IAQF Academic Problem 2018

The Relation between Momentum and Option Strategies

Momentum strategies have become popular investment strategies over the past several years with a remarkable number of papers/blogs/websites touting the usefulness of such strategies (a Google search on "momentum trading" returns more than 28 million results). Generally speaking, the existence of a momentum effect implies that asset returns exhibit trends rather than being randomly distributed and, thus, violates the efficient markets hypothesis. Nonetheless, there is substantial evidence that momentum does exist in most markets (equities, commodities, fixed income, and currencies), across countries, and through time. To capture momentum, investors use a variety of techniques: they must choose the asset class, the signal construction, the lookback period, the rebalance frequency, and a number of other criteria.

In theory, a well-designed momentum strategy on an index is akin to a particular option strategy – a straddle on the underlying index (when the strategy is considered through time – what is when plotted against the underlying). When the index is increasing in value, the investor should be long. When the index is decreasing in value, the investor should be short. This would be equivalent to holding a call when value is rising and a put when value is falling. Choosing when to be long (or to own the call) and when to be short (or to own the put) is essentially a filtering problem where the investor is attempting to "filter" or extract out the trend in prices (or returns) from a noisy market signal. A simple filter often used in momentum strategies is known as a moving-average-cross-over where the investor uses two moving-averages with differing window lengths to determine the buy or sell signal.

As a beginning, we recommend constructing the following four portfolios (over a minimum time period of 10 years; assuming no transaction costs):

1. Portfolio 1: Use the S&P500 index and construct the daily time series of a momentum strategy as follows:
    a. If the 60-day moving average price of the index is greater than the 120-day moving average price – the position is long one unit of the index.
    b. If the 60-day moving average price of the index is less than the 120-day moving average price – the position is short one unit of the index.
2. Portfolio 2: Using Black-Scholes (to keep things simple), construct a daily time series of the returns of portfolios of at-the-money puts and calls (90 day horizon) to match the time series of the moving average. (NB: Remember to construct, for example, the call portfolio that you would buy a call at the close of day 0, and sell that call at the end of day 1 – that would be the return for day 1. You would then buy a new call at the end of day 1 and sell that call at the end of day 2 – that would be the return for day 2 – keep this construction strategy in mind for most of the other portfolios. Use a 90 day option each day.)
    a. If the 60-day moving average price of the index is greater than the 120-day moving average price – the position is long one call.
    b. If the 60-day moving average price of the index is less than the 120-day moving average price – the position is long one put.

3. Portfolio 3: Still relying on Black-Scholes, construct a daily time series of the returns of at-the-money (current index price) straddles to match the time series of the moving average.
4. Portfolio 4: Finally, construct an at-the-money straddle at the beginning of the moving average time series and dynamically hedge that portfolio on a daily basis so it is equivalent to an at-the-money straddle each day. Generate the daily time series of returns associated with that strategy, rebalancing each time at option expiration.

Do these four portfolios produce the same (or essentially the same) return streams? Which return stream has the best performance? Do any of the options strategies replicate the returns from the momentum strategy? Are the distributions the same? Which strategy would you employ in a mean-variance framework? Why? And how would you implement? For risk management purposes, *e.g.* the calculation of value-at-risk, conditional-value-at-risk, maximum drawdown, duration of maximum drawdown, etc., which strategy gives a more realistic view of future risk of a momentum strategy? If the returns of one of the option strategies does adequately represent the returns of the momentum strategy, does the fact that it is comprised of options provide additional information about the risk of the position? If so, how do you use that information? Does it contain implications for use in a mean-variance framework – how would it apply there?

If the options strategies outlined above do not adequately represent the returns from the momentum strategy, what strategy does? Same questions as above.

Abstracting from the design of the underlying momentum trading strategy, the literature lacks a careful consideration of how such strategies should actually be incorporated into portfolio analytics. Can the returns associated with a momentum strategy be used as an input to standard mean-variance optimization? Should the data be the current long or short position or something else? Similarly, for risk management, if the investor was long yesterday but short today and may be long tomorrow, what represents the "correct" view of risk (when one is using value-at-risk or conditional-value-at-risk) – is it the risk associated with the long, the short, or the data generated by the strategy of longs and shorts? Do the answers to these questions change if the investor uses the options or straddles instead of the momentum strategy?

Please present your analysis, results, and conclusions (along with any "enhancements") in the form of an academic paper.