

Less is More, more or less.

Diversification is the holy grail of investing. An equally weighted basket of uncorrelated returns streams, (aka independent bets), reduces your risk by $\sqrt{\text{number of bets}}$ and hence super-charges your Sharpe by the same factor. Even [this random guy on the internet](#) says so...

So how best to achieve this diversification? When I first started my life in CTA land, I was told trend can be diversified along three axes, in decreasing order of effectiveness: markets, speed and style (style being different implementations like breakout vs MACD). Diversifying to new markets was considered the best: new markets are “always” additive to performance, improve your ex-ante Sharpe and make risk management easier, mitigating the potential shocks to be found in individual markets.

I am not the only one who was told this. It is a very powerful narrative and indeed, almost every client I have ever met, and almost every CTA fund manager I have ever talked to, seemed to hold this as gospel truth. “How many markets do you trade?” is pretty much the second question I am asked by all clients (with “Are you really fifty, you look so young” being the first).

Is the number of markets really a good proxy to actual diversification? Let us have some mathematical fun and show how false this universal truth can be. Along the way we will discover that a portfolio can have many markets but is **concentrated** (most of the risk is in few bets) while sometimes fewer markets can give you a **diversified** portfolio, one that Ray would be proud of.

The stock picker’s analogy

Suppose you wanted to invest in an S&P stock picking specialists. This one is a highly specialist picker with only two stocks: A and B. Even this specialized portfolio gives you two *types* of risk: a “factor risk”, a generic equity beta, and “idiosyncratic risk”.

This is because one can imagine a single equity index factor driving all stocks. When we look at the (volatility-normalized) stock return, we can decompose it into a beta to the (volatility normalized) factor return and an alpha to the (volatility normalized) idiosyncratic return:

$$\text{stock_rtn}(i) = \text{beta}(i) \text{ factor_rtn} + \text{alpha}(i) \text{ idiosyncratic_rtn}(i)$$

In CAPM we talk about breaking **realised** returns into alpha and beta, but here I am, first and foremost, modelling the **risk**. The ratio of alpha to beta is the ratio of risk availability: if your stock has a high beta, it usually does not have much idiosyncratic risk and vice versa. Because both sides of the equation have unit variance, $\text{alpha}^2 + \text{beta}^2 = 1$.

Further, any two stocks are correlated only via their factor loading, so this simple model gives us for A and B:

$$\text{correlation}(A,B) = \text{beta}(A) \times \text{beta}(B)$$

For the sake of argument, let us assume a reasonably low 0.4 beta to the index for each and all stocks. This means most of the risk exposure is idiosyncratic, since $\text{alpha} = \sqrt{1 - \text{beta}^2} = 0.92$. The pair-wise correlations of A and B will be 16%.



Suppose our stock picker's portfolio consists of \$1-risk allocated to A and another \$1 risk bet on B. The stock picker has \$0.8 worth of exposure to the S&P, plus \$0.92 on idiosyncratic A and \$0.92 on idiosyncratic B. These three bets have roughly equal size and are all uncorrelated.

Now suppose your stock picker allocates to 25 different stocks, A,B,C,...,Y with \$1 of risk to each of them. The risk (standard deviation) of the S&P bet grew 25-fold and is now \$10 and the risk on the highly diversified idiosyncratic portfolio grew by $\sqrt{25}$ and is only \$4.6. We do have lots of independent side bets, which is great. But we also have one huge, massive bet on the index. I am not sure I value this guy as a stock picker.

What if my stock picker allocates \$1 of risk to each of the S&P 500 stocks? One should realise our stock picker is no longer a stock picker at all: this portfolio is equivalent to a massive \$200 bet on the S&P and less than \$21 in idiosyncratic bets. The more markets added, the more concentrated the position!

.... back in CTA land

We can think of a market within a CTA as a “trend market”. Its return stream (P&L) depends on the signal (which determines the risk-adjusted position) and the actual underlying market return:

$$\text{trend market return} = \text{trend signal} \times \text{market returns}$$

Just like the stock picker, a CTA aims to have as many independent bets as possible in different “trends”. The trend signal may be fancy and mathematically opaque, but when we strip away its complexities, trend is a factor, not dissimilar to the stock picker's equity factor. And just like our single stock example, each univariate trend has a beta loading on a factor, which I like to call “macro trend” that spans multiple markets and asset classes:

$$\text{trend market return} = \text{beta} \times \text{macro_trend_factor_rtn} + \text{alpha} \times \text{idiosyncratic_trend_rtn}$$

So to understand a portfolio of trend markets better, we must understand the correlations and beta to macro trend better...

No negative beta markets and quite a few low beta markets

To get that understanding, let us make a quick detour to the mighty 60/40 portfolio. Adding bonds to your equity portfolio in the last twenty years has mostly been a clear winner. That is because treasuries had a negative beta to equities whilst also having positive alpha. The success of many 60/40 portfolios (and indeed all-weather and risk parity portfolios) has been predicated on that negative correlation.

Do negatively correlated assets exist in the CTA universe? The answer is no. If we examine the correlation between two assets, $c = \text{cor}(A_returns, B_returns)$, c can be negative. But that correlation does not stay negative in trend space. If A is going up and B is going down, then we would be long A and short B, and the resulting P&L would be positively correlated. Mathematically, when we construct the two trend signals, their correlation is also proportional to c and the P&L correlation ends up being proportional to c^2 .



It's not all bad news though: $\text{correlation}(\text{trend markets}) \sim \text{correlation}(\text{markets})^2$ also means that the beta each trend asset has to the macro trend factor is naturally lower (0.16 instead of 0.4). That means even a simply constructed portfolio with 100 trend-markets, will tend to be more diversified than an equity portfolio with 100 stocks.

Eventually though, if we add too many markets, we will end up in the same place as a the “diversified” stock picker, and with a highly concentrated bet.

Further, the quadratic nature of c^2 creates real advantage to selecting low correlation markets. We can enhance the diversification by pre-selecting markets with lower underlying correlations, which will translate to even lower trend correlations. You can do this, for example, by focussing on a segment of the traded universe where correlations are naturally lower, e.g. commodities. You can run a complicated optimization algorithm, and the outcome will reflect the intuition I just outlined: largest weights on the lowest beta markets.

How CTAs got their skew

We saw that through adding more markets indiscriminately, we may achieve higher concentration: we have more varied side-bets, but the risk allocated to them is smaller when compared to the beta to the macro factor. The first thing to realise is that this is not necessarily a problem to most allocators. By trading many markets, a CTA gets a more concentrated, a more stable, implementation of macro trends. This is why pure trend CTAs are so highly correlated. It is why CTA indices make sense and why it is possible to compare one CTA to another. From an allocator perspective, this consistency and comparability is useful.

The concentrated portfolio (the one with lots of markets and high loading on macro trend) also provides CTAs the positive skewness we all love, and I refer you to the most excellent Katy Kaminski's [talk](#) where she explains how CTA positive skew comes through concentration, not diversification.

But there is no question in my mind that this factor bet concentration violates the first law of quant investing: “Thou shalt not make outsized bets”. When the going is good, and the macro tide rises, CTAs make money. But I am a risk manager, and I want my portfolio to be resilient when the tide goes out.

The index tracker and the stock picker

Now that you understand that more markets can mean less diversification, you are in a better position to understand how to allocate to different CTAs. But first, let us revisit your equity allocation:

- For generic equity beta, you would allocate a large chunk of your risk budget to the low-cost index-tracker ETF.
- For alpha, you probably have a budget for the skilled stock picker, or the equity market neutral hedge fund manager. You hire them to have a higher quality diversified portfolio which has low or zero correlation to your index exposure. You should certainly not pay them 2/20 for equity beta!

For CTAs, you may want to adopt an analogous approach. You want to have a distinct allocation to the “macro trends” via a cheaper allocation to the more generic trend solution. It will give you the convexity and the positive skew of trend following macro factor concentration we all love. But you



should also think about allocating to a more diversified, higher quality solution that aims to harvest uncorrelated trend alpha by actively shunning high beta markets: sometimes less is more.

Allocating this way will achieve a more properly diversified portfolio, with more even bet sizes and less correlation to the mainstream trend factors. We should move away from the “my portfolio has more markets than your portfolio” discourse and concentrate on quality, rather than quantity.

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