PWL

Five Factor Investing with ETFs

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Benjamin Felix, *Portfolio Manager*, PWL Capital Inc.,"Five Factor Investing with ETFs"

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1. Introduction

Index funds are an increasingly popular and undoubtedly sensible tool for building investment portfolios. The push toward index investing is based on the Efficient Market Hypothesis (EMH) (Fama, 1970), which simply states:

> In general terms, the ideal is a market in which prices provide accurate signals for resource allocation: that is, a market in which firms can make production-investment decisions, and investors can choose among securities that represent ownership of firms' activities under the assumption that security prices at any time "fully reflect" all available information. A market in which prices always "fully reflect" available information is called "efficient."

If the market is efficient then prices contain all relevant information about the expected returns of a stock at that point in time. Price changes will be based on new information, which cannot be predicted reliably. In an efficient market it is not possible to earn reliable excess returns without taking on excess risk. Excess returns without excess risk, known as alpha, is the goal of traditional active management. Active management involves some combination of selecting a subset of stocks and timing the market to generate alpha.

The consistent failure of active management to generate persistent alpha, as documented by Carhartt (1997) and Fama and French (2010), supports market efficiency. As investors have become increasingly aware of the empirical failure of active management, and its theoretical implications, they have rightfully shifted their dollars toward low-cost broadly diversified index funds. This shift is sensible given the pervasive evidence of market efficiency.

We would stop here to arrive at the conclusion that index investing is the smartest way for most people to invest. If it is nearly impossible to consistently generate returns in excess of those associated with taking on risk, then it is sensible to minimize costs and maintain long-term exposure to known risks. Index investing using a market capitalization weighted index fund, like the iShares ETF XIC tracking the S&P/TSX Composite index for Canadian stocks, offers low-cost exposure to market risk.

Since the introduction of the EMH as a falsifiable model in the mid-1960s, the field of asset pricing has revealed other theoretically consistent and empirically robust risks that systematically affect asset prices, independent of market risk. This is where an evidence-motivated investor may choose to diverge from the basic concept of market capitalization weighted index investing. Rather than taking on only market risk, it may be sensible to pursue long-term exposure to a combination of independent risks.

Considering the increasing correlations of global stock markets, exposure to multiple risk factors may be even more beneficial than exposure to the stock markets of multiple countries. Combining risk factor diversification with geographical diversification will provide investors with greater diversification benefits than market capitalization weighted index funds alone. This paper will introduce the risk factors included in a prominent asset pricing model, the Fama French Five-Factor Model, and the empirical case to include exposure to these risk factors in portfolios. We will propose a model portfolio of ETFs that aims to achieve exposure to all five independent risk factors.

2. Expected Stock Returns

Investing in a company's stock means purchasing the rights to a portion of that company's expected future profits. The expected future profits are not guaranteed, so they are purchased at a discount. If things work out as expected for the company then the shares deliver their portion of the expected profits; the investment return is the difference between the discounted price paid for the expected profits and the actual profits that accrue to the shares. That last sentence is extremely important: Expected stock returns are not dictated by the profits that a company generates - they are dictated by the amount that was paid for those profits. Investors will be willing to pay less for riskier future profits and more for safer future profits. The documented relationship between risk and expected returns goes back to the Capital Asset Pricing Model (CAPM) (Sharpe, 1964), the first asset pricing model.

2.1 Asset Pricing Models

In an efficient market asset prices fully reflect available information. Market efficiency is a theoretical model, but it has stood the test of time as the best model that we have to understand how the financial markets operate. If we accept that prices reflect all available information, then prices can be used to gain insight into differences in expected returns between securities. Since the CAPM in 1964 there has been an overwhelming amount of research conducted on asset pricing resulting in hundreds of documented risk factors – independent risks that may contribute to the explanation of differences in expected returns.

Before going any further, it is important to note that asset pricing models do not prove or disprove market efficiency. This must be true because any test of market efficiency using an asset pricing model is jointly a test of market efficiency and a test of the asset pricing model - this is known as the joint hypothesis problem. If an asset pricing model suggests that the market is not incorporating information into prices it is impossible to say whether the market is inefficient, or the model is wrong. One of the most obvious historical cases of the joint hypothesis problem in action is the empirical failure of the CAPM.

2.2 Market Beta: The Original Factor

Any discussion on asset pricing must start with market beta. Market beta is market risk as described by the CAPM. The CAPM looks at the measure of sensitivity between an asset or portfolio and the risk of the overall market. A market capitalization weighted equity index fund should have a market beta of 1. A Portfolio consisting of 50% market cap weighted equity index fund and 50% cash should have a market beta of 0.5. If the market goes up 10%, the portfolio with a beta of 1 would be expected to go up 10%, while the portfolio with a beta of 0.5 would be expected to go up 5%.

If two portfolios with the same beta had different returns, the difference in returns could be attributed to the portfolio manager's ability to select securities and time the market, or to some as-yet unidentified factor. A portfolio that delivers returns higher than expected based on its level of risk is desirable. That excess risk-adjusted return is known as alpha; alpha is the holy grail of investing. The CAPM was the foundation of asset pricing models – the first model to relate a measure of risk to expected returns – but it is a severely flawed model. The CAPM is only able to explain about two-thirds of the differences in returns between diversified portfolios.

The CAPM was first shown to be flawed in Fischer Black's 1972 paper *Capital Market Equilibrium with Restricted Borrowing*. Rolf Banz followed up with his 1981 paper *The Relationship Between Return and Market Value of Common Stocks*. Banz showed that small stocks had consistently higher average returns that could not be explained by their market beta. In other words, viewed through the CAPM lens, small stocks were generating persistent alpha. The CAPM took another blow in 1985 when Barr Rosenberg, Kenneth Reid, and Ronald Lanstein found that stocks with a high book value relative to their market price (value stocks) had higher average returns that were not explained by market beta. Their paper *Persuasive Evidence of Market Inefficiency* was further evidence that market beta does not tell the full expected stock returns story.

Their findings, at the time, seemed to be proof that markets were not efficient. If some types of stocks could have consistently higher returns without any additional risk, then the market is mispricing those types of stocks. If that is in fact the case then markets are, by definition, not efficient. However, we must remember the joint hypothesis theorem: a test of market efficiency using an asset pricing model is jointly a test of market efficiency and a test of the asset pricing model. Was the market inefficient, or did we need a better model?

2.3 The Fama-French Three-Factor Model

In 1992, Eugene Fama and Kenneth French pulled together the empirical anomalies that had apparently been disproving the EMH and offered an alternative asset pricing model. They showed that with a better model the market was not mispricing small cap and value stocks, it was pricing in the independent risks of those types of stocks. Adding in the independent risks of small and value stocks alongside market beta in the asset pricing model significantly increased the explanatory power of the model and eliminated the empirical anomalies that had been making the market look inefficient from a CAPM perspective.

Instead of explaining two-thirds of the difference in returns between diversified portfolios the three-factor model explains 90% of the difference. While it was a big leap forward, the Three-Factor model is an empirical model without strong roots in financial theory. Fama and French had taken the empirical observation that market risk was not sufficient to explain the returns of small cap and value stocks and proposed a model with better explanatory power. The model still has known imperfections and is only loosely tied to valuation theory.

Later research by Robert Novy-Marx (2013) and Titman, Wei, and Xie (2004) showed persistent anomalies unexplained by the Three-Factor model: profitability and investment. Controlling for size and relative price, firms with robust operating profitability tend to perform better than firms with weak operating profitability, and firms with conservative asset growth tend to perform better than firms with aggressive asset growth. These empirical anomalies caused financial economists to revisit the Three-Factor model. Adding profitability and investment to the Three-Factor model not only increased the explanatory power of the model, it brought the empirical asset pricing work closer in line with valuation theory.

2.4 The Fama-French Five Factor-Model

The dividend discount model says that the theoretical value of a share of stock is the discounted value of expected dividends per share.

$$m_t = \sum_{\tau=1}^{\infty} E(d_{t+\tau})/(1+r)^{\tau} \quad (1)$$

Equation 1 shows that the stock price m_t at time t is equal to the expected future dividends per share, $E(d_{t+\tau})$, discounted at the long-term average expected stock return r.

One of the problems with the dividend discount model is that not all firms pay dividends. Miller and Modigliani (1961) showed that given investment policy, dividend policy is irrelevant to the valuation of shares. With dividend policy irrelevance, the value of expected dividends is equal to expected earnings minus expected investment. According to Miller and Modigliani (1961), the total market value of the firm's stock is given by Equation 2

$$M_t = \sum_{\tau=1}^{\infty} E(Y_{t+\tau} - dB_{t+\tau})/(1+r)^{\tau} \quad (2)$$

here $Y_{t+\tau}$ is the earnings and $dB_{t+\tau}$ is the expected change in book equity (asset growth). Scaling both sides of Equation 2 by the book value of equity, B_t, Equation 3 gives the theoretical valuation equation as presented by Fama and French (2015).

$$\frac{M_t}{B_t} = \frac{\sum_{\tau=1}^{\infty} E(Y_{t+\tau} - dB_{t+\tau})/(1+r)^{\tau}}{B_t} \quad (3)$$

This theoretical valuation equation makes three statements about expected stock returns.

1. If we hold everything in Equation 3 constant except for the market value of the stock, M_t, and the expected stock return, r, then a lower ratio of M_t/B_t must imply a higher expected stock return. All else equal, a company with a lower price must have a higher discount rate.
2. If we hold everything in Equation 3 constant except for expected future earnings, $Y_{t+\tau}$, and the expected stock return, r, then higher expected earnings must imply a higher expected stock return. All else equal, if two companies trade at the same price, the company with higher profits must have a higher discount rate. This is an expression of the profitability premium.
3. If we hold everything in Equation 3 constant except for the expected growth in book value of equity, $dB_{t+\tau}$, and the expected stock return, r, then higher expected asset growth must imply a lower expected stock return. All else equal, if two companies trade at the same price, the company with higher investment must have a lower discount rate. This is an expression of the investment premium.

Measuring expected profitability and expected investment had been a challenge for many years. In 2012, Robert Novy-Marx documented the finding that profitability, measured by gross profits-to-assets, adds further explanatory power to asset pricing models. He found that controlling for gross profitability explains most earnings-related anomalies that the Three-Factor model had been unable to explain. In 2013, Aharoni, Grundy, and Zeng documented a weaker but statistically reliable relationship between asset growth and average returns. They found that firms with aggressive investment policies, as measured by the growth in the book value of their assets, tend to have lower average returns.

Informed by the theoretical valuation equation and the advances in measuring expected profitability and expected investment, Fama and French proposed a five-factor asset pricing model in their 2015 paper *A Five-Factor Asset Pricing Model*. The five factors include market beta, company size, relative price, gross profitability, and investment. The Five-Factor model is able to explain closer to 95% of the differences in returns between diversified portfolios, and it is able to solve many of the anomalies left unexplained by the Three-Factor model.

One of the most important insights that we gain from the valuation equation is that the factors should not be considered in isolation. For example, a portfolio that focuses on profitability without controlling for relative price is likely to result in a portfolio of growth stocks, and a portfolio that focuses on relative price without controlling for profitability is likely to result in a portfolio of stocks with weak profitability. Novy-Marx (2014) argues that buying stocks with robust profitability without paying premium prices is just as much value investing as buying average profitability assets at discount prices. The stocks with the highest expected returns in the market would tend to be the stocks with low relative prices *and* robust profitability. This makes targeting value and profitability jointly one of the most important aspects of managing a multi-factor portfolio.

2.5 Company Size

Company size was the original pricing anomaly. Interestingly, company size does not make an explicit appearance in the theoretical valuation equation, and the standalone size premium has not been statistically different from zero since publication of the effect by Banz (1981). It would be easy to dismiss the inclusion of small cap stocks based on this information, but that would ignore one of the other empirical realities: other factor premiums are much stronger in small cap stocks. Blitz and Hanauer (2021) show empirically that there are powerful interaction effects between size and other factors, such as value. They show that academic factor portfolios, which consist of 50% large caps and 50% small caps, have significant alphas compared to factor portfolios constructed with 90% large caps and 10% small caps representing market capitalization weights. The conclusion is that the interaction between size and other known factors may be a sufficient reason for long-only investors to systematically overweight small-cap stocks, even if the size characteristic itself is not rewarded with a premium.

2.6 Momentum

While the five factors in the Fama-French Five-Factor model fit nicely into a theoretical valuation framework, momentum continues to be an unexplained anomaly, at least from an EMH perspective. Momentum was first documented by Jegadeesh and Titman in their 1993 study *Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency*. It is the observed phenomenon that stocks which have been increasing in price recently tend to continue increasing in price for a short time, and stocks that have been decreasing in price tend to continue decreasing in price for a short time.

In 1997 Mark Carhart combined the Fama-French Three-Factor model with momentum to create a four-factor model. Adding momentum to the Three-Factor model further increased its explanatory power. There are theoretical explanations from behavioral finance for the excess returns of stocks with positive momentum. From a portfolio management perspective momentum is important when considering a value strategy. Value stocks are stocks that have decreased in price to become value stocks. Purchasing value stocks as they cross the value threshold ends up being a bet against positive price momentum.

3. Historical Factor Premiums

Factors are characteristics that explain differences in returns between diversified portfolios. As seen in the valuation equation they also have a theoretical relationship with expected returns. Small cap and value stocks broke the CAPM because they had higher average returns than expected based on their market betas. Stocks with robust profitability and stocks that invest conservatively had a similar impact on the Three-Factor model.

As we will see, the higher average returns associated with all five factors in the Fama-French Five-Factor model have been persistent through time and pervasive across markets.

3.1 Defining a Factor Premium

Factors are technically defined as a portfolio that is long one group of assets and short another. The market factor is the portfolio that is long the stock market and short one-month US treasury bills. The size premium is the portfolio that is long small stocks and short large stocks. Mathematically, it is the return of small stocks minus the return of big stocks; that is how the size factor gets the name small minus big (SMB). The value factor is defined as the returns of high book-to-market stocks minus low book-to-market stocks, or high minus low (HML). The profitability factor is firms with robust profitability minus firms with weak profitability, or robust minus weak (RMW). The investment factor is firms that invest conservatively minus firms that invest aggressively, or conservative minus aggressive (CMA). Aggressive investment is also referred to as aggressive asset growth.

The academic factors are designed to disentangle the factors from each other. This is accomplished by giving the academic factor equal weight contributions from big and small stocks. For example, the academic value factor is defined in Equation 4.

$$HML = \frac{1}{2}(Small\ Value + Big\ Value) - \frac{1}{2}(Small\ Growth + Big\ Growth). \quad (4)$$

In the context of assessing the existence of a single factor premium these academic factors may be less relevant because the market portfolio has closer to a 10% value weight in small stocks and a 90% value weight in big stocks. Interestingly, Blitz and Hanauer (2021) compare the academic factor portfolios to value weighted factor portfolios to demonstrate the additional excess return associated with over-weighting small caps to increase the effectiveness of other factors. A market capitalization weighted investor with a factor tilt toward value, high profitability, or low asset growth might be more interested in the value weighted factor premiums, while an overweight small cap investor with a factor tilt may be more interested in the academic factor premiums. Our model portfolio lands somewhere in the middle with a roughly 30% weight in small stocks.

For the US we will present data on historical premiums using value weighted portfolios in addition to the academic factor portfolios to demonstrate the difference in the magnitude of the premiums. Ken French publishes US data on value weighted portfolios sorted by each factor. The data are calculated as the top and bottom 30% of stocks sorted by each factor. For example, the value premium is defined as the portfolio of the cheapest 30% of stocks minus the portfolio of the most expensive

30%, and the small cap premium is the smallest 30% of stocks minus the largest 30%. These sorts are similarly carried out for operating profitability and asset growth.

While demonstrating the difference in historical premiums between the academic factor portfolios and the value weighted factor portfolios is important, the remainder of the paper will focus on the academic factors.

3.2 US Data

The premiums associated with factor portfolios have been significant economically and, for the most part, statistically.

Table 1 - US Value Weighted Factor Premiums 7/1/1963 - 6/30/2020

7/1/1963 - 6/30/2020	MKT-RF	SMB	HML	RMW	CMA
Annualized US Five-Factor Premiums (%)	5.37	1.58	1.99	2.59	1.92
t stat	3.16	1.39	1.80	2.56	1.99

Source: Benjamin Felix; Data source: Ken French Data Library

Table 2 - US Academic Factor Premiums 7/1/1963 - 6/30/2020

7/1/1963 - 6/30/2020	MKT-RF	SMB	HML	RMW	CMA
Annualized US Five-Factor Premiums (%)	5.37	2.04	2.68	2.80	2.93
t stat	3.16	1.85	2.39	3.06	3.42

Source: Benjamin Felix; Data source: Ken French Data Library

These data are showing us that in the value weighted sample the market beat one-month treasury bills by an annualized 5.37%, small stocks beat big stocks by 1.58%, cheap stocks beat expensive stocks by 1.99%, stocks with robust operating profitability beat stocks with weak operating profitability by 2.59%, and stocks with conservative asset growth beat stocks with aggressive asset growth by 1.92%. Most of these premiums are statistically significant at the 95% confidence level except for the value weighted premiums associated with smaller stocks over larger stocks with a t statistic of 1.39 and value stocks over growth stocks with a t statistic of 1.80, and the academic premium associated with smaller stocks over larger stocks with a t statistic of 1.85.

The academic value premium over the full sample is statistically significant, however over the more recent sub-sample from 07/1990 through 06/2019 it is not statistically significant. The existence of the US value premium has been questioned due to the recent run of historically severe under-performance that it has endured. This was addressed in a 2020 paper by Eugene Fama and Kenneth French simply titled *The Value Premium*. They argue that there is too much noise in the data to conclude that the value premium has ceased to exist since its initial publication.

3.3 Developed Ex-US Data

The developed ex-US evidence is not as statistically reliable as the US evidence. This may be partially explained by a shorter time series of historical data and, for the market minus risk-free rate (MKT-RF) premium, the recently poor performance of non-US developed market stocks. In this data set, the value and profitability factors generated statistically reliable premiums at the 95% confidence level, whereas market, size, and investment factors did not.

Table 3 - ex-US Academic Factor Premiums 7/1/1990 - 6/30/2020

7/1/1990 - 6/30/2020	MKT-RF	SMB	HML	RMW	CMA
Annualized ex-US Five-Factor Premium (%)	2.40	0.81	3.01	4.30	1.34
t stat	1.25	0.82	2.36	5.00	1.36

Source: Benjamin Felix; Data source: Ken French Data Library

3.4 Emerging Markets Data

The emerging markets data similarly display less statistically reliable, though still economically meaningful premiums. Here, the value and investment factors provided statistically significant premiums to the 95% confidence level, whereas market, size, and profitability factors did not. Again, the short time series of historical data should be noted as a likely partial explanation for reduced statistical reliability.

Table 4 - Emerging Markets Academic Factor Premiums 7/1/1992 - 6/30/2020

7/1/1992 - 6/30/2020	MKT-RF	SMB	HML	RMW	CMA
Annualized EM Five-Factor Premium (%)	5.01	0.71	6.67	1.82	2.66
t stat	1.79	0.71	4.57	1.89	2.30

Source: Benjamin Felix; Data source: Ken French Data Library

3.5 The (un)Reliability of SMB

An interesting thread through these data, which speaks to the commentary in Section 2.5, is that the standalone SMB premium has not been statistically different from zero in any of the regions and time periods under examination. However, we know empirically that the other factors have been more economically meaningful and statistically reliable in smaller capitalization companies. The important implication for index investors is that a small cap index with no other factor loadings would not be expected to reliably improve the expected outcome.

4. Explaining Differences in Returns

The long-short factor portfolios can be used to run multiple linear regression analysis in order to determine what is driving the performance of a diversified portfolio. Considering the explanatory power of the Five-Factor model, we would not expect a substantial portion of returns to be left unexplained. Any unexplained portion of a portfolio's return is alpha.

4.1 A Multifactor Index

To illustrate the explanatory power of the Five-Factor model we will observe the historical results of the Dimensional US Core Equity Index. This is a retrospectively constructed index designed to target US securities with an emphasis on companies with smaller capitalization, lower relative price, and higher profitability, excluding those with the lowest profitability and highest relative price within the small cap universe. The index also excludes those companies with the highest asset growth within the small cap universe. An easy way to think about this index is that it is a US total market index with a slightly higher weight in smaller, cheaper, and more profitable companies relative to the market, with an exclusion for small cap growth companies with weak profitability that invest aggressively.

The index has delivered higher returns and higher risk-adjusted returns than the CRSP 1-10 Index, which represents the market capitalization weighted US market.

Table 5 - Historical Returns of Dimensional US Core Equity Index and CRSP 1-10 Index

1/1/1975 - 6/30/2020	Dimensional US Core Equity Index	CRSP 1-10 Index
Annualized Return (%)	13.52	12.12
Annualized Standard Deviation (%)	15.43	15.41

Source: Benjamin Felix; Data source: Dimensional Returns Web

While an annualized difference of 1.40% may not seem meaningful, over the full time period it results in a large difference in ending wealth. With a starting $10,000 invested in 1963 the Dimensional US Core Equity Index grew the asset to $3,209,000 by June 2020, while the CRSP 1-10 grew it to $1,819,000.

If it is the case that exposure to the known factors explains the excess risk-adjusted returns of the Dimensional US Core Equity Index relative to the CRSP 1-10 Index we would expect a multiple linear regression to result in a high coefficient of determination[1] and an alpha not statistically different from zero.

[1] The coefficient of determination, R^2, is a measure of how well an observed outcome is explained by a model. It is based on the proportion of the total variation of outcomes explained by the model.

Table 6 - Dimensional US Core Equity Index Factor Regression Output

1/1/1975 - 6/30/2020	MKT-RF	SMB	HML	RMW	CMA	Annualized Alpha (%)
Dimensional US Core Equity Index Five-Factor Loadings	1.01	0.11	0.13	0.14	0.05	-0.16
t stat	282.84	19.06	19.67	19.45	5.20	-0.92

Source: Benjamin Felix; Data source: Dimensional Returns Web, Ken French Data Library

As expected, we see a coefficient of determination of 99.73%, leaving almost none of the monthly variation in returns unexplained by the model, and an alpha that is not statistically different from zero. The fund has statistically significant loadings to the factors in the Five-Factor model. There are no surprises here considering that this index has been constructed specifically to capture the factor premiums.

If we were to compare the Dimensional US Core Equity Index to a market index like the CRSP 1-10 considering only their historical risk-adjusted returns from a CAPM perspective, the Dimensional index looks significantly better than the CRSP 1-10 index. Before multi-factor asset pricing models like the Five-Factor model, this performance difference could command a high fee – it would look like alpha. However, with the Five-Factor model it is possible to see that the performance can be systematically implemented through an index fund. The excess returns are no longer alpha; they are fully explained by the risk exposures of the index.

4.2 Dividend Growth Investing

Examining an index that has been designed to capture the factor premiums had a predictable result. The same analysis can be applied to strategies like dividend growth investing. It is easy to make the empirical observation that dividend growth stocks have matched the market's returns while being less volatile. Take the Vanguard Dividend Appreciation ETF, VIG, as an example. From June 2006 through June 2020 VIG delivered nearly identical annualized returns and higher CAPM risk-adjusted returns than the Vanguard Total Stock Market ETF, VTI.

Table 7 - Historical Returns of VIG and VTI

6/1/2006 - 6/30/2020	Vanguard Dividend Appreciation ETF	Vanguard Total Stock Market ETF
Annualized Return (%)	9.29	9.33
Annualized Standard Deviation (%)	12.50	14.72

Source: portfoliovisualizer.com

With the empirical observation alone there seems to be a link between dividend growth and risk adjusted stock returns. Are dividends special, or is there another explanation? By nature of the fact that they pay consistent and growing dividends, it is sensible to think that dividend growth stocks are likely to be larger stocks with robust profitability that reinvest conservatively – robust profits and conservative investment should result in the cash to pay consistently growing dividends. It would also be reasonable to expect companies with long histories of growing their dividends to have low prices relative to the book value of their assets – growth stocks with high prices relative to their book value do not tend to be dividend growth stocks.

The results are consistent with these expectations. In a Fama-French Five-Factor regression on VIG we see a coefficient of determination of 94.80% - the model explains 94.80% of the fund's monthly variation in returns. We see negative loading to the size factor and slight negative loading to the value factor. The slight negative loading to the size and value factors is expected based on the higher loading to the profitability factor alongside no controls for size and relative price. All these factor loadings are statistically significant at the 95% confidence level. We also see a negative alpha that is not statistically different from 0 at the 95% confidence level.

Table 8 - Vanguard Dividend Appreciation ETF Factor Regression Output

6/1/2006 - 6/30/2020	MKT-RF	SMB	HML	RMW	CMA	Annualized Alpha (%)
VIG Five-Factor Loadings	0.88	-0.15	-0.06	0.15	0.26	-0.48%
t stat	47.64	-4.49	-1.96	3.23	4.48	-0.55

Source: Benjamin Felix; Data source: Dimensional Returns Web, Ken French Data Library, Morningstar Direct

The ability of the historical long-short premiums in the Five-Factor model to explain differences in returns is powerful. Dividend growth investing is not the only case study. In the 2014 paper *Dissecting Anomalies with a Five-Factor Model*, Fama and French show that the higher average returns associated with low market beta, share repurchases, and low volatility are all well-explained by the Five-Factor model.

With its factor exposures it may seem that VIG is a reasonable ETF choice to capture the risk premiums in the Five-Factor model. The problem? The portfolio has a negative loading to both the size and value factors. More intentional portfolio construction, as opposed to the naïve factor exposures gained from a dividend growth focus, could solve this problem.

5. Persistence of the Premiums

We have seen the available historical data in full, which are compelling. However, looking at the full historical period means that we are not observing any sub-periods where the factor premiums may have been negative.

5.1 Rolling Historical Periods

If we look at 10-year rolling periods with a one-month step interval for US stocks from July 1963 through April 2020, SMB has been positive in 72% of rolling 10-year periods, HML has been positive in 86% of 10-year rolling periods, RMW has been positive in 86% of 10-year rolling periods, and the market has beaten treasury bills in 81% of rolling 10-year periods. Over 20-year periods the data are even more compelling. The following table summarizes the percent of historical rolling 10 and 20-year time periods where Five-Factor premiums were positive.

Table 9 - Persistence of US Academic Factor Premiums

7/1/1963 - 6/30/2020	US MKT	US SMB	US HML	US RMW	US CMA
10-year Positive Premiums (% of total periods)	80.70	71.50	86.02	85.66	98.40
20-year Positive Premiums (% of total periods)	100.00	82.47	100.00	100.00	100.00

Source: Benjamin Felix; Data source: Ken French Data Library

Reflecting on the data, we see that HML, RMW, and CMA have been more consistent at delivering a positive premium than the market over 10-year rolling historical periods.

Similar data are observed for global ex-US Developed stocks starting July 1990 and Emerging Markets stocks starting July 1992, both ending June 2020. There are not enough data for a meaningful 20-year rolling period comparison in these cases.

Table 10 - Persistence of ex-US Academic Factor Premiums

7/1/1990 - 6/30/2020	Ex-US MKT	Ex-US SMB	Ex-US HML	Ex-US RMW	Ex-US CMA
10-year Positive Premiums (% of total periods)	87.55	86.31	90.87	100.00	92.95

Source: Benjamin Felix; Data source: Ken French Data Library

Table 11 - Persistence of Emerging Markets Academic Factor Premiums

7/1/1992 - 6/30/2020	EM MKT	EM SMB	EM HML	EM RMW	EM CMA
10-year Positive Premiums (% of total periods)	85.71	49.77	99.08	100.00	100.00

Source: Benjamin Felix; Data source: Ken French Data Library

While the persistence over rolling periods alone is of some interest, the relative timing of positive premiums may be more important. When one premium has been negative, at least one of the others has tended to be positive in the sample. The chart below shows the 10-year rolling MKT, SMB, HML, RMW, and CMA premiums for US stocks from July 1963 through June 2020.

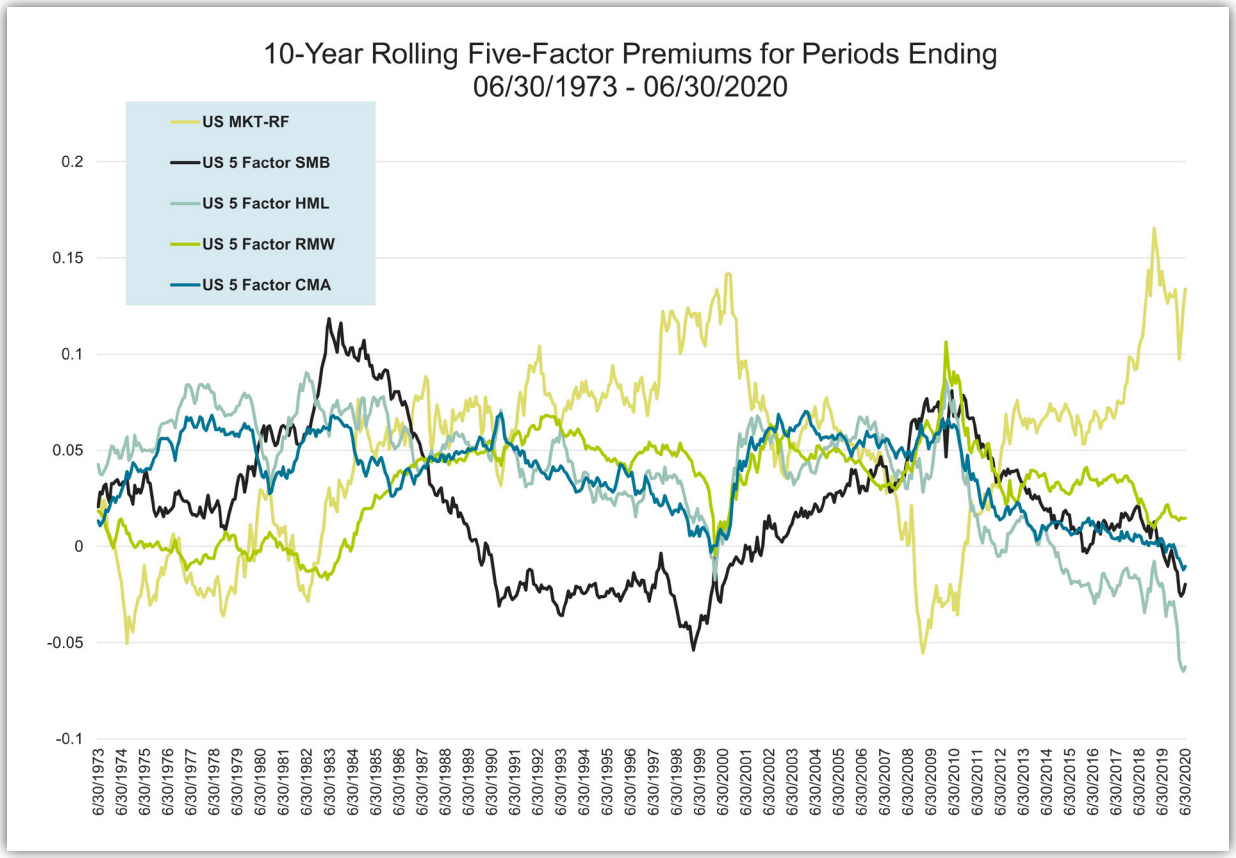

Figure 1 - 10-Year Rolling Five-Factor Premiums

Source: Benjamin Felix; Data Source: Ken French Data Library

The time-varying relationship between factor premiums is also observable through their historical correlations with each other, as seen in the following tables.

Table 12 - US Academic Premium Correlation Matrix 7/1/1963 - 6/30/2020

	MKT-RF	SMB	HML	RMW	CMA
MKT-RF	1.00	0.29	-0.22	-0.21	-0.38
SMB	0.29	1.00	-0.04	-0.34	-0.10
HML	-0.22	-0.04	1.00	0.07	0.68
RMW	-0.21	-0.34	0.07	1.00	-0.03
CMA	-0.38	-0.10	0.68	-0.03	1.00

Source: Benjamin Felix; Data source: Ken French Data Library

Table 13 - ex-US Academic Premium Correlation Matrix 7/1/1990 - 6/30/2020

	MKT-RF	SMB	HML	RMW	CMA
MKT-RF	1.00	-0.23	-0.14	-0.18	-0.38
SMB	-0.23	1.00	0.10	-0.06	0.02
HML	-0.14	0.10	1.00	-0.35	0.59
RMW	-0.18	-0.06	-0.35	1.00	-0.28
CMA	-0.38	0.02	0.59	-0.28	1.00

Source: Benjamin Felix; Data source: Ken French Data Library

Table 14 - EM Academic Premium Correlation Matrix 7/1/1992 - 6/30/2020

	MKT-RF	SMB	HML	RMW	CMA
MKT-RF	1.00	-0.21	0.12	-0.28	-0.30
SMB	-0.21	1.00	-0.02	-0.17	0.04
HML	0.12	-0.02	1.00	-0.53	0.31
RMW	-0.28	-0.17	-0.53	1.00	-0.14
CMA	-0.30	0.04	0.31	-0.14	1.00

Source: Benjamin Felix; Data source: Ken French Data Library

5.2 Waiting for the Premiums

One of the casual arguments against adding additional risk factors to portfolios is that the risk factors may take a long time to pay off. That is true - we have seen that there are historical 10-year periods with negative premiums for all the factors in the Five-Factor model. The current time period is an example; US value stocks have underperformed US growth stocks for more than 10 years at the time of writing. This experience is not a reason to avoid value stocks. The market premium has similarly had 10-year periods of underperformance in the past. When the market went through those periods, the size and value premiums were generally positive. It should be apparent in Figure 1 that this recent period is unusual relative to history with the market risk premium dominating while other premiums struggle.

A recent example of the market going through a prolonged period of underperformance is US stocks for the 10-year period ending July 2009. Over that time period the US stock market represented by the CRSP 1-10 index lost an annualized 0.19% while the Fama/French US Small Value Research Index returned an annualized 9.51%, the Fama/French US Value Research Index returned an annualized 3.78%, the Fama/French US High Profitability Research Index returned an annualized 2.09%, and one-month US Treasury Bills returned an annualized 2.95%. The growth of $1 in each of these indices over the 10-year time period is illustrated in Figure 2.

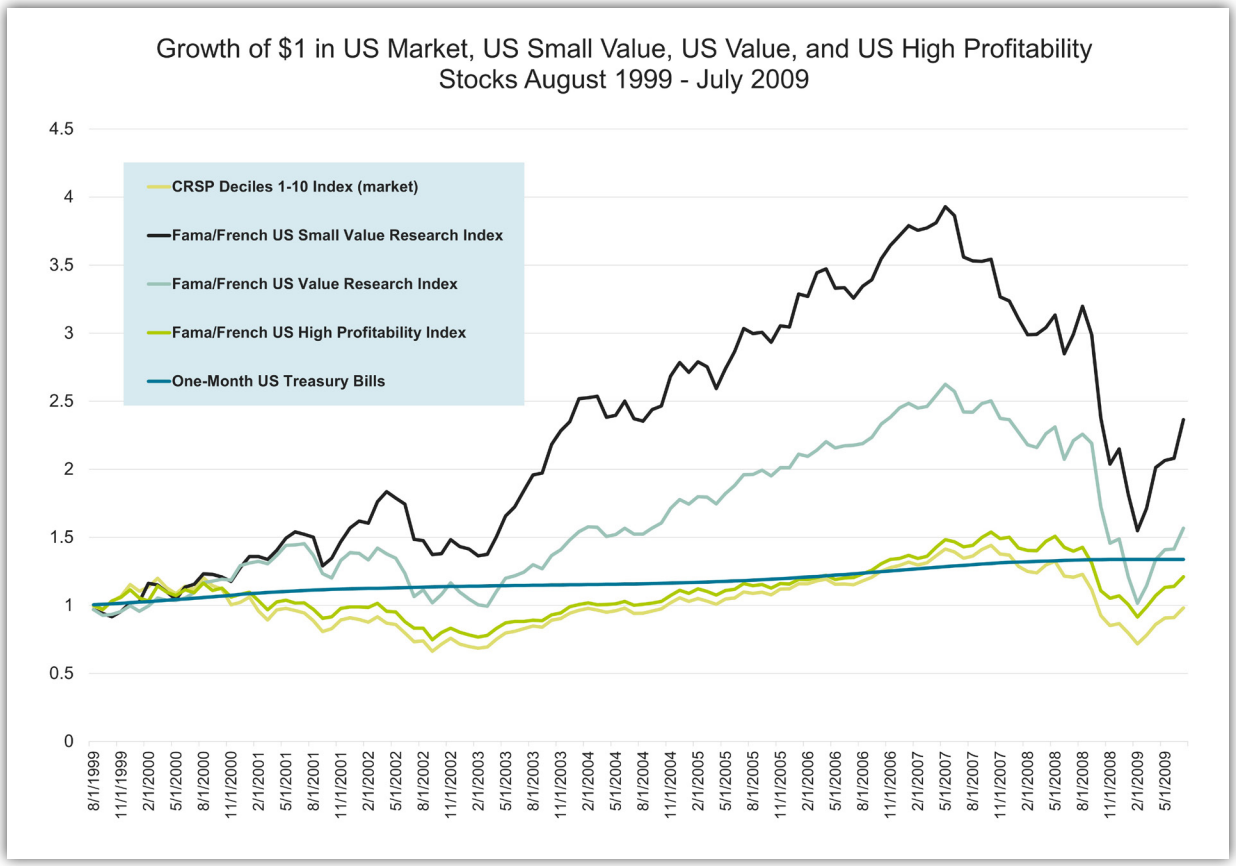

Figure 2 - Growth of Wealth in US Stocks 1999 – 2009.

Source: Benjamin Felix; Data Source: Dimensional Returns Web.

This is far from an isolated incident. There were 111 10-year periods ending between July 1973 and June 2020 where the US market premium was negative. Over those same 111 periods where the market premium was negative, SMB, HML, and CMA were all positive, while RMW was negative in 53 of the 111 periods.

The single worst time to retire in the US stock market data was December 1968. From then until January 1984, the US market gained an annualized 7.26%, but trailed one-month US Treasury Bills which returned an annualized 7.63%, and barely beat inflation which ran at an annualized 7.22%. Over the same time period, the Fama/French US Small Value Research Index returned 15.80% annualized, and the Fama/French US Value Research Index returned 13.46% annualized.

A more extreme example is Japan from July 1990 through December 2019. Over the full period the Japanese stock market measured by the Fama/French Japan Market Index delivered an annualized return of 2.36%, trailing one-month US Treasury Bills which returned 2.63%. The Fama/French Japan High Profitability Index delivered similar performance at an annualized 2.27%. Meanwhile, the Dimensional Japan Small Cap Value Index and the Fama/French Japan Value Index delivered annualized returns of 5.43% and 7.96% respectively. The growth of $1 in each of these Japanese indices from 1990 to 2019 is illustrated in Figure 3.

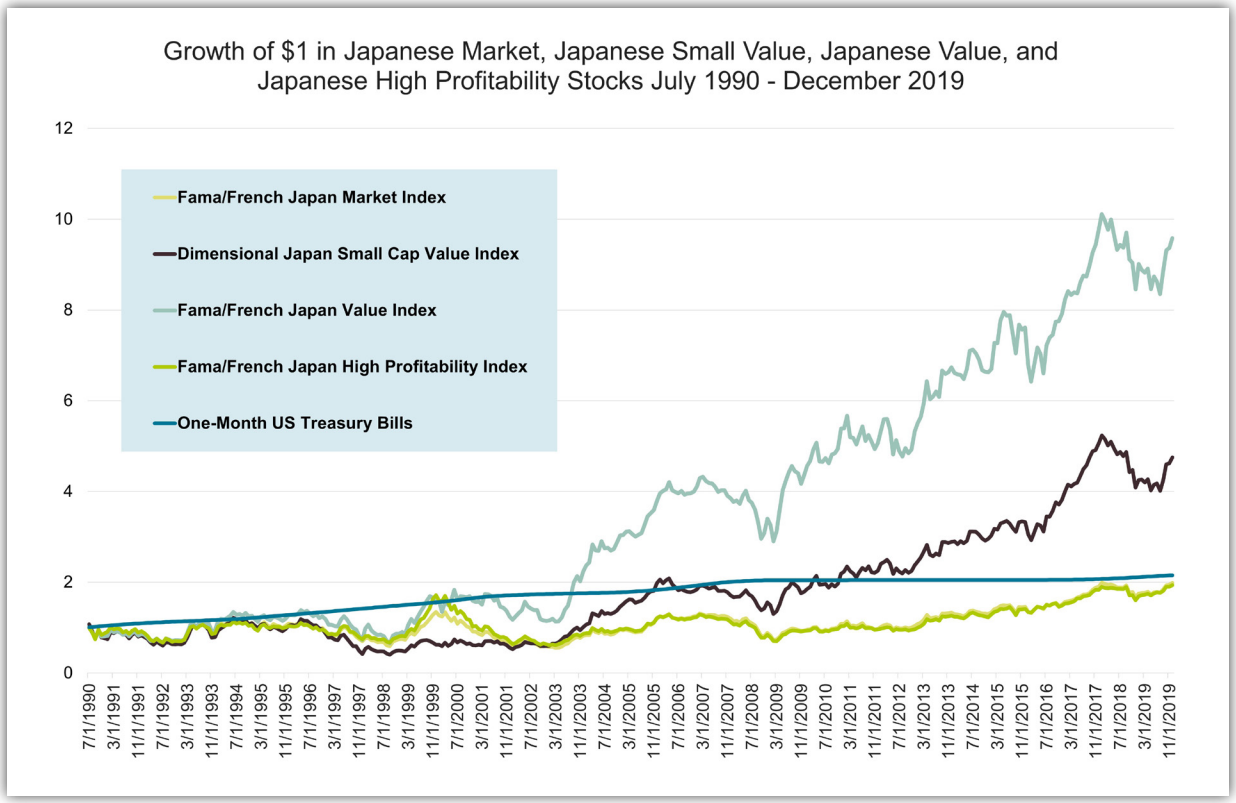

Figure 3 - Growth of Wealth in Japanese Stocks July 1990 - December 2019

Source: Benjamin Felix; Data Source: Dimensional Returns Web.

The statement that equity risk factors may take a long time to deliver their premiums is true, but the market risk premium is not immune to those periods of underperformance. In fact, the market has historically been less reliable at delivering positive 10-year premiums than most of the other risk factors. Combining multiple risk premiums together in a portfolio not only increases expected returns, it adds independent sources of expected returns which may show up at different times to increase the reliability of the long-term outcome.

Understanding the evidence is important – it is only useful if it can be applied to practical portfolio construction.

6. Five-Factor Investing with ETFs

Product availability has been one of the biggest constraints for investors wishing to capture multiple risk premiums in a low-cost and well-diversified portfolio. Dimensional Fund Advisors has been implementing empirical asset pricing anomalies and asset pricing theory into investment portfolios for as long as the evidence and theory have existed – Dimensional launched their first product coincident with Banz' 1981 paper. Unfortunately for DIY ETF investors, Dimensional has only recently filed for a handful of ETFs and otherwise restricts access to their mutual funds to institutions and clients of certain investment firms.

6.1 Product Availability

In our March 2019 paper *Factor Investing with ETFs*, we demonstrated that many funds labeled as "multifactor" fail to deliver meaningful exposure to the desired characteristics, especially after costs. A possible explanation for the observed "light" risk factor exposure in many retail products is that fund companies want to minimize their funds' tracking error relative to the capitalization weighted index to avoid volatile asset flows.

In that paper we proposed a portfolio with exposure to US value through the iShares Core S&P U.S. Value ETF and US small cap value through the iShares S&P Small-Cap 600 Value ETF to gain access to some of the known risk factors. That portfolio intentionally targeted size and value in the US while ignoring US profitability and investment based on a lack of low-cost, well-diversified, and low turnover product availability; outside of the US, factors were ignored entirely for the same reason.

More recently Avantis Investors launched ETF products that, in broad terms, mirror the approach of Dimensional Fund Advisors. Using these products, we have constructed a model portfolio that is designed to approximate the characteristics of the portfolios that we use for our wealth management clients.

6.2 Approach to Obtaining Factor Exposure

One of the fundamental portfolio management decisions required when constructing a portfolio designed to capture multiple risk factors is whether the desired factors will be targeted across the full spectrum of market capitalizations (small, mid, large) or targeted only in small caps. Targeting a given level of factor exposure across the full spectrum of capitalizations results in less concentration in individual securities, which is desirable. There is strong evidence from Bessembinder (2018) and Dai and Wicker (2018) that more concentrated portfolios are increasingly likely to underperform especially over long periods of time due to the skewness in individual stock returns. However, the products available for Canadians to target risk factors are listed on US exchanges, adding additional complexity and cost to the portfolio management process. To manage these trade-offs, we have taken the approach of combining US listed small cap value funds with Canadian listed market capitalization weighted funds for this model portfolio. Our ideal portfolio is factor tilted across the full spectrum of market capitalizations, but we believe that given the other considerations this is a reasonable trade-off.

One of the biggest considerations for investors implementing this strategy is that the concentrated nature of the factor exposure may result in behavioral challenges to sticking with the strategy. At the portfolio level volatility should not be materially different from a market capitalization weighted portfolio, but the small cap value holdings on their own are likely to exhibit higher volatility.

6.3 Avantis ETFs

It is important to note that as the Avantis products are relatively new there is insufficient historical live fund data to perform meaningful analysis on them. Instead, we are using a combination of hypothetical back-tested data net of fund fees and live fund data where it is available. Back-tested data tends to look good, often better than comparable live fund data. However, back-test data should still provide insight for our purpose of evaluating the fund strategies' exposure to the risk factors that we want to target in portfolios.

We will use five-factor regression based on the Fama French Five-Factor model to estimate factor exposure. Regression outputs tell us how much of a factor premium a fund would have historically captured. Alpha in the regressions is the component of fund returns that was not explained by factor exposure. It may have come from security selection, market timing, rebalancing, or exposure to some as-yet unknown factor that is not included in the Five-Factor model.

In addition to back-tested returns data and regression outputs we will examine the characteristics of each fund relative to a capitalization-weighted total market benchmark.

6.3.1 AVUV

AVUV is the Avantis U.S. Small Cap Value ETF. This fund is intended to be a US small cap ETF that emphasizes cheaper and more profitable companies within the small cap universe. AVUV has a management fee of 0.25%. Relative to the US total market, AVUV is substantially smaller and contains lower priced stocks.

Table 15 - AVUV Characteristics

Characteristics 6/30/2020	Avantis U.S. Small Cap Value ETF	Russell 3000
Weighted Average Market Cap	$1.9B	$328.4B
Weighted Average Book/Market	1.23x	0.21x
Weighted Average Profits/Book	0.32x	0.47x
Number of Holdings	507	3,009

Data source: FactSet

Table 16 - AVUV Five-Factor Regression Outputs

	Annualized Alpha	MKT-RF	SMB	HML	RMW	CMA
Avantis U.S. Small Cap Value ETF 1/1/1979 - 6/30/2020*	0.43%	1.03	0.89	0.55	0.34	-0.04
t stat	1.04	124.04	72.80	36.52	20.89	-1.46

*hypothetical 1/1/1979 - 09/30/2019

Table 17 - AVUV Historical Performance (Hypothetical until 09/30/2019)

Portfolio performance 1/1/1979 - 4/30/2020 (CAD, %)	Avantis U.S. Small Cap Value ETF*	Russell 3000 Index
1-Year Return	-17.86	10.43
3-Year Annualized Return	-3.77	11.74
5-Year Annualized Return	1.38	11.88
10-Year Annualized Return	11.12	16.52
20-Year Annualized Return	9.94	5.69
Full period Annualized Return	16.11	12.04
Full period Annualized Standard Deviation	17.12	13.80
Lowest 1-Year Return (4/19 - 3/20); (4/02 - 3/03)	-35.77	-30.64

*hypothetical 1/1/1979 - 09/30/2019

6.3.2 AVDV

AVDV is the Avantis International Small Cap Value ETF. This fund is intended to be a non-U.S. developed small cap ETF that emphasizes cheaper and more profitable companies within non-U.S. developed countries. AVDV has a management fee of 0.36%.

Table 18 - AVDV Characteristics

Characteristics 6/30/2020	Avantis International Small Cap Value ETF	MSCI World ex USA Index
Weighted Average Market Cap	$2.0B	$52.9B
Weighted Average Book/Market	1.23x	0.59x
Weighted Average Profits/Book	0.36x	0.29x
Number of Holdings	864	3,498

Data source: FactSet

Table 19 - AVDV Five-Factor Regression Outputs

	Annualized Alpha	MKT-RF	SMB	HML	RMW	CMA
Avantis International Small Cap Value ETF 1/1/2003 - 6/30/2020*	0.90%	1.11	0.72	0.39	0.09	-0.31
t stat	0.81	50.59	14.29	5.88	0.96	-3.92

*hypothetical 1/1/2003 - 09/30/2019

Table 20 - AVDV Historical Performance (Hypothetical until 09/30/2019)

Portfolio performance 1/1/2003 - 6/30/2020 (CAD, %)	Avantis International Small Cap Value ETF*	MSCI World ex USA Index (gross div.)
1-Year Return	-8.01	-1.18
3-Year Annualized Return	-1.11	2.85
5-Year Annualized Return	3.50	4.44
10-Year Annualized Return	10.18	8.78
Full period Annualized Return	9.94	6.51
Full period Annualized Standard Deviation	15.79	12.57
Lowest 1-Year Return (11/07 - 10/08); (3/08 - 2/09)	-44.59	-35.44

*hypothetical 1/1/2003 - 09/30/2019

7. Proposed Equity Model Portfolio

Based on the information presented in this paper, it would seem sensible to target multiple risk factors in a portfolio. In order to accomplish factor exposure without making things too complicated we propose a 6 ETF equity portfolio consisting of primarily Canadian listed ETFs. Our factor exposure comes from AVUV and AVDV, both US listed ETFs. A feature of this model is that it lends itself to easy adaptation for RRSP tax efficiency using US listed ETFs; VUN, XEF, and XEC have US listed counterparts (VTI, IEFA, and IEMG) which would increase the portfolio's tax efficiency in an RRSP account without affecting the portfolio's overall asset class exposures presented in *Factor Investing with ETFs* (2019) by adding exposure to International small cap value stocks, and by using funds that consider all five factors as opposed to only three of them. It does however give up exposure to large and mid-cap value in an effort to keep things simple.

Table 21 - Proposed Five-Factor ETF Model Portfolio

Fund		Factor Tilted	Benchmark
iShares Core S&P/TSX Capped Composite ETF	XIC	30%	30%
Vanguard US Total Market ETF	VUN	30%	40%
Avantis U.S. Small Cap Value ETF	AVUV	10%	0%
iShares Core MSCI EAFE IMI Index ETF	XEF	16%	22%
Avantis International Small Cap Value ETF	AVDV	6%	0%
iShares Core MSCI Emerging Markets IMI Index ETF	XEC	8%	8%
Weighted Average Expense Ratio		0.17%	0.11%

Table 22 - Five-Factor ETF Model Portfolio Historical Performance (Performance Methodology in Appendix B)

Portfolio performance 7/1/2000 - 6/30/2020 (CAD,%)	Factor Tilted	Benchmark
1-Year Return	-0.66	2.48
3-Year Annualized Return	4.65	6.29
5-Year Annualized Return	6.07	7.13
10-Year Annualized Return	10.14	10.55
20-Year Annualized Return	5.78	4.96
20-Year Annualized Standard Deviation	12.29	11.93
Growth of $10,000	$30,800	$26,300
Lowest 1-Year Return (3/08 - 2/09)	-33.75	-33.65

Appendix A – Model Portfolio Performance Methodology

iShares Core S&P/TSX Capped Composite ETF

- 07/2000 - 02/2001: Monthly return of S&P/TSX Capped Composite Total Return Index net of 0.0050% estimated fees per month
- 03/2001 - present: Monthly return of the iShares Core S&P/TSX Capped Composite ETF

iShares Core S&P U.S. Total Market Index ETF

- 07/2000 - 08/2013: Monthly return of MSCI USA Net Return Index net of 0.013% estimated fees per month
- 09/2013 - present: Monthly return of Vanguard US Total Market ETF

Avantis U.S. Small Cap Value ETF

- 07/2000 - 09/2019: Avantis monthly US small cap value backtest data net of estimated withholding taxes and 0.021% estimated fees per month
- 10/2019 - present: Monthly returns of Avantis U.S. Small Cap Value ETF

iShares Core MSCI EAFE IMI Index ETF

- 07/2000 - 04/2013: Monthly return of MSCI EAFE IMI Net Return Index net of 0.018% estimated fees per month
- 05/2013 - present: Monthly return of iShares Core MSCI EAFE IMI Index ETF

Avantis International Small Cap Value ETF

- 07/2000 - 12/2002: Monthly returns of the Dimensional International Small Cap Value Index net of estimated withholding taxes and 0.030% estimated fees per month
- 01/2003 - 09/2019: Avantis monthly International small cap value backtest data net of estimated withholding taxes and 0.030% estimated fees per month
- 10/2019 - present: Monthly returns of Avantis International Small Cap Value ETF

iShares Core MSCI Emerging Markets IMI Index ETF

- 07/2000 - 04/2013: Monthly return of MSCI EM IMI Net Return Index net of 0.023% estimated fees per month
- 05/2013 - present: Monthly return of iShares Core MSCI Emerging Markets IMI Index ETF

Appendix B - Backtest data and Index Methodologies

The backtested Avantis performance results provided here are largely hypothetical (until October, 2019). Hypothetical performance results have many inherent limitations. Hypothetical trading does not involve financial risk, and no hypothetical trading record can completely account for the impact of financial risk in actual trading. In addition, the hypothetical performance results do not represent actual recommendations or trading decisions, and they may not reflect the impact that economic and market factors might have had on the investment decision-making. For example, the ability to withstand losses or to adhere to a particular trading program in spite of losses can adversely affect actual results. There are numerous other factors related to the markets in general or to the implementation of any specific trading program that cannot be fully accounted for in the preparation of hypothetical performance results, but which can adversely affect actual results.

No representation is being made that any account will or is likely to achieve profits or losses similar to those shown. In fact, there are frequently sharp differences between hypothetical performance results and actual results. Backtested performance results do not represent the results of actual trading using client assets but were achieved by means of the retroactive application of a hypothetical portfolio that was designed with the benefit of hindsight. The hypothetical performance results should not be considered indicative of any actual performance results, or of any results that could be attained by clients. Backtested performance is no guarantee of future results. The hypothetical strategy performance was calculated using historical US company data on a monthly basis with annual reconstitutions and assuming dividend reinvestments. The hypothetical strategy focuses on securities of companies in the small cap universe that have high equity to price and high profitability. Returns are gross of fees and do not assume any trading costs.

The Dimensional International Small Cap Value Index has been retrospectively calculated by Dimensional Fund Advisors and did not exist prior to April 2008. Accordingly, the results shown during the periods prior to April 2008 do not represent actual returns of the Index. The calculation methodology for the Dimensional International Small Cap Value Index was amended in January 2014 to include profitability as a factor in selecting securities for inclusion in the index. The calculation methodology for the Dimensional International Small Cap Value Index was amended in November 2019 to include asset growth as a factor in selecting securities for inclusion in the index. The Dimensional International Small Cap Value Index consists of small cap companies in eligible markets whose relative price is in the bottom 35% of their country's respective constituents, after the exclusion of utilities and companies with either negative or missing relative price data. The index excludes securities with the lowest profitability within their country's small cap universe. The index also excludes those companies with the highest asset growth within their country's small cap universe. Profitability is defined as operating income before depreciation and amortization minus interest expense divided by book equity. Asset growth is defined as change in total assets from the prior fiscal year to current fiscal year. The index monthly returns are computed as the simple average of the monthly returns of four sub-indices, each one reconstituted once a year at the end of each quarter of the year. Maximum index weight of any one company is capped at 5%. Countries currently included are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, and United Kingdom. Exclusions: REITs and Investment Companies. Dimensional Index data compiled by Dimensional.

Appendix C - Foreign Withholding Tax

Using US listed ETFs as a Canadian investor has some unique tax implications that need to be considered. When a dividend is paid by a company to a foreign shareholder, the country of origin will typically withhold some tax. For example, a Japanese company paying a dividend to a Canadian shareholder would result in some tax being withheld before the dividend leaves Japan. There are two levels of foreign withholding tax that a Canadian resident investor may experience. Level 1 withholding tax is withheld by the source country – Japan in the previous example. Level 2 withholding tax occurs when the Japanese stock is owned inside of a US listed ETF. In that case Japan withholds tax before paying the dividend to the US shareholder (the ETF) and then the US withholds tax when the ETF pays the dividend to the Canadian unitholder. US withholding tax is 15% for a Canadian investor who has certified their Canadian residency using the form W-8 BEN. Foreign non-US withholding tax for a US resident (the US listed ETF's residency) is closer to 8-9% on average across foreign developed countries and 14-15% for emerging markets. Estimating the average foreign withholding tax rate in an international developed or emerging markets ETF is accomplished by examining the fund's annual report. Depending on the account type and the underlying ETF structure, different levels of foreign withholding tax can be expected.

Table 18 - Foreign Withholding Tax by Account Type

Held in your account	Held in the ETF	RRSP		TFSA		Taxable	
		Level 1	Level 2	Level 1	Level 2	Level 1	Level 2
US Listed ETF	US Stocks	Exempt	Not applicable	Unrecoverable	Not applicable	Recoverable	Not applicable
US Listed ETF	International Developed Stocks	Unrecoverable	Exempt	Unrecoverable	Unrecoverable	Unrecoverable	Recoverable
US Listed ETF	Emerging Markets stocks	Unrecoverable	Exempt	Unrecoverable	Unrecoverable	Unrecoverable	Recoverable
Canadian Listed ETF	US Listed ETF of US stocks	Unrecoverable	Not applicable	Unrecoverable	Not applicable	Recoverable	Not applicable
Canadian Listed ETF	US Stocks	Unrecoverable	Not applicable	Unrecoverable	Not applicable	Recoverable	Not applicable
Canadian Listed ETF	US Listed ETF holding International Developed Stocks	Unrecoverable	Unrecoverable	Unrecoverable	Unrecoverable	Unrecoverable	Recoverable
Canadian Listed ETF	International Developed stocks	Unrecoverable	Not applicable	Unrecoverable	Not applicable	Recoverable	Not applicable
Canadian Listed ETF	US Listed ETF holding Emerging Markets stocks	Unrecoverable	Unrecoverable	Unrecoverable	Unrecoverable	Unrecoverable	Recoverable

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