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Abstract

I study long-short portfolio strategies formed on seven different stock characteristics representing various measures of past returns, value, and size. Each individual characteristic results in a profitable portfolio strategy, but these single-characteristic strategies are all dominated by a diversified strategy that places equal weight on each of the single-characteristic strategies. The benefits of diversifying across characteristic-based long-short strategies are substantial and can be attributed to the mostly low, and sometimes substantially negative, correlation between the returns on the single-characteristic strategies.

JEL classification: G11, G12.

Keywords: Diversification; Portfolio choice; Stock characteristics.

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1 Introduction

Portfolio strategies based on stock characteristics, such as momentum and value, occupy a great deal of the finance literature. Such portfolios tend to generate returns that cannot be readily explained by standard asset pricing models and therefore represent, to some extent, empirical 'anomalies'. Most studies focus on one characteristic at a time and evaluate to what extent a trading strategy based on that characteristic delivers significantly positive returns. In recent work, Asness, Moskowitz, and Pedersen (2009, AMP hereafter) study value and momentum jointly and find that using a portfolio strategy based on both of these characteristics tends to strongly outperform each of the individual characteristic strategies. In their analysis, AMP start out with typical long-short momentum and value strategies and then combine these two strategies into a joint equal-weighted momentum-value strategy. The generally negative correlation between the returns on the two individual strategies provide substantial diversification benefits and leads to often large increases in the Sharpe ratio, relative to the individual strategies.[1]

In the current study, I extend the AMP analysis and study the performance of long-short characteristic-based strategies, diversified across a relatively large number of characteristics. In particular, I analyze the performance of long-short strategies based on the following characteristics: (i) Short-term reversals, (ii) medium-term momentum, (iii) long-term reversals, (iv) book-to-market value, (v) cashflow-price ratio, (vi) earnings-price ratio, and (vii) size. The performance of the single-characteristic portfolios are compared to an equal-weighted portfolio of the single-characteristic ones. The empirical results are clear-cut, with the equal-weighted diversified portfolio almost always delivering substantially better Sharpe ratios than any of the single-characteristic portfolios or the two-characteristic momentum-value portfolio considered by AMP. From a portfolio management perspective, there are thus great diversification benefits from combining long-short strategies based on several different characteristics. From an asset pricing perspective, the large Sharpe ratios obtained for the diversified portfolios illustrates even further the problem of reconciling observed returns on stocks with rational economic models.

[1] AMP also study diversification across different asset classes and countries, using joint momentum-value strategies, which leads to even greater Sharpe ratios. In the current paper, I focus only on U.S. stocks.

2 Portfolio strategies

2.1 Data and characteristics

Monthly data on returns for portfolios sorted on different characteristics were obtained from Kenneth French's web site.[2] That is, for each characteristic, all stocks on the NYSE, AMEX, and NASDAQ, are sorted into deciles of the stock characteristic and the equal-weighted return on each decile is recorded. Seven different characteristics, or sorting criteria, are considered. The first three represent serial correlation patterns in stock returns: (i) Short-term reversals (ST-Rev), defined as the prior month's $(t-1)$ return, (ii) medium-term momentum (Mom), defined as the returns from month $t-12$ to $t-2$, and (iii) long-term reversals (LT-Rev), defined as the returns from month $t-60$ to $t-13$. The next three represent different valuation ratios: (iv) Book-to-market value (BM), (v) cashflow-price ratio (CP), and (vi) earnings-price ratio (EP). The final characteristic is (vii) firm size, measured as market equity (ME). The sample period over which returns on all these characteristic-sorted portfolios are available spans from July 1951 to December 2008, for a total of 690 monthly observations. More exact details on these portfolios are available on Kenneth French's web site.[3]

From the returns on the decile portfolios for each characteristic, the returns on a long-short high-minus-low portfolio are constructed by calculating the difference between the returns on the top decile portfolio and the bottom decile portfolio. In the case of short-term reversals, long-term reversals, and size, where the returns are expected to *decrease* in the characteristic, the returns on the low-minus-high (or equivalently, the negative of the high-minus-low) portfolios are instead constructed. This produces return series for seven long-short characteristic based portfolios.

Table 1 shows the correlation structure for the returns on the seven long-short portfolios. Results for the full sample period from 1951 to 2008 are shown, as well as results for three different subsamples, spanning the first and second halves of the sample as well as the last ten years of the sample, respectively. As would be expected, the three valuation ratios, BM, CP, and EP, result in portfolio returns that are fairly highly correlated with each other. Depending a bit on sample

[2] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[3] Portfolios sorted on the dividend-price ratio were also available on the website, but we omit this characteristic here since far from all firms pay dividends. In addition, when combined into a joint equal-weighted portfolio, the current set of characteristics provides an attractive equal weight on value and past returns, with three characteristics representing value and three representing past returns.

period, the valuation ratios are mostly negatively correlated with Short-term reversals (ST-Rev), only weakly correlated with momentum (Mom), and generally positively correlated with long-term reversals (LT-Rev). Market equity (ME), or size, is most highly positively correlated with long-term reversals and negatively correlated with momentum. Short-term reversals are fairly strongly negatively correlated with momentum, and weakly positively correlated with long-term reversals. Momentum and long-term reversals exhibit a fairly large negative correlation. Overall, and apart from the high correlation between the returns on the valuation ratio portfolios, the correlation matrices shown in Table 1 indicate that there may be substantial diversification benefits across the different characteristics.

2.2 Portfolio performance

2.2.1 Single-characteristic portfolios

The left hand side of Table 2 shows annualized summary statistics for the returns on the single-characteristic portfolios described above. The (annualized) mean, standard deviation, Sharpe ratio, and CAPM alpha and beta are shown; standard errors are shown in parantheses below the estimates. The excess returns, over the one month T-Bill rate, on the value weighted CRSP portfolio are used as market returns in the CAPM regressions; the annualized mean, standard deviation, and Sharpe ratio for the market excess returns are shown in the right-most column in Table 2. Full sample results, as well as results for the three sub-samples listed above, are shown. From a portfolio performance perspective, the final sub-sample covering the most recent ten years is of extra interest both because it may be a better indicator of which strategies currently work and also because it spans a very difficult period for the U.S. stock market with both the dotcom crash in the early 2000s as well as the recent credit crisis (the average excess return over the period was -2.1 percent). This sample period thus provides a good test of whether the long-short strategies are capable of delivering excess returns in adverse market conditions.

Starting with the mean estimates, it is evident that the zero-cost long-short portfolios generally deliver average returns that are statistically different from zero. Over the full sample (Panel A), the mean estimates are always more than two standard deviations away from zero. During the first and second half of the sample period (Panels B and C), it is only for size (ME) in the latter

half of the sample that the null hypothesis of zero average returns cannot be rejected at standard significance levels. In the shortest sub-sample spanning the last ten years, the mean estimates are often not precise enough to reject the null. Since the CAPM betas for most of the strategies are small, the significant mean estimates also typically translate into significantly positive CAPM alphas. The only strategy that exhibits a sizeable positive CAPM beta is the short-term reversal (ST-Rev) strategy. All three valuation ratio strategies (BM, CP, and EP) exhibit fairly large, and significant, negative betas.

The annualized Sharpe ratios show that over most periods and for most characteristics, the long-short portfolios also deliver sizable risk-adjusted returns. Apart from the size-based portfolios, the other characteristics result in Sharpe ratios that are typically in the region between 0.6 and 1. This is substantially larger than the Sharpe ratios achieved for the market portfolio, which is generally in the 0.4 to 0.5 range as seen in the final column of Table 2. In the first half of the sample (Panel B), the short-term reversal strategy performs by far the best, with an annual Sharpe ratio of two. In the second half of the sample (Panel C), the value based strategies all perform well, with Sharpe ratios close to one. Size appears to perform the worst in general, although it did quite well during the last ten years (Panel D).

The summary statistics for the long-short portfolios ignore the impact of transaction costs. However, although transaction costs will inevitably lead to lower returns, their impact may not be that great in these types of portfolios, as evidenced by Brandt et al. (2009) who also study characteristic based strategies. They find that controlling for transaction costs only marginally lowers the performance of their characteristic based portfolios, as long as the transaction costs are taken into account in the portfolio rebalancing decisions. In addition, the qualitative benefits of diversification that are described in the following section are likely to hold also under transaction costs, even if the overall level of the Sharpe ratios may shift downwards. Thus, although a full ananlysis of transaction costs is outside the scope of the current study, there are strong reasons to believe that the conclusions would remain the same also after controlling for transaction costs.

2.2.2 Multi-characteristic portfolios

The right hand side of Table 2 shows the summary statistics for the portfolios that are diversified across the characteristics. In particular, from the single characteristic portfolios, I create two

different diversified portfolios. The first one is simply the equal weighted portfolio across all seven characteristics. The second one is the equal weighted portfolio of the momentum strategy and the book-to-market strategy, which are the two characteristics studied by AMP.

The empirical results presented in the second half of Table 2 are very strong. In almost all cases, the equal weighted portfolio across all characteristics strongly outperforms the single-characteristic portfolios, measured by the Sharpe ratio, and also offers substantial gains over the momentum-book-to-market portfolio studied by AMP. This is particularly true during the last ten years (Panel D), where the equal weighted portfolio across all characteristics achieves a Sharpe ratio of 1.3, whereas the single characteristic portfolios all have Sharpe ratios below 0.8, and the momentum-book-to-market portfolio only has a Sharpe ratio of about 0.6. The Sharpe ratio for the market over the last ten years was negative.

Only the short-term reversal portfolio, and only during the first half of the sample (Panel B), ever outperforms the all-characteristics portfolio, in terms of Sharpe ratios. Interestingly, the performance of the all-characteristics portfolio is very similar during the first (Panel A) and second (Panel B) halves of the sample, whereas the Sharpe ratio for the short-term reversal portfolio is almost twice as large during the first half of the sample as compared to the second half.

Table 2 thus provides strong evidence in favour of the benefits of diversification across characteristics. Importantly, these benefits appear to have been present also during the last ten years when the market on average performed dismally and most of the single-characteristic portfolios also performed below their longer-run averages.

3 Conclusion

From a portfolio management perspective, there appears to be large gains to be had from pursuing diversified characteristic-based strategies. The Sharpe ratios obtained for the diversified portfolio are consistently large across all sub-samples and almost always greater than the Sharpe ratios for any of the single-characteristic portfolios.

Of course, to the extent that these stock characteristics may actually represent priced risk factors, as has been analyzed in many studies (e.g., Fama and French, 1992, 1996), diversifying across the characteristics will not eliminate exposure to these risk factors. However, if the different

characteristics represent, or load on, somewhat different risk factors, the diversification should reduce the sensitivity to any given risk factor.

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Table 1: Correlations for the single-characteristic portfolios. The table reports the correlations of the monthly returns on the single-characteristic portfolios for the following seven characteristics: (i) Short-term reversals (ST-Rev), (ii) medium-term momentum (Mom), (iii) long-term reversals (LT-Rev), (iv) Book-to-market value (BM), (v) cashflow-price ratio (CP), (vi) earnings-price ratio (EP), and (vii) firm size (ME). Panel A reports the results for the full 1951-2008 sample, Panels B and C report the results for the first and second halves of the sample and Panel D reports the results for the final 10 years of the sample.

	ST-Rev	Mom	LT-Rev	BM	CP	EP	ME
Panel A. Jul. 1951 - Dec. 2008							
ST-Rev	1.000						
Mom	−0.565	1.000					
LT-Rev	0.290	−0.368	1.000				
BM	−0.083	−0.064	0.504	1.000			
CP	−0.105	0.012	0.349	0.818	1.000		
EP	−0.108	0.028	0.267	0.768	0.893	1.000	
ME	0.346	−0.418	0.689	0.205	0.059	−0.027	1.000
Panel B. Jul. 1951 - Dec. 1979							
ST-Rev	1.000						
Mom	−0.538	1.000					
LT-Rev	0.390	−0.384	1.000				
BM	0.243	−0.355	0.771	1.000			
CP	0.075	−0.209	0.576	0.786	1.000		
EP	0.011	−0.141	0.523	0.715	0.868	1.000	
ME	0.444	−0.479	0.610	0.508	0.267	0.175	1.000
Panel C. Jan. 1980 - Dec. 2008							
ST-Rev	1.000						
Mom	−0.580	1.000					
LT-Rev	0.231	−0.363	1.000				
BM	−0.261	0.108	0.301	1.000			
CP	−0.215	0.155	0.157	0.844	1.000		
EP	−0.176	0.129	0.067	0.805	0.912	1.000	
ME	0.286	−0.382	0.760	−0.017	−0.111	−0.180	1.000
Panel D. Jan. 1999 - Dec. 2008							
ST-Rev	1.000						
Mom	−0.608	1.000					
LT-Rev	0.159	−0.222	1.000				
BM	−0.346	0.283	0.138	1.000			
CP	−0.256	0.294	0.070	0.860	1.000		
EP	−0.206	0.243	0.060	0.871	0.927	1.000	
ME	0.269	−0.308	0.828	−0.070	−0.089	−0.129	1.000

Table 2: Annualized performance statistics for the single- and multi-characteristic portfolios, as well as the market returns. The table reports summary statistics for the returns on all seven of the single-characteristic portfolios and the multi-characteristic portfolios formed as equal-weighted portfolios of either all the single-characteristic portfolios or of only the momentum and book-to-market portfolios. The last column shows the summary statistics for the excess returns on the market. Panel A reports the results for the full 1951-2008 sample, Panels B and C report the results for the first and second halves of the sample and Panel D reports the results for the final 10 years of the sample. The first rows in each panel report the annualized mean with the standard error given in parentheses below, and the annualized standard deviation and Sharpe ratio for the excess returns on each portfolio. The last four rows report the annualized CAPM alpha and beta, with standard errors in parentheses below the point estimates. The individual characteristics are as follows: (i) Short-term reversals (ST-Rev), (ii) medium-term momentum (Mom), (iii) long-term reversals (LT-Rev), (iv) Book-to-market value (BM), (v) cashflow-price ratio (CP), (vi) earnings-price ratio (EP), and (vii) firm size (ME).

	Single-characteristic portfolios							Equal-weighted multi-characteristic portfolios		
	ST-Rev	Mom	LT-Rev	BM	CP	EP	ME	All characteristics	Mom and BM	Market
Panel A. Jul. 1951 - Dec. 2008										
Mean	23.267	14.956	9.314	11.651	9.766	8.839	5.145	11.849	13.304	6.104
	(2.122)	(2.515)	(2.096)	(1.820)	(1.380)	(1.332)	(2.241)	(0.938)	(1.504)	(1.958)
Std. Dev.	16.088	19.067	15.890	13.802	10.462	10.096	16.995	7.113	11.405	14.848
Sharpe ratio	1.446	0.784	0.586	0.844	0.933	0.875	0.303	1.666	1.167	0.411
α	21.655	15.642	9.873	13.717	11.262	10.389	4.781	12.474	14.680	
	(2.074)	(2.524)	(2.104)	(1.708)	(1.304)	(1.245)	(2.256)	(0.923)	(1.449)	
β	0.264	−0.112	−0.091	−0.338	−0.245	−0.254	0.060	−0.102	−0.225	
	(0.040)	(0.049)	(0.041)	(0.033)	(0.025)	(0.024)	(0.044)	(0.018)	(0.028)	
Panel B. Jul. 1951 - Dec. 1979										
Mean	26.026	14.915	9.923	8.036	9.295	8.267	8.063	12.075	11.476	6.592
	(2.421)	(2.983)	(2.927)	(2.320)	(1.847)	(1.705)	(3.083)	(1.364)	(1.530)	(2.621)
Std. Dev.	12.927	15.922	15.625	12.388	9.861	9.103	16.456	7.282	8.166	13.994
Sharpe ratio	2.013	0.937	0.635	0.649	0.943	0.908	0.490	1.658	1.405	0.471
α	24.373	15.868	10.123	9.069	10.125	9.497	7.031	12.298	12.469	
	(2.355)	(2.990)	(2.957)	(2.308)	(1.837)	(1.651)	(3.088)	(1.376)	(1.494)	
β	0.251	−0.145	−0.030	−0.157	−0.126	−0.187	0.157	−0.034	−0.151	
	(0.048)	(0.061)	(0.061)	(0.047)	(0.038)	(0.034)	(0.063)	(0.028)	(0.031)	
Panel C. Jan. 1980 - Dec. 2008										
Mean	20.557	14.996	8.716	15.204	10.230	9.401	2.278	11.626	15.100	5.623
	(3.466)	(4.038)	(3.002)	(2.787)	(2.049)	(2.042)	(3.248)	(1.291)	(2.575)	(2.908)
Std. Dev.	18.667	21.743	16.167	15.010	11.034	10.996	17.493	6.952	13.864	15.661
Sharpe ratio	1.101	0.690	0.539	1.013	0.927	0.855	0.130	1.672	1.089	0.359
α	19.016	15.486	9.501	17.903	12.132	11.126	2.376	12.506	16.695	
	(3.397)	(4.057)	(2.995)	(2.429)	(1.810)	(1.849)	(3.270)	(1.216)	(2.456)	
β	0.274	−0.087	−0.140	−0.480	−0.338	−0.307	−0.017	−0.156	−0.284	
	(0.062)	(0.074)	(0.055)	(0.045)	(0.033)	(0.034)	(0.060)	(0.022)	(0.045)	
Panel D. Jan. 1999 - Dec. 2008										
Mean	13.634	11.867	10.833	13.218	10.849	8.232	12.217	11.550	12.543	−2.149
	(8.640)	(9.773)	(5.396)	(6.023)	(4.333)	(4.182)	(6.369)	(2.775)	(6.424)	(5.074)
Std. Dev.	27.323	30.905	17.062	19.046	13.703	13.223	20.141	8.776	20.315	16.046
Sharpe ratio	0.499	0.384	0.635	0.694	0.792	0.623	0.607	1.316	0.617	−0.134
α	14.607	10.788	10.826	12.023	9.939	7.306	12.428	11.131	11.405	
	(8.370)	(9.482)	(5.423)	(5.347)	(3.782)	(3.582)	(6.381)	(2.606)	(5.865)	
β	0.453	−0.502	−0.003	−0.556	−0.424	−0.431	0.098	−0.195	−0.529	
	(0.151)	(0.171)	(0.098)	(0.097)	(0.068)	(0.065)	(0.115)	(0.047)	(0.106)	