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 whitepaper. 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.
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Quarterly review

Quantitative overview of key developments in Q2 2019

Alternative industry performance

Global markets experienced positive returns in both equity and fixed income markets, with return differentials among a broader set of asset classes unusually narrow. This performance was reflective of the opposing forces of rising geopolitical risk and recurring trade tension flare-ups pushing investors to seek out safe-haven assets (notably sovereign bonds, gold, and the Japanese yen), against the US Federal Reserve (Fed) and European Central Bank (ECB) making efforts to persuade markets that they are ready to loosen monetary policy if justified by deteriorating conditions justify – acting as a boost for equities.

As a result, global equity markets gained in the low single digits (despite being pulled down by double digit losses in May), with Bonds rallying. The US 10-year benchmark featured yields below 2% for the first time since November 2016, and the German Bund sank lower into negative territory, reaching negative 0.32% by quarter-end.

Alternative managers enjoyed a good quarter, with the majority of global benchmark HFRX Indices ending in positive territory. The benchmark HFRX Global Hedge Fund Index gained 1.6%, with the HFRX Merger Arbitrage (-0.9%) and Equity Hedge (-0.56%) two lone exceptions to overall positive performance. Within alternative risk premia, slight negative performance was largely due to underperformance of equity market neutral portfolios: the Société Générale Multi Alternative Risk Premia Index1 dipped half a percentage point.

The headline story, however, was the good performance of Commodity Trading Advisors (CTAs). The Société Générale CTA Index2 posted a gain of 2.8% in Q2, following the 1.9% it recorded in Q1. The majority of gains were from positioning in the fixed income market. The Barclay CTA Index3 (2.8% over the quarter) registered similar performance.

The one year rolling average absolute correlation between all futures contracts, often taken as an indicator of CTAs’ ability to diversify, fell during Q2, and reached close to 16% at the end of June. The correlation, between bonds and equities (with the US 10-year and US benchmark indices taken as proxies), whilst having remained negative, slipped further to ~35%, before settling at ~32% after the dual rally of bonds and equities during the final weeks of June.

The hedge fund industry saw slight net redemptions of ~$20 billion in Q2, the largest majority of the total having been redeemed in June.

Total return for Equity Market Neutral (EMN) and CTA hedge fund indices over the past year4

The principal implied volatility indices across four asset classes over the past year5

The log of the dollar risk weighted average daily volume across futures on the four asset classes over the past year6

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1 The Société Générale Multi Alternative Risk Premia index is an equal-weighted index of funds, capturing the returns of managers employing multi-risk premia investment strategies across multiple asset classes.

2 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 recognised as such within the industry and are open to new investment. For construction methodology and a full list of constituents, see: https://cib.societegenerale.com/en/prime-services-indices/.

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

4 The EMN index is that calculated by HFR, while the CTA index is calculated by Société Générale.

5 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.

6 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.
May 5 announced an increase on Chinese tariffs (from 10% to 25% on $200 billion worth of goods), and on May 31, threatening that the US would levy a 5% tariff on all Mexican goods, were the main sources dragging on main US and global indices during the month. Chinese, and more broadly emerging market indices fared less well, with key EM indices registering near flat returns in Q2, and underperforming their developed market counterparts by ~3%. The trade-sensitive Singapore benchmark index featured particularly violent swings, and was the worst performer when our generic trend signal was applied.

US equity indices saw most sectors perform positively, with the exception of the Energy sector. This sector came under pressure on soft commodity prices – mainly oil, which saw the benchmark Brent future drop 2.7% in Q2. The Consumer, Discretionary sector did best, supported by record low employment in the US and upbeat consumer confidence figures (the University of Michigan Consumer Sentiment Index is still hovering at record highs). However, as in Q1, it was the Information Technology sector that took top spot amongst sectors.

European equities, mimicking those of peers across the Atlantic, featured negative returns in May, crammed between good returns in April and June. The gains in European stocks were in no small part thanks to Mario Draghi, who, speaking at the annual symposium of the ECB in Sintra, said that "Further cuts in policy interest rates and mitigating measures to contain any side effects [the risk of price stability being threatened] remain part of our tools." Markets responded positively, with the Eurostoxx finishing 3.6% higher in Q2. Amongst the European bourses, it was the export-heavy German DAX that stood out as one of the best performers. The German DAX, a capitalisation-weighted index of the 30 largest German companies traded on the Frankfurt Stock Exchange, gained 7.6% in Q2 (in euro terms) as markets favourably digested the likelihood of more ECB stimulus, and constructive trade negotiations towards quarter-end. At least half of the constituents of the DAX earn more than 50% of their revenue from foreign sources. Brexit uncertainties continued to weigh on UK markets, with the leading UK blue chip benchmark dipping 1.5% (in euro terms).

It was, however, the Australian stock market that outperformed most of its global peers. The Aussie market was riding high on a cocktail of equity supporting measures and ended largely flat in May (while most other global indices tumbled). First was the election of Liberal Party leader Scott Morrison in May, muting chances of 

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**Equity indices**

Investors had plenty to untangle: from ongoing trade disputes and rising geopolitical tensions in the middle-east and beyond, to repeated market rhetoric of the US finding itself in a ‘late’ or ‘advanced’ stag-

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**The return of the generic trend signal referenced in the text over the past year**

[Graph showing the return of the generic trend signal over the past year]

**HFRX Indices quarter performance**

[Graph showing HFRX Indices quarter performance]

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**Alternative Beta Matters**

Our generic trend is calculated as described 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 $S_t(S) = \frac{p_t - \text{EMA}_{5\text{m}}}{\text{Vol}}$. The instruments are equally risk weighted in the portfolio.

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Our generic trend 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 the sign (either +1 or -1) of the difference of the last price and an exponential moving average of the past 5 months’ prices, divided by the volatility $S_t(S) = \frac{p_t - \text{EMA}_{5\text{m}}}{\text{Vol}}$. The instruments are equally risk weighted in the portfolio.

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www.cfm.fr
Labour party proposals to reel in the financial sector. Banks and insurers duly rallied, pushing the benchmark Aussie index to its highest level since late 2007. The Reserve Bank of Australia (RBA) moreover lowered interest rates in June by 25 basis points to 1.25%, with investors expecting them to do so again in the next six months. The mining sector, a large contributor to the Australian economy, also benefited from strong iron-ore prices (see Commodities section) giving another boost to the index. As a result, when applying our generic trender signal, it was the Australian index that performed best in Q2 (repeating its podium result from Q1). It was also the second most overbought index, with a Relative Strength Index (RSI) of 64 points on May 2 (slightly behind the Stockholm OMX 30 RSI of 65 achieved on April 30). The Hang Seng Index, however, had the lowest RSI of 37 points, registered on May 28.

Volatility was muted, with implied volatility drifting lower throughout the period, bar a spike during the first part of May. Finally, 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, drifted lower, reaching levels last seen in January.\(^9\)

**Stocks and equity factors**

Factor-based investment strategies recorded a slight negative quarter, with the HFRX Equity Market Neutral Index (HFRXEMN) down -0.5%.

In a reproduction of the Fama-French-Carhart factors, European small-cap equities outperformed those in the US and Japan. The Small Minus Big (SMB), or Size factor, however, delivered negative returns in all regions. In the High Minus Low (HML) factor, all regions lost, with Japanese Value stocks delivering the most negative returns. US and European Value stocks, drifted mostly sideways and in near unison, ending the quarter in slightly negative territory. Europe is the only regions where Value stocks have shown positive performance over the past 12 months. Good performance in Momentum stocks in the Up Minus Down (UMD) factor coincided from a spurt of risk-on as markets wagered on looser monetary policy. European and US stocks made strong gains, while the Japanese market for momentum was much more muted, featuring mostly sideways movement.

Looking at long only implementations of factors, Momentum Indices performed best over Q2, with gains in the mid-to-low single digits. Growth Indices, typically featuring a large quantity of technology stocks, also fared well – recording near similar returns with momentum on account of tech stock, following good earnings reports, marching upwards.

Quality Indices (along with Low Volatility) continued to outperform Value indices, reflective of these being viewed as defensive factors. The amplified market volatility in May, favoured these defensive factors, while the Momentum and Value factors regained ground in June.

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

\(^9\) Defined according to https://www.investopedia.com/terms/r/rsi.asp. The RSI varies between 0 and 100 with 70 implying an instrument is overbought and 30 implying the instrument is oversold.

\(^{10}\) For more information on the CBOE Skew Index, please refer to the official documentation and the methodology on the official website: [http://www.cboe.com/products/vix-index/volatility/volatility-indicators/skew](http://www.cboe.com/products/vix-index/volatility/volatility-indicators/skew).
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

Policy makers grabbed headlines again, with central banks on both sides of the Atlantic strongly hinting at looser monetary policy conditions. The Bloomberg Barclays Multiverse – the biggest (and broadest) global fixed income benchmark index – gained 3.31% as global yields tumbled.

It was however in June, when the Fed fired the first material salvo: while markets remained preoccupied in an attempt to decipher the possible policy shifts from the Fed, the Federal Open Market Committee (FOMC) statement in June yielded a slight deviation from the previous (April/May) meeting in that the word ‘patient’ was removed from the prepared statement, markets taking the cue that the FOMC was poised to loosen monetary policy imminently. Moreover, President of the Federal Reserve Bank of St. Louis and FOMC voting member, James Bullard, dissented and voted against the motion of keeping interest rates at the 2.25-2.5% level. Despite being a known policy dove, a first dissent of the FOMC since 2017 is suggestive. He suggested a lowering of the federal funds rate by 25 basis points as “insurance against further declines in expected inflation and a slowing economy subject to elevated downside risk.” As illustrated by the ‘Dot-plot’, FOMC members lowered their median expectation for the year-end 2019 target rate to 2.375% (following the June meeting), down from the 2.875% median following the December meeting.

The Fed has been navigating policy through markets testing record highs, alongside a sputtering global economy. Downside risks from trade disruptions, geopolitical unease, and disappointing macroeconomic indicators besides. Economic growth has been slowing, with the International Monetary Fund (IMF), lowering its growth predictions for all advanced economies in its April World Economic Outlook (WEO) from six months prior. The IMF adjusted the growth forecast of the US by 0.2% to 2.3% for 2019, on account of the January government shutdown as well as lower fiscal spending. The IMF did, however, increase the growth outlook for 2020, citing a “more accommodative stance of monetary policy”.

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.
The ECB added its most convincing dovish stamp to evolving sentiment, when, during June, Mario Draghi alluded to more bond buying and looser monetary policy measures in general. European sovereign debt yields tumbled, with the German Bund dropping 30 basis points, and a near -0.4% during the quarter. When applying our generic trender, the German 10-year Bund was the best performing bond, while the Canadian 10-year was the worst performer (still positive). The lowest RSI of 50 points was reached on April 18 by the UK 10-year Gilt, while the Euribor recorded the highest RSI of 74 points on June 21.

Towards the end of June, the French 10-year yield also turned negative for the first time, bringing the tally of countries featuring negative yields on their benchmark bonds to five. The US 3-month/10-year yield curve inverted again during May, and remained inverted as of the end of Q2. As yields tumbled, volatility jumped, with implied volatility – the CBOE TVIX acting as proxy – hitting a 16-month high of 5.7 points on June 3.

The benchmark Barclays Global Aggregate suite of indices offered comparable returns: the Total Return Index (unhedged) returned 3.3% over the period (5% for the hedged version), while the sister Global Aggregate Corporate Total Return Index (unhedged) gained 4%. Corporate bonds (especially non-investment grade) underperformed, with the High Yield Total Return Index (unhedged) gaining 2.5%.

### The return of Barclays Global Aggregate Bond indices for the last year

![Graph showing the return of Barclays Global Aggregate Bond indices for the last year](chart)

**Commodities**

Most headlines in the asset class were grabbed by the dramatic rise in the price of gold. The yellow metal, traditionally viewed as a store of value during times of market uncertainty, reaped good returns over the quarter, driven by anxiety over the odds of a continued economic expansion. Gold gained 9.3% by benefitting from a combination of lower interest rate expectations (making a non-interest-bearing asset like gold more appealing), elevated geopolitical risks, and higher demand as central banks added strongly to their inventory. This dramatic rise in the price of the yellow metal was accompanied by a burst of volatility as 15 trading days featured daily price changes in excess of ± 0.5%, along with a surge of 3.6% on June 20 – the largest single daily price move since June 2016. Implied volatility also spiked, breaching the 15 points level – the highest since April 2017. Gold, subsequently, recorded the highest RSI of 66 points on June 26.

In other metal news, palladium, a key component in catalytic converters and in high demand for curbing pollution from gasoline cars, again saw strong gains (following a price correction at the end of March). In Q2, the metal was back on its previous upward trend, gaining 14.6% over the period.

Another standout market over the quarter was that of iron ore. The commodity hit a five-year high on a cocktail of higher demand from largest consumer China, along with lower supply from largest producers Australia and Brazil. As global exports are expected to fall 30 million tonnes this year, and supply chains strained, the iron ore contract rose 14.6%.

At the other end of the spectrum, soybean futures closed at their lowest level in 10 years mid-May as the Sino-US trade war dragged on. Moreover, the large-scale culling of pigs in China, following an outbreak of African swine fever, put a dent in demand (much of Chinese soybean imports is destined for livestock feed.) The soft commodity tanked by 4.9% in April, before a sharp recovery mid-May. It recorded the lowest RSI, bottoming out at 33 points on May 14.

Oil, despite rising through April (as demand was affected following US sanctions implemented against Iran), slumped during, and finally crashed at the end of May (following a setback in Washington-Beijing trade negotiations along with President Trump’s threat of sanctions against Mexico). Both fearing a spill-over to lower economic growth and subsequent lower demand for oil, Brent fell 11.4% during May and finished -2.7% lower for the quarter (WTI Crude forfeited 2.8%).

On aggregate, commodities settled lower, with the Bloomberg Commodity index falling just shy of 1.8% in Q2 (in dollar terms) in large part owing to the poor performance from WTI and Brent (together constituting -17% of the index). Industrial metals fared particularly poorly, reflective of the concern over global growth – Copper lost 7.9%.

Nevertheless, when applying our generic trender, it was cotton that performed best on short positioning. The soft commodity – another victim of the US-China trade standoff – lost as much as 16% between its quarter high in mid-April, and quarter low in mid-June. The US is the world’s largest exporter of cotton, and, heavily dependent
on Chinese demand. Sugar, on the other hand, performed the worst.

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

![Graph showing commodity indices]

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**FX**

The dollar fell victim mostly to dovish posturing by the Fed. With markets anticipating a rate cut, and lower yields in the US and Europe likely, investors’ appetite for risk assets increased and sending dollars in search of higher yield. The greenback ultimately sunk -1.2% against a basket of its global peers.

The JP Morgan Emerging market currency index, a gauge of emerging market currencies, climbed 0.5%, driven by the global monetary policy easing tilt. Since developed central banks are easing, the emerging market currency carry trade looks more attractive. An index that measures arbitrage returns from an equally weighted long position on eight emerging market currencies, funded by a short US dollar position, approached a one-year high during the quarter. Moreover, the expected swings, or implied volatility as measured by one-month (and, one-year) at-the-money implied volatility of major emerging market currencies fell.

There were, however, a few hiccup along the quarter. The Mexican peso had one of its worst one day performances against the US dollar on May 31, dropping 2.4% as the threat of tariffs on all imports from the US’ Southern neighbour came under threat.

When applying our generic trender, positioning in FX garnered divergent, and modest returns across both G7 and emerging market currencies. The best performance came from a short position in the Korean won as the currency plummeted to a 19-month low during May. The Korean economy is particularly susceptible to disruptions in international trade, with two of its largest trading partners, the US and China now famously entangled in an ongoing trade dispute. The exposure to this downside risk materialised, as exports from Korea have fallen every single month since the start of the 2019, with exports for June having tumbled by -13.5% YoY alone. The Korean economy also recorded a negative -0.4% QoQ GDP expansion (final reading) in Q1. The won finally settled down 1.6% for the quarter.

As such, the Korean won recorded the lowest RSI (32 points on May 21). Meanwhile, the Indian rupee attained the highest (59 points on April 4).

The Japanese yen also performed well with our generic trender applied. The yen soared as its status as safe-haven asset was against tested. A cocktail of US monetary easing, trade disputes with China (and threats of new disputes elsewhere), an unresolved and uncertain Brexit outcome, along with diplomatic warfare and threat of sanctions against Iran all proved favourable for the yen. It reached a 12-month high against the dollar in June, and ended the quarter 2.8% stronger.

The one-month at-the-money implied volatility of most US dollar-G7 currency pairs moved sideways, except during the first week of May as trade tensions intensified. The stagnation in implied volatility was despite a few pronounced spikes, notably in the Japanese yen, also during the first weeks of May (investors piling into safe-haven assets with the yen gaining 0.44% and 1% weeks ending May 3 and 10 respectively). One exception to subdued FX implied volatility was the British pound that marched gently lower, the one-month at-the-money implied volatility of major emerging market currencies fell.

Trading news and regulation

In June, a £3.7B equity fund run by Woodford Investment Management suspended redemptions in the midst of outflows caused by poor performance. The incident received extensive coverage by multiple media outlets. As is often the case, funds contain investments with different levels of liquidity. In this instance, some of the holdings were in unlisted companies that cannot be sold on short notice. Several funds managed by H2O Asset Management were also hit by outflows after disclosure of illiquid and possibly inaccurately valued positions by the Financial Times. The funds do not plan to suspend redemptions, but their valuations may still suffer. These events serve as a reminder of how difficult it is to properly fund the liquidity of a vehicle. Systematic, liquid alternatives can typically be unwound on a week, or even one day notice at a reasonable cost – but this is not the norm. Bank of England governor Mark Carney went as far as saying that daily funds with illiquid investments are
“built on a lie”. We strongly agree that transparency to investors about the true cost and speed of potential liquidation is important, and asset managers have a duty to monitor and mitigate the related risks.

Three new American equity exchanges are soon to be launched. First, 'Members Exchange', which is backed by major investment banks, and whose idea is to create a low cost alternative – in particular for market data – with only a few, simple order types. This is expected to go live as early as next year, and given its strong support, could garner market share rather quickly. Second, the owner of MIAX Exchange Group which operates markets in equity options is planning to branch out into cash equities by leveraging their existing technology and giving out equity stakes to large trading firms for providing liquidity. And, finally, in May a new venture called 'Long-Term Stock Exchange' has been approved by the SEC, funded by tech investors with a focus on voting rights and on tech IPOs with terms more suited to Silicon Valley firms. Whilst interesting, these initiatives are likely to further increase the fragmentation of the US equity market, and their viability remains untested.

In March and April markets had plenty of scares of a no-deal Brexit and we are not yet out of the woods. The next, possibly final deadline on 31 October looms ever closer. We know that a temporary grace period will likely apply to some market activities but the scale of disruption is difficult to estimate. On July 1, markets had a taste of what might transpire, when a cross-border free trade agreement of equities between Europe and Switzerland called “Swiss equivalence” expired without renewal. As with Brexit, the reasons were stalled talks over a permanent solution, and a deeply politicised context far beyond finance. In this pre-Brexit “experiment”, Swiss primary listed names were required to cease trading on European MTFs, whereas formerly those represented up to 30% of liquidity.

CFM continues to support the Machine Learning and Data Science ecosystem: we hosted the first AI Engineering Meetup in Paris, with talks ranging from the architecture of machine learning platforms in leading tech companies, to faster object detection when looking directly at compressed images. More details on the event here: https://www.meetup.com/IA-Engineering/events/260308136/

CFM also proudly sponsored the second consecutive ‘Data Science Summer School’ in collaboration with École Polytechnique. If you are interested in learning more about the latest developments in the field of Machine Learning and Data Science, you can check out the posters available on their website. https://www.ds3-datascience-polytechnique.fr/

The 2019 CFM Challenge Data is still running and will conclude at the end of 2019. Half year, intermediate rankings were assessed on June 1, with the top-10 teams invited for individual interviews at CFM. The CFM Challenge Data remains open to all, and has the added benefit of being employed as a tool, especially in academia, for the organisation of class competitions or grading.

Finally, as a supporter of Open Source Software and Data Science, CFM hosted a 3-day Jupyter Kernel Workshop in Paris. The Jupyter notebook has become a key component of today's Data Science tools, allowing millions of users to program interactively. CFM, and the 15 international volunteers are proud of having contributed to making the Jupyter notebook more powerful thanks to this workshop.
Extended abstract

Portfolio selection with active strategies: how long only constraints shape convictions

Paper by Charles-Albert Lehalle and Guillaume Simon

This paper explores the drivers of equity portfolio selection with an active strategy, combining an expected return (ER) and a risk model. We show how quantitative long only portfolios are high conviction portfolios: few strong bets, and hence few non-zero positions. This conclusion is valid whether the focus is on the ER or on the risk control. Non-parsimonious portfolios with a high number of positions are naturally close to the Benchmark in terms of performance and risk, with low excess risk. To deviate substantially from the Benchmark, one needs to take strong bets, which translate in terms of positions.

The paper derives theoretical results that are, to our knowledge, missing in the literature. We show how a long only constraint naturally induces a high concentration of the portfolio. Moreover, closed-form formulas are derived for the weights of the portfolio. When following a strategy while controlling risk, selected stocks are those that realise a trade-off between a low beta and a high ER; this trade-off is driven by endogenous thresholds, leading to a recursive procedure to select the stocks and the weights of the final portfolio.

Those results suggest that it is challenging to obtain a portfolio risk that is different from the Benchmark. To do so, the portfolio focus on stocks that are not “random” in that they must either have a high ER, or possess strong risk features. The aforementioned threshold selects the level of conviction of the portfolio, taking into account the desired level of risk (the smaller the risk, the more demanding the threshold). A strong message following our results is also the essential role played by low beta stocks, and by the interaction of the ER with the risk model, as the selectivity effect is higher for ER with a low co-linearity with the risk model. In any case, it is always possible to soften this threshold, by introducing concentration limits, or by blending the ER with an implied factor, inferred from the Benchmark. Both will naturally increase the number of stocks in the portfolio.

Other news

- CFM picked up the top honour at the HFM European Hedge Fund Awards in June. The firm was awarded the best quantitative strategy over $1bn for the Discus program, along with the Outstanding Industry Achievement award. See more details and pictures of the event on the HFM website: https://hfm.global/hfmweek/news/cfm-picks-up-top-hfm-european-award/
- Tess Shih, a member of the North America Investor Relations team, was nominated as one of Institutional Investor’s ten Hedge Fund Rising Stars. Read more about Tess and her accomplishments on the website of Institutional Investor: https://www.institutionalinvestor.com/article/b1q0nyh023s9bc/Tess-Shih
- The annual flagship North America Spring Seminar was held in New York in May. Please see our website for a summary of the proceedings: https://www.cfm.fr/insights/north-america-spring-seminar-2019/
- We hosted nearly a dozen of our very successful and popular ‘Food for Systematic Thought’, or FFSTs lunches in Q2. Please get in touch with your CFM representative for further details on upcoming events near you.
- Charles-Albert Lehalle, CFM’s Head of Data Analytics, took part in a roundtable discussion on efficiency and stability in computerised markets as part of the AI ethics in the financial sector at the Alan Turing Institute. More details can be found here: https://www.turing.ac.uk/events/ai-ethics-financial-sector
- CFM is excited to have entered into a partnership with Columbia University in New York. For more details on this, and our scientific approach to management, see a recent profile of the firm in HFM: https://hfm.global/ctaintelligence/analysis/cfm-the-rewards-of-research/
- See the details of all our other upcoming events here: https://www.cfm.fr/events/
- Below is a selection of our recent papers:
  > Impact is not just volatility arXiv:1902.03457 [pdf, other]
  > Digging holes in rough landscapes arXiv:1906.01490 [pdf, other]
CFM Talks To

Emanuel Derman

We had the pleasure of chatting with Professor Emanuel Derman at his office at Columbia University. Probably best known for his work on option pricing, he introduced, together with Fischer Black and Bill Toy, what was to become known as the BDT, or Black-Derman-Toy model, a popular model used for pricing interest rate derivatives. Following research postings at the University of Pennsylvania and Oxford amongst others, he spent five years at AT&T Bell Laboratories before joining the fixed income department at Goldman Sachs in the mid-80s. After a short hiatus at Salomon Brothers, he re-joined Goldman Sachs in 1990, finally leaving in 2002 as head of the Quantitative Risk Strategies group. He is currently professor, and director of the MS in Financial Engineering Program at Columbia University in New York. He has contributed extensively to the fields of physics and finance, and gained mainstream appeal for his book “My Life as a Quant. Reflections on Physics and Finance”. He was awarded the Financial Engineer of the Year award (in 2000), and was elected to the Risk Hall of Fame in 2002.

“The failure of the model to be correct liberates you to trade the thing the model assumed was going to be constant”

CFM: In your memoir, you recall the early days of quantitative finance and what it was like to be ‘a good quant’, i.e. being “part trader, part salesperson, part programmer, and part mathematician.” Reflecting on what the industry looks like today, do you think this still holds?

ED: Yes. I think even more so in some sense. When I first started working in finance during the mid-80s, many of the quantitative researchers weren’t programmers. They were doing the quantitative modelling and IT did the programming – there was a gap which led to mistakes with neither side able to figure out where errors crept in. Now, with nearly universal electronic markets and quants wholly dependent on wrangling large quantities of data, that is necessitating a further closing of this gap.

CFM: Most of the first wave of quants on Wall Street hailed from physics departments and laboratories. Do you think the success of physicists in quantitative finance was owing to this jack of all trades approach?

ED: Yes. Physicists do their own dirty work. At least in my day. You didn’t have somebody who could do your programming for you. When I was running the group at

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Goldman, we never had a boundary between quants and IT, which I preferred, and which I think worked well.

**CFM**: Do you think such an interdisciplinary attitude to research in quantitative finance is bound to gain more emphasis, or has the industry become so complex that more specialisation will be required?

**ED**: I’m a little torn. I think it is important to be an interdisciplinary thinker, but at the same time I notice people becoming ever-more specialised, ever-more pigeon-holed. Often, somebody’s name appears on a research paper having only done a very specific part of the data analysis for example. Being an expert might be very useful for this purpose, but, then again, take for example the excitement of ‘Big Data’, where I feel there is a risk of researchers doing statistics on data without knowing the field they’re working in. And I disapprove of this trend – I believe you not only need to understand the style, but also the content, and the context of what you are doing research on.

**CFM**: You mention Big Data. Together with Artificial Intelligence (AI) and Machine learning, this trinity of topics are claimed to hold great promise, with many scrambling to employ these tools in their business. Do you think it will revolutionise finance?

**ED**: I am sure that it will revolutionise medical science, and even fields like media and advertising. For finance it is less clear to me. This scramble has forced many to make bold claims, and that they are actively employing these tools – when it might just be for window dressing. Not talking from first-hand experience, but it may well be that there is some untapped potential in the explosion of alternative data sources, using these new tools in unison. Besides, I have found a lot of students becoming more interested in machine leaning and Big Data, which bodes well for the field.

**CFM**: This allows me to shift to your current role as director of the MS in Financial Engineering (MSFE) at Columbia. In this role as an educator, how have you seen the academic landscape changing over the past decade, and has it kept pace with what is required from graduates in the workplace?

**ED**: There is for one, a noticeable shift from sell-side, to buy-side centric education. The needs of the industry, especially since the financial crisis, but even a little before, have been moving away from sell-side research and derivative product design, to serve the demand in the asset management and hedge fund business, where skills for risk management, asset allocation, and alpha generation are prized. A second shift, is the way in which quantitative finance is taught, with a much more Martingale-style approach. Something which I disapprove of.

> I believe you not only need to understand the style, but also the content, and the context, of what you are doing research on.

**CFM**: What is your main criticism against this approach of teaching?

**ED**: Finance being taught as an axiomatic, mathematical field based on probability theory has become almost standard. People teach the fundamental theorem of finance which is some theorem of changing measures. However, there is no fundamental theory of chemistry or physics, so why – I ask myself – “Why should there be a fundamental theorem of finance?” Even saying there is a fundamental theorem makes it sound like a mathematical science. There are no theorems in Physics, there are laws. Furthermore, none of those intrinsic axioms of finance hold true in the real world, and yet students get taught in this style. The risk is that students and practitioners develop a sense that finance is governed by laws, and you can turn a crank to get the right answer on a problem.

**CFM**: Do you think this undermines the ability of original thought?

**ED**: When students do everything the Martingale way, they always get the ‘right’ answer, but they don’t understand the intuition behind what they are computing. When you ask for example “How do you value a forward”, they tell you to go into the risk-neutral measure and you discount it at the riskless rate and you get the price. But they don’t understand that there is, in practice, a trading and a hedging strategy lurking somewhere in there.

I used to interview people at Goldman who came out of Math-Finance programs and I would ask them: “Supposing I am an intelligent person, but I don’t know that much about physics, explain to me why we can shoot a rocket to the moon?” Then they would tell me about

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12 In probability theory, a Martingale is a sequence of random variables (or, as it is commonly referred to as, a stochastic process).
Newton’s laws and explain dynamics. Then I would ask: “Supposing I am a reasonable person, but I don’t know that much about finance, tell me why people can agree on an option price?” And, invariably, they would say “because of Girsanov’s theorem” as though that was the equivalent of Newton’s laws. But the real answer should be because I can hedge out the risk, or I can make a riskless portfolio by going long the call and short the stock. But they somehow thought the Girsanov’s theorem was a law of nature.

There is no fundamental theory of chemistry or physics, so why – I ask myself: “Why should there be a fundamental theorem of finance?”

CFM: Short of a universal law in finance, do you think there is a Holy Grail in finance, an ideal equation to model markets?

ED: No I don’t. When I started at Goldman in ’85, and soon thereafter started working on what was to become the BDT model, I always imagined we would find the one description of interest rates that would allow for the valuation of anything. Fischer Black didn’t have that attitude, although I didn’t properly understand it at the time. He thought there were many parallel ways of looking at different parts of the market – there didn’t need to be one consistent way. Over time, when I started working on the volatility smile, I realised that most finance models are just glorified interpolations – you write down a model with plausible dynamics, fit all the liquid instruments that you can value, because it is calibrated to them, and finally, you try to value the illiquid instruments by interpolation. But! Things change as market behaviour changes. There was for example no ‘smile’ in gold options markets before 1998, but it appeared thereafter.

CFM: Is there anything you are working on, anything you published recently?

ED: I recently wrote an article on the Black-Scholes model that will be in ‘Inference’ – a sort of critical review as to what extent Black-Scholes works, and to what extent it doesn’t. In the article I quote Elie Ayache who wrote a book called the “The Medium of Contingency”, in which he argues that derivatives aren’t really derivatives, for he claims, you can’t really replicate an option, because you don’t know what future volatility is. I’ll explain: I want to hedge an option; but I need the future volatility to hedge it; so, not knowing what future volatility is, I calibrate my model to fit the market; giving me the implied volatility; so, I use the implied volatility to calculate the delta, to hedge the option; but then tomorrow there is a new implied volatility. So, Black-Scholes, being predicated on knowing the future volatility in order to replicate the option, fails, because you can’t replicate an option because volatility keeps fluctuating. Every day your estimate of volatility changes, and so when you hedge an option, what you are really doing, is betting on volatility.

So, because volatility is not constant and is stochastic, and different volatility measures change independently (implied and realised volatilities), the failure of the model allows you to trade volatility.

In other words, the failure of the model to be correct liberates you to trade the thing the model assumed was going to be constant.

CFM: Do you think, inherently, the structure of volatility has changed?

ED: Certainly compared to twenty years ago, my impression is that volatility mean-reverts much more quickly. Of course, implied volatility has been much lower than historic levels, but, after spikes in volatility seems to revert back to levels prior to the spike, more quickly. It is interesting how the market has developed over the past couple of decades – certainly, 40 years ago, nobody was thinking of volatility as something you could trade. They were just directional when they used options, and now you can trade volatility of volatility instead of the direction of volatility.¹⁴

CFM: This is reflective of the culture of the finance industry?

ED: Take credit default swaps – 30 years ago, if you wanted to trade credit, you had to buy a corporate bond and short Treasuries to trade the credit spread and you had to be quite sophisticated. With the invention of credit default swaps, anybody could trade credit. This is dangerous. And I think the same thing has happened with volatility. Today you can trade in VIX futures or options, and I think it may be too easy.

It reminds me of research on the ‘anthropology of finance’ by a group at the New School in New York, who

¹³ The article entitled ‘Trading Volatility’ is available on the website of Inference: https://inference-review.com/article/trading-volatility.

¹⁴ Interested readers are referred to our technical note that investigates the features of volatility and, more specifically the features of the volatility risk premium: Is there a ‘new normal’ in Volatility Markets?...
observed, perhaps somewhat fancifully, how the world, around the time of Black-Scholes, got more interested in randomness than directionality. Culturally, this was observed in French cinema during the 50s, slightly predating the publication of the Black-Scholes model. These films were often plotless, with a flâneur, strolling around aimlessly, who experiences life without having an aim of where he or she is going, but experiences and enjoys the volatility of crowds. The theory goes that finance evolved in a similar vein, though more quantitatively, in that it became more focussed on the volatility, i.e. by how much the price fluctuates, as opposed to its direction (i.e. either drifting up or down).

In physics, if something does not behave according to your laws, you say “my understanding of the phenomenon is wrong”. In finance, if markets or people don’t obey or behave according to your theory – you say “they are acting irrationally!”

**CFM:** Is there any contemporary research that you find of particular interest?

**ED:** There is a field of economics called ergodicity economics, which proposes an interesting alternative to certain foundations of economic theory, particularly to the bias approach of behavioural economics. I generally dislike many of the views of behavioural finance for a bunch or reasons. They [behavioural economists] argue human beings act irrationally. They call them irrational, because their simplistic rules for what ‘rational’ should be does not capture human behaviour. Ergodicity economics proposes a competing view of financial values based on time averages, rather than ensemble averages that may explain people’s financial behaviour better.

**CFM:** So irrationality is just another way of saying the uncertainty of action, or human behaviour that is not captured by a pre-defined set of behavioural rules?

**ED:** Yes. To use an analogy: in physics, if something does not behave according to your laws, you say "my understanding of the phenomenon is wrong". In finance, if markets or people don’t obey or behave according to your theory – you say "they are acting irrationally!" – instead of saying you don’t understand what is driving their particular behaviour. It is unrealistic to imagine there are hundreds of irrational ‘biases’.

**CFM:** What is the most interesting, or difficult, option you ever had to price?

**ED:** I won’t claim there is just one of particular interest or difficulty, but, there were options I particularly disliked. Right around my final days at Goldman, French ‘Mountain Range’ options became popular. In the 80s and the 90s, markets were mostly doing interesting pay-offs on single underliers, barrier options, average options, Parisian options and the like. But then during the late 90s, Société Générale introduced options with names like ‘Himalayan’ and ‘Everest’, and they were simple pay-offs on baskets of underliers. They were correlation, rather than structural trades. They were, ultimately, subtle bets on the correlation between winners and losers. Horrible things.

- For a selection of books by Emanuel and how to order them, please see his author page on Amazon: [https://www.amazon.com/Emanuel-Derman/e/B001HCRXYC](https://www.amazon.com/Emanuel-Derman/e/B001HCRXYC)
- For more details on the MS in Financial Engineering at Columbia University, please see their website: [https://ieor.columbia.edu/masters/financial-engineering](https://ieor.columbia.edu/masters/financial-engineering)
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Whitepaper

On Business Cycles... and when Trend Following works

Executive summary

The US just celebrated its longest economic expansion on record, with markets and policy makers anxious about a slowdown in global growth. Given any likely slowdown, investors may want to allocate more to defensive strategies in anticipation of a shift in the economic cycle. However, economic (or business) cycles are indistinctly defined, notoriously difficult to time, and, since each business cycle exhibit idiosyncratic features, unreliable as a repeatable investment conditioner. In lieu of depending on competing, ‘official’ definitions of business cycles, we propose a simple macroeconomic-quadrant model, which measures the “accelerating” and “decelerating” GDP and inflation dynamics of an economy. We then assess how a trend following strategy performs based on this objective business cycle definition.

Introduction

Market commentators and policy makers are ostensibly uneased by the ageing US economic expansion. Now, after having registered the longest, sustained economic expansion on record, investors are questioning whether an economic slowdown is inevitable, or a recession imminent.

Adding to this unease, is the International Monetary Fund (IMF) who, citing a flurry of geopolitical risks and an escalating trade war, revised down their short-to-medium term economic growth forecast for the US, along with all other developed nations. The US Federal Reserve (Fed), for one, has been making plenty of dovish noises, with designs of an “insurance” rate cut as per Jerome Powell, seemingly having materialised when the Fed Funds target rate was cut by 25 basis points on July 31. Looking at the Fed’s “dot-plot”, a gauge of the average expected rate level from Fed voting members, shows the expected median Fed Funds rate for 2020 having fallen 50 basis points between the March and June FOMC meetings.

Figure 1: The bar chart shows the length, in months, of each economic expansion since 1854 accompanied by the date when the specific expansion reached a peak. This expansion has, of course, little in common with other periods of economic expansion. Moreover, post-mortems typically reveal business cycles have inherently different characteristics and are unlikely to be identical to any previous cycles. The most recent clusters of expansions have also shown lower rates of growth, with the last four expansions averaging 2.8%, compared to the 4.1% annual average growth rate of all the expansions from 1854 till the creation of the Federal Reserve and implementation of the US Revenue Act of 1913.

The US Federal Reserve (Fed), for one, has been making plenty of dovish noises, with designs of an “insurance” rate cut as per Jerome Powell, seemingly having materialised when the Fed Funds target rate was cut by 25 basis points on July 31. Looking at the Fed’s “dot-plot”, a gauge of the average expected rate level from Fed voting members, shows the expected median Fed Funds rate for 2020 having fallen 50 basis points between the March and June FOMC meetings.

The US Economy entered uncharted territory, when, in June 2019, it registered a 121-month economic expansion—the longest since records began in 1854. The title for the longest expansion of any developed economy is, however, still held by Australia, which, as at the end of Q2 2019, boasts an uninterrupted 28 year economic expansion.

Adding to this unease, is the International Monetary Fund (IMF) who, citing a flurry of geopolitical risks and an escalating trade war, revised down their short-to-medium term economic growth forecast for the US, along with all other developed nations. The Fed, for one, has been making plenty of dovish noises, with designs of an “insurance” rate cut as per Jerome Powell, seemingly having materialised when the Fed Funds target rate was cut by 25 basis points on July 31. Looking at the Fed’s “dot-plot”, a gauge of the average expected rate level from Fed voting members, shows the expected median Fed Funds rate for 2020 having fallen 50 basis points between the March and June FOMC meetings.
Figure 2: The individual curves of the median of the FOMC members' projected level of the Fed Funds rate. At the last meeting which included a package of 'Projection Materials' (see footnote 4), the median outlook for the Fed funds rate for 2019 was 2.375%, down from the 2.875% at the December FOMC meeting. Expectations have continuously been lowered during the last four meetings. The Fed hinted strongly in early June of monetary policy easing, stating that they “will act as appropriate to sustain the expansion.”

With divergent performance between asset classes within different business cycles commonly understood, investors may contemplate shifting exposure to those strategies, asset classes, or equity sectors that have typically performed better in an economic slowdown/recession. However, timing strategies using any anticipatory, or forecast-based approach assumes an ability to accurately and consistently predict a change in a cycle. Moreover, the classification of a business cycle is ambiguous, and pinpointing frontiers between different phases of the cycles a challenge.

The temptation is, nevertheless, strong.

Geared with the knowledge that trend following shows comparable performance across different, conventionally defined business cycles, we review this strategy’s performance in an alternative, and impartial classification of an economic regime.

We conceived and constructed, as such, an objective economic regime description – consisting of four unique quadrants – that significantly reduces the definitional ambiguity of traditional business cycle classifications. We show, primarily, that the returns of a generic trend following strategy, exhibit no statistically significant sensitivity to our definition of an ‘accelerating’ or ‘decelerating’ business cycle. Moreover, a generic trend following strategy delivers a comparable magnitude of returns in each of our four distinct economic regimes.

A quick refresher: what is a business cycle?

There is an immense body of literature on the theory of business cycles, often accompanied by inconsistent, yet synonymously used terminology. Most readers will however recognise the emblematic four-phase representation of a business cycle as in Figure 3 below, which illustrates and describes the fluctuations (often called the output gap) in the level of economic activity around a long-term growth trend.

How are the phases of the business cycle defined?

In the US, ‘dating’ of business cycles is the responsibility of the ‘Business Cycle Dating Committee’ of the National Bureau of Economic Research (NBER). The NBER “does not have a fixed definition of economic activity”, but,
instead, examines a broad variety of measures and indicators. This approach attempts to identify local maxima and minima of selected time series to determine ‘peaks’ (after an expansionary phase), and ‘troughs’ (following a contraction phase) of economic activity. Their dating is not an entirely trivial exercise, as various government agencies rely on this dating for their own work. The United States is one of only a few countries, (also notably Japan\textsuperscript{21}), that does not follow the broadly used definition of a recession being two consecutive quarters of negative GDP growth – what many economists refer to as a ‘technical recession’ for knowing when an economy is heading for, or finding itself in a recession. There are advantages and drawbacks to both these dating approaches.

Following the technical recession definition is both timely and objective: policy makers need only wait until the next publication of GDP data.\textsuperscript{22} However, GDP data is subject to non-trivial revisions. See Table 1.

But importing a lag in ‘certifying’ an economic recession, such as the NBER, also has its own pros and cons. While this method does avoid the problem of significant revisions, it suffers from a long lag – a year or more, when an economy may already be deep into a slowdown or recession. This approach lends itself to the risk of policy measures not being enacted, that could (should) have been deployed earlier.\textsuperscript{23}

<table>
<thead>
<tr>
<th>GDP Vintage</th>
<th>Average revision (in annual percentage points)</th>
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<tr>
<td>Advance to Second</td>
<td>± 0.5</td>
</tr>
<tr>
<td>Advance to Third</td>
<td>± 0.6</td>
</tr>
<tr>
<td>Second to Third</td>
<td>± 0.2</td>
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<tr>
<td>Advance to Latest</td>
<td>± 1.2</td>
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Table 1: In the US, the Bureau of Economic Analysis (BEA) releases a series of estimates, subject to revisions as more comprehensive information becomes available. The average GDP revision varies from as little as ±0.2, to as much as ±1.2 between the first (Advance) to the final (Latest) release. Policy relying on advanced GDP readings could fall victim to revisions, where, for example, an erstwhile recession could be wiped away with a subsequent revision, making the enacting of certain policies, possibly, unnecessary or unwanted.

\textsuperscript{21}Japan, not much unlike the US, the dating of business cycle turning points rest under the purview of an independent panel, based on monthly data published by the Economics and Social Research Institute in the Cabinet Office (ESRI). The government panel retroactively determines the length of economic cycles, a process which has a lag of more than a year.

\textsuperscript{22}Quarterly GDP data is released with a lag of no more than a couple of months.

\textsuperscript{23}Mexico is another country that recently alluded to its dismay about the unnecessary rigidity of using the traditional technical definition of a recession. A Mexican Central Bank board member, Jonathan Heath, recently recently called the two quarter negative GDP growth definition a “rule of thumb for defining a recession” but “no guarantee.”
Macro quadrant proposal

Although research have shown that trend following earns positive returns in different phases of the business cycle, it has typically been done by at least using the official NBER definition of business cycles of the US, or, comparing the performance of trend following under the scenario of a recession as per the technical definition.

We are interested to ascertain whether trend following also works in an alternative definition of business cycles.

In order to sidestep the definitional ambiguity, and discrepancy between competing domestic approaches of business cycle identification, we propose an intuitive – and simple – alternative. We construct, in the spirit of the ‘4-Quadrant model’, a similar ‘Macroeconomic Quadrant’ (MEQ) model of four unique economic regimes, but, by measuring and combining the ‘acceleration’ or ‘deceleration’ of GDP and inflation as in Figure 5.

In this model, we use the sign of a 4-quarter minus a 20-quarter trend in order to timely detect whether the underlying macroeconomic variables, GDP and inflation are ‘accelerating’ or ‘decelerating’. Of course, the choice of the trend timescales is arbitrary, but we believe that the 1-year over 5-year trend is reasonable.

![Figure 5: The economic quadrant model showing the four distinct regimes defined and combined by either accelerating/decelerating GDP or inflation.](image)

There are various benefits to this classification of an economic regime.

First, as is the case when using the technical definition of recession, using a mechanical macro trend indicator is unambiguous, universally applicable across countries and introduces well-defined boundaries.

Second, this approach is level independent and thus avoids the need for arbitrary reference levels. The global economy has experienced sustained, yet low growth rates since the GFC. By using this measure, one can detect subtle shifts over the entire period. In fact, the very definition of high/low-growth regimes strikes us as very country dependent and, as a consequence, subjective. Our focus on the direction of change instead of the level completely removes this ambiguity.

Finally, once the timescales have been fixed, the definition of accelerating or decelerating regime is definite. Some macroeconomic variables, like sovereign bond yields in developed countries, exhibit long-term trends in one direction. For such variables, the total length of the accelerating regime and the decelerating regime will be very different. Nevertheless, the number of data points in the shorter of both regimes is by far greater than we would have at our disposal if we stuck to the conventional definitions of expansion/contraction. This greatly improves the statistical significance of the study.

Methodology and data

- We use real GDP growth and inflation since both variables are of pivotal importance for any economy. The first captures the condition of the economy, while the latter reflects changes in the purchasing power of the domestic currency. It is well known that both variables are among the most important indicators central banks assess when setting monetary policy. Furthermore, prices of almost every tradable asset are sensitive to at least one of these variables. Stocks typically perform well in economic expansions, while bonds typically perform worse when inflation accelerates. Commodities are directly influenced by domestic (and worldwide) consumption and thus linked to GDP. Finally, the price of every currency depends on its ability to store value and thus is related to inflation.

- Recessions may be deflationary or inflationary, usually depending on the amount of debt denominated in foreign currencies and/or the amount of “hot money” from foreign investment in the economy. Similarly,

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25 This work may also inform our future research on whether one could use this information to condition exposure to different risk premia, depending on the stage of the business cycle.

26 While the economies of most developed countries have shown positive growth, the magnitude of this growth has been much lower than in other periods of expansion. See for instance again Figure 1 above, which shows the slowing growth rate of economic expansions.

27 We thus, for example, clearly detect the slowdown of the growth rate of the Chinese economy that has been making headlines. The real Chinese GDP growth rate, however, still stands at more than 6%/annum, so the economy is very far from a contractionary regime. It is not even clear whether the current reading should be interpreted as a high or low growth regime.

28 We use the seasonally adjusted, real YoY GDP growth rate of 27 countries extracted from the database of the OECDs and others. We source Consumer Price Index (CPI) data mostly from IMF, but complement it with different sources if necessary. If the publication frequency is monthly, we resample the inflation data quarterly by taking the mean of the three months constituting a quarter.
economic expansions are not necessarily accompanied by accelerating inflation.

- The direction of change in both variables, while not completely independent, allows for the isolation of four distinct economic regimes as illustrated in Figure 5.
- We assign nationality to every futures contract in our pool: this is straightforward for most of the index, bond and STIR futures, exceptions being the MSCI Emerging Market, EUROSTOXX, and EURIBOR futures for which we calculate the average of the main economies related to each contract. Every index, bond or STIR future is thus allotted a signed trend of the domestic macroeconomic variable or a signed equally-weighted average of relevant macroeconomic variable trends.
- For currency pairs, we subtract the trend of the variable currency(14,2),(992,987) from the trend of the fixed currency before taking the sign, for example: we first subtract the inflation trend in the US from that in the Eurozone when looking at the EUR/USD exchange rate and only then sign the result.
- For commodities, we decided to draw up a list of main global economies and equally weight the corresponding signed trends before taking the sign. The alternative would be to use the currency of the contract to determine “nationality”.
- We define accelerating environment for a given contract as all quarters in which the trend indicator of the associated macro variable has a positive sign. (The same procedure is applied for a decelerating environment.)
- Since we use two different economic variables, the real YoY GDP growth and inflation, we dissect the time series of each contract in the pool into 4 separate subsets.

**Trend-following strategy**

We construct a generic trend following strategy, which is an exponentially weighted 6-month moving average returns trend indicator, as follows:

$$ S_n(t) = \sqrt{260} \text{EMA}_n^{t-1} \left( \frac{(X(t))}{\sigma_n^{t-1}} \right) $$

Where

- $n = 21$ business days$^*6 = 6$ months;
- $X = $ price returns;

$\sigma = $ rolling standard deviation of returns

We apply this predictor to a set of ~100 fixed income, equity index, FX and commodity future contracts.

We explain how we compute the returns of each quadrant by taking the example of the $GDP_{acc}In_{fact}$ quadrant. The construction of the other 3 quadrants follows a similar recipe.

On every business day starting from the beginning of the backtest, we select those contracts for which:

- The returns of the trend strategy constructed above is available;\(^{29}\)
- Both the GDP and inflation trends have a positive sign on that day.\(^{50}\)

Finally, we compute the average returns for the day by averaging over the selected contracts.

**Results**

Our results show that a generic trend following strategy delivers good historical performance, in each of the unique states of the economy as per our objective definition of an economic regime. See Figure 6.

![Figure 6: Performance of risk-managed PnLs per quadrant shows that trend following delivers positive performance in each of the economic regimes.](www.cfm.fr)

These results are consistent with other attempts at matching the effects of macroeconomic regimes (and regime changes) on the performance of trend following, except, we propose what we believe to be an objective, unambiguous tag or description of a business cycle,

\(^{29}\) Some contracts enter the pool later than others for various reasons: a) the contract itself has not been traded before, b) the quality of data in the past was insufficient for accurate mark-to-market, c) the underlying did not exist before (e.g. the euro was only introduced in 1999, etc.)

\(^{50}\) We use quarterly GDP and inflation data. We assume no lag between the value date and the announcement date. After we compute the trend signals we resample them to business days by backfilling the entire quarter using the value for the quarter. Our study is thus non-causal. We are, as such, agnostic to revisions and do not require point-in-time macroeconomic data since the purposes of this study is simply to ‘stress test’ trend following over different economic cycles.
universally applicable, and which can be applied consistent across regions.\textsuperscript{31}

Research to test the performance of other conventional risk premia within the same (and extended) quadrant model is under way. Stay tuned.

Conclusion

Investors have traditionally called upon trend following as a strategic addition to their portfolio during times of heightened recessionary pressure. Trend following as an option-replicating-like strategy (only, typically much cheaper), which profits from fat-tailed events like market sell-offs, have been shown to offer protection in market drawdowns.\textsuperscript{32}

This study confirms that a generic trend following strategy not only delivers positive performance in a ‘decelerating’ economic environment, but delivers comparable, consistent returns in all phases within our definitional framework of a business cycle. Our approach not so much replaces, as complements research that has shown that trend following strategies deliver positive returns in the different stages of traditionally, and alternatively defined business cycles.\textsuperscript{33}

These results further strengthen our belief that trend following is a robust, all season strategy that delivers consistent returns irrespective of underlying macroeconomic conditions.

We show, that investors need not revisit the question as to whether trend following works in economic downturns, but focus how the strategy works in all economic environments, including in a universally defined expansion or contraction environment.

\textsuperscript{31} Our earlier work has delivered similar result, showing that trend following strategies deliver comparable returns in different interest rate environments. See the technical note “CTAs in a regime of rising rates” available on the CFM website: \url{https://www.cfm.fr/insights/ctas-in-a-regime-of-rising-rates/}.

\textsuperscript{32} Interested readers are referred to our whitepaper “The Convexity of Trend Following” available on the CFM website: \url{https://www.cfm.fr/insights/the-convexity-of-trend-following}.

\textsuperscript{33} See similar results found by Ilmanen, A. et al. “Factor Premia and Factor Timing: A Century of Evidence.”

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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 2 9159 3100
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