PREDICTING THE EXCESS RETURN AND THE VOLATILITY OF THE EXCESS RETURN OF VALUE STOCKS OVER GROWTH STOCKS[1]

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ABSTRACT

Whether Fama and French's High Minus Low (HML) portfolio is a risk factor or a behavioral anomaly, theory would suggest dispersion of book-to-market, which is a measure of how deep value is relative to growth, may be useful in predicting both the future returns of HML as well as the future volatility of HML's return. We find that higher dispersion predicts higher HML return and high HML returns predict future lower HML returns and vice versa. In addition, we find higher dispersion predicts higher volatility of HML returns. Lastly, we find that the Sharpe Ratio of HML can be predicted over long time horizons using past historical HML volatility and return.

Keywords: finance, investments, stock return predictability

1. INTRODUCTION

That high book-to-market stocks (value stocks) outperform low book-to-market stocks (growth stocks) historically is easily one of the most well-known relations in finance (Fama and French, 1992). Whether this outperformance represents a risk factor or a behavioral anomaly has been a source of endless debate. While we lack the tools to resolve this debate, we will try to provide ways to predict value stocks' excess return over growth stocks and the volatility of that excess return and investigate whether that predictability fits more closely into a model of a rational framework or a behavioral anomaly.

2. PREDICTING HML RETURN

Fama and French constructed a zero-cost high book-to-market minus low book-to-market portfolio (the high minus low or HML portfolio) by averaging the top three book-to-market deciles, subtracting the average of the short the bottom three book-to-market deciles in large capitalization stocks (above median market capitalization) and small capitalization stocks (below median market capitalization), and finally averaging the returns of the large cap and small cap zero cost portfolios.

Book-to-Market Dispersion

We would like to see under what assumptions certain variables may be expected to predict the excess return and volatility of the HML portfolio. Let us first assume that stock prices are noisy estimates of their true fair values. Random noise in stock prices around their fair value generates the small and value effects if that random noise reverts to zero (Arnott, Hsu, Liu, and Markowitz 2006). They also show that the expected return would increase with a particular fundamental-to-price ratio, e.g. book-to-market ratio or dividend yield. This would imply that the higher the book-to-market ratio of value stocks and the lower the book-to-market ratio of growth stocks, the higher the expected return of the portfolio. Instead of directly measuring the book-to-market ratio of value and growth stocks, we will use a proxy for the distance between these book-to-market ratios, which we will call book-to-market dispersion. We define book-to-market dispersion as follows:

$$Disp_t = \ln\left(\frac{\mathrm{BEME}_{75\mathrm{th}}}{\mathrm{BEME}_{25\mathrm{th}}}\right)$$

Where $\mathrm{BEME}_{75\mathrm{th}}$ and $\mathrm{BEME}_{25\mathrm{th}}$ is the 75^{th} and 25^{th} percentile book-to-market, respectively.

Alternatively, if we were to see value stocks as riskier than growth stocks, then we may very well come to the exact same conclusion—that when value stocks are more deeply value relative to growth stocks, they will earn an even higher risk premium relative to growth stocks, and therefore HML will earn a higher return when dispersion is high. Therefore, we will run the following regression:

$$HML_t = \alpha + \beta_{Disp} \times Disp_{t-1} + \varepsilon_t$$

Where HML_t is the return on the HML factor in period t. From our previous discussion, we would expect β_{Disp} to be positive.

However, even if we find that β_{Disp} is positive, we should not assume that dispersion is necessarily what is directly driving returns. It may be that risk aversion is rising as dispersion increases and risk aversion declines as dispersion decreases. How could we possibly make such an argument? This argument is unfortunately not at all straightforward and requires several steps.

We will use median book-to-market as a measure of the market risk premium. In order to do so, we must believe that the median book-to-market contains information on future returns more so than on future cash flows. High earnings and dividend yields predict higher future returns, implying that such accounting variable-to-price ratios are indeed measures of risk premium (Campbell and Shiller, 1988 and Campbell and Shiller, 2001). Further, price-to-earnings contains information about discount rate news but little to no information about cash flow news (Campbell and Vuolteenaho 2004).

If we are willing to take the median book-to-market as a measure of risk aversion, we can determine the extent to which our measure of dispersion is correlated with the median book-to-market. Why might we expect them to be correlated? If value stocks are in fact considered riskier, then when risk aversion rises, the median book-to-market will rise, but the book-to-market for value stocks will rise yet faster than that of the rest of the market or for growth stocks in particular, which will result in higher dispersion. If dispersion and median book-to-market are correlated—and they have a 0.63 correlation (t-stat: 7.35)—perhaps it is only the median book-to-market that predicts HML. We will run the following regression:

$$HML_t = \alpha + \beta_{BEME} \times BM_{t-1} + \varepsilon_t$$

Where BM_{t-1} is the median book-to-market in period t-1.

Autoregressive term

It is not immediately clear why we would choose to include an autoregressive term in our regression. We may argue that there is a time varying mean reverting risk premium assigned to holding value stocks. But if that were the case, the effect should be captured in dispersion. As investors become more risk averse towards value, book-to-market ratios for value stocks would rise relative to those of growth stocks, resulting in higher dispersion, which would signal a higher future value premium.

If we were to believe that an autoregressive term were a useful addition to our regression, we cannot suggest it would make sense because of movements in relative price-to-book ratios of value and growth stocks, which would be captured by dispersion; we would have to appeal to a mispricing or time varying risk premium by the market that would follow changes in book. Specifically, there would have to be a component of returns that would co-move with changes in book. Furthermore, those changes in book would have to mean revert resulting in the component of returns that track book to mean revert over time. And lastly, the sensitivity to this cycle would have to be different for growth stocks and value stocks.

It seems like a tall order. Several assumptions have to be put in to place to convince ourselves that an autoregressive term makes sense in this regression, but we will argue it is not so hard to believe as it initially seems. The earnings of value firms may be sensitive to different economic variables and in different degrees than growth firms.

Assuming that there is any pricing component that seems to follow these economic variables and these economic variables are cyclical in some way, then it would make sense to include an autoregressive term in the regression. Our regression with just the autoregressive term would look as follows:

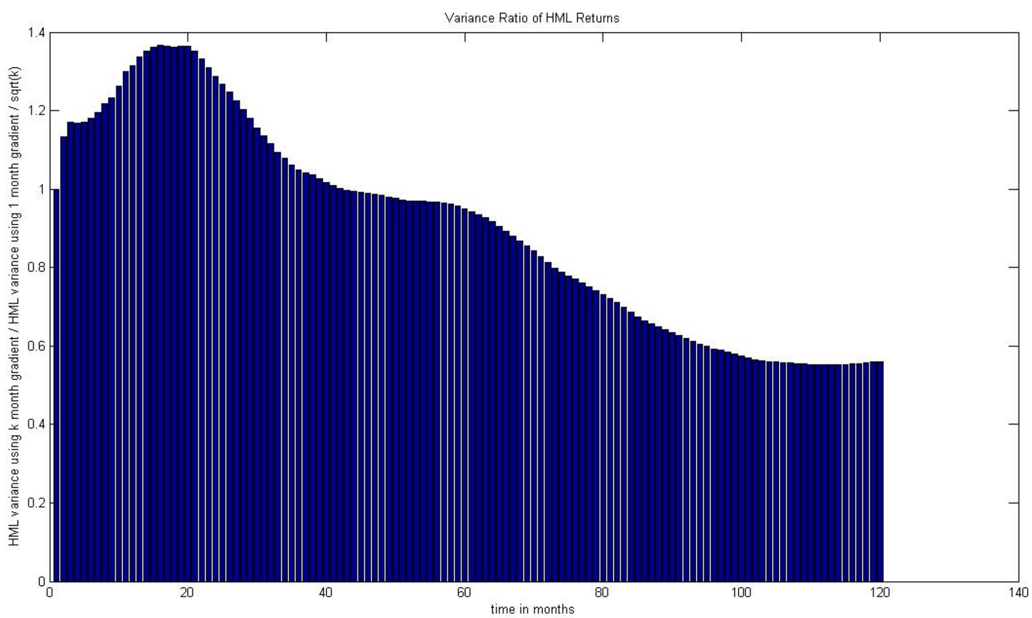
$$HML_t = \alpha + \beta_{AR} \times HML_{t-1} + \varepsilon_t$$

The regression with both the autoregressive and dispersion terms would look as follows:

$$HML_t = \alpha + \beta_{Disp} \times Disp_{t-1} + \beta_{AR} \times HML_{t-1} + \varepsilon_t$$

We will also again replace $Disp_{t-1}$ with BM_{t-1} to determine whether dispersion is higher simply due to higher general risk aversion.

For HML to be mean reverting, we would expect that the variance over k month periods will be less than the square root of k times the variance over 1 month periods.



We do see reversal in HML over longer periods, so we believe our inclusion this regressor appears promising.

However, for our argument to hold any water, it must be the case that HML returns should co-move with some economic variable that impacts book value of value stocks differently than it impacts the book value of growth stocks. It must reflect the health of value stocks relative to growth stocks. We will use change in dividends as that variable. The dividend yield and the book-to-market ratio for the market as a whole are correlated (Kothari and Shanken,1997). Presumably, this relationship holds cross-sectionally as well. That is, high book-to-market stocks also have high dividend yields. Therefore, dividend growth may describe an economic variable that proportionately affects value stocks versus growth stocks. We run the following regression:

$$HML_t = \alpha + \beta_{Div} \times \Delta Div_t + \varepsilon_t$$

Where ΔDiv is the percent change in market dividends. We would expect β_{Div} to be positive as negative shocks to dividend growth would suggest a shock to the economy that may disproportionately hit value companies. Note that unlike most of our regressions, the regressor is contemporaneous, not predictive.

3. PREDICTING HML VOLATILITY

Whether we believe the value factor to be a risk or mispricing, we may well expect dispersion to predict higher volatility. Assume high dispersion is a sign of likely mispricing with value stocks' being undervalued and growth stocks' being overvalued.

We may expect that large-scale mispricing would be more likely to occur during market dislocations when there would be higher volatility. If that were the case, then we would expect not only higher HML volatility but also higher market volatility when dispersion is high.

It is also conceivable that we would expect dispersion to predict HML volatility assuming that value is a risk factor. If stocks are more deeply value relative to growth, we may expect that co-movement with the true underlying economic risk is higher and therefore, volatility would also be higher. In this case, it would seem that book-to-market dispersion would not necessarily predict higher market volatility.

However, there may be a more intuitive reason why we would expect volatility to be higher under periods of higher dispersion. The relative sector allocations between value and growth may be higher during periods of high dispersion. That is, it may be for example that during the technology bubble in the late 1990s the relative weight in technology was higher in growth relative to value than it is during normal times. Volatilities tend to be strongly dependent on sector specific factors, so larger net sector exposures in HML would perhaps suggest higher volatility (Ray and Tsay 2000). However, if this were the case, we would not necessarily expect high dispersion to predict higher stock market volatility—only higher HML volatility.

We will run the following regressions:

$$\sigma_{HML,t} = \alpha + \gamma_{Var} \times \sigma_{HML,t-1} + \varepsilon_t$$

$$\sigma_{HML,t} = \alpha + \gamma_{Var} \times \sigma_{HML,t-1} + \gamma_{Disp} \times Disp_{t-1} + \varepsilon_t$$

$$\sigma_{HML,t} = \alpha + \gamma_{Var} \times \sigma_{HML,t-1} + \gamma_{BEME} \times BM_{t-1} + \varepsilon_t$$

Where $\sigma_{HML,t}$ is the volatility of the HML return. We will test the extent to which the dispersion or median book-to-market term adds explanatory power to an autoregression of volatility.

We will also test whether the volatility of the market can be predicted by dispersion or median book-to-market.

$$\sigma_{Mkt-Rf,t} = \alpha + \tau_{Var} \times \sigma_{Mkt-Rf,t-1} + \varepsilon_t$$

$$\sigma_{Mkt-Rf,t} = \alpha + \tau_{Var} \times \sigma_{Mkt-Rf,t-1} + \tau_{Disp} \times Disp_{t-1} + \varepsilon_t$$

$$\sigma_{Mkt-Rf,t} = \alpha + \tau_{Var} \times \sigma_{Mkt-Rf,t-1} + \tau_{BEME} \times BM_{t-1} + \varepsilon_t$$

Where $\sigma_{Mkt-Rf,t}$ is the volatility of the market excess return.

4. PREDICTING HML SHARPE RATIO

Since we believe that book-to-market dispersion predicts both higher return and higher volatility, we are left unsure as to what the effect will be on the Sharpe Ratio. We will run the following regression to determine which if any of these effects is dominant:

$$SR_{HML,t} = \alpha + \delta_{InvVol} \times 1/\sigma_{HML,t-1} + \delta_{Disp} \times Disp_{t-1} + \delta_{Ret} \times HML_{t-1} + \varepsilon_t$$

We have no prior expectation of whether the Sharpe Ratio will be predictable or not. However, we do expect δ_{InvVol} to be positive as we expect volatility to be persistent and δ_{Ret} to be negative as we expect returns to reverse.

5. DATA

The 75^{th} percentile and 25^{th} percentile book-to-market ratios and the HML factor returns came from Kenneth French's data library. We use log HML returns in all analysis. Earnings and dividend data come from Robert Shiller's website. We use annual frequencies for all data with all annual data calculated from July of a given year to June of the next year. We compute returns this way because July is when HML portfolios are reconstituted using new fundamental data. The HML breakpoints provided on Kenneth French's website are also from July.

Regressions are run using one year to five year data. Regressions involve overlapping data for two to five year data. In these cases, Newey-West standard errors are used to compute t-stats.

6. PREDICTING RETURN RESULTS

Book-to-Market Dispersion

The results of the dispersion regression are as follows:

	TABLE 1				
	HML RETURNS AGAINST DISPERSION				
	α		β_{Disp}		R-squared
	Coeff	t-stat	Coeff	t-stat	
1 Year	-0.16	-2.19	0.24	2.99	10%
2 Year	-0.26	-2.01	0.40	2.64	16%
3 Year	-0.29	-1.99	0.49	2.84	21%
4 Year	-0.28	-1.39	0.55	2.30	21%
5 Year	-0.25	-1.11	0.58	2.17	19%

$HML_t = \alpha + \beta_{Disp} \times Disp_{t-1} + \varepsilon_t$

As expected, book-to-market dispersion predicts higher future HML return. The strength of the prediction is higher over longer time horizons.

Now, we test whether this dispersion is simply a proxy for a market risk premium that is captured in the median book-to-market.

	TABLE 2 HML RETURNS AGAINST MEDIAN BOOK-TO-MARKET				
	α		β_{BEME}		
	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	-0.05	-1.38	0.10	3.40	13%
2 Year	-0.04	-0.56	0.15	2.28	14%
3 Year	-0.01	-0.11	0.17	3.70	18%
4 Year	0.05	0.81	0.17	3.06	14%
5 Year	0.14	1.79	0.15	2.14	8%

$HML_t = \alpha + \beta_{BEME} \times BM_{t-1} + \varepsilon_t$

Although for the first year, median book-to-market explains more of the variance of HML returns, dispersion outpaces book-to-market in explanatory power for longer time periods. However, the t-stats are more significant for median book-to-market. Over one to three years, it is hard to argue that dispersion adds too much explanatory power to our regression, but over four and five years, it seems that dispersion may add some explanatory power to the regression. In order to determine whether this is in fact the case, we must regress the residuals from the Regression 2 on dispersion. That is, we must run the following regression:

$$\varepsilon_t = \alpha + \theta_{Disp} \times Disp_{t-1} + e_t$$

Where ε_t is the residual from Regression 2. We must again use Newey-West adjusted standard errors for the longer than one year regressions.

	TABLE 3 HML AGAINST BEME RESIDUALS AGAINST DISPERSION				
	α		θ_{Disp}		
	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	-0.06	-0.86	0.07	0.88	1%
2 Year	-0.15	-1.19	0.16	1.10	3%
3 Year	-0.19	-1.44	0.21	1.32	5%
4 Year	-0.24	-1.27	0.27	1.16	6%
5 Year	-0.32	-0.32	0.34	0.34	7%

$\varepsilon_t = \alpha + \theta_{Disp} \times Disp_{t-1} + e_t$

It appears that for the dispersion does not add significant value to our regression over and above what we get from median book-to-market. This suggests that the variation in HML return may be driven by changes in risk premium, which is in line with the model of value as a risk factor.

Autoregressive Term

The results of the autoregression are in Table 4.

	TABLE 4 HML RETURNS AGAINST PREVIOUS HML RETURNS				
	α		β_{AR}		
	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	0.06	3.27	-0.09	-0.80	1%
2 Year	0.15	4.44	-0.30	-1.93	9%
3 Year	0.22	4.76	-0.23	-1.64	6%
4 Year	0.35	6.34	-0.49	-4.11	27%
5 Year	0.44	6.57	-0.57	-4.34	36%

$HML_t = \alpha + \beta_{AR} \times HML_{t-1} + \varepsilon_t$

There is very little predictive ability over one-, two-, or three-year periods However, the predictive ability of the AR term over four- and five-year periods is highly significant with a negative β_{AR} suggesting mean reversion of returns. This is in line with what we see from the graph of variance ratios. We include the dispersion and median book-to-market ratio in separate regressions in Tables 5 and 6.

	TABLE 5						
	HML RETURNS AGAINST DISPERSION AND PREVIOUS HML RETURNS						
	α		β_{Disp}		β_{AR}		
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	-0.17	-2.22	0.25	3.08	-0.13	-1.19	12%
2 Year	-0.24	-2.36	0.43	3.33	-0.32	-2.68	27%
3 Year	-0.26	-2.33	0.53	3.93	-0.26	-2.48	31%
4 Year	-0.17	-1.32	0.56	4.47	-0.48	-3.85	52%
5 Year	-0.04	-0.25	0.52	3.20	-0.54	-4.08	53%

$HML_t = \alpha + \beta_{Disp} \times Disp_{t-1} + \beta_{AR} \times HML_{t-1} + \varepsilon_t$

	TABLE 6						
	HML RETURNS AGAINST MEDIAN BOOK-TO-MARKET AND PREVIOUS HML RETURNS						
	α		β_{BEME}		β_{AR}		
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	-0.05	-1.43	0.11	3.68	-0.17	-1.62	15%
2 Year	-0.01	-0.17	0.16	3.53	-0.35	-2.95	27%
3 Year	0.03	0.63	0.19	4.68	-0.30	-2.65	27%
4 Year	0.16	2.54	0.19	5.08	-0.50	-4.80	45%
5 Year	0.29	3.55	0.14	3.20	-0.56	-4.96	45%

$HML_t = \alpha + \beta_{BEME} \times BM_{t-1} + \beta_{AR} \times HML_{t-1} + \varepsilon_t$

The β_{Disp} and β_{BEME} add significantly to a regression that includes just an AR term and vice versa. Again, we regress the residuals of Regression 6 on book-to-market dispersion to determine whether book-to-market dispersion adds value to our regression.

	TABLE 7 HML AGAINST BEME, AR RESIDUALS AGAINST DISPERSION				
	α		θ_{Disp}		
	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	-0.06	-0.82	0.06	0.84	1%
2 Year	-0.15	-1.49	0.16	1.38	4%
3 Year	-0.20	-1.87	0.22	1.76	6%
4 Year	-0.23	-2.02	0.25	2.01	9%
5 Year	-0.26	-1.62	0.28	1.62	9%

$\varepsilon_t = \alpha + \theta_{Disp} \times Disp_{t-1} + e_t$

Surprisingly, when we include an autoregressive term in our regression, we do find dispersion may add value to our prediction of HML returns over and above the predictive value from median book-to-market. Our θ_{Disp} coefficient for the 3 year regression is significant at a 0.10 level while the coefficient for the 4 year regression is significant at a 0.05 level. All θ_{Disp} coefficients are in the expected direction.

Given the strong significance of the autoregressive term in all but the first regression, we may be convinced that there truly is a mean reverting economic factor that co-moves more with value. We proposed the possibility that dividends may be a proxy for such a factor. We test that in the following regression.

	TABLE 8 HML RETURNS AGAINST CONTEMPORANEOUS DIVIDEND GROWTH				
	α		β_{Div}		
	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	0.06	3.36	-0.15	-0.80	1%
2 Year	0.12	3.85	-0.22	-0.78	3%
3 Year	0.18	5.20	-0.39	-1.78	10%
4 Year	0.25	6.27	-0.45	-3.05	13%
5 Year	0.31	7.18	-0.41	-2.95	10%

$HML_t = \alpha + \beta_{Div} \times \Delta Div_t + \varepsilon_t$

The results are literally the exact opposite of what was expected. That is, dividend growth appears to negatively co-move with HML returns. We are unable to explain this behavior and leave the negative autocorrelation of HML returns for further research.

7. PREDICTING VOLATILITY RESULTS

First, we look at whether we can predict current period volatility using previous period volatility.

	TABLE 9				
	HML VOLATILITY AGAINST PREVIOUS HML VOLATILITY				
	α		γ_{Var}		
	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	0.04	4.03	0.53	5.57	28%
2 Year	0.06	6.25	0.44	4.07	19%
3 Year	0.07	6.60	0.27	3.38	7%
4 Year	0.08	7.11	0.15	2.04	3%
5 Year	0.08	6.90	0.10	1.22	3%

$\sigma_{HML,t} = \alpha + \gamma_{Var} \times \sigma_{HML,t-1} + \varepsilon_t$

Fully in line with what we might expect, there is positive autocorrelation in volatility with that positive autocorrelation decreasing with time period. We now include the dispersion and median book-to-market variables in separate regressions.

	TABLE 10						
	HML VOLATILITY AGAINST PREVIOUS HML VOLATILITY AND DISPERSION						
	α		γ_{Var}		γ_{Disp}		
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	-0.11	-4.06	0.05	0.40	0.22	6.07	51%
2 Year	-0.12	-2.17	-0.19	-1.39	0.26	3.42	52%
3 Year	-0.07	-1.16	-0.24	-1.13	0.21	2.34	29%
4 Year	-0.02	-0.51	-0.23	-1.30	0.15	2.38	18%
5 Year	0.02	0.55	-0.14	-1.14	0.10	2.30	14%

$\sigma_{HML,t} = \alpha + \gamma_{Var} \times \sigma_{HML,t-1} + \gamma_{Disp} \times Disp_{t-1} + \varepsilon_t$

	TABLE 11						
	HML VOLATILITY AGAINST PREVIOUS HML VOLATILITY AND MEDIAN BOOK-TO-MARKET						
	α		γ_{Var}		γ_{BEME}		
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	0.02	1.33	0.24	2.20	0.06	4.18	41%
2 Year	0.03	1.83	0.16	1.29	0.06	2.13	34%
3 Year	0.06	4.39	0.15	1.41	0.03	1.27	10%
4 Year	0.08	5.43	0.09	0.82	0.01	0.57	4%
5 Year	0.08	5.42	0.08	0.78	0.00	0.28	3%

$\sigma_{HML,t} = \alpha + \gamma_{Var} \times \sigma_{HML,t-1} + \gamma_{BEME} \times BM_{t-1} + \varepsilon_t$

The first thing that is clear is that our dispersion and median book-to-market variables add substantial explanatory power to our autoregression of volatility. The second thing we notice is that when dispersion is included in the regression, past volatility becomes completely insignificant and even changes signs such that in-sample, high volatility follows low volatility and vice versa after controlling for dispersion. The third thing we see is that the dispersion variable seems to add additional value to our regression versus the median book-to-market variable. We test whether this is in fact the case by regressing the residuals of Regression 11 on our dispersion variable.

TABLE 12

HML VOLATILITY AGAINST PREVIOUS HML VOLATILITY AND MEDIAN BOOK-TO-MARKET RESIDUALS AGAINST DISPERSION

	α		θ_{Disp}		
	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	-0.07	-2.97	0.08	3.04	10%
2 Year	-0.08	-1.93	0.09	1.78	13%
3 Year	-0.07	-1.66	0.08	1.49	8%
4 Year	-0.06	-1.94	0.06	1.79	6%
5 Year	-0.04	-1.60	0.04	1.66	4%

$\varepsilon_t = \alpha + \theta_{Disp} \times Disp_{t-1} + e_t$

At least over one year periods, we can be highly confident that dispersion adds predictive power to our regression. Over 2, 4, and 5 year periods, we also see significance at a 0.10 level.

We now test whether we can predict the volatility of the market using dispersion. If that were the case, we would expect that high dispersion tends to be followed by high volatility and low dispersion by low volatility, assuming very high dispersion is a proxy for market dislocation.

TABLE 13

MARKET VOLATILITY AGAINST PREVIOUS MARKET VOLATILITY

	α		τ_{Var}		
	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	0.08	4.47	0.51	5.23	26%
2 Year	0.09	3.28	0.43	2.10	18%
3 Year	0.10	4.43	0.38	2.33	15%
4 Year	0.09	6.52	0.41	4.18	22%
5 Year	0.09	6.38	0.42	5.14	35%

$\sigma_{Mkt-Rf,t} = \alpha + \tau_{Var} \times \sigma_{Mkt-Rf,t-1} + \varepsilon_t$

	α		τ_{Var}		τ_{Disp}		
	TABLE 14						
	MARKET VOLATILITY AGAINST PREVIOUS MARKET VOLATILITY AND DISPERSION						
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	-0.03	-0.69	0.30	2.52	0.15	2.84	33%
2 Year	-0.06	-0.70	0.05	0.28	0.23	2.25	32%
3 Year	-0.06	-0.80	-0.15	-0.68	0.28	2.22	32%
4 Year	-0.03	-0.35	-0.03	-0.13	0.21	1.67	34%
5 Year	0.01	0.22	0.14	0.76	0.13	1.37	44%

$\sigma_{Mkt-Rf,t} = \alpha + \tau_{Var} \times \sigma_{Mkt-Rf,t-1} + \tau_{Disp} \times Disp_{t-1} + \varepsilon_t$

	α		τ_{Var}		τ_{BEME}		
	TABLE 15						
	MARKET VOLATILITY AGAINST PREVIOUS MARKET VOLATILITY AND MEDIAN BOOK-TO-MARKET						
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	0.06	3.33	0.34	2.57	0.04	1.77	29%
2 Year	0.08	2.57	0.28	1.33	0.04	1.04	21%
3 Year	0.09	3.89	0.27	1.53	0.03	0.94	16%
4 Year	0.09	5.17	0.34	3.32	0.02	0.65	23%
5 Year	0.08	4.75	0.32	3.49	0.02	0.99	38%

$\sigma_{Mkt-Rf,t} = \alpha + \tau_{Var} \times \sigma_{Mkt-Rf,t-1} + \tau_{BEME} \times BM_{t-1} + \varepsilon_t$

We see that higher dispersion does predict higher market volatility which may mean that dispersion is highest during market dislocations. However, we also see that median book-to-market is high preceding times of high volatility, so it may be that risk premiums are high during preceding periods of high volatility, which is presumably what we would expect. So, we must see whether we can explain the residuals of Regression 15.

	TABLE 16				
	MARKET VOLATILITY AGAINST PREVIOUS MARKET VOLATILITY, BEME RESIDUALS AGAINST DISPERSION				
	α		θ_{Disp}		R-squared
	Coeff	t-stat	Coeff	t-stat	
1 Year	-0.07	-1.67	0.07	1.71	4%
2 Year	-0.08	-1.93	0.09	1.78	7%
3 Year	-0.07	-1.66	0.08	1.49	7%
4 Year	-0.06	-1.94	0.06	1.79	5%
5 Year	-0.04	-1.60	0.04	1.66	3%

$\varepsilon_t = \alpha + \theta_{Disp} \times Disp_{t-1} + e_t$

The θ_{Disp} coefficient is significant a 0.10 level over all periods save 3 year periods. This suggests that dispersion may contain information about future market volatility.

8. PREDICTING SHARPE RATIO RESULTS

We find that both the HML return and volatility are higher following periods of high dispersion. The question then arises whether it is possible to predict the Sharpe Ratio using the same variables we used to predict the return and volatility. Those results follow:

TABLE 17

HML SHARPE RATIO AGAINST INVERSE PREVIOUS HML VOLATILITY, DISPERSION, AND PREVIOUS HML RETURN

	α		δ_{InvVol}		δ_{Disp}		δ_{Ret}		
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	R-squared
1 Year	1.32	1.09	-0.05	-1.48	-0.15	-0.16	-0.67	-0.62	4%
2 Year	1.28	0.75	-0.05	-0.95	0.73	0.59	-2.36	-2.79	8%
3 Year	1.46	0.74	-0.06	-0.88	1.41	0.90	-0.94	-0.90	6%
4 Year	3.85	1.71	-0.13	-1.99	1.43	0.83	-3.76	-3.00	24%
5 Year	6.01	2.01	-0.17	-2.18	1.49	0.62	-6.72	-5.70	42%

$$SR_{HML,t} = \alpha + \delta_{InvVol} \times 1/\sigma_{HML,t-1} + \delta_{Disp} \times Disp_{t-1} + \delta_{Ret} \times HML_{t-1} + \varepsilon_t$$

Over shorter time periods, the HML Sharpe Ratio is all but unpredictable but over four and five year periods, it does appear to be predictable. The coefficient on dispersion is insignificant in all regressions. The lagged return coefficient is highly significant and negative as expected over 2, 4, and 5 year periods. The inverse volatility coefficient is significant over 4 and 5 years and is unexpectedly negative over all periods. Using median book-to-market in place of dispersion makes virtually no difference to the results. We do not include the results of that regression here.

9. ANALYSIS AND CONCLUDING REMARKS

We have found that over at least some horizon, return, volatility, and the Sharpe Ratio of the HML factor are predictable.

Dispersion does appear to add some predictive power to predicting HML return over and above what is provided by the median book-to-market. This leaves us with three possibilities. The first and most obvious is that the relation is noise, completely non-robust, and will have no predictive power going forward. We require international and perhaps other out-of-sample tests to verify the robustness of this relationship. The second possibility is that this HML predictability is in fact behavioral. It may be that the noisy market hypothesis would predict that the greater the dispersion, the higher the probability that prices have deviated from their fair market value, and therefore, the higher the expected HML return. The fact that it predicts higher market volatility may suggest that dispersion can only reach significant heights during market dislocations. The third possibility is that book-to-market dispersion is related to some other risk factor. It may be that there is an unobserved risk factor which underlies dispersion. It is possible that, in the terms used by Campbell and Vuolteenaho, when value stocks have on average abnormally high book-to-market ratios relative to growth stocks, it may be that they have yet higher cash flow betas and lower discount rate betas relative to growth stocks than in periods of lower dispersion (Campbell and Vuolteenaho 2004). We leave this to further research to determine the precise cause of this relationship or whether there is in fact a relationship at all.

Dispersion evidently has little to no ability to predict HML's Sharpe Ratio but does have ability to predict volatility. From a risk management standpoint, this predictive ability should allow investors to reduce exposure to HML during periods of high dispersion to reduce volatility or tracking error in long short or long-only portfolios, respectively.

The predictability of the HML Sharpe Ratio suggests that investors can vary exposure to HML over long time horizons to maximize their risk-adjusted return. However, to test whether this is truly the case, we must backtest trading strategy that utilizes only the data available to an investor at the time to vary exposure to HML. We leave this analysis for further research.

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