**Harnessing Risk Factor Premia & Multi-Factor Portfolio Construction Methodology**

**Introduction**

Factor Investing has become increasingly popular among institutional investors in last 10 years. There has been a significant rise in the number and variations of products, and assets flowing into this space. A common perception is that all quantitative managers are the same: they analyze the same data, use the same factors, and employ the same statistical techniques. It follows, then, that they invest using the same generic factor models such as value, quality, momentum, or size. However, while the underlying concepts may be similar, how one constructs a model and transforms a common dataset makes a substantial difference in the returns and risk profile of the outcomes. These are the following factors that should be considered while building any single or multifactor risk premium strategy:

* Signal measure (Different Metrics representing the factor in question)
* Lookback period (Signal look back. For Ex, 3m, 6m, 9M, 12M momentum)
* Rebalance frequency (Ex: Weekly, Monthly, Quarterly)
* Concentration (Ex: Top 10 percent, 20 percent)
* Weighting Scheme (Market Cap, Equal, Fundamental, Signal, Risk, Correlation)
* Sector Constraints (Neutral, overweight, underweight)
* Multifactor Portfolio Construction (Mixing, Integrating, Optimization)

**Data**

All securities from Russell 3000 index with market cap > 500 mm and Price > $1.

**Value Factor**

Academic researchers have published multiple literature since Graham and Dodd showing that value investing can consistently generate positive returns over the long run. Consequently, value investing has become the bedrock of many quantitative processes with models systematically identifying cheap stocks. Value stocks can be identified using various atomic signals. For ex - the Fama-French 3 factor models use High minus Low (HML) factor is a book-to-price (B/P) measure to partition value and growth stocks.

**Below figure compares the returns for the value stocks using B/P ratio over the period 1999-2018** 

\**Above returns chart generated by constructing equal weighted quintile portfolio using monthly rebalancing*

As the value model becomes more refined using different atomic signals for value metrics and reducing the biases, we generally observed improved total return as well as better risk-adjusted returns.

**Table below compares the value portfolio returns using different value metrics (1999-2018)**





In the above table, we have used the market cap weighting scheme to build a value portfolio. However, one of the contentions with using this scheme is that the overvalued firms will have more exposure in the portfolio and therefore diluting the desired exposure to cheap stock. Empirically we can show that using an equal weighting scheme will not only improve the annual returns but also risk adjusted returns as well which we can see in the form of improved IR.

**Equal Weighted Value Portfolio**



As evidenced in the above table, with the equal weighting scheme, not only the annual returns improved but returns also became consistent across different metrics as well as we can see improvement on risk adjusted basis as well.

**Data Bias Exploration**

Simple factor models have persistent biases that may not be immediately apparent. While building a factor portfolio, the researcher may be unintentionally focusing on certain industries and gaining exposure to other risk factors if the models aren’t properly adjusted. For Ex: TMT and Healthcare tend to have higher P/E ratios as compared to Materials and Industrials counterpart. When using an unadjusted value metrics, a portfolio would be concentrated in historically higher value metrics industries. This is why we see a higher risk adjusted returns for the industry adjusted value metrics as highlighted in the below table.



Similarly, the different value metrics mentioned above in the table tends to exhibit different biases in building the portfolio. For example

* High B/P ratio sometimes leads to selection of Junk companies
* High E/P ratio leads to selection of cyclical stocks
* High S/P ratio sometimes leads to selection of low margin stocks
* High CF/P leads to under selection of industries where cash flows are low such as Financial sector

Here I have created a combined value signal that is equal weighted measure of all the above value metrics shown in the tables above. (1999-2018)



***Monthly Return Spread Consistency (vs MSCI Barra Equal Weighted Index as Benchmark)***



**Value Portfolio – Characteristics** (*Equal weighted industry adjusted combined value metric)*

*Volatility Profile*

Below chart shows, that one of the possible driver of returns for value portfolio is in its inherent tendency to have more volatility and hence more required return.



This is also affirmed by the fact that when you look at the beta for value portfolio (Benchmark = MSCI Barra Equal Weighted Index) on a forecasted basis (ex-ante) using Bloomberg factor risk model, you could see that there is a consistent positive beta exposure bias which could also explain some of the returns and high volatility.

***Bloomberg US Equity Model predicted beta of equal weighted industry neutral combined value***



***Factor Exposure* (*Bloomberg US Equity risk factor Model)***

Below char shows that the portfolio did have significant value exposure and very low exposure to growth factor as intended



*Other Style Factor Exposure – A prospective case for factor diversification*

From the below charts, we can clearly see that with single factor portfolio construction style, the portfolio incorporates some unintended exposure to other factors. For Ex, The portfolio has significant negative exposure to size, which could also be, enhancing from the weighting scheme incorporated here (apart from the fact that Value may be more prominent among small caps stocks), there by exposing to small cap stocks and in turn enhancing the returns. Similarly, we could see negative exposure to Profitability aka Quality as well some Momentum and Leverage.



The above chart shows that value factor portfolio has consistent negative exposure to Profitability and Volatility (also affirmed from the fact that predicted beta is positive and consistently higher than 1)

**Momentum Factor**

Researchers have convincingly demonstrated that momentum strategies have power to predict stock returns. For instance, Jegadeesh and Titman (1993) showed that strategies that tend to buy winners and sell losers based on cross sectional returns over the previous 6-12 months generate excess returns. Asness (1995) have showed that these strategies are more effective when momentum definition exclude the most recent month returns.

Using the definition of momentum as last 12 month return ex most recent month returns (1999-2018),





The below chart shows the performance of momentum factor (weighting scheme: Equal Weighted, adjusted for industry biases, Benchmark taken as Barra Equal Weighted Index)



**Excess Return (Top/Bottom Quintile minus Benchmark = M2USEW) under different weighting scheme**



From the above charts, we can clearly see that winners and losers portfolio behaviors changes significant as you consider different weighting schemes and adjust for industry momentum.

**Momentum Factor Exposure** **from the perspective of Standard Risk Factor Model** (*Bloomberg US Equity Factor Model*)



**Predicted Beta for Momentum Factor Portfolio**



**Other Factor Exposures in Momentum Portfolio**



Much like Value, Momentum has also certain unintended factor exposure such as negative exposure to Profitability asn positive exposure to Volatility, which is also affirmed from positive exposure to Predicted beta over time. All these factor exposures gives us a possible case for factor diversification using a low beta portfolio/High Quality factor Portfolio, there by enhancing performance on an risk adjusted basis.

**Momentum Factor – Case for Diversification when combined with Value Factor Portfolio**



The above chart shows that Momentum has a persistent negative correlation with the value factor. Academics and Industry practitioners have depicted that this relationship between value and momentum is consistent across various asset classes with varying degrees over the last century. In addition, we can see that momentum as a factor has long-term positive excess return with a moderate IR ratio. Hence, we believe that combining momentum with value will definitely improve performance of the value factor portfolio on a risk-adjusted basis.

**Multi-Factor Portfolio Construction and Portfolio Characteristics** (*Combining Value (60%) and Momentum (40%)*)

As we have shown above, Value and Momentum both generates consistent returns over long-term horizon. Not only that, both exhibit persistent negative correlation. Hence, combining the two-factor should produce better risk-adjusted returns. Here, we have combined the two factors (Value and Momentum) in the portfolio in 60/40 ratio. Reason being you could clearly see that Momentum has some negative value exposure and hence underweighting on the momentum portfolio.







**Risk Exposure Characteristics** (*Using Bloomberg US Equity Factor Model*)







From these charts, Value and momentum definitely have high positive exposures as intended, though there seems to be some vol bias (as evident from positive exposures to Volatility factors as well as consistent positive predicted beta) as well as quality bias. These two factors exposures present an interesting opportunity to explore further diversification by adding a low vol/beta and Quality factor to the mix of this Value and momentum factor portfolio.