Do Portfolio Factors or Characteristics Drive Expected Returns?

by

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ABSTRACT

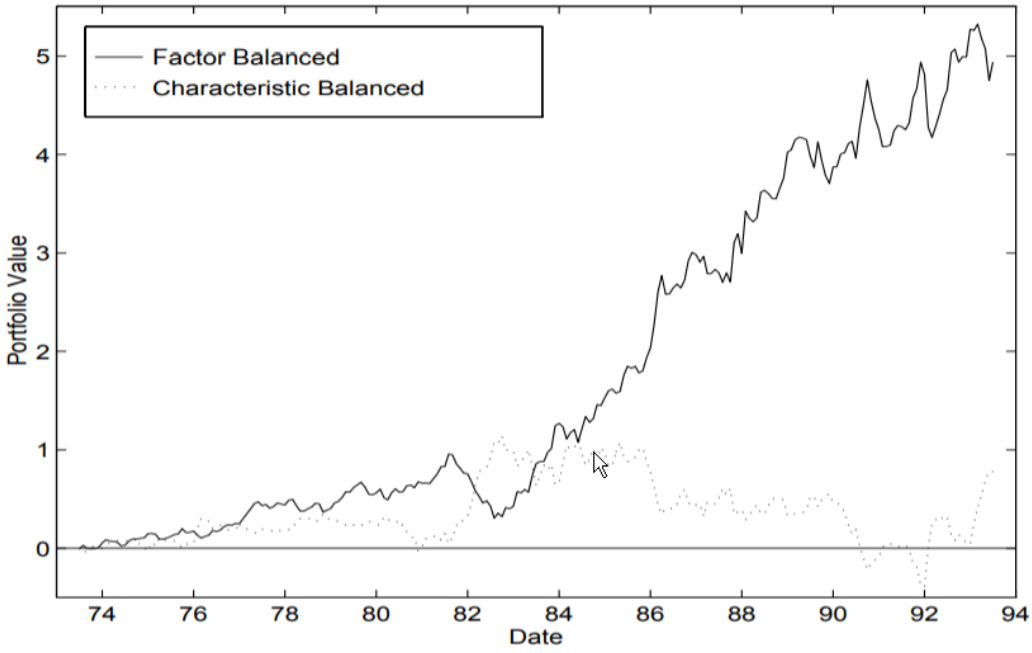
This article examines a somewhat overlooked, but important, discussion that raged among academic researchers in the late 1990s and early 2000's. The topic: **factors versus characteristics.**

What do you mean, *"Factors versus characteristics?"*

We often highlight that the value premium can be explained by either risk and/or mispricing. A core aspect of the risk argument is that a portfolio's factor "loading," or covariance, on a specific factor (e.g., Fama and French HML value factor) represents a proxy for some unobserved systematic risk. The characteristics argument claims that value firms earned a higher expected return simply because they have higher B/M ratios (which may be independent of systematic risk).

The evidence from the primary set of papers (here and here) under discussion strongly suggests that investors should focus on characteristics, not factors:

Figure 5: Cumulative Returns on Characteristic and Factor Balanced Portfolios



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As we'll show, the debate is arguably not as clear as the chart above seems to suggest, and academics have continued to argue over the interpretation of the value premium for almost 25 years now. ***Why?*** The argument driving the value premium underlies core arguments related to how markets work -- a fundamental question we still don't completely understand.

A summary of each argument is described below: [1]

- The risk theory says that Value stocks are inherently riskier due to a loading on an unknown distress factor. Since they are riskier, investors should demand a higher

rate of return for taking on additional risk. Under this model, the value premium will continue to exist as long as investor risk preferences stay the same; however, if investor risk preferences change and they are willing to take on additional risk for a lower rate of return (unlikely!), the value premium would go away. [2].

- The LSV behavioral theory is a mispricing theory that claims that investors incorrectly extrapolate past growth rates (behavioral error) and cause value stocks to be under-priced, and growth stocks to be over-priced--this causes the future higher (lower) returns to value (growth) stocks. [3]

Under this model, the value premium will continue to exist as long as investors continue to make behavioral errors and the limits to arbitrage exist--we give a deep explanation of this model here. However, if investors stop making behavioral errors **and** the limits to arbitrage disappear, the value premium would go away. [4]

The characteristic theory claims that characteristics explain the cross-section of stock returns and that value firms had higher returns due to having a certain characteristic, such as a high B/M ratio. What are the implications for this model? Directly from the last paragraph of the 1997 Daniel and Titman paper: [5]

> *Another possibility is that investors consistently held priors that size and book-to-market ratios were proxies for systematic risk and, as a result, attached higher discount rates to stocks with these characteristics. … If this is the case, then the patterns we have observed in the data should not be repeated in the future.*

So what's the answer? A new paper entitled, "Interpreting Factor Models," says it best:

> *We argue that tests of reduced-form factor models and horse races between "characteristics" and "covariances'" cannot discriminate between alternative models of investor beliefs.*

In short, nobody really knows.

We would argue that there is a mix of all three ideas going on at the same time. As more investors learn about an investment approach that previously had higher returns (value investing), the expected returns to that approach may diminish in the future (implication of the characteristic theory), if arbitrage constraints are minimal. [6]

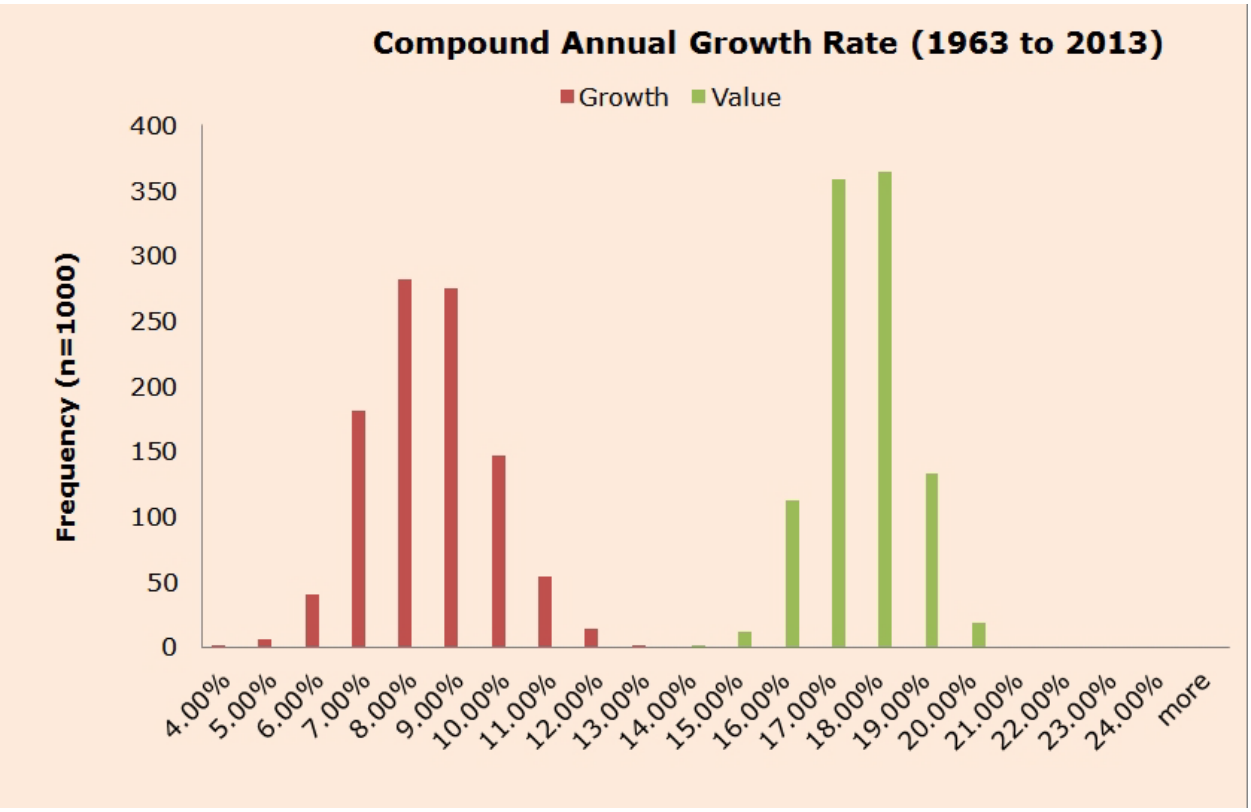
The rest of the article is broken into three sections:

1. A dive into the characteristic versus risk debate.
2. An examination of what this means for a long-only value investor
3. A review of live portfolios with a breakdown of factors and characteristics

Let's dig into the debate on factors or characteristics.

1. Do Portfolio Factors or Characteristics Drive Expected Returns?

Most in finance are aware of the value premium: Historically, cheap stocks have outperformed expensive stocks (based on some price to fundamental). Below is a chart from a simulation exercise which highlights the performance of cheap vs. expensive portfolio simulations from 1963 to 2013.



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One of the original papers on the value premium topic was Fama and French in 1993. In their paper, they find that there are three factors (the market, size, and value proxied by Mkt_rf, SMB, and HML) that explain the cross-section of stock returns. More important to this discussion, they suggest that value is a ***risk factor,*** as value firms covary with one another. In their story, the covariance matters, and is why the loading on HML is important. [7]

But what are some implications of this theory? Directly from FF 1993:

> *The regression slopes and the historical average premiums for the factors can then be used to estimate the (unconditional) expected return for the portfolio.*

In other words, the HML loading can be used to estimate future expected returns. A higher loading implies a higher amount of risk, which implies a higher rate of expected return. This is exactly the type of interpretation we often hear from DFA advisors, many of whom have been taught by Fama and French.

But the factor approach (and the reliance on regression slopes to make decisions) is not a panacea and has plenty of holes like any other approach.

We have discussed in detail, an alternative explanation to risk being the driver of the value premium is the LSV behavioral theory. The LSV theory suggests that investors over extrapolate data, causing prices to sometimes deviate from fundamentals and limits to arbitrage prevent these mispricings from being "arbitraged" away.

It is important, for this discussion, to note that the argument between the risk and LSV behavior camps does not focus on whether or not the return premia of value and small firms can be explained by a **factor** model--they agree it can. However, they argue whether the factors represent an economically relevant risk or mispricing that is costly to exploit.

However, there is a 3rd explanation for the value premium, which is also a "mispricing" based argument--the premium is simply driven by ***characteristics*** (not covariances, or factors). In other words, your HML loading does **NOT** matter, but your portfolio book-to-market ratio does matter.

Why Characteristics Matter: The Theory

This theory was proposed by Kent Daniel and Sheridan Titman in 1997, in their paper titled "Evidence on the Characteristics of Cross Sectional Variation in Stock Returns." [8,9]

This is a well-written paper. The introduction very clearly states what the paper will test, and what they find:

> *In contrast, this article addresses the more fundamental question of whether the return patterns of characteristic-sorted portfolios are really consistent with a factor model at all. Specifically, we ask (1) whether there really are pervasive factors that are directly associated with size and book-to-market; and (2) whether there are risk premia associated with these factors. In other words, we directly test whether the high returns of high book-to-market and small size stocks can be attributed to their factor loadings.*
>
> *Our results indicate that (1) there is no discernible separate risk factor associated with high or low book-to-market (characteristic) firms, and (2) there is no return premium associated with any of the three factors identified by Fama and French (1993), suggesting that the high returns related to these portfolios cannot be viewed as compensation for factor risk...*
>
> *Once we control for firm characteristics,* ***expected returns do not appear to be positively related*** *to the loadings on the market, HML, or SMB factors.*

So what this paper is trying to argue is that after controlling for characteristics, factor exposures (i.e., factor "loadings") don't tell us much about expected returns. In other words, if an investor is calculating "HML loadings" as a means to tell them something about future returns, they should stop this practice. Instead, investors should identify the

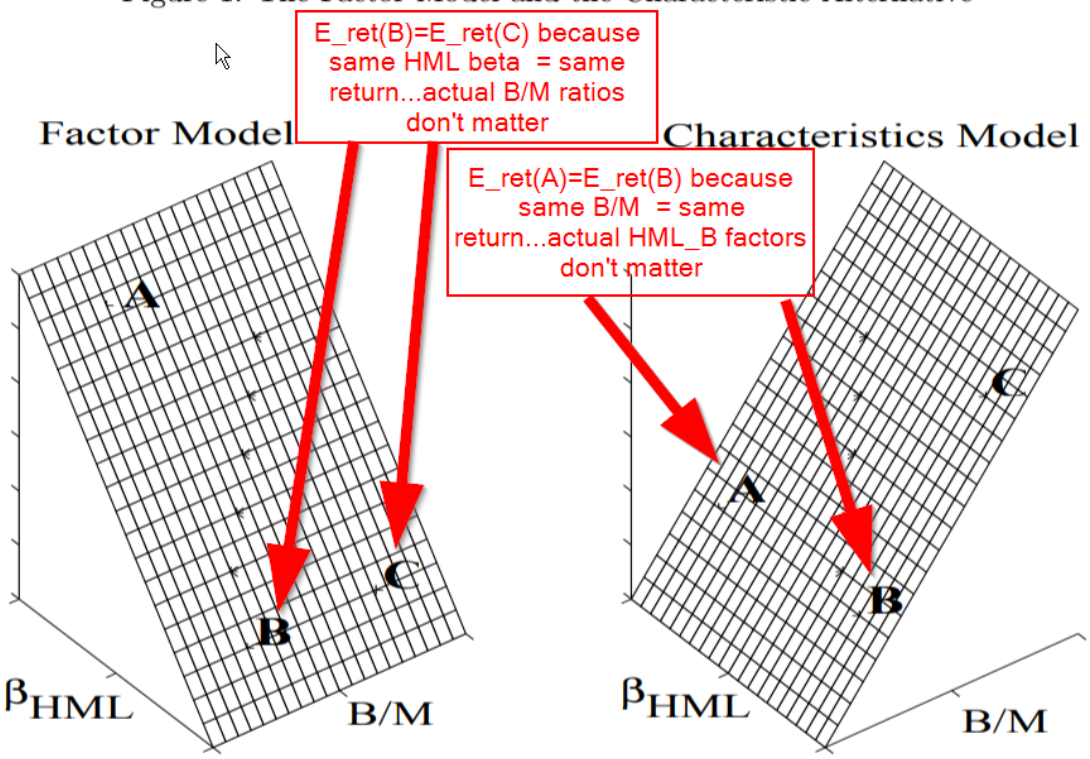
book-to-market ratio of their portfolio, which will be much more predictive of expected returns.

Before digging into Daniel and Titman's 1997 Journal of Finance paper, I will quote and use a few images from their 1998 Journal of Portfolio Management paper, which nicely explains their argument. This paper can be found here and a working paper (used below) can be found here. Consider that we have 3 stocks: A, B, and C. Here are the assumed facts about these securities:

- Stock A and stock B have the same B/M ratio
- Stock A has a higher HML loading (β_{HML}) than stock B.
- Stock C has a higher B/M ratio than stock B.
- Stock B and stock C have the same HML loading (β_{HML}).

Figure 1 highlights the facts, and the arguments for the factor model versus the characteristic model. The y-axis in this image is expected returns. As can be seen in the left image, if the factor model is correct, then firms with the same β_{HML}, such as firms B and C, should have the same expected return. On the other hand, A has a higher β_{HML} than B or C, which implies that A should have a higher expected return, according to the factor model. Now the right image documents the characteristic model. Here, stocks A and B have the same B/M ratio, so they should have the same expected return. Since C has a higher B/M ratio than A and B, it should have a higher expected return. according to the characteristic model.

Figure 1: The Factor Model and the Characteristic Alternative



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Why Characteristics Matter: The Evidence

In the 1997 paper, the authors form 45 portfolios to test their idea that characteristics are better than factors (covariances). The form portfolios employing a 3-way split. They first split firms into 3 groups on both size and B/M, yielding 9 portfolios. Within each of the 9 portfolios, they then split firms into five groups based on their HML loading, yielding 45 portfolios. Table IV of the 1997 paper highlights shows the 45 portfolios, first split on size and B/M, and then on HML. [10]

Table IV

Average Book-to-Market and Size of Test Portfolios

Portfolios are formed based on size (SZ), book-to-market (BM), and preformation HML factor loadings. At each yearly formation date, the average size and book-to-market for each portfolio is then calculated, using value weighting:

$$\overline{SZ}_t = \frac{1}{\Sigma_i \, ME_{i,t}} \sum_i ME_{i,t}^2 \qquad \overline{BM}_t = \frac{1}{\Sigma_i \, ME_{i,t} \, \Sigma_i \, BM_{i,t} \cdot ME_{i,t}}.$$

Then, at each point, $\overline{SZ}_t$ and $\overline{BM}_t$ are divided by the median market equity (ME) and median book-to-market for NYSE firms at that point in time. The two time series are then averaged to get the numbers that are presented in the table below.

Char Port		Factor Loading Portfolio				
BM	SZ	1	2	3	4	5
		Panel A: Book-to-Market Relative to Median				
1	1	0.415	0.466	0.492	0.501	0.440
1	2	0.404	0.453	0.487	0.501	0.505
1	3	0.360	0.399	0.457	0.507	0.542
2	1	0.980	0.991	1.013	1.017	1.011
2	2	0.963	0.996	1.003	1.013	1.021
2	3	0.949	0.975	0.998	1.027	1.025
3	1	1.908	1.841	1.876	1.941	2.242
3	2	1.624	1.725	1.708	1.732	1.890
3	3	1.568	1.563	1.554	1.638	1.747
Average		1.019	1.045	1.065	1.097	1.158

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http://www.kentdaniel.net/papers/published/jf97.pdf

How does one go about testing the characteristic model against the factor model when characteristics and factors are so correlated? [11]

The authors build what they call characteristic balanced portfolios based on HML loadings. [12]

For each of the 9 portfolios split on size and B/M, the authors go long the top two portfolios on the HML loadings and short the bottom two portfolios on the HML loadings. In the end, each portfolio has similar characteristics, such as size and B/M ratios, but the HML dimension is allowed to vary. [13]

What would the factor model predict versus the characteristics model predict for these portfolios?

The factor model would suggest the following:

- The L/S portfolio should have positive expected returns because the portfolios are long the high HML firms and short the low HML firms.
- Alpha should be zero because the Fama and French 3-factor model will pick up the variation in returns via a higher HML loading.

The characteristic model predicts something different:

- The L/S should have flat expected returns because the portfolios are formed with similar characteristics (Size and B/M).
- Alpha could be positive because the 3-factor model may fully not pick up the variation in returns due to characteristics.

Table VI of the paper highlights the ***main takeaway.*** As shown below, the combined portfolio, which is long high HML firms and short low HML firms, while controlling for the characteristics, has a positive and significant 3-factor alpha. In addition, from the text of

the paper, the mean return to this portfolio is -0.116% per month, and is not significantly different from zero (t-stat of -0.60).

The evidence supports the characteristics model's predictions: Controlling for characteristics, factor loadings don't matter.

Table VI

Regression Results for the Characteristic-Balanced Portfolios

This table presents each of the coefficients and t-statistics from the following time-series regression of the zero-investment portfolio returns, described below, on the excess-Market, SMB and HML portfolio returns:

$$R_{i,j,k} - R_f = \alpha + \beta_{\text{Mkt}} \cdot R_{\text{Mkt}} + \beta_{\text{HML}} \cdot R_{\text{HML}} + \beta_{\text{SMB}} \cdot R_{\text{SMB}}.$$

The regressions are over the period July 1973 to December 1993.

The left hand side portfolios are formed based on size (SZ), book-to-market (BM), and preformation HML factor loadings, and their returns are calculated as follows. From the resulting forty-five returns series, a zero-investment returns series is generated from each of the nine size and book-to-market categories. These portfolios are formed, in each category, by subtracting the sum of the returns on the 4th and 5th quintile factor-loading portfolios from the sum of the returns on 1st and 2nd factor-loading portfolios.

The first nine rows of the table present the t-statistics for the characteristic-balanced portfolio that has a long position in the low expected factor loading portfolios and a short position in the high expected factor loading portfolios that have the same size and book-to-market rankings. The bottom row of the table provides the coefficient estimates as well as the t-statistics for this regression for a combined portfolio that consists of an equally-weighted combination of the above nine zero-investment portfolios.

Char Port		Char-Balanced Portfolio: t-Statistics				
BM	SZ	$\hat{\alpha}$	β_{Mkt}	β_{SMB}	β_{HML}	R^2
1	1	1.43	−0.43	−2.69	−9.21	31.48
1	2	0.50	0.18	1.98	−8.99	31.48
1	3	−0.48	−1.62	−2.52	−8.57	27.11
2	1	1.37	−2.02	1.31	−7.13	18.43
2	2	2.12	−0.99	−2.07	−4.69	10.96
2	3	0.79	−1.41	−2.34	−3.96	9.11
3	1	2.53	−5.30	−0.48	−8.00	23.36
3	2	2.01	−2.30	−0.63	−4.52	8.58
3	3	1.08	−1.30	−2.36	−4.98	12.39
Combined portfolio		0.354	−0.110	−0.134	−0.724	41.61
		(2.30)	(−3.10)	(−2.40)	(−12.31)	

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The results additionally hold for the SMB and Mkt_RF loadings, which are once again consistent with the characteristic model. These results are shown in Tables VII and VIII of the 1997 paper. The above portfolios are characteristical balanced portfolios.

But what about factor balanced portfolios?

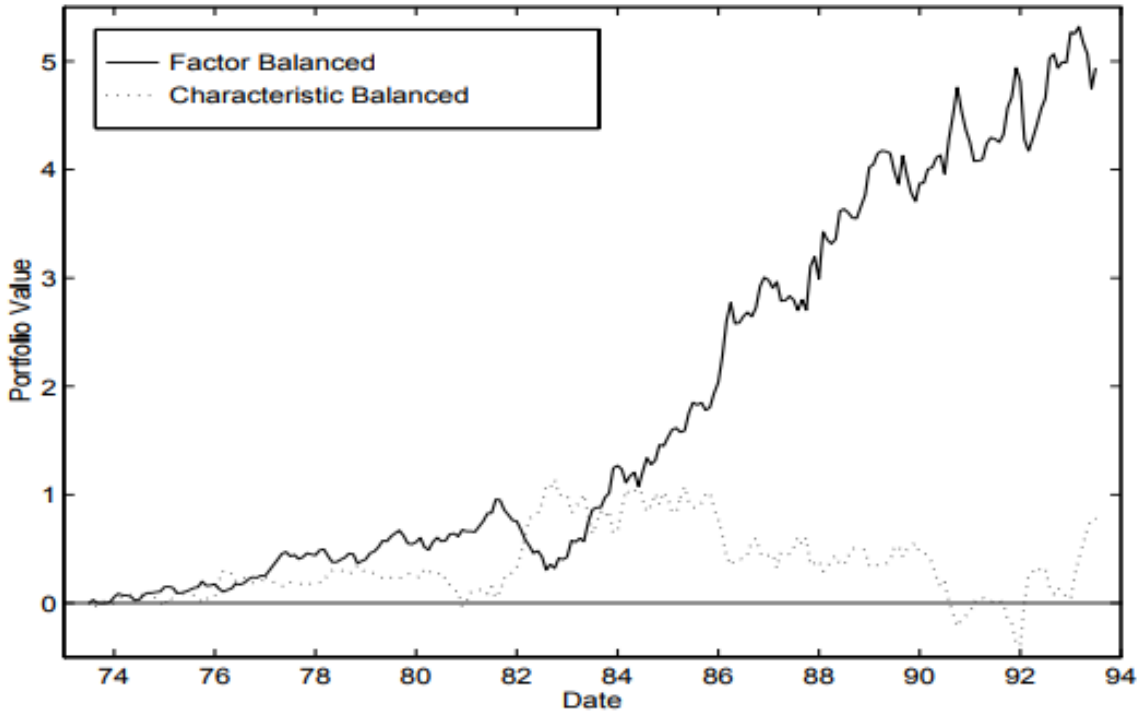
This analysis is done in the 1998 JPM paper. They compare to the returns to the characteristic balanced portfolios against the factor balanced portfolios. Factor balanced portfolios are now balanced along the dimensions of factors--these portfolios have a loading of 0 on each of the 3 factors (market, size, and value), while they vary along the characteristic dimensions (size and B/M).

We have two portfolios to test:

- Characteristic Balanced: Long high HML firms and short low HML firms, controlling for characteristics
- Factor Balanced: Long high B/M firms and short low B/M firms, controlling for factor loadings (market, size, and value).

The results are shown in Figure 5 of the 1998 paper, and are shown below:

Figure 5: Cumulative Returns on Characteristic and Factor Balanced Portfolios



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This image of the cumulative returns highlights two things:

1. Controlling for characteristics, factor loadings do not matter.
2. Controlling for loadings, characteristics do matter.

Bottom line: Focus on your portfolio characteristics, not your portfolio factor loadings!

2. Fama and French Fight Back

Why is everyone still using factor models in 2017? Well, the debate didn't end with Daniel and Titman 1997. In 2000, James Davis, Eugene Fama, and Ken French (DFF) came to defend factor models. Their paper is titled, "Characteristics, Covariances, and Average Returns: 1929-1997." [14] DFF run similar tests as the DT paper, but over a longer time cycle. A minor portfolio construction change is made, by creating 27 portfolios, as opposed to 45. Similar to DT, DFF first split the universe into 9 portfolios based on size and B/M ratios. Next, for each of the 9 portfolios split on size and B/M, the authors split the firms into 3 groups along the HML loadings--this leads to 27 portfolios. Within each of the 9 portfolios sorted on size and B/M, DFF go long the high HML firms and short the low HML firms.

As a reminder, here is that the two models would predict (from above):

The factor model would say the following:

- The mean monthly return should be positive, as the portfolios are long the high HML firms and short the low HML firms.
- The mean alpha should be zero, as the 3-factor model should pick up the variation in returns via a higher HML loading.

The characteristic model would say the following:

- The mean monthly return should be zero, as the portfolios are formed by controlling for the characteristics (Size and B/M).

- The mean alpha should be positive, as the 3-factor model may fully not pick up the variation in returns due to characteristics.

The results are shown in Table IV of the DFF paper and below:

Table IV

Regressions for Hh-Lh Portfolios Formed from Sorts on Size, BE/ME, and HML Slopes

$$\text{Hh-Lh} = a + b(R_M - R_f) + s\text{SMB} + h\text{HML} + \epsilon$$

At the end of June of each year t (1929 to 1996), we allocate the NYSE, AMEX, and Nasdaq stocks in our sample to three size groups (small, medium, or big; S, M, or B) based on their June market capitalization, ME. We allocate stocks in an independent sort to three book-to-market equity (BE/ME) groups (low, medium, or high; L, M, or H) based on BE/ME for December of the preceding year. The breakpoints are the 33rd and 67th ME and BE/ME percentiles for the NYSE firms in the sample. We form nine portfolios (S/L, S/M, S/H, M/L, M/M, M/H, B/L, B/M, and B/H) as the intersections of the three size and the three BE/ME groups. The nine portfolios are each subdivided into three portfolios (Lh, Mh, or Hh) using pre-formation HML slopes. The slopes are estimated with five years (three years minimum) of monthly returns ending in December of year $t - 1$. Value-weight returns on the portfolios are calculated for July of year t to June of $t + 1$. Hh-Lh is ((S/L/Hh-S/L/Lh) + (M/L/Hh-M/L/Lh) + (B/L/Hh-B/L/Lh) + (S/M/Hh-S/M/Lh) + (M/M/Hh-M/M/Lh) + (B/M/Hh-B/M/Lh) + (S/H/Hh-S/H/Lh) + (M/H/Hh-M/H/Lh) + (B/H/Hh-B/H/Lh))/9. Ave is the average Hh-Lh return, and t(Ave) is its t-statistic. The 7/29–6/72 & 1/94–6/97 period includes all the months in the full 7/29–6/97 sample except those in the Daniel and Titman (1997) period, 7/73–12/93.

Period	Ave	t(Ave)	a	b	s	h	$t(a)$	$t(b)$	$t(s)$	$t(h)$	R^2
7/29–6/97	0.12	1.56	−0.06	−0.01	0.03	0.38	−0.83	−0.48	0.91	11.92	0.29
7/29–6/63	0.19	1.49	0.01	−0.01	0.06	0.35	0.11	−0.19	1.09	6.99	0.24
7/63–6/97	0.05	0.56	−0.14	0.01	−0.01	0.43	−2.07	0.48	−0.28	14.32	0.42
7/73–12/93	0.03	0.25	−0.22	0.02	0.03	0.46	−2.28	0.61	0.80	11.35	0.44
7/29–6/72 & 1/94–6/97	0.16	1.63	−0.00	−0.01	0.03	0.36	−0.01	−0.31	0.74	8.80	0.26

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by Davis, Fama, and French. Accessed on 10/23/17 from:
https://www8.gsb.columbia.edu/sites/valueinvesting/files/files/06davis_fama_french_2000_29-97.pdf

Examining the first (full-time period) and last row (full-time period excluding the DT time period), we find that the results are consistent with the factor model. The average return is positive and significant, while the alpha is insignificantly different than zero. This is different than the time period studied in the JT paper, which was July of 1973-December of 1993. During that time period, DFF find the results are consistent with the characteristic model--the average return is insignificantly different than zero and there is a significant alpha not picked up by the 3-factor model.

So in conclusion, DFF find that over the entire sample, the results are more consistent with the factor model, whereas the results from the DT paper may be specific to a certain time period. Thus, factor models are saved!

So is that the end of the story? Not exactly.

Out of Sample Studies to Settle the Factors Versus Characteristics Debate

Two additional studies conduct the same tests, out of sample, by using returns from Japan and the U.K.

Here is the abstract from a 2001 paper titled, "Explaining the Cross-Section of Stock Returns in Japan: Factors or Characteristics" by Kent Daniel, Sheridan Titman, and K. C. john Wei.

> *Japanese stock returns are even more closely related to their book-to-market ratios than are their U.S. counterparts, and thus provide a good setting for testing whether the return premia associated with these characteristics arise*

> *because the characteristics are proxies for covariance with priced factors. Our tests, which replicate the Daniel and Titman [1997] tests on a Japanese sample, reject the Fama and French [1993] three-factor model, but fail to reject the characteristic model.*

Here is the abstract from a 2007 paper titled, "UK Evidence on the Characteristics versus Covariance Debate" by Edward Lee, Weimin Liu, and Norman Strong.

> *We evaluate the Fama–French three-factor model in the UK using the approach of Daniel and Titman (1997) to determine whether characteristics or covariance risk better explains the size and value premiums. Across all three factors, we find that return premiums bear little relationship to the corresponding loadings. We show that small and value stocks earn higher returns irrespective of their return covariance. Our study contributes to the existing literature by reporting original findings on the Fama–French three-factor model in the UK and by reporting results that complement existing evidence from similar studies in the USA and Japan.*

So in two out-of-sample datasets, the evidence is in favor of the characteristic model. [15]

What do we make of all this?

First off, factor models are just that-- a model. It should be pointed out that many still examine and give weight to the beta of a portfolio, which is built upon the covariance of the portfolio relative to the variance of the market. A higher beta should imply higher returns--we know that is not necessarily the case. Additionally, saying that the HML loading of a portfolio is unrelated to the B/M of the portfolio is untrue as well--the HML factor creates a long/short portfolio return by sorting stocks on B/M!

So in the end, it is hard to ascertain which is 100% correct. In the end, both characteristics and loadings probably matter when explaining the cross-section of stock returns.

But how does this affect a long-only value investor? Below I examine this question directly.

3. I'm Not From the Ivory Tower: How Does This Affect Me and My Clients?

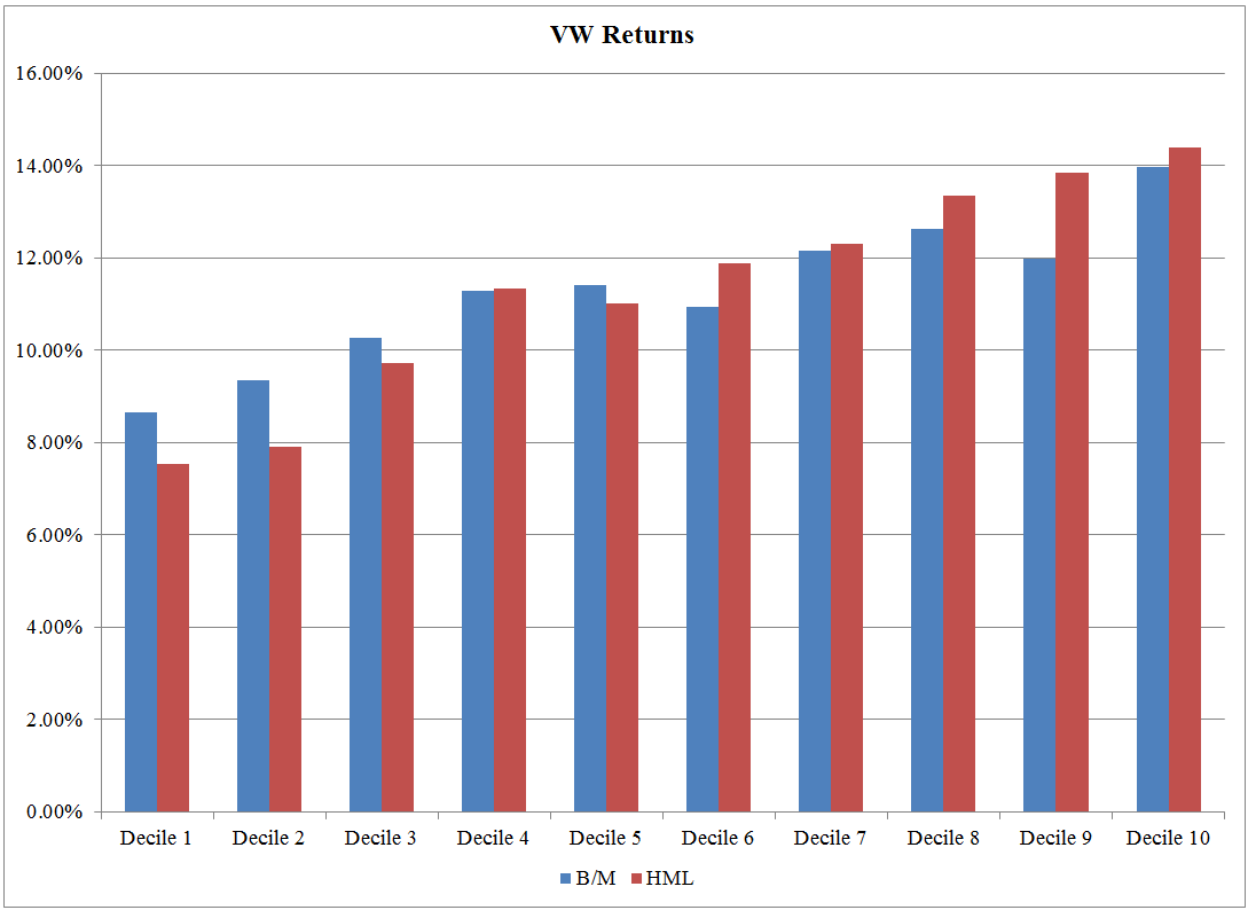
While the analysis above is an academic debate within long/short portfolios, what are the implications for a long-only investor who is interested in a particular investment approach, such as Value and Momentum investing? Below I examine this in the context of a Value investor by allowing portfolios to be split into Value-Growth Deciles by two methods:

1. The previous HML loading.
2. The B/M ratio.

The HML loading for each stock is the Beta on the HML factor from Ken French's website from a regression on the 4-factor model over the past 36 months. [16] Stocks without 36 months of past returns are eliminated from the sample. Similarly, stocks without B/M ratios are also eliminated from the sample. Last, I exclude firms below the 40th percentile of NYSE market capitalization, to eliminate small and micro-cap stocks from the sample, and focus mainly on mid/large-cap firms. Portfolios are formed annually on 6/30 each year, and the returns are examined from 7/1 of year *t* to 6/30 of year *t+1*. Compound Annual Growth Rates (CAGRs) are measured from 7/1/1973 - 12/31/2016 and are shown below, gross of any fees or transaction costs. [17] For reference, over this time period, the VW and EW Universe returned 10.80% and 13.18%

respectively, while the SP500 and Sp500 EW returned 10.69% and 13.66% respectively, gross of any fees or transaction costs. [18]

VW Returns: 7/1/1973 - 12/31/2016



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As seen in the image above, the CAGRs for the portfolios increase for both the HML deciles and the B/M deciles as one moves from Growth to Value firms (left to right). This highlights that using both characteristics (B/M) and factors (HML loadings) to create

Value portfolios worked in the past, as the Value decile outperformed the Growth decile. For most long-only investors, it would be hard to argue, given the evidence in our charts and the papers above, that sorting a portfolio on characteristics is a bad way to form value portfolios. Across each decile, the correlation between the portfolios formed on B/M and HML loadings are high and range between 0.86 and 0.925. It should be noted that the high B/M and HML decile portfolios (both VW and EW) have a tracking error relative to the SP500 of at least 10%, so these are portfolios that would not be used by many professional money managers (too much career risk!). Sub-period analysis is done and shown in the below reference--it is generally found that characteristics performed better in the original DT sample period (7/1/1973-12/31/2016), whereas forming

portfolios on HML performed better (especially for the VW portfolios) in the period thereafter (1/1/1994-12/31/2016). [19]

But given that we have the data, what are the loadings of the Value portfolios formed either by sorting on B/M ratios or by HML loadings?

Below we show the 4-factor loadings over the entire time period tested above (7/1/1973-12/31/12016):

4-Factor Regression						
		Alpha (Annual)	MKT_RF	SMB	HML	MOM
High HML VW	4-Factor	0.00	1.17	0.10	0.60	0.00
p-value	0.8907	0.0000	0.0574	0.0000	0.9542	
High B/M VW	4-Factor	0.00	1.05	0.04	0.78	-0.15
p-value	0.7484	0.0000	0.2746	0.0000	0.0000	
High HML EW	4-Factor	0.00	1.12	0.36	0.58	0.00
p-value	0.9423	0.0000	0.0000	0.0000	0.9055	
High B/M EW	4-Factor	0.02	1.01	0.25	0.71	-0.15
p-value	0.7484	0.0000	0.0000	0.0000	0.0000	

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These regression estimates highlight that portfolios formed by ex-ante sorting on either B/M ratios or HML loadings have similar ex-post HML loadings themselves! Again, all of this makes sense--the HML factor is a long/short portfolio formed by sorting firms on size and B/M! So while one can debate whether or not it is optimal to form a portfolio using factors or characteristics, we highlight above that in the past, the two methods end up yielding similar results for a long-only investor. ***Thus, when assessing potential portfolios or investments, such as ETFs and mutual funds, one can examine both the loadings from a factor regression and the characteristics of the underlying portfolio (easier to interpret than regression outputs).***

This can be important for the analysis by advisors on certain funds. Let's say as an advisor, you want to assess a fund that claims to sort firms on P/E ratios. [20]

Well, almost by construction, sorting firms on P/E will most likely (but not always) lead to a lower HML, or "value" loading, than another fund that sorts on B/M. [21] So does this mean that the P/E fund is not a value fund as it doesn't have a high HML loading? Not necessarily; and one way to ascertain what the P/E fund is doing is to examine the characteristics of the portfolio. Similarly, how can one assess a multi-factor fund? Without tools to assess the portfolio, it can be tough to decide.

Let's examine a live portfolio and highlight both the factor loadings and the overlap to the academic value portfolio formed on characteristics. We will then discuss a new tool we plan to launch soon, which will help advisors assess the characteristics of an ETF or even a portfolio of ETFs.

4. Examination of a live portfolio

To examine both the factor loadings, as well as the portfolio characteristics, I chose the Vanguard's VTV ETF. A huge "value" ETF known to most professional investors.

To examine the factor loadings, I use the online tool, PortfolioVisualizer. A link can be found here and an image of the factor loadings to VTV is shown below:

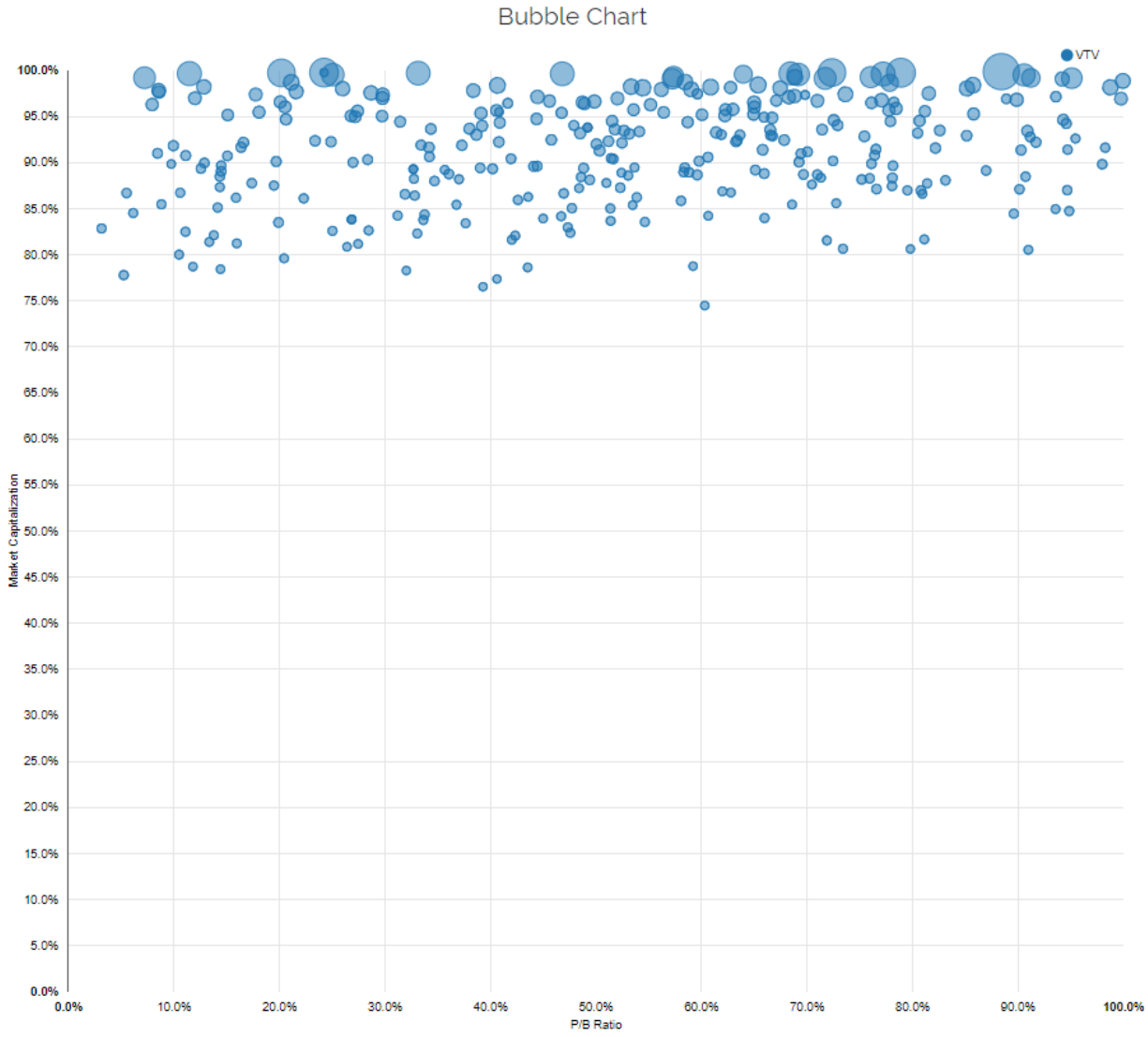
Vanguard Value ETF

Ticker	VTV				
Time Period	Feb 2004 - Aug 2017				
Coefficient of Determination (R^2)	97.5%				
Adjusted R^2	97.5%				
Regression F statistic	2,108.64 (p-value = 0.000)				
Autocorrelation	No autocorrelation confirmed (Durbin-Watson test value is 1.820 with p-value 0.120)				
Heteroskedasticity	No heteroscedasticity confirmed (Breusch-Pagan test value is 5.878 with p-value 0.118)				
Factor	**Loading**	**Standard Error**	**t-stat**	**p-value**	**95% Confidence Interval**
Market (Rm-Rf)	0.96	0.014	69.550	0.000	0.935...0.989
Size (SMB)	-0.19	0.024	-7.871	0.000	-0.237...-0.142
Value (HML)	0.27	0.020	13.350	0.000	0.233...0.314
Alpha (α)	0.03bps	0.001	0.006	0.995	-0.10%...0.10%
Annualized Alpha (α)	0.00%				

Source: https://www.portfoliovisualizer.com/

As can be seen above, the fund's loadings are 0.97 on the market, a negative 0.19 loading on SMB, and a positive 0.27 loading on HML--all are significant. Since this is a value fund, where the positions are mainly value-weighted (market-cap weighted), these loadings make sense--market beta ~ 1 as it market-cap weights large stock positions, a negative size loading as it invests in large stocks, and a positive HML loading as it is a Value fund. So nothing surprising here.

Next, we examine this same ETF using our Visual Active Share tool--an explanation of this tool can be found here. Our tool allows an investor to analyze a fund from a characteristics-based framework as opposed to a regression/factor-based framework.



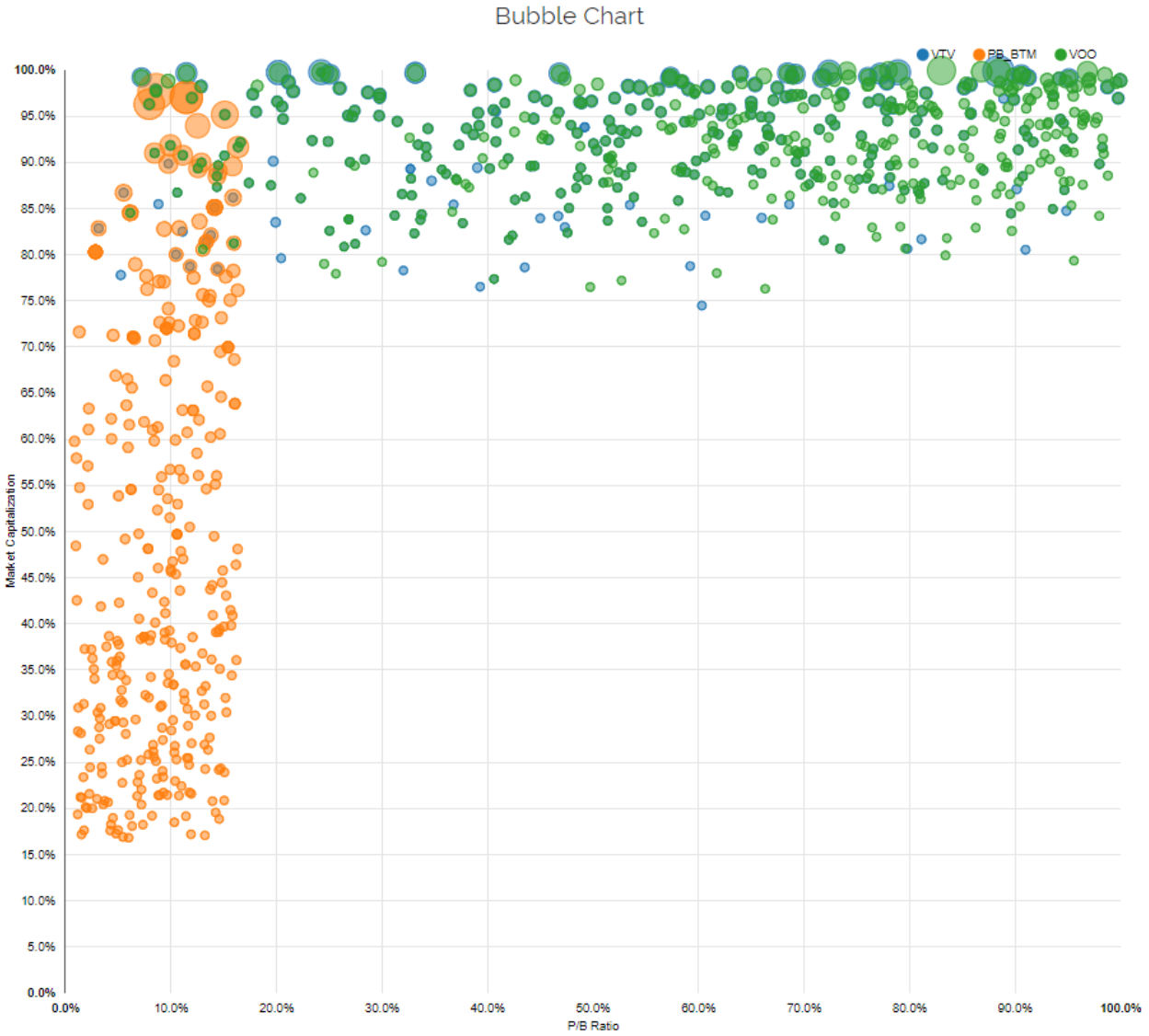
Source: Alpha Architect, accessed 10/24/17

On the image above, each circle represents an underlying stock, with the size of the circle representing the weight of the stock within the ETF. The x-axis ranks all non-micro-cap stocks on P/B (inverse of B/M), while the y-axis ranks all stocks on size. As shown above, VTV is a larger cap fund, as the holdings are ~ 75th percentile and higher, which a huge

emphasis on the largest stocks in the universe. The Fund seems to have little relationship with P/B, as the dots are spread out across the spectrum of cheap/expensive.

Let's dig further.

How does VTV compare to "academic" value portfolios, formed on characteristics? Within the visual active share tool, we have the academic characteristic portfolios pre-built (start typing "academic" and they'll show up). Below we add the academic bottom decile on P/B (inverse of B/M), where a lower P/B indicates a firm is cheaper. We also add Vanguard's SP500 ETF, VOO to view the index holdings.



Source: Alpha Architect, accessed 10/24/17

As can be seen above, the VTV and VOO ETFs (Value and SP500) hold very similar positions. The fee difference is 0.02%, so one can't really complain about the funds being too similar (you aren't paying for any differentiation). Also, one notices that these funds are different than the academic characteristic-based P/B portfolio. This makes sense--Vanguard gives investors access to the market-cap portfolio, for a very cheap price. They

are not trying to be that different than the market, and by doing so, have helped many investors. But clearly, this fund is not the same as the characteristic-based academic portfolio. Our Visual Active Share tool can be helpful to visually view the differences between live funds and the characteristic-based academic portfolio.[22]

Bottom line: We're building out a capability for investors to assess portfolios based on characteristics, as opposed to factors.

5. Conclusion

We started this discussion by highlighting the perpetual debate regarding the value premium--risk or mispricing? We introduced an alternative way of viewing the world via characteristics-based asset pricing.

The main takeaways are the following:

1. There is a clear academic debate about whether higher returns to value and small firms are driven by factors or characteristics. There is decent evidence to suggest that both models have legs to stand on, and this has an implication for the future expected return to the value premium. However, it should be noted that the two are clearly related--the HML is formed by sorting firms on size and B/M, so an HML loading has some relation to the B/M characteristic. We don't necessarily take a side here, but rather highlight that one can examine **both** loadings and characteristics to assess a fund.
2. When assessing the returns to value paper portfolios, sorting on either factors or characteristics yielded a similar result from a CAGR and ex-post factor loading perspective. Thus, examining current characteristics of portfolios is not a bad idea.

3. We walked through an example of a value fund and highlighted our Visual Active Share tool, which allows investors to visually view underlying stocks along different characteristics.

Overall, factor investing comes in many shades. We highlight above that while factor loadings can be important, examining characteristics is arguably just as effective (and probably more intuitive!).

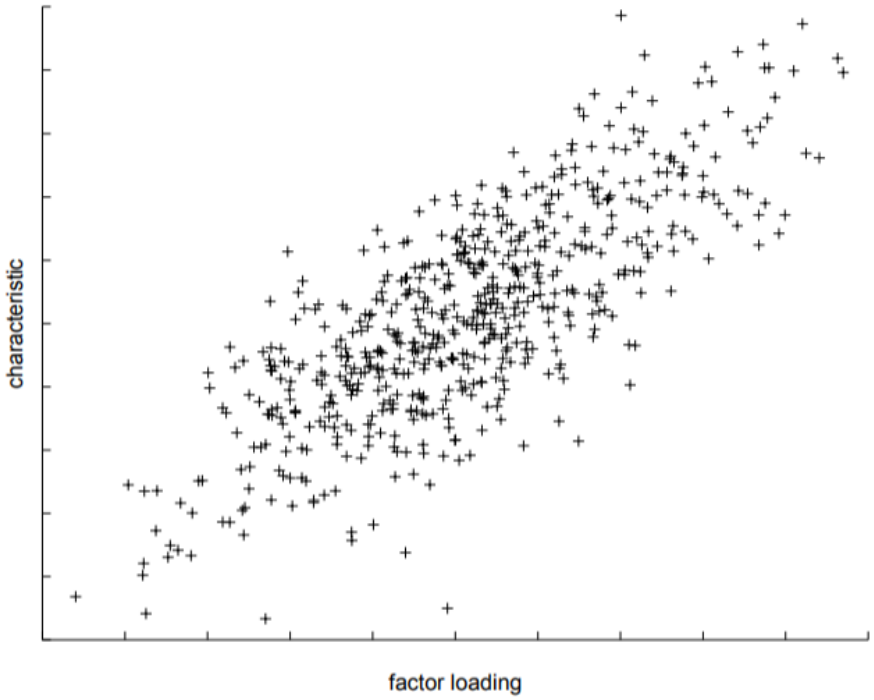
In the end, factor investing is more art and less science.

Notes:

1. Note -- a 4th explanation of the value premium is that it was a chance result, and is unlikely to be found out of sample. However, the out-of-sample data contradicts this idea. Value and Momentum have been found to work (almost) everywhere.
2. Note, or if investors decide to purchase value stocks, regardless of risk, this could diminish the premium
3. discussed here
4. We believe the largest cost of arbitrage is tracking error risk, which is further explained in this paper on "Interpreting Factor Models."
5. This can be viewed as mispricing theory, or maybe not.
6. "Fact, Fiction, and Value-investing" also outlines the argument that there probably isn't a catch-all explanation for factor premiums.
7. As a reminder, a stock's market Beta is a measure of the firm's covariance with the market, divided by the variance of the market.
8. I highly recommend everyone read the entire paper.
9. A great replication and explanation of this paper, as well as the source code, was done by Alex Chinco and can be found here.

10. A pretty version of this analysis is here.
11. (see table below from 1998 paper).

Figure 3: The Distribution of Characteristics and Factor Sensitivities

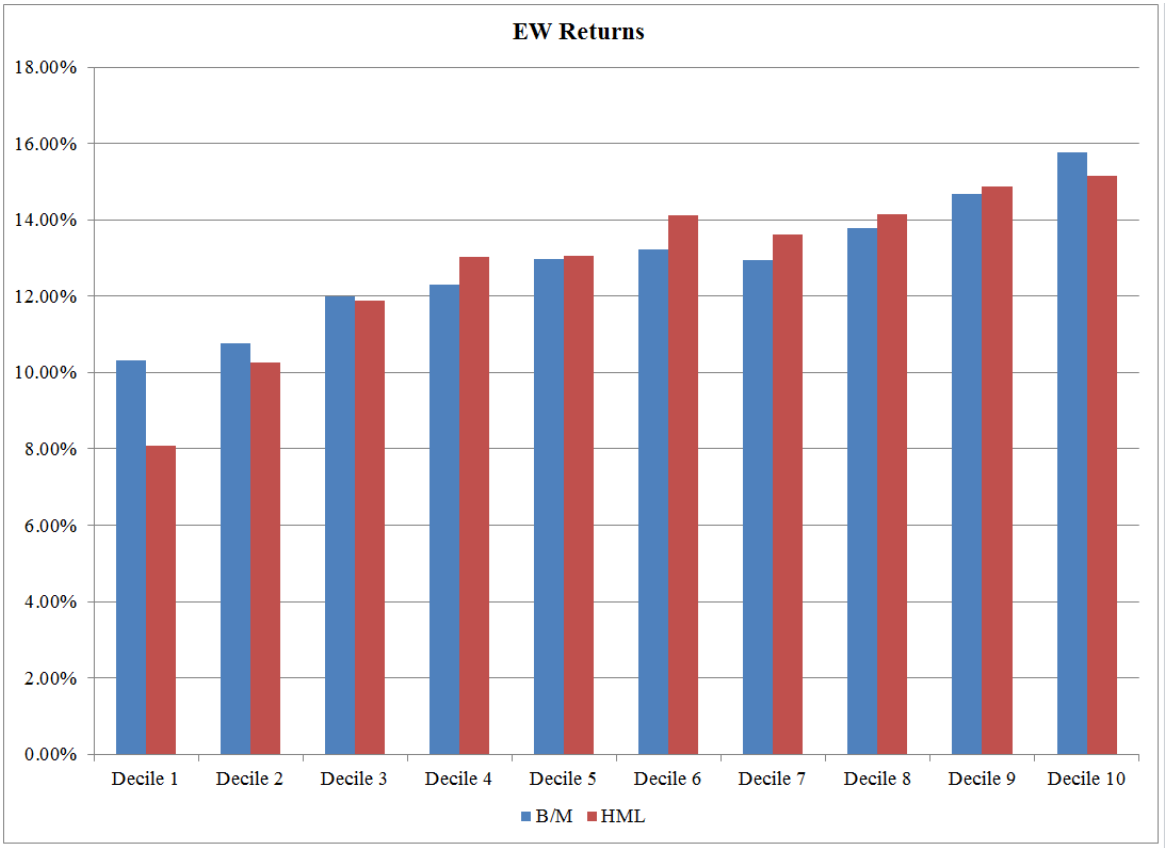


The results are hypothetical results and are NOT an indicator of future results and do NOT represent returns that any investor actually attained. Indexes are unmanaged, do not reflect management or trading fees, and one cannot invest directly in an index. Additional information regarding the construction of these results is available upon request.

12. This term is used in the 1998 JPM paper, but is instructive so I use it here.
13. Again, this portfolio sort is possible because there are groups of cheap small-cap value stocks that have high HML betas and there are groups of cheap small-cap value stocks that have low HML betas.

14. Note the dates are included in the title of the paper--a big chunk of the paper is devoted to highlighting that the Daniel and Titman results are very specific to the time period tested in the DT paper -- 1973-1993.
15. Here is a paper that examines mutual fund portfolios using characteristic-based benchmarks--this is one way to assess mutual funds and ETFs.
16. Regression of excess stock returns against the market-risk free, SMB, HML, and MOM factors.
17. Manager Fees and transaction costs would lower the returns to each of the decile portfolios

18. EW Returns: 7/1/1973 - 12/31/2016



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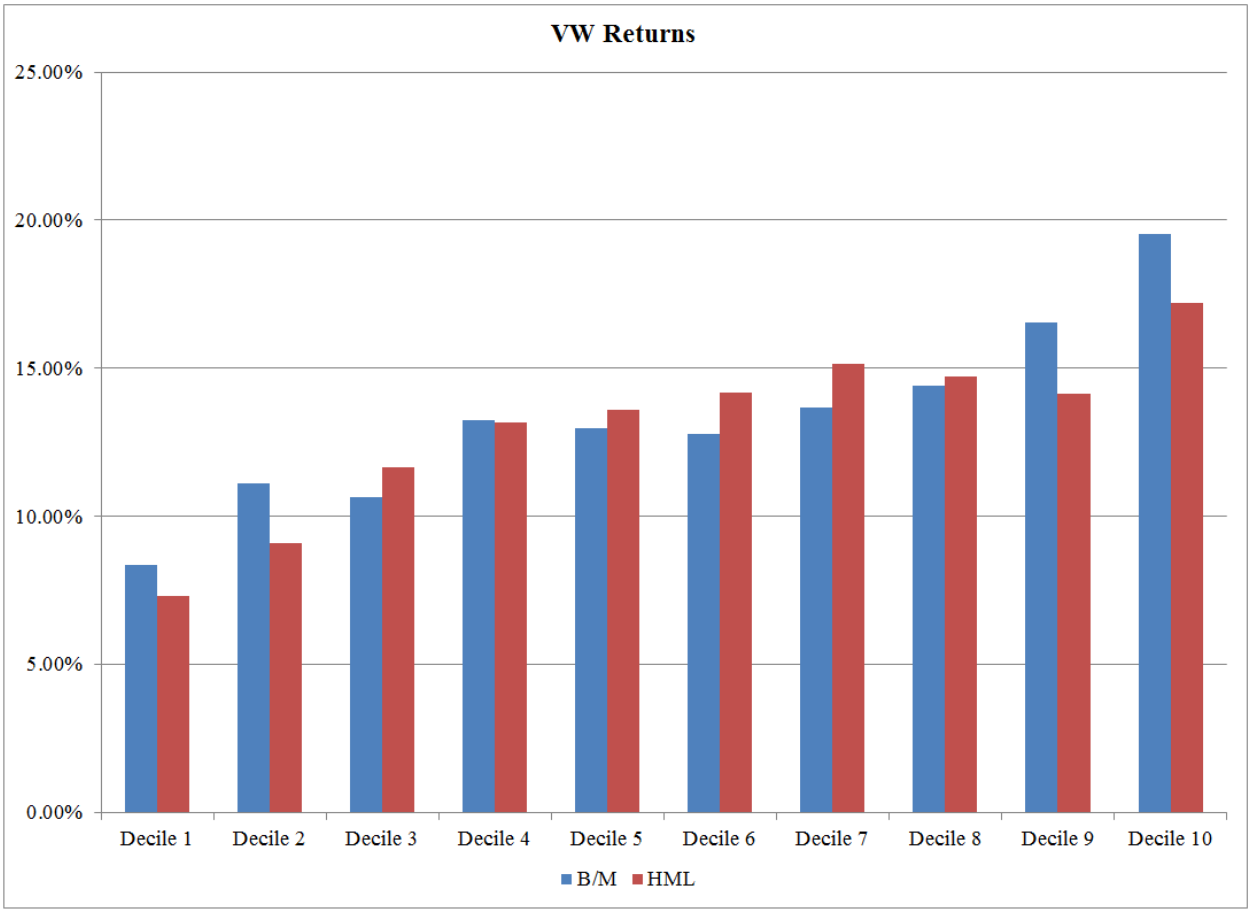
19. VW Returns: 7/1/1973 - 12/31/1993



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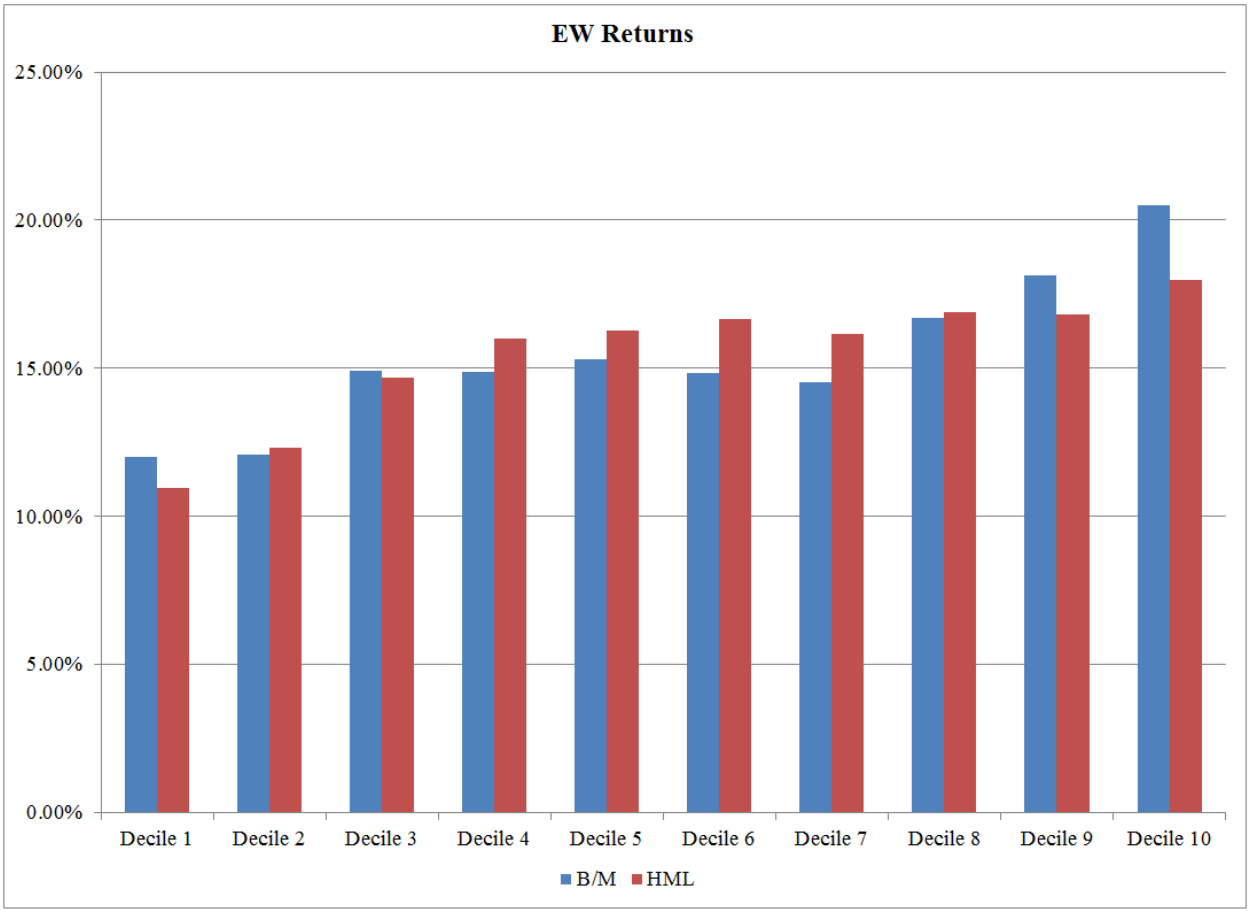
EW Returns: 7/1/1973 - 12/31/1993



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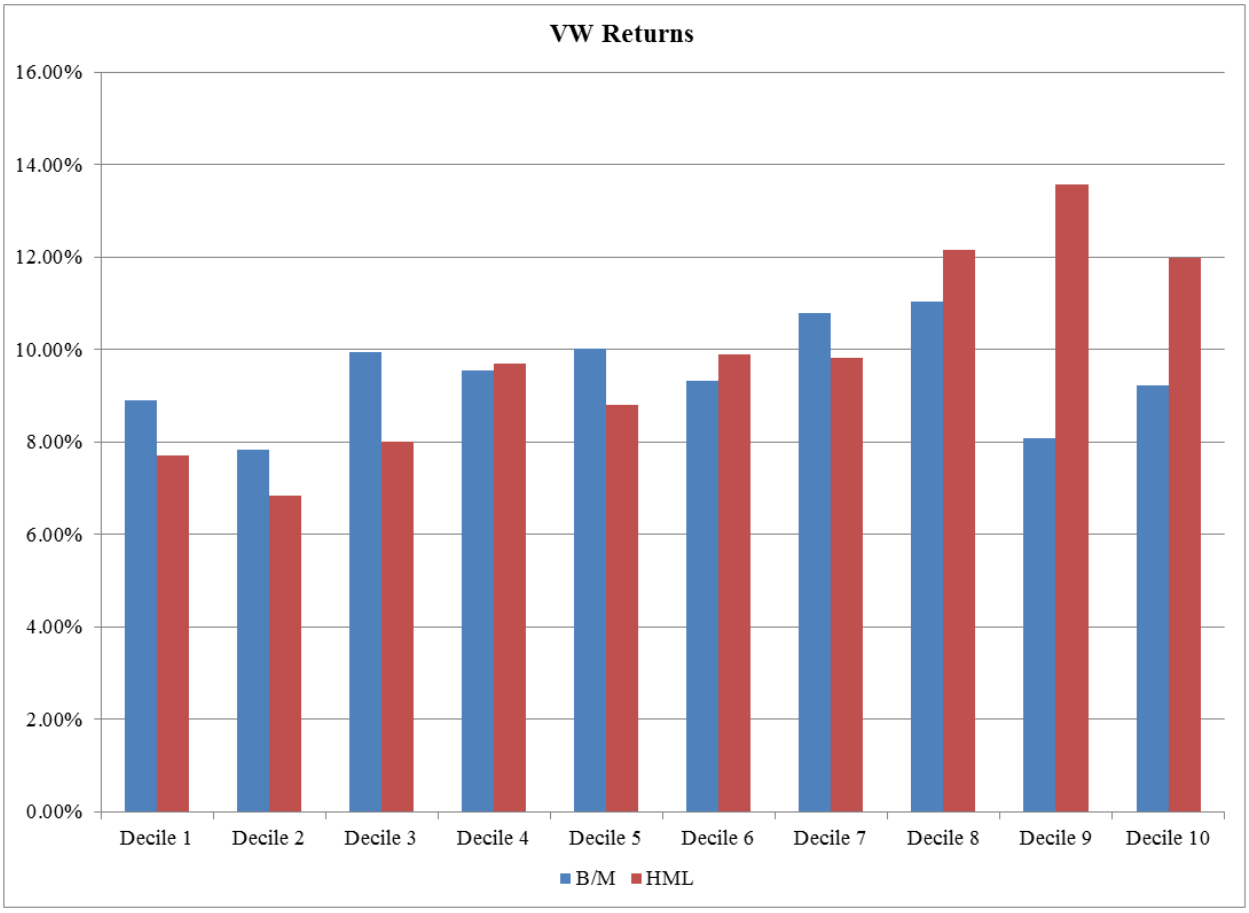
VW Returns: 1/1/1994- 12/31/2016



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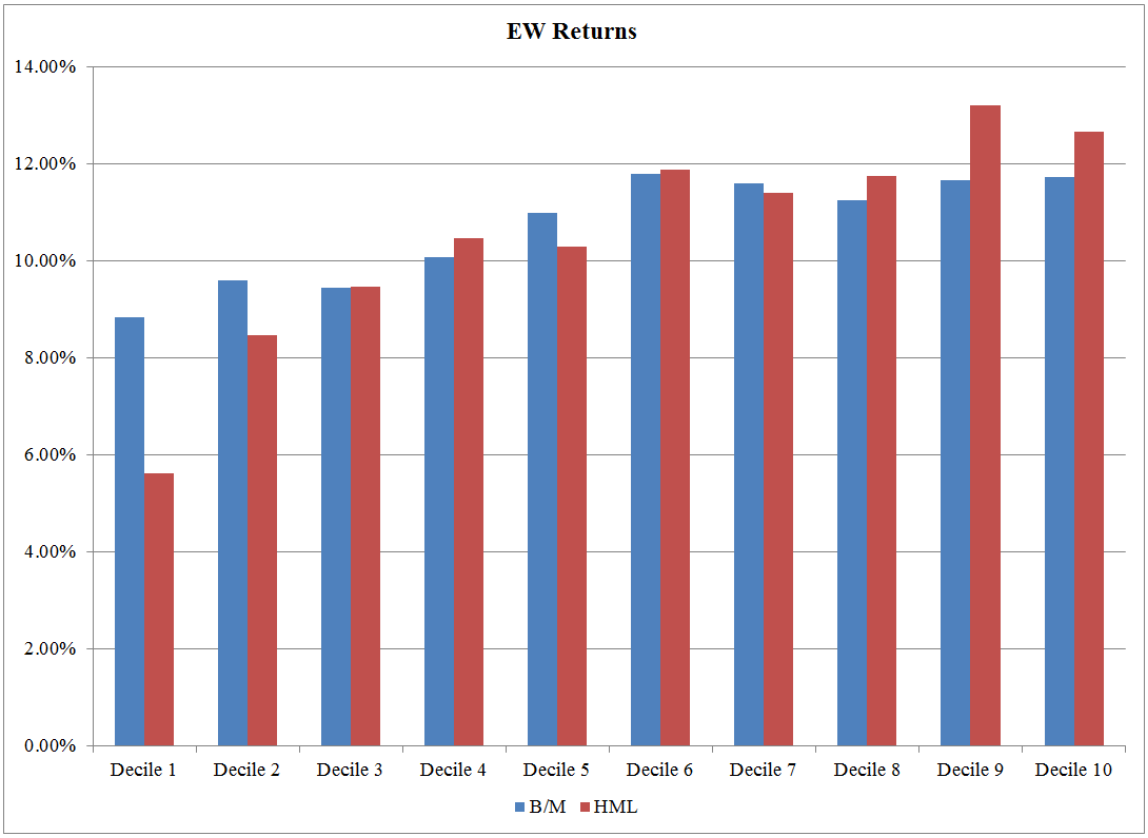
EW Returns: 1/1/1994- 12/31/2016



The results are hypothetical results and are NOT an indicator of future results and do NOT represent returns that any investor actually attained. Indexes are unmanaged, do not reflect management or trading fees, and one cannot invest directly in an index.

20. Note we are big fans of Enterprise Multiples, as shown in our analysis here and here.
21. Assuming that P/E and B/M are not 100% correlated when it comes to sorting firms, this P/E fund will most likely have a lower HML loading.
22. While this is a nice tool, we have had two common requests from those using the tool:
    1. Can we simply get summary statistics (characteristics) of the ETFs

2. Can we see the overlap and summary characteristics of a portfolio of ETFs

We are working on building these tools out now! The new tools will allow advisors to view the average characteristics of the ETFs--an example being the average Enterprise multiple being 10% for fund A and 6% for the Sp500. We will do this by calculating the value-weighted average for each characteristic. The second tool will allow advisors to build a portfolio of ETFs, and then view the overall overlap (relative to some index) as well as the average characteristics (P/E, Momentum, expense ratio, etc.) of the portfolio. So in total, we will have three tools that will allow advisors to better assess the characteristics of ETFs and portfolios of ETF.