of models in order to ultimately identify the most appropriate one. The CFM Challenge Data competition in data science continues until the end of the year! New participants can now get a leg up by studying videos where the top participants from mid-2018 present their methods.

Extended abstract

Co-existence of Trend and Value in Financial Markets: Estimating an Extended Chiarella Model

Paper by Adam Majewski, Stefano Ciliberti, and Jean-Philippe Bouchaud

Trend and value are pervasive anomalies, common to all financial markets. These two market anomalies pose a major challenge for the Efficient Market Hypothesis and consequently they have gained a lot of attention, both from academics and practitioners.

In this paper we address the problem of the co-existence and interaction between the two anomalies within the framework of a heterogeneous agent-based model. More specifically, we extend the Chiarella (1992) model to have three types of investors: trend-followers, fundamentalists and noise traders, which interact with each other to form prices. Additionally we assume a non-linear demand of fundamentalists which is more consistent with empirical findings and economic intuition.

We use Bayesian filtering techniques to calibrate the model on time series of prices across a variety of asset classes since 1800. The proposed estimation methodology offers a general and efficient procedure to extract the fundamental value of a financial asset from price time series which can also be applied for assets without cash-flow, like currencies or commodities.

Our extended model reproduces many empirical observations, including the non-monotonic relation between past trends and future returns. When we control the trend effect for value, the mean-reversion of trend effect disappears. Interpretation of this result is that large trend signals goes hand in hand with large mispricing, which enhances the activity of fundamentalists who are wiping out the profits of a trend-following strategy by taking the opposite position to trend. A practical conclusion is that universal trend following strategies should be supplemented by universal price-based value strategies in order to obtain the best investment results.

We also conclude that the non-linear demand function of fundamentalists, together with the destabilising activity of trend-followers, leads to a bimodality in the distribution of price distortions (differences between market price and the fundamental value). If confirmed by independent research, such bimodality would be a spectacular stigma of the failure of the efficient market hypothesis, since the most probable state of affairs would be that assets are either over-valued or under-valued by the market for long periods of time.

CFM Talks To

Bruno Dupire

We had the pleasure of welcoming Dr. Bruno Dupire at our offices in Paris for a candid discussion about the world of finance in general, the status of quantitative finance and research in particular, and his views on a variety of developments set to shape the industry.

Bruno is currently the Head of Bloomberg Quantitative Research, and a former head of derivative research at Société Générale, BNP Paribas and Nikko FP. Bruno also lectures in the Courant Master of Sciences Program at NYU. He is probably best known for his ground breaking research in derivative pricing, having shown how to derive a local volatility model consistent with a surface of option prices across strikes and maturities – establishing the so-called Dupire's approach to local volatility for modelling the volatility smile. The Dupire equation has since become a standard tool in the industry and has been used to price trillions of dollars of options over the years. Bruno also developed the Functional Itô Calculus which is a framework for path dependency with many applications, notably, the decomposition of volatility risk across strikes and maturities.

He was awarded the Lifetime Achievement Award by Risk magazine in 2008 for his pioneering work in local volatility modelling.

> **“There is a belief, or illusion, that everything can emerge from the data itself, just let the data speak. But data also benefits from rules. Machines can learn from examples but they certainly can benefit from explanations and guidance.**

CFM: *You are head of Quantitative Research at Bloomberg. Can you briefly discuss the nature of you and your team's research? What is it that Bloomberg Quantitative Researchers typically do?*

BD: We serve the needs of a broad community of over 300,000 users with incredibly varied needs. We cover derivatives, machine learning (ML), portfolio construction, pricing of illiquid assets, electronic trading, visualisation methods, election prediction and much more... We collaborate with numerous teams internally, but we also develop our own initiatives: for instance we have originated an ambitious project - a quant platform with innovative tools for visualisation and interaction. It enables the Bloomberg user to create elaborate studies.

We are also deeply involved in thought leadership – we present our work in the industry and academic conferences, publish research papers and we are running the Bloomberg Quant (aka BBQ) seminar: the world's largest (200 attendees on average) monthly quantitative finance series. It is a recognised intellectual forum for the community.

CFM: *What do you regard as the most discernible shifts in the focus of quantitative research within the industry? What do you see as the next frontier in quantitative research?*

BD: Over the past years we have witnessed a shift from the sell side to the buy side. From eliminating risk premium for the risk neutral pricing of derivatives, to seeking risk

premium for investments. From theory to data. From stochastics to statistics. Indeed, over the past five years the quant community has massively embraced ML, AI and the use of alternative data sets.

At Bloomberg we deploy a massive effort in data science: we now employ hundreds of engineers and we are very active on the communication side as well, together with the heads of ML and of Data Science. I have been talking about it in Europe, Russia, Asia, North and South America - everywhere only over the past year.

CFM: *When did you first get involved in AI?*

BD: My own involvement with AI predates my last 30 years in finance. In the early 80s I obtained a Master's degree in AI in Paris and in the mid-80s I worked with Francisco Varela on self-organising systems when we started experimenting with neural nets. Then I had the idea of applying neural nets to time series forecasting and sold, in 1987, a study on currency exchange rates to Caisse des Dépôts. It was probably a first. After that I mostly underwent the "winter of AI" until the early 2010s when the company and my group became active in it.

CFM: *You mentioned the advent and large-scale uptake of machine learning and big data as key developments that have the potential of upending the industry. In fact, in a recent article in Risk magazine, entitled "Do or die – asset managers take up data science", the author stresses a belief amongst many managers that gaining expertise and keeping ahead of the curve in data science (and machine learning, amongst others) is indispensable for staying competitive in the industry. Do you share this view?*

BD: Some say it is the future, others say it still needs to prove its relevance in finance. In my view, ML in finance is here to stay, but it will not solve everything. Currently the hype is intense, so intense that many feel compelled to pepper their speeches with phrases such as AI, ML, big data, predictive analytics, deep strategies, which is all often a varnish to hide a void.

> **"In my view, ML in finance is here to stay, but it will not solve everything.**

Finance has always tried to relate the available current information to future behaviour in order to improve investment or risk management decisions and ML is the approach of choice to mechanically establish these links. ML relies on three pillars: data, algorithms and computing power. There is a galore of alternative data in finance and the algorithms and computing power have improved substantially. It is thus natural that finance has embraced ML. ML/AI can be used for Natural Learning Processing (NLP) (sentiment extraction, queries, comment generation), option pricing, outlier detection, data compression, covariance matrix cleaning, regime linked strategy selection, pricing of illiquid assets, transaction cost analysis, among other examples.

Some aspects of finance are similar to physics, with experiments that can be repeated, other aspects are more grounded on game theory, with a circle of anticipating the anticipations. In the first category we can find option pricing. Computing one option price as a function of its parameters and of the model parameter may be complicated but learning the whole pricing function can be easier once enough examples have been presented.

On the game theory side one can find trading and investment. It is impossible to repeat an experiment exactly under the same conditions. Regularities such as performance of strategies according to the market regime can be observed, but there is no guarantee of their persistence. The physical side can clearly benefit from ML, which is less obvious for the "game theoretical" one.

CFM: *The explosion in 'alternative data' and, as a consequence, a proliferation of alternative data providers is a challenging undertaking for most asset managers, not to mention separating the chaff from the wheat. How do you see managers positioning themselves in this era of an ever-growing amount of data and data providers?*

BD: Opportunities rotate quickly and one has to be nimble to identify and exploit them. Many people will be late to the game but the providers of alternative data will definitely be busy for quite some time.

Examples of alternative data are text, satellite images, supply chain, Environmental, Social, and Governance (ESG), vessel routes, credit cards, geolocation data, etc. But data is certainly not enough. When most market participants have access to the same data, what makes the difference is the ideas and the tools.

CFM: *Having access to all this new, and often very enticing data sources, is embraced as a revolutionary boon for data science and financial research. Do you harbour any reservations about the use and application of data?*

BD: There is a belief, or illusion, that everything can emerge from the data itself, just let the data speak. But

data also benefits from rules. Machines can learn from examples but they certainly can benefit from explanations and guidance.

Another issue is the use of the data. It is very difficult to read causation from data. If when I observe that when the value of X is A then Y tends to be around B, does it mean that when I force X to be A then Y will be around B? This question cannot be resolved by the data itself. In the absence of randomly controlled trials, it is necessary to have a causal assumption, as brilliantly explained by "The Book of Why" of Judea Pearl. This is how one can reveal the structure of dependencies without intervening.

CFM: *You included ESG data as another area of focus for, and of alternative data providers, with new sources springing up all the time. Which, if any, of the common reservations about ESG data do you share?*

BD: There is a pressure for transparency, a premium for reporting and there is a massive shift towards increased disclosure. Currently the best data is probably from G, governance (independence, entrenchment, shareholder rights, diversity...), with some solid reporting especially from the early 2010s. However, it is difficult to harmonise data across providers and cultures; for instance the notion of board independence differs according to each region. Sustainability data depend partly on the sector and S, social, is especially patchy. A lot of effort is made to backfill and curate the data and push for better future disclosure.

The data, even if not a complete set, is voluminous. There are time series for hundreds of fields for thousands of stocks. Whether you intend to define a “goodness” score or to find value in the data for factor investing, you need good tools to represent and navigate the data. My team is working on novel ways to visualise and navigate the data that makes it easier to reveal associations.

CFM: *ESG, it would seem, has now become fully embedded in the industry framework. INDEFI, a strategic advisor for the asset management industry, entitled their latest survey, “The Rapid Mainstreaming of ESG Investment Practices among European Asset Owners”. What is your take on the ability of asset managers, especially quantitative, and systematic managers to respond to the ever-increasing ESG demands set by investors?*

BD: Whichever composite factor can be extracted by inspecting past data, the future is bound to be different. ESG data will deeply affect investment decisions due to its ethical dimension and regulatory pressure. Numerous sovereign funds and asset managers express explicitly their preference for good ESG investments, sometimes acting as activists to change corporation practices. Many millennials want to invest only in good ESG stocks. This will generate massive asset migrations, which opens a whole array of opportunities.

CFM: *It is not uncommon to hear that certain institutional investors espouse the mantra that ‘simpler is better’, finding it much more palatable to avoid what they deem to be ‘black box, or black box like” strategies. Do you perceive any disenchantment from the industry towards quantitative strategies?*

BD: Data snooping, overfitting, or apophenia (tendency to interpret noise as a pattern) is indeed a huge pitfall. An algorithm that optimises over the past offers no guarantee of good future performance. The more complex, the more prone to overfitting. The way out is a parsimonious model and a solid narrative that can support statements such as “It has worked in the past and here is the reason it is likely to carry on working”.

The market is a machine that destroys signals. If a quant finds a signal that has worked in the past, he is likely to not be the only one and quickly competitors will try to grab this opportunity away from him. Risk premia are not a law of nature. Opportunities vanish quickly and the investor needs to be creative and to have efficient tools.

However, there are some more resilient strategies, for instance based on behavioural principles. Cognitive biases are here to stay: even to be aware of your own cognitive biases does not prevent you from following them. This means that over-reaction, disposition and endowment effects, conjunction fallacy, remorse aversion, anchoring, herding and reaction to sunk costs will not disappear.

> “ **The market is a machine that destroys signals.**

CFM: *What do you see as the key risks, or pitfalls for quantitative investment managers?*

BD: As mentioned earlier, a major issue is overfitting.

Beyond that, a pervasive problem, whether it be in biology, social sciences or quantitative finance, is a clash of culture between the domain expert and the data scientist, with relevance being the collateral damage. Using NLP to analyse DNA sequences without knowledge of the field will generate biological nonsense. Similarly, using convolution nets to link returns to characteristics is perilous. The portfolio manager and his data scientist have

to both make an effort to create a compatible conceptual platform.

CFM: *Do you have any pet peeves about the industry?*

BD: A dimension of quantitative finance that I find sorely missing is what financial engineering was supposed to address: use techniques to bring solutions to different economic agents. Whether it be in derivative product design or in asset allocation, it seems that the needs of the individual agents are somewhat disregarded. As an example, what matters for a retiree is not if midcap pharmaceuticals in Asia will outperform the market but rather that she will not over live her savings. Her risk is her own longevity, not the performance of the value factor. The asset allocator should definitely adapt to the investor and his or her personal benchmark.

CFM: *Any interesting projects you and your team are focussing on at the moment?*

BD: Beyond its daily tasks and its modelling role, my group explores many different directions: perceptual tests, colour theory, hand movements to input parameters, assistive technology. Moreover we have open sourced bqplot, our graphical library. It is important to give back to the community; the best researchers do not like to do just one thing and they want to have a purpose.

Disclaimer

Other news

- Alix Egloff – an Executive Director in CFM's EMEA Investor Relations team – has been named among the 50 Leading Women in Hedge Funds 2018 by Hedge Fund Journal, in association with EY. Read the full report here: https://thehedgefundjournal.com/50-leading-women-in-hedge-funds-2018/
- Philippe Jordan, President of CFM International, has been appointed to the Board of Directors of the Alternative Investment Management Association (AIMA). Please see the press release for further details: https://www.aima.org/article/press-release-aima-announces-new-council-and-board-of-directors.html
- Marc Potters, CFM's Chief Investment Officer, gave a series of talks in the US and Canada in September on Risk Premia and how to manage expectations as part of our 'Food for Systematic Thought' event series. To join us for any of our talks, please don't hesitate to contact us: https://www.cfm.fr/contact-us/
- CFM, is using machine learning in many aspects of our investment process. See a video, and an insightful whitepaper on the topic on our website: https://www.cfm.fr/insights/artificial-intelligence-how-cfm-uses-machine-learning-to-remain-at-the-forefront-of-asset-management/
- A recent academic paper of ours, "Black was right: price is within a factor 2 of value", was featured in Risk Magazine as part of their "Our take" series. Read the synopsis here: https://www.risk.net/our-take/6022966/fischer-black-was-right-somewhat
- CFM was proud to sponsor the 3rd Annual Systematic Investment Symposium, held in London on September 13-14. Philippe Jordan spoke about the pitfalls of ESG, while Stefano Ciliberti gave a presentation on the many facets of drawdowns. For further details, please refer to the website: https://www.iiforums.com/Institutional-Investor-Forums/3rd-Annual-Systematic-Investment-Symposium
- Charles-Albert Lehalle, Senior Scientific Advisor, gave a talk on mean field games as a model for liquidity on financial markets at the 10th World Congress of the Bachelier Finance Society, held in Dublin during July. More detail can be found here: http://bachelliercongress2018.com/
- See the details of all our other upcoming events here: https://www.cfm.fr/events/
- We have recently submitted the following paper:
  - How does latent liquidity get revealed in the limit order book? Lorenzo Dall'Amico, Antoine Fosset, Jean-Philippe Bouchaud, Michael Benzaquen. https://arxiv.org/abs/1808.09677

Whitepaper

Making fat right tails fatter with trend following... most of the time

Executive summary

Our prior work has demonstrated the mechanically convex behaviour of trend following that many in the investment industry have enthusiastically embraced as a possible protector of asset portfolios. In this short paper we develop and explain the consequences of these ideas in terms of how this convexity leads to a positively skewed returning strategy, which in turn then becomes a performance chaser's nightmare – selling after prolonged periods of inevitable disappointing performance before missing the next, unpredictable acceleration in positive performance. We contrast this with the P&Ls of most other strategies and assets that are predominantly negatively skewed. This opposing return pattern lures investors into a false sense of security and is equally dangerous to performance chasers. We argue that trend following should form a core and stably allocated component alongside traditional assets in a diversified portfolio. Performance chasers: beware!

Introduction

Many probing questions have historically been asked about trend following and its longevity as a strategy. Many more probing questions were asked after most Commodity Trading Advisors (CTAs) – firms that predominantly exploit trend following strategies[14] – failed to 'protect' against the abrupt, and severe market sell-off in February earlier this year.[15] The efficacy of trend following as an anti-correlated strategy to equities, and, as it is often marketed, a *protective*[16] addition to a portfolio are some of the key qualities often espoused by trend managers. Trend followers on aggregate did, however, not live up to this misplaced expectation in February, when markets sold off and implied volatility went through the roof. The two most widely quoted CTA performance benchmarks, the Société Générale CTA (NEIXCTA) and BarclayHedge CTA (BARCCTA) indices fell by 6.3% and 3.7% respectively during February.[17] The S&P 500 meanwhile lost a 'mere' 3.9%.

Trend following strategies, in times of severe, instantaneous market jumps or corrections, have a 50% chance of being on the right or wrong side of a large market move. No trend following program could for instance have protected against the 8.7% tumble in the S&P 500 registered over the six trading days that started on Friday, February 2. Even the fastest trend signals would have been unable to react quickly enough to have profited from the downside move. Trend following, as such, is much more adept at providing uncorrelated protection in a long and drawn out bear market (also providing protection from a long and drawn out bull market!).

Speculation as to the apparent failure of trend following strategies is rife. Some observers ask whether trend following is 'dead',[18] while others claim that a new regime of higher volatility and a directionless environment will spell doom for trend followers. Some worry that trend followers have become too correlated with equities (offsetting its anti-correlated properties), while others have asserted that trend was killed by the large quantitative easing (QE) experiment of central banks, and that a rising interest rate environment will prove problematic.[19] It is worth noting that trend followers inherently do not hold, nor position a strategy on any discernible macroeconomic information.

It was, despite the mounting chorus of negative rhetoric, not so long ago that trend followers were considered the darlings of the alternative industry when CTAs outperformed during the 2008 financial crisis, surfing the downward trend in stocks, and the rally in bonds. The crisis revealed that money managers on the whole were exposed to an uncorrelated set of risk premia in normal times, only to become correlated in the heat of the crisis.

[14] Please see our paper entitled "Explaining hedge fund index returns" available on our website: https://www.cfm.fr/insights/explaining-hedge-fund-index-returns/

[15] For those who need reminding, the S&P 500 lost 2.1% on Friday February 2, (and 4.1% on the following Monday) with the index erasing most of its year to date gains by the following weekend. The debate as to the genesis of the selloff is varied, with most pundits placing the blame on the better-than-expected wage growth in the January Employment Report (non-farm payrolls) that was released on Friday, February 2. This unexpected wage growth prompted many investors to reconsider the trajectory of Federal Reserve rate hikes, placing bets that the Fed will become much more hawkish

[16] The term 'Crisis Risk Offset®' or simply CRO is attributed to Pension Consulting Alliance (PCA) – a US-based consultancy that promote a class of strategies that are designed to "have a high probability of appreciating significantly during material market drawdowns while also generating a positive return over the long term". PCA count "Systematic Trend Following" as amongst one of these strategies

[17] These two indices attempt to capture the aggregate performance of many managed futures. The SG CTA Index is a daily index, launched in 2000, containing the largest 20 CTA managers as measured by AUM with methodology that can be found here: https://cib.societegenerale.com/en/our-offering/global-markets/prime-services/prime-services-indices/
The BarclayHedge CTA Index, with data stretching back to 1980, only publishes monthly returns but contains a much larger sample of managed future managers: there are currently 541 programs included in the index. Methodology can be found here: https://www.barclayhedge.com/barclay-cta-indices/barclay-cta-index/

[18] See for instance: https://www.cmegroup.com/education/alternative-investment-resource-center/research/is-trend-following-dead.html

[19] See our paper entitled "CTAs in a Regime of Rising Rates", in which we empirically show that the performance of trend following is impervious to raising (or falling rates). The paper is available for download on our website: https://www.cfm.fr/insights/ctas-in-a-regime-of-rising-rates/

Trend following proved itself to be an outlier in offering good returns (and liquidity) in a period of market stress.

One may nevertheless forgive the not-so-dyed-in-the-wool trend advocates of questioning the efficacy of trend following as a complimentary, alpha generating addition to a portfolio. Investors, one may rightly argue, are reasonable in rethinking their commitment to trend following, and/or hesitant to invest in a strategy that seemingly fails to protect against a sell-off, and moreover, has registered lacklustre performance since 2015. Yet, trend following strategies have remained popular with consistent inflows of nearly 15% average per annum since 2000. This growth may of course lead investors to question whether the space has become "crowded".

We acknowledge many investors' anxieties with the recent performance of trend following, along with the concerns about its protective properties, a crowded space, and correlation magnification. We nevertheless consistently champion the idea that trend following is a long term, diversifying strategy that is highly statistically significant, not overly sensitive to trading costs and takes advantage of one of the classic behavioural biases – that of the human propensity to follow trends. We furthermore believe it is in the best interest of any investor to remain invested, and not attempt to try and time entry and/or exit decisions. Investors and asset managers alike grapple with timing decisions, looking for spurious signals that may indicate an opportune time to either invest, or redeem from a strategy. Basing a decision on noisy price signals to enter or exit a position is fraught with difficulty, as we will explain below.

Convexity and skewness: a recap

Trend following has been shown to exhibit unique convexity features that are mechanically stable over timescales comparable to that used for the trend. Key to understanding why investors should proceed with caution when (or if) deciding to change their allocation to trend following is to understand the origin of the convexity and the 'positive skewness' that it produces. We have written extensively on the concept of convexity,[20] and while this paper is not intended to rehash nor expand on what has been well-covered before by ourselves and others, it is worth recapping what these stylised facts are, and tease out why these features are central to the danger of any attempt to time trend following.

Convexity is simply the feature where the P&L does not exhibit a linear relationship with the performance of the underlying instrument. In other words, if the price of an underlying changes, it does not hold that the output (the resulting P&L) will change by the same magnitude. In Figure 1 we demonstrate this mechanical feature of trend following by applying the strategy to the returns of a (necessarily unpredictable) random walk.[21] One sees clearly that the performance of the trend is positive for the infrequent, big moves up or down of the random walk. The overall total P&L is zero (again the random walk is unpredictable) but one observes convexity on the timescale of the trend.

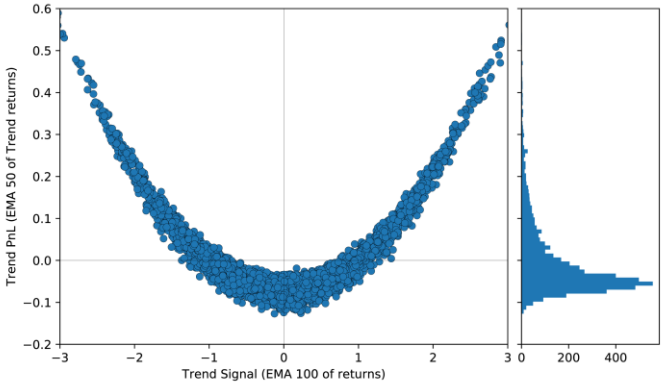


Figure 1: The convexity of trend following on a random walk. The y-axis is a 50 day Exponentially weighted Moving Average (EMA) of the P&L arising from applying a 100 day EMA to the timeseries while the x-axis corresponds to a 100 day EMA of the timeseries. On the right hand side one sees the cross sectional profile of the averaged trend following returns that exhibits a clear positive skew albeit with a zero mean. Stated differently, the P&L of trend following on a random walk is positively skewed on a timescale comparable to that of the trend but the overall long term P&L is necessarily zero (the random walk being unpredictable!)

This same convex payoff is most commonly associated with buying options. Buying options is a sure-fire way to protect against big moves in a market, but, is by its nature a very costly proposition. If an investor harbours a specific investment mandate or objective, this cost could be a justifiable expense. Nevertheless, we want to stress that trend following should not be compared to buying options (or considered a suitable replacement) as a hedge against large, instantaneous moves in the price of assets. Trend following instead offers protection to long, drawn-out and protracted large moves.

[20] See our paper "The Convexity of Trend Following: Protecting your assets but perhaps not as much as you would like!" available on the CFM website: https://www.cfm.fr/insights/the-convexity-of-trend-following/. Or, for a more technical and in-depth explanation, we invite you to read our academic paper, "Tail protection for long investors: Trend convexity at work" available on arXiv: https://arxiv.org/pdf/1607.02410.pdf

[21] One can build a fake timeseries of price returns by generating random numbers taken from a bell shaped distribution and summing them up. The timeseries of S&P 500 returns, for example, can be thought of as one "Random Walk". Using random numbers has the advantage of being able to generate as much data as we need!

Strategies can also be said to exhibit either positive, or negative *skewness*. Skewness is a measure of symmetry, i.e. how symmetrical the return distribution is. Being long the market is typically a negatively skewed strategy – many small gains are made, but the occasional large loss should be endured (think of February). A positively skewed strategy, on the other hand, is one where many small losses, but a few large gains are registered. Buying options, for example, is a positively skewed strategy: one buys options (paying a premium and taking on small 'losses') in order to be protected from large moves in the underlying instrument (when your option insurance pays out). Selling volatility is then, conversely, a negatively skewed strategy – it is the mirror opposite of buying options! We show the P&L of being systematically short options in Figure 2 where one clearly sees a negatively skewed return stream, albeit one with an overall positive return and Sharpe ratio. The relationship between convexity and skewness is again mechanical. A strategy such as trend following that exhibits large positive returns infrequently and small negative (or at least close to zero) returns frequently translates into a positively skewed return distribution. Convexity and skewness are therefore one and the same thing.

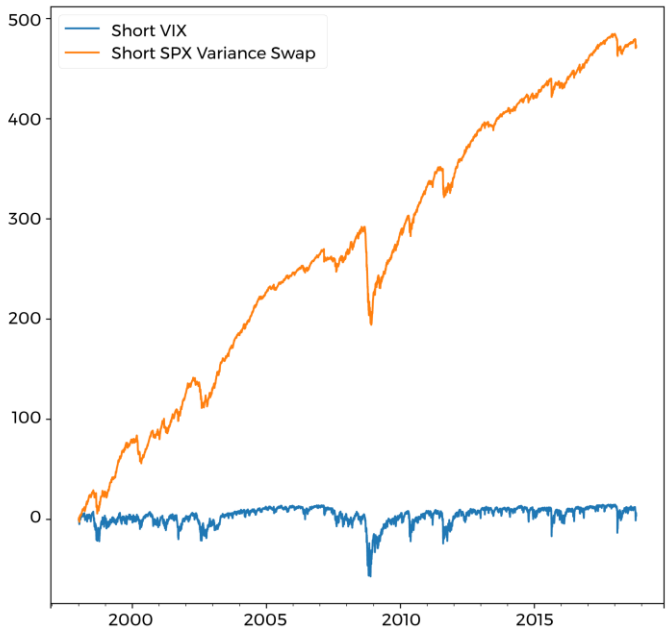


Figure 2: The inverted or "short" VIX timeseries and the P&L of being short a Variance Swap on the SPX - the archetypal negatively skewed strategy. The protection P&L, buying the Variance Swap, is the mirror opposite of this and is therefore a costly, albeit positively skewed, strategy.

We have shown how trend following exhibits *positive skewness*, due to its mechanical convexity, and how the return profile is therefore uniquely different from most underlying asset classes. This return distribution is exactly what has made, and, in our opinion, will continue to make trend following an attractive addition to any portfolio, i.e. its ability to protect against long and protracted drawdowns in traditional asset classes. CTAs, put another way, attempt to *preserve* the upside potential of traditional beta, while *limiting* the downside risk.

The positive skewness and protective features of trend following thus make it behaviourally appealing. Most market participants, as behavioural economists have shown, succumb to the same behavioural idiosyncrasies, namely a much stronger aversion to losses than the relative enjoyment of gains.[22] These behavioural traits are persistent over time, with Paul Samuelson once having quipped that "a person's capacity for risk could no more be changed than his nose".[23] This is one of the reasons that selling insurance is such a lucrative business: people are willing to sacrifice a lot in order to avoid huge losses! Trend following has the best of both worlds – a positive Sharpe ratio and a positive skewness – meaning instead of paying a premium for protection, investors receive a premium *and* get protection, albeit only statistically.

However, the positive skewness of the trend following P&L also brings its own behavioural challenges and investors often find it tough to stay the course. Investors too sensitive to loss aversion impulses, and, confronted with a positively skewed strategy such as trend following – where small losses occur frequently and can persist – are overwhelmed by these impulses and often shy from this, and other similar strategies. Investors and managers are moreover stymied by entrenched incentive structures that are too commonly focused on short-term performance, where Year-To-Date performance can determine bonuses and careers.

The positive skewness of trend following – which timescale is your favourite?

The return skewness of trend following can be illustrated with the return distribution of the monthly returns of the BarclayHedge CTA index in Figure 3.[24] The returns in the histogram are clearly positively skewed, i.e. concentrated

[22] Curious readers may find the seminal works of Daniel Kahneman, Amos Tversky, and Richard Thaler particularly revealing. See for example "Prospect Theory: An Analysis of Decision under Risk" by Kahneman and Tversky, as well as "The Effect of Myopia and Loss Aversion on Risk Taking: An Experimental Test" by Thaler et al.

[23] "When does the case for long-term investment make sense?" From The Economist: https://www.economist.com/finance-and-economics/2018/10/13/when-does-the-case-for-long-term-investment-make-sense

[24] Our paper on explaining Hedge Fund indices (see footnote 1 for more details and a link to the paper) shows that CTAs can be accurately modelled with trend following and this same positively skewed distribution can be generated using a generic trend following approach

on the right-hand side (positive) side of the return distribution.

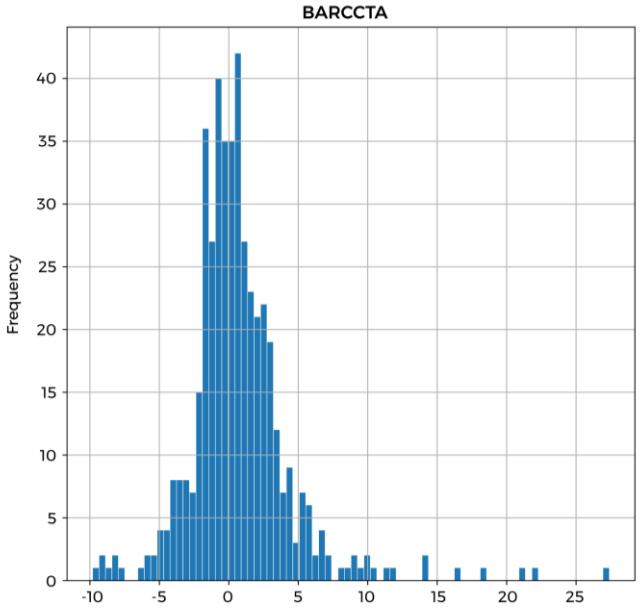
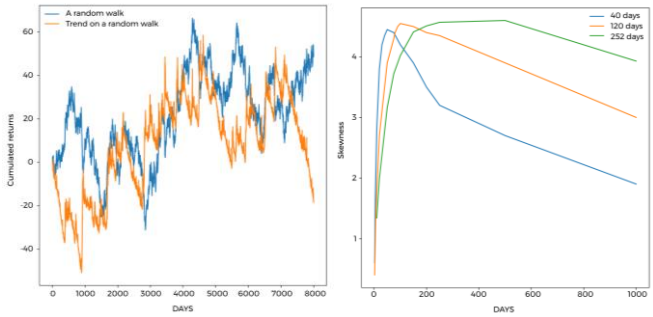


Figure 3: The monthly return distribution of the Barclay Hedge CTA Index since 1980. The returns are visually seen to be positively skewed, with a "fat" right tail, i.e. infrequent large positive returns (on the right-hand side of the return distribution).

This *monthly* return distribution is satisfactorily positively skewed. Looking at a more granular level, on a *daily* timescale for example, reveals return distributions that are more *symmetric*. This is a natural consequence of the source of the convexity of trend following being on (or close to) the timescale of the trend. A trend follower cannot offer protection against a big instantaneous move in an underlying as the strategy has, as we mentioned earlier, a 50/50 chance of being on the right or wrong side of the move. If this move leads to a protracted, drawn out move in either direction then the trend follower adapts his position and benefits all the while the move persists. In order to illustrate this we show in Panel 1 the skewness[25] of the returns of trend following on different timescales resulting from applying a standard implementation using exponentially weighted moving averages of price returns on three different timescales (2 months, 6 months, and 1 year), to a timeseries of random numbers. One sees, as expected, that first the skewness on a daily timescale is strictly zero, whereas, as one decreases the return sampling frequency from daily, to weekly, to monthly etc., that the skewness of the trend following returns peaks at timescales close to that of the trend timescale. This is indeed interesting - an investor can maximise the skewness on his preferred timescale by trending on something close to that timescale. From a behavioural perspective maybe the preferred timescale should be that of the frequency of an allocator's own work performance appraisal i.e. 6 months or a year?!



Panel 1: On the left hand side we illustrate a random walk (blue line) and trend following on that same random walk (orange line). The positive skewness of the orange line is quite clear with infrequent large moves up and frequent small moves down. The overall return of the trend following strategy is close to zero as expected. On the right hand side we measure the skewness of the trend following returns using return windows of differing lengths for three different trend timescales. For each trend timescale the skewness of 1 day returns is strictly zero. As we increase the size of the windows – weekly, fortnightly, monthly returns etc. – one observes a positive skewness emerging that peaks at timescales close to the trend timescale itself.

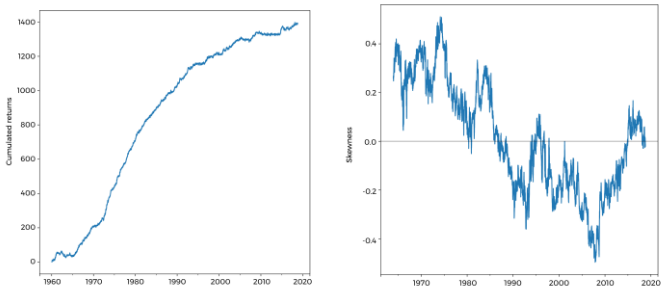
Measures of skewness on daily timescales have been studied as a potential indicator or precursor to a crowded trade[26] – the unwinding of multiple investors generating a downward spiral of performance as selling trades lead to further unwinding and negatively skewed returns. The daily skewness of trend following is indeed changing through time and has passed from being positive to being distinctly negative with recent data – see Panel 2 below that shows this pattern using real daily return data. The daily returns of trend following are however very sensitive to the very short term autocorrelation of price returns. Trend following on artificially, serially autocorrelated returns (today's return then easily being forecast by what happened yesterday) leads to an enhanced daily skewness.[27] We feel it is more likely that the reduction in daily skewness of trend following is actually due to the disappearance of a short term (on the timescale of a few days) autocorrelation, rather than a crowding of the trade presumably due to more competition in the short term space with barriers to entry to these markets having being lowered which could indeed, therefore, be loosely referred

[25] Measured as Pearson's second skewness coefficient https://en.wikipedia.org/wiki/Skewness#Pearson%27s_second_skewness_coefficient_(median_skewness)

[26] Please see our paper, entitled "Two centuries of trend following", available on our website: https://www.cfm.fr/insights/two-centuries-of-trend-following/

[27] As discussed in our academic paper entitled "Tail protection for long investors: convexity at work", assuming an autocorrelation structure $C(u) = q^u$ with $0<q<<1$ and u the separation in time of daily returns, one finds that the skewness of daily returns is $6q + O(q^2)$.. If q is positive (short term autocorrelated daily returns) then the skew is positive whereas if q=0, as is the case for a random walk, then the daily skew is zero. Please refer to this paper that can be downloaded from our website: https://www.cfm.fr/insights/tail-protection-for-long-investors-convexity-at-work/

to as crowding. The longer term autocorrelation of price returns remains robustly present on the other hand.



Panel 2: The performance of a short term (3 day) trend (left plot) applied to a portfolio of approximately 40 futures and the rolling skew of a 100 day trend (a timescale closer to that of the CTA industry) on the same pool of futures that has evolved over time from being positive to negative (right plot). The short term trend performance does not include trading costs and the inclusion of realistic cost estimates results in a loss making strategy. However, one observes on the left that the short term autocorrelation of price returns was strong in the past (albeit not strong enough to beat costs) and weakening as we approach recent data. The daily skew of the 100 day trend was positive and has evolved towards being more negative, an effect that can also be related to the disappearance of a short term trend signal.

Conclusion

Much has been written about trend following. One of the more successful and popular books in financial literature, a desk-bending behemoth, entitled, simply, *Trend Following* championed many of the benefits, and, equally, highlighted the drawbacks of trend following.[28] We have similarly concluded plenty of research on trend following, and have shown that it has properties, albeit over timescales comparable to that of the trend approach employed, that make it a suitable addition to most traditional portfolios.[29]

Investors and asset managers alike have contemplated the merits of 'timing' managed futures, which is to say to estimate the most opportune entry or exit time. Theoretically, this presents an obvious dilemma, since claiming an ability to time one's entry or exit is predicated on an ability to predict the future performance of the trend following strategy itself. Even if, in a hypothetical setting, one could manage to tactically and successfully engage in timing entry and exit decisions, one should account for additional transaction costs - one could tactically time the market only if the additional alpha harvested from such a strategy exceeds the trading costs.

We instead prefer to take an empirical approach. Trend following produces a long term highly statistically significant P&L; can be slowed such that it is relatively insensitive to costs; has produced good out-of-sample returns; and seems consistent with the preponderance of literature demonstrating that human beings find it difficult to avoid following trends! Even the way that investors and analysts were forecasting the death of trend following prior to the acceleration of performance in 2014 of the CTA industry, only to be followed by those same investors and analysts reinvesting having seen the error of their ways – illustrates the way that people trend follow on the performance of trend following itself. This anecdotal example, but, similar to many similar examples in history, demonstrate the perverse (but persistent) nature of investors' inherent need to follow trends.

We have demonstrated that the mechanically convex nature of trend following also produces mechanically positively skewed returns, albeit with a skewness that is maximised on the timescale of the trend. This feature of the strategy makes for an uncomfortable ride for the investment industry's performance chasers – being attracted to the strategy and investing after the draw ups while being inevitably disappointed and redeeming prior to the next one. It is our belief, based on the extensive research we have done on the strategy, that these accelerations are unpredictable. Therefore, to garner the most benefit from the strategy one needs to allocate to it as a core component of a portfolio.

Interestingly, negatively skewed strategies also pose problems for performance chasers. Investors are lulled into a false sense of security as (often hidden) risk goes unseen for long periods of time, leading to overinvestment and the inevitable tears that follow when strategies sell off – leaving portfolios and investors to attempt to recuperate losses. Ironically, this often involves a subsequent investment in a recently over performing trend follower only to redeem months and years later while impatiently awaiting the next draw up!

[28] Trend Following: How to Make a Fortune in Bull, Bear, and Black Swan Markets. Michael W. Covel

[29] Here the reader is again encouraged to refer to our "Two centuries of trend following" paper, specifically in section 4.4 for further details

Disclaimer

ANY DESCRIPTION OR INFORMATION INVOLVING MODELS, INVESTMENT PROCESSES OR ALLOCATIONS IS PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY.

ANY STATEMENTS REGARDING CORRELATIONS OR MODES OR OTHER SIMILAR BEHAVIORS CONSTITUTE ONLY SUBJECTIVE VIEWS, ARE BASED UPON REASONABLE EXPECTATIONS OR BELIEFS, AND SHOULD NOT BE RELIED ON. ALL STATEMENTS HEREIN ARE SUBJECT TO CHANGE DUE TO A VARIETY OF FACTORS INCLUDING FLUCTUATING MARKET CONDITIONS, AND INVOLVE INHERENT RISKS AND UNCERTAINTIES BOTH GENERIC AND SPECIFIC, MANY OF WHICH CANNOT BE PREDICTED OR QUANTIFIED AND ARE BEYOND CFM'S CONTROL. FUTURE EVIDENCE AND ACTUAL RESULTS OR PERFORMANCE COULD DIFFER MATERIALLY FROM THE INFORMATION SET FORTH IN, CONTEMPLATED BY OR UNDERLYING THE STATEMENTS HEREIN.

CFM has pioneered and applied an academic and scientific approach to financial markets, creating award winning strategies and a market leading investment management firm.

Contact us

Capital Fund Management S.A.
23, rue de l'Université, 75007
Paris, France
T +33 1 49 49 59 49
E cfm@cfm.fr

CFM International Inc.
The Chrysler Building, 405 Lexington Avenue - 55th Fl.,
New York, NY, 10174, U.S.A
T +1 646 957 8018
E cfm@cfm.fr

Capital Fund Management LLP – Sydney branch
Level 16, 333 George Street
Sydney, NSW, 2000, Australia
T +61 04 39 16 0125
E cfm@cfm.fr

CFM Asia KK
9F Marunouchi Building, 2-4-1, Marunouchi, Chiyoda-Ku,
100-6309 Tokyo, Japan
T +81 3 5219 6180
E cfm@cfm.fr

Capital Fund Management LLP
64 St James's Street, London
SW1A 1NF, UK
T +44 207 659 9750
E cfm@cfm.fr