RiskLab Report

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Introduction

After financial crisis with subprime loans in 2007 - 2008, today's global business environment still has not won back investors' confidence. There is a new type of investment that involves both passive and active aspect becoming increasingly popular in the current financial industry. With following smart beta strategies regarding capitalization level, companies' industries and market risks, our clients could better diversify the risk in their portfolio and earn above-the-market returns.

Smart Beta Factors

Smart beta investing has seen a significant increase in recent years with global adoption rate reaching a record high of 48% in 2018. The benefits of smart beta range from risk reduction, diversification and getting an exposure of both passive and active investment strategies. In this report, we would like to illustrate the construction of a multi-factor model and evaluate its accuracy, limitations and potential areas of improvement.

This asset pricing model consists of three beta factors, with two of them being considered as 'smart' by industry standard. The first beta factor is the common beta used in the CAPM model that measures the individual's stock's correlation to the general market. The second beta factor is a smart beta factor that measures an individual stock's correlation to the one-year return differences exhibited by low versus high volatility stocks. The difference is obtained through calculations of the 18 stocks given by grouping them into low and high volatility categories respectively, and calculating the market-cap-weighted return in each group. The final beta factor is also a smart beta factor that measures an individual stock's correlation to the one-year return

differences exhibited by low versus high dividend yield stocks. The difference, similarly, is obtained through the historical return from the 18 stocks, divided into two groups.

Volatility & Dividend Grouping

Ticker	Dividend Yield
AD	6.65%
SPB	5.89%
CSH.UN	5.17%
H	4.98%
NPI	3.98%
PKI	3.91%
TVK	3.81%
RY	3.75%
X	2.95%
SU	2.49%
AGT	2.44%
TCS	0.77%
MFI	0.53%
CSU	0.51%
DOL	0.50%
KXS	0.00%
ZYME	0.00%
WEED	0.00%

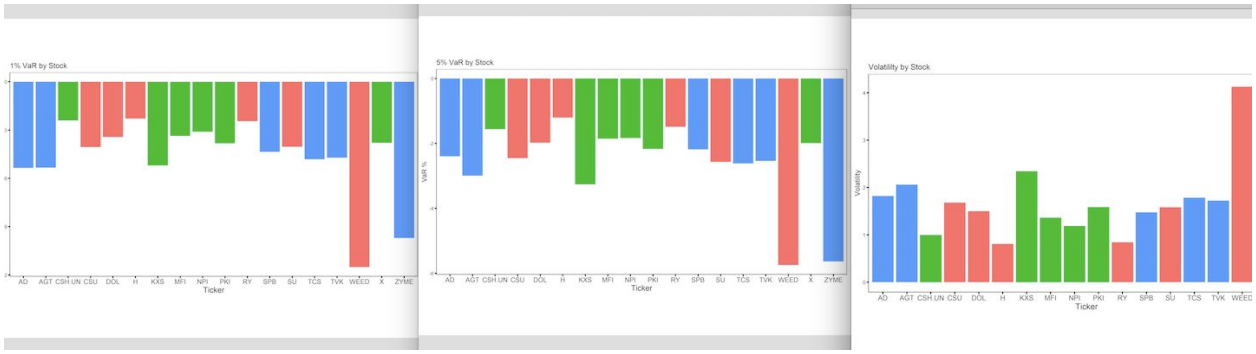
Ticker	Volatility
H	0.808154
RY	0.841686
CSH.UN	0.997041
NPI	1.186490
X	1.349041
MFI	1.362540
SPB	1.476352
DOL	1.499576
SU	1.580948
PKI	1.584159
CSU	1.680898
TVK	1.721703
TCS	1.785165
AD	1.818544
AGT	2.058636
KXS	2.343552
WEED	4.126353
ZYME	4.183296

Model Development *Microsoft Excel & Rstudio are the two main softwares used for multilinear regression analysis in the construction of the model.

	Low Vol Beta		High Div Beta		Market Beta
WEED	-29.1967	KXS	-10.2612	WEED	-1.2517
RY	-1.86796	CSU	-5.99755	TVK	-0.21131
TVK	-0.95821	DOL	-2.52396	RY	-0.11961
SPB	-0.88561	PKI	-1.04266	SU	-0.10171
PKI	-0.33144	AGT	-0.2543	TCS	-0.01182
TCS	0.18185	NPI	0.04535	AD	0.20586
AD	0.53509	MFI	0.36692	X	0.30136
SU	0.8728	H	0.61259	H	0.360318
NPI	1.93647	SU	1.4362	SPB	0.375708
X	2.02584	TVK	3.57032	PKI	0.94785
MFI	2.23399	X	3.66517	NPI	1.0504
ZYME	3.52474	ZYME	3.77947	MFI	1.06249
CSU	3.57194	CSH	3.8245	CSH	1.29617
DOL	3.72462	RY	3.925395	ZYME	1.48764
H	4.254161	TCS	4.10507	DOL	1.68045
AGT	4.85626	SPB	5.531464	CSU	1.92764
KXS	5.61161	AD	8.80116	AGT	3.10781
CSH	7.44624	WEED	9.25653	KXS	6.34114

Hypothesis: It is believed that companies with low-volatile performance and high dividend would be have high beta indices and then high volatility and low dividend welfare indicate low beta in our model, vice versa.

Market Risk



(Comparison of 1% VaR, 5% VaR and the volatility of 18 stocks)

When comparing 1% vaR, 5% var and the volatility(calculated by taking the standard deviation of daily market return distribution) of the 18 companies, we see that the three attributes are strongly correlated to each other: lower the 1% vaR, lower the 5% vaR and higher the volatility. This shows that these three attributes are all true and effective measures of the instability of the return of each stock, in other words, the market risk.

Market Risk for low beta and high beta companies:

Beta 1 accounts for a company's sensitivity to volatility, which is measured as the difference between the market-cap weighted return of high volatility and low volatility stocks. In the calculated beta 1 figures of all 18 stocks and industries, it is clear that companies with low volatilities have higher beta. For example, CSH has extremely low volatility and the value of its beta1 is the highest among the 18 stocks. However, there is an outlier RY is a company with low beta1, but also with low volatility. This is due to the model's autoregression features that

puts heavier weight on its beta2, which is RY's consistent dividend yield. Model attributes its return to sensitivity to dividends instead of its sensitivity to volatility. Another interesting behaviour is from Weed whose beta1 is abnormally low. This is incurred by the legalization of marijuana in Canada recently. It also explains why the average of beta1 for large company sector is relatively small. This model may indicate that the main reason people invest in RY being high dividend paying and consistently raising dividends and people consider less about volatility when investing in bank stocks. On industry level, companies from energy sector whose volatility are among the big half tend to have a smaller beta 1. Again, since the abnormal behaviour of WEED, healthcare sector has a much smaller beta1 than the energy sector.

Beta2 is responsible for a stock's sensitivity to dividend which is determined by the difference between the market-cap weighted return of high dividend and low dividend stocks. In the calculated beta 2 figures of all 18 stocks and industries, it is clear that companies with high dividends have higher beta2. On company level, AD is a case in point. As shown in VaR/volatility chart, high dividend companies have higher beta. An outlier is TCS which is a company with low beta, but also with high dividend. This can be attributed to the model's autoregression features that puts a heavier weight on other betas. For high dividend stocks, the model attributes its return to sensitivity to volatility instead of its sensitivity to dividends. People buy Weed mainly because it increases dramatically while it provides no dividends at all. On industry level, let alone healthcare industry (due to WEED), financial sector also has relative big beta2, consistent with the fact that companies from financial sector provides correspondingly high dividend.

Credit Risk (Relationship to Company Traits)

Credit Ratings	Company Tickers
AA	RY
A	H, X, AD, MFI, SU
BBB	TCS, KXS, CSH, DOL, CSH.UN, NPI
BB	SPB, NPI, WEED, PKI
B	AGT

In our prediction, credit risk is an essential factor determining our smart betas, as demonstrated as its correlation with a specific firm's ability to make profits and investors' expectation towards it. Indeed, companies with high credit rating such as RY and H, possess high beta in both volatility and dividend difference. There is no doubt that the two firms above belong to steady industries, finance and utilities. Moreover, RY owns a market capital of 110 billions in US dollars that ranks the eleventh worldwide, upgrading from AA negative to stable in credit rating by S&P in 2018. The latter, Hydro One was a Crown corporation supported by the Ontario government, committing to electricity transmission service in the province until 2015. In their 2018 quarter four report, Hydro yields $0.27 earnings per share, accompanied by less occurrences in electrical outage, and positive outcomes in various project management regarding aggregate in-servicing plans with the Ontario Energy Board (OEB) and reduction of tree trimming cycle. From a prudent perspective from investment, these two should be people's top choice out of the given 18 companies, benefiting from longing stocks and high dividend yield rate.

	Low Vol Beta		High Div Beta		Market Beta
WEED	-29.1967	KXS	-10.2612	WEED	-1.2517
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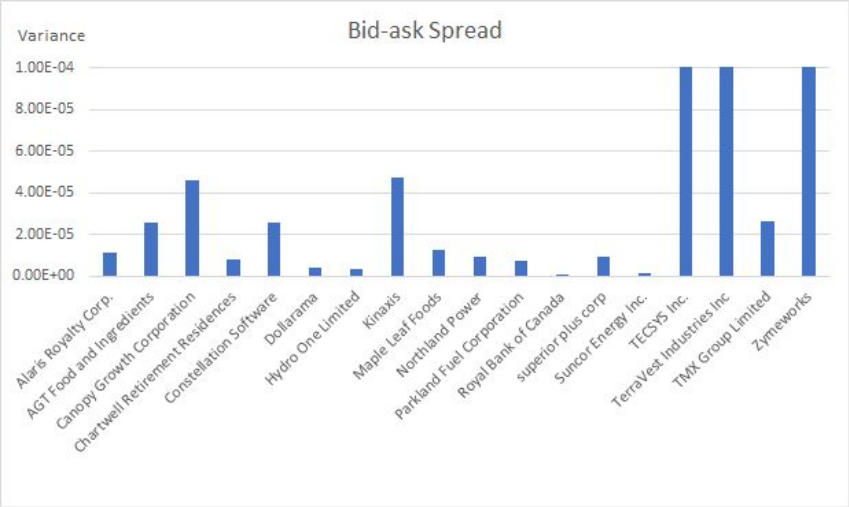
In contrast, AGT beta performance is relatively poor in these two indicators. The volatility difference betas for RY and H are -1.86796 and 4.254161, and dividend betas are 3.925 and 0.61259, respectively. AGT merely shows a beta coefficient of 4.85626 and -0.2543 with the market for its volatility and dividend. Another two abnormal companies such as WEED and ZYMES which have extremely low beta1 and beta2 values but a relatively good credit rating(BB and BB high) in our ETF. This is due to the nature of their products that drugs and medicines are both inelastically demanded by customers, so that they have the ability to proceed forward and make profits in the future.

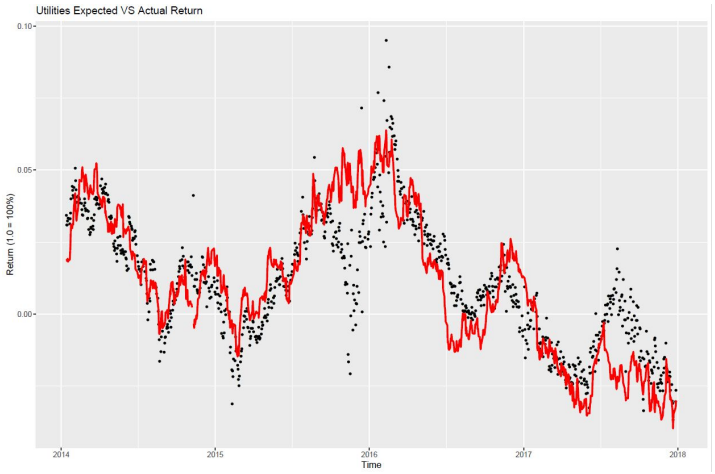
Liquidity Risk (Relationship to Company Traits)



Our hypothesis is that beta-one indices demonstrate the stability of a stock, so high beta-one stocks should have a low bid-ask spread. It works almost perfect on big-sized companies such as RBC, Dollarama and Hydro One, performing well in beta-one test as well as having a low bid-ask spread. To the contrary, the extremely high bid-ask spread of three companies -- TXS, TMX and Zyme(rightmost in graph) doesn't imply low beta. Their high bid-ask spread value should be explained by the market size of these three companies. All of them are very small, so there's a big gap between the stockholder's willingness to buy and willingness to pay.

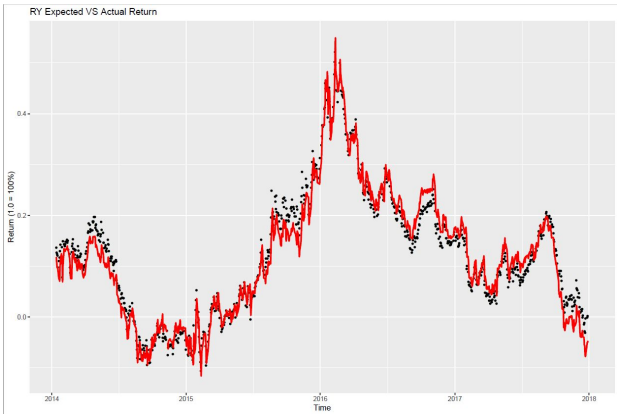
Model Backtesting & Evaluation

In order to test the validity of the model, backtesting is used in which the annualized expected returns are plotted against the annualized actual return to see the correlation and the predictive behaviour of the model.

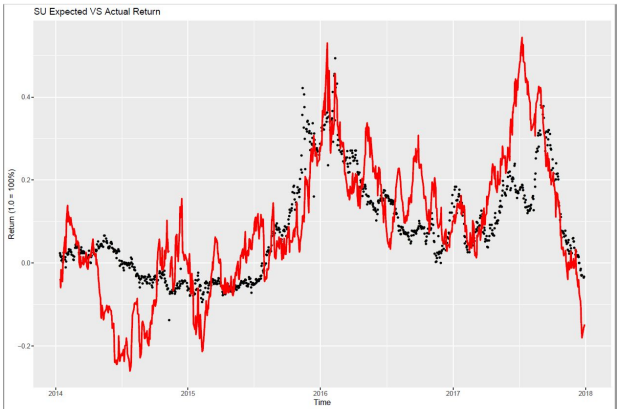


This chart illustrates the predictive power of the model to the Utilities Sector of the 18 stock samples with an adjusted R square of 0.7224. The actual return is represented as the red line while the expected return are represented with dots. The actual return mostly follows the

expected return in terms of longer trends with some deviations around certain regions. This could be a result of external factors, such as rate hikes and other general macroeconomic factors that were not factored into the model.



In comparison, the model's backtesting power to Royal Bank of Canada(Ticker: RY) is much stronger, partially due to the stock having a higher weight in the factors of 'low' vs 'high' dividend/volatility returns. The model successfully predicts RY's annualized return over a four year time frame with respect to its excess return over the market, sensitivity to dividend and volatility.



For energy stocks like Suncor that have large sensitivity to oil price movements, the model also successfully predicts the longer trend of the return with the actual return(indicated in

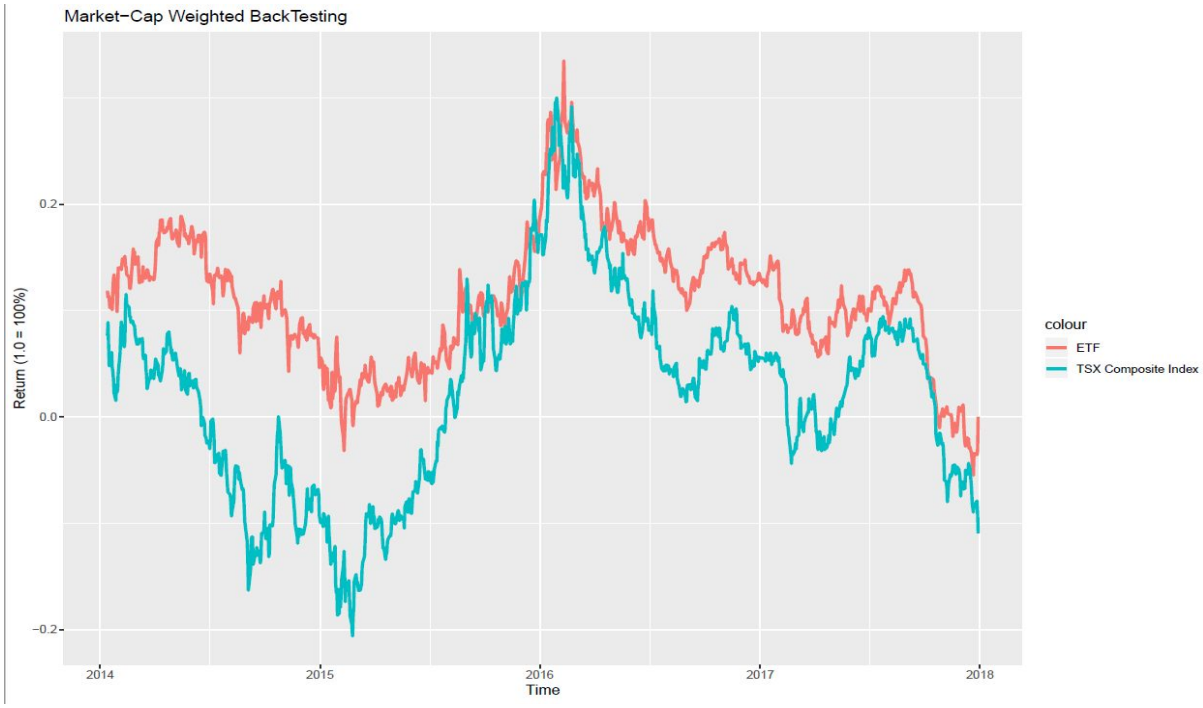
the red line) showing more volatility as the oil price factor is not accounted. That being said, the error terms between the expected and the actual returns are a result of company-specific/sector-specific factors. For example, the healthcare sector consists of a market-cap stock that is part of the pharmaceuticals industry, a medium-cap stock that provides services to seniors and a large-cap stock that grows cannabis. Although they are classified to be in the same sector, the growth perspective of each stock is vastly different. This may result in lower accuracy of the model.

Notably, the low number of stock samples and a relatively short time frame may have led to skewness. A potential way to improve the accuracy of the model is to select a longer time frame so the regression analysis contains more variations of macroeconomic conditions and to select a larger number of stock samples to diverge away unsystemic risk in the model development phase.

ETF Construction & Backtesting

To construct the ETF, a variety of ten-stock combinations are used to test the highest return in excess of the general market (defined by the market-cap weighted return) of the 18 stocks. The best outcome of the ETF contains the 10 stocks with the highest smart beta factors(low volatility and high dividend). This results is the most optimal in market-cap weighted scenario. (In this case, WEED is excluded due to the main factor driving the stock being legalization of marijuana in Canada and the company-specific factor is mainly responsible for its price movements)

The ten stocks selected are CSH.UN, KXS, AGT, H, DOL, AD, SPB, TCS, RY, CSU, with each constituting their relative weight dependent on their market capitalization.



The result shows significant outperformance across most of the time periods in the past 5 years. It also shows that the ETF is less volatile (partially due to the lack of presence of energy stocks in the portfolio) so it outperforms significantly during the oil price crash from 2014 - 2016. This is the evidence that low volatility and high dividend stock strategy is able to generate above-market-return in the past 5 years. Understanding the relative small size of the stocks and relatively simplified sector distribution, this strategy definitely needs more testing with different markets and a more diversified range of stocks with different market cap and industry to further strengthen the hypothesis that in the long run: low volatility and high dividend stock tend to outperform the general market.

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