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MODELLING FORWARD LOOKING RETURNS AND COMBINING TRADITIONAL AND ALTERNATIVE BENCHMARKS

Executive summary

Back-tests are frequently used to gauge the quality of an investment strategy or the usefulness of a particular instrument to a portfolio. These simulated results are however susceptible to many sources of bias. In this short note we discuss how best to estimate the future performance of a selection of traditional benchmarks together with one alternative benchmark, that of long term trend following, in order to guide us in allocating to non-traditional investments within a typical portfolio.

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Introduction

The allocation of strategies and assets in a portfolio is a non-trivial task for investors. If we suppose we have a basket of investments from which to build our portfolio and we know which strategy gains the most, in order to maximize the total dollar gain we should allocate maximally to that best performer and even double up on the allocation through the use of leverage. This optimal solution is clearly absurd as one cannot know the future returns of strategies but shows to what extent a good estimate of future returns is important to allocation! Because of the inherent and necessary uncertainty of future returns a statistical approach is necessary in which, nonetheless, a knowledge of future returns is generally required as input to the problem before solving to obtain the maximum gain adjusted for risk – or Sharpe ratio.

Various optimization techniques exist which require not only strategy returns but also inter-strategy correlations and which can easily and significantly improve any number of in-sample back-tests. As any serious investor knows, however, improvements to strategies and the use of optimizers rarely lead to improvements in realized returns. Generally these techniques involve in-sample optimisation with returns and correlations that are known perfectly in-sample ie in the past, but which can change and evolve in the future. These in-sample quantities are thus biased and often poor estimators of future returns and correlations and therein lies the problem.

This white paper accompanies our work on biases in investing[1] and should serve as a guide to the techniques of getting (hopefully) robust estimates of future performance which can then be used in optimisation techniques (or simpler techniques, which are often even better!) to mitigate expectations and allocate to the best of one's ability to the investments available.

In this short note we begin with some examples of how traditional investments in equities and bonds can be deceptive with past performance a misleading estimator of the future. We next discuss some ideas on how to objectively evaluate the forward looking performance of such strategies. We then move on to the archetypal alternative benchmark of trend following on equity indices, bonds, commodities and FX before also tentatively touching on some of the equity market neutral (EMN) factors much popularised by the work of Kenneth French and Eugene Fama. We then attempt to build estimates of forward looking performance of each strategy before looking at the results of a combined portfolio of traditional investments with a long term trend following approach.

[1] See, for example, our white paper 'In-sample overfitting – avoiding the pitfalls in datamining', available on the CFM website

Some classic pitfalls illustrated using traditional

The misleading assumption of the extrapolation of future returns from good past performance, or in-sample bias, is perhaps best illustrated with the example of long term interest rates in developed markets. From the late 1980s to today developed market central banks have steadily been gaining control over inflation and have been reducing interest rates accordingly in order to keep real interest rates at a level conducive to positive growth. The crisis of 2008 was particularly extreme and pushed central banks across developed markets to reduce rates to historical lows. With rates that low, central banks have had little room to manoeuvre requiring many to resort to further unconventional monetary policy to bring rates even lower than a zero rate. The rather spectacular performance of developed market bonds in this period is seen in **Figure 1** and a naïve bond investor could easily be misled into thinking that rates of return from holding bonds are much better than is reasonable for a world where rates are now floored at zero. A fuller history of these bonds is also seen in **Figure 1** and shows that the return characteristics are much more in line with a more modest Sharpe ratio. Expectations of bond returns need to be managed, therefore, with this example clearly demonstrating that past returns cannot be a good indicator of future returns due to the fact that yields cannot go too far below zero.

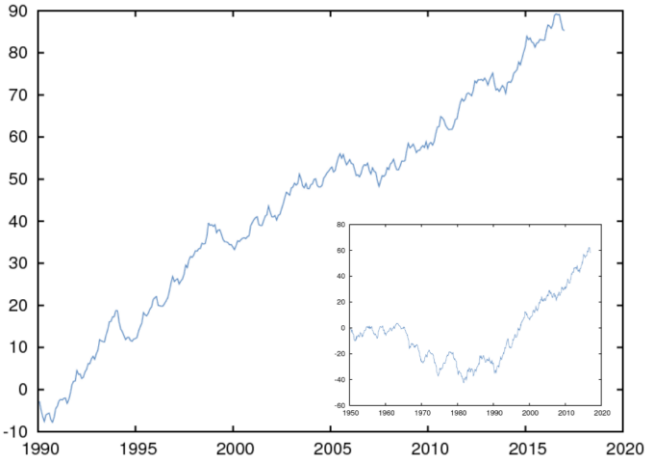

Figure 1: The performance of an equally weighted basket of 10-year sovereign debt from the following countries – US, UK,

Australia, Canada, Switzerland, Japan and Germany. The inset plot shows the performance of these same bonds since 1950, illustrating that the post-1990 drift upwards is atypical.

Another topical example of unreasonable return expectations comes from developed market equity indices which have risen spectacularly since the 2008 financial crisis, again on the back of central bank interest rate cuts producing asset price inflation with an ever decreasing discount factor in the valuation of future cashflows from dividends and earnings. As the year 2008 becomes further relegated to history, investors are more and more inclined to extrapolate post 2008 performance into the future. In **Figure 2** we plot the S&P 500 index since the 2008 financial crisis showing a spectacular surge in performance. However, if we open up the history further to include the period since 2000 we see that performance over the past 16 years has actually been somewhat more modest. As a new generation of investors comes to the market then the crash of 2008 becomes a historical relic of past Wall Street excesses and fades in the memories of investors. In order to evaluate the actual long term premium from holding equities one needs to go much further back in history. In **Table 1**, below, we list the average volatilities and returns for a range of equity index markets across the world. This is a much better indication of what equity markets have in store and is taken as an estimate of future returns in what follows.

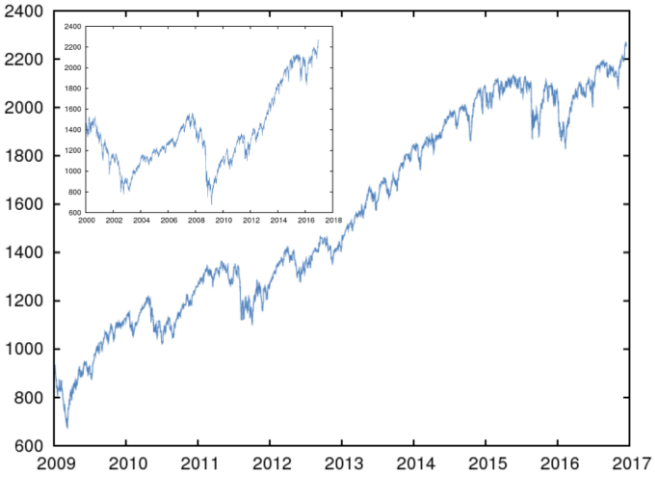

Figure 2: The S&P 500 index following the 2008 global financial crisis. The inset plot shows a zoom out of the index since 2000 illustrating that the post-2009 period is atypical.

Another source of overoptimistic performance expectations comes from survivorship bias. This is a strong effect that arises from inadvertently selecting winners from a data-base where the losers are either absent or penalised in the filtering of the data. For example, selecting investment managers from a data-base gives a biased optimistic view of fund performance due to the fact that managers don't necessarily report funds that have underperformed and conversely will be more likely to quickly report an outperforming fund. A more commonplace example can be seen in the stock market, investors can be blinded by the performance of success story stocks such as Apple, Amazon and Google as shown in **Figure 3**. When viewed in isolation investors confuse the performance of these outperformers as being reflective of the performance of the stock market as a whole which can induce a false sense of security that the potential upside for stocks is bigger than that of a portfolio chosen without these glitzy stocks. This is often also true of the real estate market in certain parts of the world that give residents of such places an inflated opinion of the future return potential of real estate.

Figure 3: Apple, Amazon and Google stocks traded in the US over a recent history. These stocks are well known outliers and can give investors and false sense of comfort that stock picking and investing is easy!

A recipe for getting estimates of forward looking performance

Our objective estimates for forward looking performance depend on whether we are considering an instrument that has clearly defined future cashflows, and if not then we attempt to gauge future performance being guided by back-tests and attempting to garner as much information as possible regarding the in-sample bias of these simulated results.

Fixed Income instruments have very clearly defined future cashflows that can be valued according to the yield curve. One can also convert the price of the instrument into a yield – given an investment of $1, how much would a bond yield from now until maturity. If interest rates do go down,

as they did through the nineties and noughties then a bond holder makes money. However, an objective expectation for return should assume that rates stay where they are today and therefore the yield to maturity for a fixed income interest is a good objective measure of forward looking return. This yield should then have the risk free rate removed from it to give an estimate of excess return. The volatility for these bonds is based on an analysis of the historical time-series.

The above logic for fixed income instruments also applies to corporate debt with the exception that one also has to consider the possibility of default. The yield to maturity of a bond assumes that the coupons and principal get paid back at the end of the life of the bond and does not account for the possibility of a government or company defaulting on the payments. If the issuing entity looks likely to default then the price of the bond goes down and the yield goes up in order to entice people in to buy the bond with a higher return but with a higher probability of loss from default. The yield therefore contains some Risk Premium, or an extra yield boost that compensates the bond holder for this possibility of default. Averaging over a basket of bonds, therefore, one should not receive the advertised yield but instead we need to discount for the loss incurred, on average, from default. In order to get an estimate of this expected loss we have calculated an average historical break even credit spread (the fair price of the insurance in a CDS without the extra premium for the risk) which is added to the corresponding risk free sovereign debt for the tenor of the corporate bonds. The volatility for the bond index is again based on a historical measure.

For equity indices we cannot employ the same logic, as equities do not pay out with a fixed schedule of dividends and earnings can be retained in the company. The market does indeed quote earnings and dividend yields but these are not instructive in the same way due to the inherent uncertainty and ambiguous nature of the cashflow to a shareholder, which can be distributed as dividends and buy backs or simply retained on the balance sheet. In order to address the problem of future return estimates therefore we instead focus on averaging the past performance of equity indices across geographical zones and across time, covering many economic cycles in order to get as unbiased an estimate possible of what equity indices actually deliver to investors. The results of this study[2] are seen in **Table 1** and the average annualised excess return of stock indices was estimated to be ~5%.

Country	Start date	Risk Premium (%/y)	Vol. (%/y)
Australia	1983	4.77	16.7
Canada	1934	4.44	14.8
Germany	1870	4.23	19.6
France	1898	6.65	19.7
Finland	1970	8.09	23.1
Italy	1925	6.24	26.6
Hong Kong	1996	5.24	26.1
Hungary	1999	2.51	24.7
India	1988	13.6	30.3
Indonesia	2009	13.8	20.4
Japan	1980	2.04	18.7
South Korea	2000	9.33	24.3
Malaysia	1974	6.32	28.2
Mexico	2001	10.0	18.2
The Netherlands	1957	4.57	16.9
New Zealand	1984	3.02	17.8
Norway	1969	5.21	24.3
Philippines	1996	-1.96	26.6
Poland	1999	2.29	23.3
Singapore	1973	7.51	24.7
South Africa	1983	5.26	20.4
Spain	1948	5.25	18.3
Sweden	1960	6.69	17.1
Switzerland	1966	4.58	15.6
Thailand	1997	5.25	35.1
United Kingdom	1958	5.71	18.8
United States	1871	5.33	15.2

Table 1: The result of our study of the Equity Risk Premium using stock markets from a range of different countries

Alternative benchmarks – trend following as a classic example

Alternative investment has recently become commoditized with the availability of alternative benchmark strategies at low fee levels and with high levels of manager transparency. We begin with the archetypal alternative benchmark – Long Term Trend Following. We have previously presented a study of trend following over a period of 200 years[3] using equity indices, bonds, commodities and FX and found a remarkably stable effect that has persisted with a high level of statistical significance. In **Figure 4** we show the key result from the study. This same research varied the timescale of the trend and noted the sensitivity of the Sharpe ratio to this variation, the observation being that performance varies little out to trends of about a year with Sharpe ratios that remain at about 0.8 for such slow timescales. This is definitely a positive point for the robustness of the strategy

[2] See our academic paper, 'Risk Premia: Aysmmetric Tail Risks and Excess Returns', available on the CFM website.

[3] See our academic paper, 'Two centuries of trend following', available on the CFM website.

that changing the parameters makes little difference to the performance. Positioning ourselves at slow trend timescales then has the advantage of being relatively insensitive to costs, and with a simple conservative analysis we can deduct 0.3 from the Sharpe ratio as an estimate of realistic performance expectations[4].

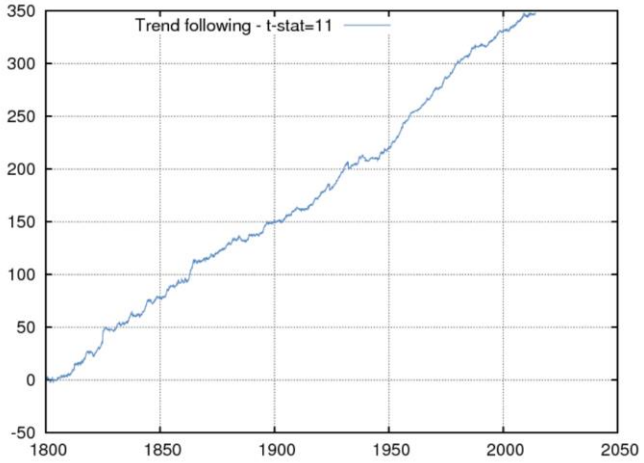

Figure 4: A plain vanilla Trend Following strategy applied to equity indices, bonds, FX and commodities over 200 years of data. The resulting performance is highly statistically significant

This research is interesting indeed but we can also complement these results with the observation of a successful CTA industry that has experienced excess returns with an approach based predominantly on trend following[5] showing that these results are not in-sample artefacts of over-fitting. The study applying the trend to 200 years of data is also out-of-sample in the sense that this extra data had not been observed and used to tune the parameters of the trend following approach.

It is this style of reasoning that helps us to establish that a particular strategy has a chance of delivering performance in the future, which is of course what every investor is trying to achieve. The strategy is slow enough to be insensitive to costs and has sufficient independent out-of-sample tests to give us confidence in its robustness. The EMN factors first described by Fama, French and Carhart are also examples of strategies that are slow, insensitive to parameters, have earnt money for the industry and have been tested with data not used by the initial study. The original work was completed in 1993 and therefore significant forward looking performance tests are available. We will not dwell on these equity factors, however, as these factors have more 'moving parts' than a long term trend approach but EMN momentum and value are good alternative benchmark candidates for the reasons cited.

Expected excess returns for a set of benchmarks

We now have some tools and ideas to give us a feel of what to expect from a few benchmark strategies. We have chosen developed and emerging market equities and sovereign debt, European and US corporate bonds and long term trend following. In the below we detail what we believe to be the most objective and agnostic estimates of the future looking returns.

- Developed market (DM) equities: we feel the best estimate of equity returns comes from the above cross sectional study of the excess returns of equity indices across historical periods and across countries (see **Table 1** above). The returns across countries are in a range of 3-9% for a volatility of ~15%
- Emerging market (EM) equities: we use the same estimate of equity returns as seen for DM equities but with a higher estimate of volatility
- Developed market (DM) sovereign bonds: the proposed excess return is based on the current 10-year yield to maturity (over risk free rate) with a volatility expectation in line with historical measurements using bond prices in developed countries[6]
- US corporates: Based on a historical study of credit spreads, the return for High Yield (HY) corporate credit is taken as the sum of the 5 year risk free rate (the sovereign yield at 5 years) and half of the current spread of the corresponding credit index. Investment Grade (IG) corporate bonds do not seem to lose much yield due to default and the same historical analysis shows that one can use the full corresponding credit index spread. In each case the excess return is calculated over the risk free rate. The volatilities are based on historical analyses of total return indices and found to be 7.7% for High Yield and 3.3% for Investment Grade bonds.
- Cash: Yields zero with an assumed volatility of zero
- Long Term Trend Following: We estimate the forward looking Sharpe ratio to be 0.5. This comes from an analysis of the performance of the CTA industry using manager data-bases and CTA indices. We are also guided by including a conservative estimate of costs into a two century back-test which exhibits a stable

[4] The trend following strategy used in the study is generic and is not employed in any program at CFM.

[5] We can model CTA indicies obtaining correlations of more than 85% with trend following approaches with a Sharpe ration which is comparable to the index after accounting for costs and manager fees.

[6] We are using excess returns of 10-year bonds in the following countries: US, Germany, Japan, UK

long term performance. We assume a volatility of 10% as being a typical volatility offered by a trend follower and thus have an expected excess return of 5%.

This is summarised below in **Table 2**[7] for each of the asset classes where we show our preliminary picture of a traditional 60/40 portfolio. Trend following is also included, albeit with zero weight for the moment.

Component	Weights	Excess return	Annual volatility
Developed Market (DM) Sovereign Bonds	25%	0.9%	6%
US IG credit	5%	1.7%	3.3%
US HY credit	5%	1.6%	7.7%
Cash	5%	0%	0%
Global DM equities	30%	5.3%	15%
Emerging markets (EM) equities	30%	5.3%	20%
Trend following	0%	5%	10%

Table 2

We can simplify the traditional basket of instruments by grouping categories together to give the below in **Table 3** for our 60/40 portfolio. We assume a 100% correlation between DM and EM equities and between HY and IG credit.

Broad category	Weights	Return over RfR	Volatility
DM bonds	25%	0.9%	6%
US credit	10%	1.6%	5.5%
Money market	5%	0%	0%
Equities	60%	5.3%	17.5%

Table 3

A simplified correlation structure

In order to obtain the expected return of a portfolio of instruments one needs to assume a correlation structure across these broad asset class categories. We suggest the correlation structure in **Table 4**, where we maintain strong and significant correlations and set others to zero. Note that the true level of correlation between cash and bonds is irrelevant, given their weak volatility there is little effect on the result.

[7] All yields are as of December 2016

	DM bonds	US credit	Money market	Equities	Trend following
DM bonds	1	0	0	0	0
US credit	0	1	0	0.8	0
Money market	0	0	1	0	0
Equities	0	0.8	0	1	0
Trend following	0	0	0	0	1

Table 4

Return and volatility for the traditional portfolio with/without trend following

Just considering the traditional portfolio we can now combine the above hypotheses (return and volatility for the portfolio's components as well as the correlation structure[8]) to obtain an expected excess return of 3.6% over the risk free rate with an expected volatility of 11%.

This traditional portfolio can now also be combined with trend following. Rather than making a choice on the amount of weight we allocate to trend following we prefer to give results for the range of weights from zero to one. **Figure 5** below shows how the expected return and volatility varies as a function of the weight allocated to a trend following approach.

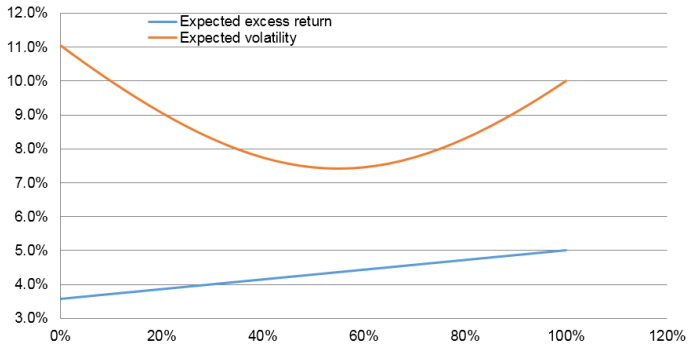

Figure 5

As we can see, with the reasonable hypotheses of future returns, we can improve the outlook for the traditional portfolio by combining with long term trend following. There is a mechanical improvement due to the fact that trend following has a higher Sharpe ratio than the traditional portfolio and is zero correlated with it. This would be the case for any such strategy with the same risk/return characteristics. This leads to an improvement in

[8] Volatility depends on the category weights Wi and cross category correlations C_{ij}: $\sigma = \sqrt{\Sigma_{j=1}^{K}\Sigma_{j=1}^{K} W_i W_j C_{ij}}$

risk adjusted returns for the traditional portfolio along with a reduction of expected drawdowns. The maximum Sharpe ratio is achieved with an approximately 60% allocation to Trend Following, improving the objective return expectation of the traditional portfolio from 3.6% to 4.5% while reducing its volatility from 11% to 7.5%.

Conclusions

We have presented realistic expectations of future excess returns for a range of traditional strategies together with realistic correlations in order to get a corresponding estimate of future excess return and volatility for the combined portfolio. We then combine the traditional benchmark with a trend following approach, again with realistic expectations of future excess returns, in order to see the effect of combining such a strategy with the benchmark portfolio. These excess returns are also agnostic to base currencies as a hedged position will deliver the same excess return in a different currency. Getting a handle on these realistic return expectations is crucial in being able to allocate across strategies and is often overlooked (mostly unknowingly) in favour of a biased view based on often over-fitted back-tests.

Important disclosures

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

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