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Abstract

We compute the Fama-French and momentum factor returns for the Indian equity market for the 1993-2012 period using data from CMIE Prowess. We differ from the previous studies in several significant ways. First, we cover a greater number of firms relative to the existing studies. Second, we exclude illiquid firms to ensure that the portfolios are investible. Third, we have classified firms into small and big using more appropriate cut-off considering the distribution of firm size. Fourth, as there are several instances of vanishing of public companies in India, we have computed the returns with a correction for survival bias. During the period, the average annual return of the momentum factor was 21.2%; the average annual return on the value portfolio (HML or VMG) was 6%; that of the size factor (SMB) was -0.8%; and the average annual excess return on the market factor (Rm-Rf) was 3.5%. The daily and monthly time series of the four factor returns and the returns of the underlying portfolios are available at http://www.iimahd.ernet.in/~jrvarma/Indian-Fama-French-Momentum/.

Keywords: Four factors, India, HML, WML, Momentum

JEL classifications: G12, C89

1   Introduction

This paper is our first step towards making available the Fama-French and Momentum factors (four factor model) of the Indian equity market to academics and practitioners[1]. In this initial attempt, we cover the 1993-2012 period, and it is our intention to keep the data updated on a regular basis while also extending the coverage backward in time. The objective is to provide data for the Indian market similar to what is provided for the US market at Kenneth French's website (French, n.d.)

The starting date of 1993 is motivated by several considerations. First, interest rates in India were deregulated only in the early 1990s and therefore there was no market determined risk free rate for earlier periods. As and when we extend the series backward, we will have to estimate the risk free rate using some estimate of the magnitude of financial repression as discussed in Varma and Barua (2006). Second, the standard source of machine readable stock price and corporate financial data (the Prowess database published by the CMIE) begins only in the early 1990s. For this study, we have relied on data from Prowess and cannot therefore go back beyond the early 1990s. Data for the earlier periods has to be hand collected from multiple sources. We plan to perform this exercise and extend the data back to the early 1980s. While the major burst of economic reforms in India occurred in 1991, India had a vibrant equity market from at least the early 1980s, and we believe it is essential to extend the data back to cover this period.

Several authors including Connor and Sehgal (2001), Bahl (2006), Taneja (2010), Mehta and Chander (2010) and Tripathi (2008) have used or tested the Fama French model or its variants in the Indian markets with relatively small number of firms over relatively short periods of time. However, the study that comes closest to ours is Eun et al. (2010), who estimated the monthly size, value and momentum factors in India, for the period between July 1993 and December 2010. They used the data provided by Datastream and the factors were estimated based on total returns including dividends. We extend the analysis of Eun et al. in several ways. Firstly, our analysis covers a larger number of the Indian firms provided by the CMIE Prowess database, the widely used database for academic research in India. Prowess covers more of medium and small firms from the Indian market than Datastream. Secondly, we extend the factor estimates to daily frequency. Finally, while Eun et al. (2010) was a one-time exercise for a specific time period, we intend to provide these factors on an ongoing basis with regular updates.

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[1]The daily and monthly time series of the four factor returns and the returns of the underlying portfolios will be made available at http://www.iimahd.ernet.in/~jrvarma/Indian-Fama-French-Momentum/.

2 Coverage of firms in the factors

We began with the list of all the firms listed in Bombay Stock Exchange (BSE)[2] covered in the CMIE Prowess database. Prowess had a total of 7,082[3] listed firms during the 1991 – 2013 period. However, of these 7,082 firms, only 6,943 firms had valid price and outstanding shares[4] data in Prowess.

The distribution of the market capitalisation of these 6,943 firms is given in Table 1. The number of firms covered significantly increases from 1992 to 2012. The minimum and maximum number of firms covered during any one-year period is 2,156 (1992) and 5,304 (1995). The total market capitalisation of the firms during the same period (1992-2012) has gone up almost 30 times. It was around ₹67 trillion (around $1.25 trillion) on September 2012. During the period, the median firm size has more than doubled and the average market capitalization has increased dramatically from around ₹1 billion in 1992 to ₹18 billion in 2012. The average market capitalisation of the firms is very close to the market capitalization of the 90th percentile firm, indicating the presence of large number of small firms in India.

2.1 Liquidity Filter

All the firms that were traded on less than 50 days in a 12-months period prior to the portfolio creation date were excluded from the sample. The 50 trading days' criterion translates into roughly one trading day per week. This ensures that the portfolios used for estimation purpose are investible. The distribution of the firms based on their trading liquidity is given in Table 2. During the early years (1990s), when shares were traded in the physical form, there were more illiquid firms. The period from 1996-2000, which also corresponds with significant market decline in India, appears to have relatively poor liquidity. Between 2004 and 2010, the market enjoyed high liquidity and even firms in the first decile of liquidity traded nearly 100 days per year. The median number of trading days was 241 days out of about 250 trading days during year 2011-2012.

The year-wise description of the firms eliminated by the liquidity criterion is provided in Table 3. Most of the firms eliminated using the 50 trading days' filter were small firms and belonged to the

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[2] The other leading exchange in India was the National Stock Exchange. However, the number of firms listed in BSE was substantially higher (more than 3 times) as compared to NSE. Further, almost all of the firms listed in NSE were also listed in BSE during the period covered in this study.

[3] CMIE Prowess database takes care of name changes and mergers and assigns a single firm identifier to the surviving entity before and after these events. We have used the CMIE identifier to distinguish the firms.

[4] In the remaining cases, either the price had a negative value or the outstanding shares were either missing or negative.

bottom 5 percentile, in terms of market capitalization. The liquidity filter eliminates a significant number of firms during 1997-2001 period. While more than 50% of the firms are excluded in the years 1998 and 2001, the market capitalisation of the excluded firms is very small. For instance, in the year where maximum number of firms are excluded (1998-1999) the market capitalisation of the excluded firms was only about 4.2%.

3 Estimation of size, value and momentum portfolios

3.1 The Fama-French Size-Value portfolios and factors

The Fama-French methodology involves a cross classification of stocks on two dimensions – size, measured by market capitalization and value, measured by the ratio of book value per share to market price per share – B/M ratio. This classification is tabulated below:

		Value as measured by B/M ratio		
		Value (V)	Neutral (N)	Growth (G)
Size	Big (B)	BV	BN	BG
	Small (S)	SV	SN	SG

We follow Fama and French (2012) and use Value(V), Neutral (N) and Growth (G) to denote the groups that Fama and French (1993) originally denoted as High (H), Medium (M), and Low (L). Apart from being more descriptive labels, this notation also allows the letter L to denote the Losers group in the momentum analysis used later.

The portfolio BV can be regarded as the intersection of B and V, while BN can be regarded as the intersection of B and N, and so on. Equally, B can be regarded as the union of BV, BN and BG; while V can be regarded as the union of BV and SV.

Following the literature, the Fama French factors – size and value – were computed using the six disaggregated portfolios (BV, BN, BG, SV, SN and SG) and not directly from the five aggregated portfolios (S, B, V, N and G). The reason for doing this was to make the size and value factors orthogonal to each other. Fama and French (1993) described the construction of the size factor (SMB) as follows:

Our portfolio *SMB* (small minus big), meant to mimic the risk factor in returns related to size, is the difference, each month, between the simple average of the returns on the three small-stock portfolios (S/L, S/M, and S/H)[5] and the simple average of the returns on the three big-stock portfolios (B/L, B/M, and B/H)[6]. Thus, *SMB* is the difference between the returns on small- and big-stock portfolios with about the same weighted-average book-to-market equity. This difference should be largely free of the influence of B/M, focusing instead on the different return behaviors of small and big stocks.

Put differently, *SMB* is the simple average of three return differences: $SG - BG$, $SN - BN$ and $SV - BV$, each of which is a difference between two portfolios that are matched in terms of value and differ only in size.

Similarly, the value factor *HML* (High minus Low)[7] is defined as the simple average of two differences: $SV - SG$ and $BV - BG$, each of which is a difference between two portfolios that are matched in terms of size and differ only in value. The *HML* factor is thus designed to capture the effect of value while being largely free of the influence of size.

3.1.1 Size breakpoints (S & B portfolios)

Eun et al. (2010) bifurcated their size ranked portfolios into small and big based on the median size. However, we defined big firms (B) as the top 10% by market capitalization and classified the remaining firms as small firms (S). The naive approach of classifying all firms above the median as large and the rest as small was considered inappropriate for the Indian market given the size distribution of firms, because:

- The Indian market was dominated by a large number of small firms. For instance, the market capitalization of the 90th percentile firm was around ₹0.7 billion (approximately $20 million) in 1997, ₹7 billion (approximately $160 million) in 2004 and ₹16 billion (approximately $300 million) in 2012. This is substantially lower than the NYSE size break-points published by French (n.d.).

- The average market capitalization of the firms over the years is close to the market capitalization of the 90th percentile firm.

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[5] *SG*, *SN* and *SV* in the Fama and French (2012) notation

[6] *BG*, *BN* and *BV* in the Fama and French (2012) notation

[7] VMG (Value minus Growth) would be a much more descriptive label for this factor, but the term *HML* is too well established to change. Fama and French (2012) while introducing the $G/N/V$ notation for various portfolios, left the *HML* name for the value factorunchanged.

- Edwards and Cavalli-Sforza (1965) suggested that the best split of observations into two clusters is one which minimizes the within-group sum of squares or maximizes the between-group sum of squares. We checked for various split-points starting from the 50th percentile to 90th percentile (based on market capitalization) in step of 10 and found the within-group sum of squares to be the lowest at the 90th percentile in all the years.

It may be recalled that even though Fama and French (1993) used the median of NYSE listed stocks as the breakpoint for size, there were a disproportionate number of small stocks in their sample because most Nasdaq and Amex stocks were smaller than the NYSE median.

3.1.2   Value breakpoints (V & G portfolios)

For the value breakpoints, we followed Fama and French (1993) and the stocks were grouped as below:

- High value group, V, consisted of the top 30% stocks in terms of the B/M ratio.

- Growth stocks (low value group), G, comprised of the bottom 30% stocks in terms of the B/M ratio.

- The remaining stocks were grouped as neutral (N) stocks.

3.1.3   Portfolio formation date

Fama and French (1993) formed their portfolios in June of each year after considering a 6-month gap from the fiscal yearends (December) to account for the time taken for the publication of accounting data. As the fiscal yearends for most Indian firms (89%) is March, assuming a 6-months gap[8] for publication of accounting data we formed our portfolio in September of each year. In this, we have followed Gregory et al. (2009) who make the same argument for the UK, and have chosen to depart from Eun et al. (2010) who used the US formation date of 30th June. To summarize our methodology relating to portfolio formation date,

- At the end of September each year, the stocks were classified as Big (B) and Small (S), based on their market capitalisation at September-end.

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[8]The 6-months gap is more appropriate in the Indian context because Indian firms are required to hold their Annual General Meeting within six months of the fiscal yearend.

- At the same time, the stocks were independently classified as Value (V), Neutral (N) and Growth (G) based on their B/M ratio. There were two possibilities here depending on the financial yearend:

    1. If the firm's financial year ended in March, the B/M ratio was computed in September using the data as at the end of March of the same year.

    2. If the firm's financial year ended in any other quarter, the B/M ratio was computed in September of year t using the data as at the firm's financial yearend of year $t - 1$.

3.1.4   Number of firms in the size-value portfolios

In the size-value portfolio creation we have excluded all the firms with negative book value from the sample. The median number (over the years) of firms categorised into the different size-value intersection portfolios are given below.

		Value as measured by B/M ratio		
		Value (V)	Neutral (N)	Growth (G)
Size	Big (B)	7	63	186
	Small (S)	666	821	494

The BV (Big-High value) portfolio is populated with fewer firms compared to the others. It indicates that most of the large Indian firms are also growth firms. In order to ensure that the portfolio returns are not driven by a few stocks, we did not consider the BV portfolio returns to estimate the SMB or HML, for years in which the number of stocks in the BV portfolio was less than five. This was the case for eight years. The choice of five stocks is based on the fact that a large part of the idiosyncratic risk is eliminated in a portfolio with as little as five stocks as may be seen in Figure 1 of Evans and Archer (1968) or Table 1 of Statman (1987).

3.2   Momentum Portfolios and Factors

As per the standard practice in the literature (Jegadeesh and Titman, 1993; Carhart, 1997), the classification of stocks as Winners (W) and Losers (L) was done based on their momentum returns at the end of each month. The momentum returns at the end of month t is the 11-months returns

from the end of month $t - 12$ to $t - 1$. By using the momentum returns, the stocks were grouped as below:

- W – group consisted of the top 30% by the momentum return

- L – group consisted of the bottom 30% by the momentum return

The buy-and-hold returns for month $t + 1$ are calculated based on the above classification.

In line with the standard methodology (for example, Fama and French (2012)), the momentum portfolios were orthogonalized to the size factor. The size groups were created at the end of each month based on the size breakpoints described in section 3.1.1. Based on the size and momentum groups, four size-momentum portfolios – WS, WB, LB, LS, were formed every month, as below:

		Momentum	
		Winners (W)	Losers (L)
Size	Big (B)	WB	LB
	Small (S)	WS	LS

The median number of firms in the different size-momemtum portfolios over the period are given below:

		Momentum	
		Winners (W)	Losers (L)
Size	Big (B)	105	31
	Small (S)	669	726

Similar to the method followed for size-value portfolios, we have excluded the portfolio in months where the number of stocks in the portfolio were less than five. As a result the BL portfolio was not considered in 10 months.

The momentum factor WML (Winners minus Losers) was computed as the simple average of the differences in the returns of $WS - LS$ and $WB - LB$. The WML factor was thus designed to capture the effect of value while being largely free of the influence of size.

4   Survivorship Bias: Adjustment for Vanishing Firms

The literature documents several instances of the vanishing of public companies in India (Rao et al., 1999, for instance). In our dataset we have found that there were 3,184 firms that stopped trading during the period covered. Out of these, we could confirm that 439 firms had stopped trading due to mergers. Taking zero returns for all the remaining firms could have upwardly biased our return estimates as some of these firms could have disappeared (vanished) as an outcome of financial distress leading to complete capital loss.

We have computed an alternative version of the factor portfolios assuming 100% capital loss for the firms vanishing due to distress[9]. Firms were identified as distressed if its last traded market price was below 50% of its face value. The year-wise distribution of these firms is given in Table 4. It can be seen that a large number of firms disappeared from the Indian market during the period 1996-2001. Most of these were small firms as they belonged to the bottom 2 deciles by market capitalization. The average market capitalization of these firms on their last trading day was only ₹0.2 million.

The change in the factor returns due to the above adjustment is somewhat trivial. Table 5 compares the portfolio returns with and without the adjustment. The difference in the cumulative returns over the 20-year period is about 6% for the SMB factor and 8% for the WML factor. This somewhat trivial outcome in terms of return occurs primarily due to the use of value weighted portfolios. Understandably, for the distressed firms, a significant portion of the loss in the market capitalisation is already captured in the available trading data.

For future extension of the analysis, we intend to consider a lookahead period of 1-year for the purpose of classifying a firm as a vanishing firm. Therefore, the factor returns after adjusting for the vanishing firms could be computed only with a one-year lag.

5   Return on Size, Value, Momentum & Market Portfolios

5.1   Computation of Returns

The adjusted closing price (*Adjusted Close*) provided by CMIE Prowess is already adjusted for stock splits and other corporate actions but not for dividends.

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[9]Some vanishing companies were not part of any portfolio on the last date because of other filters.

The total return including dividends of day t was computed using prices from BSE for each of the unique firm identifier using the following formula:

$$Total\ Return_t = \ln\left(\frac{Adjusted\ Close_t + DPS_t \dfrac{Adjusted\ Close_t}{Close_t}}{Adjusted\ Close_{t-1}}\right)$$

where DPS denotes the dividend per share. Using the above formula, we have computed the buy and hold returns for each size-value portfolio as often employed in the factor return estimation (Roll, 1983). The weight of each stock in a portfolio was based on the market capitalization on the portfolio reconstitution date (the September yearend for the size and value portfolios, and the month-end for the momentum portfolio).

5.2 Estimation of daily four-factor returns

Daily four-factor returns were calculated using the portfolios created for the monthly 4-factors. As such on any particular day, stocks were classified on three different dimensions based on the following:

- The value-size intersections (BV, BN, BG, SV, SN, SG) based on annual data.

- The momentum-size intersections (WB, WS, LB, LS) based on monthly data.

5.3 Estimation of Market Risk Premium

The market portfolio is estimated as the value-weighted portfolio of all the stocks involved in the estimation of SMB, HML, and WML portfolios. The risk free rate Rf, computed using the 91-days T-bill rate, is deducted from the return of the market portfolio to obtain the market risk premium MRP. The 91-day T-bill rate is sourced from the Reserve Bank of India's weekly auction data[10]. The implied yields have been converted to daily rates based on the number of trading days in the year following the issue.

5.4 Factor Returns

The cumulative monthly returns of the size, value, momentum and market portfolios are given in Figure 1. Over the period January 1993 to June 2012, the cumulative returns of the market

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[10]URL: http://dbie.rbi.org.in/DBIE/dbie.rbi?site=statistics, under the main heading 'Financial Market' and sub-heading 'Government Securities Market'.

portfolio (Rm) was 209% and the cumulative market risk premium (MRP) was 69%. The cumulative return on the value factor (HML) was 118%. The size factor (SMB) earned a negative cumulative return (-16%). Our results suggest that the momentum earns significant positive returns (cumulative return of 414%) in the Indian market[11]. The correlations of the monthly factor returns is given in Table 7. The correlations across the factor-returns are low and are in the lines of those reported from elsewhere in the world.

A rigorous statistical analysis of the factor returns is required to arrive at reliable conclusions on the factors and their ability to explain the cross-sectional returns in India. This would require analysis over a longer period, which the authors intend to carry out.

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[11]The momentum factor return is not strictly comparable to the other two factor returns as it would involve a higher trading cost. This would happen as the momentum returns are estimated with monthly portfolio re-balancing whereas the other two factors have holding periods of 1-year.

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Table 1: Descriptive statistics of market capitalization of firms

Year	Number of firms	Market capitalization - percentile (₹ million)					Total market cap. (₹ million)	Avg. market cap. (₹ millon)
		10%	30%	50%	70%	90%		
1992 - 1993	2,156	31	70	144	332	1,593	2,257,449	1,047
1993 - 1994	3,103	34	78	153	391	1,986	4,276,565	1,378
1994 - 1995	4,484	36	71	132	308	1,482	5,529,141	1,233
1995 - 1996	5,304	21	39	68	156	874	4,718,224	890
1996 - 1997	5,044	9	19	41	102	679	4,772,805	946
1997 - 1998	4,160	7	16	36	102	728	4,537,186	1,091
1998 - 1999	3,793	7	17	39	118	1,000	4,923,274	1,298
1999 - 2000	4,048	12	26	58	175	1,429	8,242,648	2,036
2000 - 2001	3,495	8	21	51	155	1,206	6,001,943	1,717
2001 - 2002	3,084	10	25	58	190	1,520	5,809,285	1,884
2002 - 2003	2,899	10	25	66	242	1,914	6,803,081	2,347
2003 - 2004	2,839	11	30	89	402	3,692	12,100,902	4,262
2004 - 2005	2,975	23	76	229	854	6,956	17,864,922	6,005
2005 - 2006	2,940	26	96	344	1,427	11,885	28,027,785	9,533
2006 - 2007	3,087	29	118	442	1,729	15,609	40,924,175	13,257
2007 - 2008	3,207	40	148	523	2,034	19,475	56,391,429	17,584
2008 - 2009	3,221	30	96	290	1,087	10,997	39,750,024	12,341
2009 - 2010	3,412	40	149	495	1,939	19,299	62,666,128	18,366
2010 - 2011	3,512	43	160	509	2,032	20,421	68,027,024	19,370
2011 - 2012	3,698	32	114	345	1,406	14,853	60,371,950	16,326
2012 - 2013	3,698	31	110	338	1,492	16,143	66,900,915	18,091

The table shows the cross-sectional percentiles, total and average market capitalisation for various years for all listed firms. The market capitalization of a firm is taken as its average market capitalisation over the trading days of the firm during the period of 1-October to 30-September. The 2012-13 period covers only a 9-month period from 1 October, 2012 to 30 June, 2013.

Table 2: Descriptive statistics of liquidity (Number of trading days per year)

Year	Number of firms	No. of trading days - percentile								
		10%	20%	30%	40%	50%	60%	70%	80%	90%
1992 - 1993	2156	20	58	107	143	172	191	202	209	213
1993 - 1994	3103	11	36	72	111	153	190	207	215	219
1994 - 1995	4484	28	64	98	136	171	194	210	220	225
1995 - 1996	5304	24	67	115	151	179	199	214	226	233
1996 - 1997	5044	6	19	37	59	88	120	155	189	222
1997 - 1998	4160	3	6	14	29	50	86	128	173	224
1998 - 1999	3793	3	7	19	42	76	122	167	210	240
1999 - 2000	4048	6	21	47	81	117	152	188	220	245
2000 - 2001	3495	3	6	16	34	65	108	160	214	248
2001 - 2002	3084	4	16	39	76	125	171	213	240	250
2002 - 2003	2899	9	41	82	130	175	211	234	247	250
2003 - 2004	2839	16	73	135	191	226	246	254	256	256
2004 - 2005	2975	54	169	225	245	251	252	252	252	252
2005 - 2006	2940	95	190	233	245	249	250	250	250	250
2006 - 2007	3087	94	191	232	245	248	248	248	248	248
2007 - 2008	3207	97	192	232	245	249	250	250	250	250
2008 - 2009	3221	76	151	201	225	236	240	240	241	241
2009 - 2010	3412	96	197	236	247	249	249	249	249	249
2010 - 2011	3512	91	180	227	244	250	251	251	251	251
2011 - 2012	3698	54	127	187	227	241	248	249	250	250
2012 - 2013	3698	41	85	123	151	173	183	186	186	186

The table shows the cross-sectional percentiles (calculated using data of all listed firms) of trading days in Bombay Stock Exchange during 1-October to 30-September of various years. The 2012-13 period covers only a 9-month period from 1 October, 2012 to 30 June, 2013.

Table 3: Descriptive statistics of firms excluded due to liquidity filter

Research and Publications

Year	All Firms				Firms excluded due to liquidity filter (less than 50 trading days in previous year *p-1*)				
	Number of firms	Total market cap. (₹ bn)	Average market cap. (₹ bn)	Average trading frequency (*previous year*)	Number of firms	Total market cap. (₹ bn)	Average market cap. (₹ bn)	Percentage of firms excluded	Percentage of market cap. excluded
1992 - 1993	2,156	2,257	1.0	134	238	175	0.7	11	7.7
1993 - 1994	3,103	4,277	1.4	142	396	207	0.5	13	4.8
1994 - 1995	4,484	5,529	1.2	132	760	200	0.3	17	3.6
1995 - 1996	5,304	4,718	0.9	146	729	1,169	1.6	14	24.8
1996 - 1997	5,044	4,773	0.9	153	861	536	0.6	17	11.2
1997 - 1998	4,160	4,537	1.1	102	1,799	199	0.1	43	4.4
1998 - 1999	3,793	4,923	1.3	84	2,065	206	0.1	54	4.2
1999 - 2000	4,048	8,243	2.0	101	1,611	173	0.1	40	2.1
2000 - 2001	3,495	6,002	1.7	120	1,249	203	0.2	36	3.4
2001 - 2002	3,084	5,809	1.9	98	1,585	153	0.1	51	2.6
2002 - 2003	2,899	6,803	2.3	126	1,017	70	0.1	35	1.0
2003 - 2004	2,839	12,101	4.3	150	653	179	0.3	23	1.5
2004 - 2005	2,975	17,865	6.0	178	475	597	1.3	16	3.3
2005 - 2006	2,940	28,028	9.5	208	268	203	0.8	9	0.7
2006 - 2007	3,087	40,924	13.3	213	207	196	0.9	7	0.5
2007 - 2008	3,207	56,391	17.6	213	205	490	2.4	6	0.9
2008 - 2009	3,221	39,750	12.3	214	211	273	1.3	7	0.7
2009 - 2010	3,412	62,666	18.4	197	227	998	4.4	7	1.6
2010 - 2011	3,512	68,027	19.4	215	222	360	1.6	6	0.5
2011 - 2012	3,698	60,372	16.3	212	222	255	1.1	6	0.4
2012 - 2013	3,698	66,901	18.1	195	345	145	0.4	9	0.2

The table shows the cross-sectional total and average market capitalisation and liquidity (number of trading days) of all firms and of firms excluded based on the liquidity filter for various years. The last two columns show the extent of exclusion. The market capitalization of a firm is taken as its average market capitalisation over the trading days of the firm during the period of 1-October to 30-September. The 2012-13 period covers only a 9-month period from 1 October, 2012 to 30 June, 2013.

Table 4: Number of firms that stopped trading over the years

Calendar Year of last trading day	Number of Firms that stopped trading	Stopped trading due to mergers	Stopped trading for other reasons and had $P/FV \geq 50\%$ (no capital loss)		Stopped trading for other reasons and had $P/FV < 50\%$ (considered for 100% capital loss)	
			Number of firms	Formed part of any portfolio on the last trading day	Number of firms	Formed part of any portfolio on the last trading day
1992	9	2	7	0	0	0
1993	44	9	30	8	5	2
1994	43	10	25	11	8	2
1995	119	32	67	18	20	7
1996	260	28	130	27	102	54
1997	510	27	115	38	368	253
1998	247	25	56	8	166	57
1999	251	34	59	7	158	27
2000	402	29	85	23	288	104
2001	332	34	65	13	233	99
2002	145	23	33	11	89	32
2003	139	23	38	17	78	60
2004	115	14	25	9	76	36
2005	101	23	41	24	37	20
2006	81	36	19	9	26	22
2007	67	18	27	13	22	11
2008	52	17	29	12	6	1
2009	60	11	28	12	21	17
2010	74	23	35	10	16	7
2011	79	14	45	12	20	7
2012	54	7	28	9	19	16
Total	3,184	439	987	291	1,758	834

The table shows the number of firms that stopped trading over the years. Column 3 shows number of firms that stopped trading due to mergers. Columns 4-7 shows the number of firms that stopped trading for reasons other than mergers, showing separately the details of firms for which the *price/face value* on their last trading day was less than 0.50. The difference between columns 4 and 5, and columns 6 and 7 represents those firms which were not part of a portfolio due to various filters such as liquidity filter.

Table 5: Market and four-factors returns with and without survivorship bias adjustment

Calendar Year	Four-factors with adjustment					Four-factors without adjustments				
	Rm	SMB	HML	WML	Rm-Rf	Rm	SMB	HML	WML	Rm-Rf
1993	30.9	-25.4	-1.9	33.3	22.2	30.9	-25.4	-1.9	33.3	22.2
1994	18.3	35.3	9.9	1.7	10.2	18.3	35.3	9.9	1.6	10.2
1995	-41.6	-19.2	-17.5	9.7	-53.0	-41.6	-19.2	-17.5	9.7	-53.0
1996	-13.5	-45.4	-13.9	59.6	-24.0	-13.5	-45.3	-13.8	61.3	-24.0
1997	8.9	-34.1	-25.5	44.4	2.1	9.0	-32.7	-24.0	41.5	2.2
1998	-10.1	12.9	-8.7	4.7	-17.8	-10.1	13.6	-7.7	4.8	-17.8
1999	67.8	31.7	-0.7	59.4	59.2	67.8	31.9	-0.2	58.7	59.2
2000	-31.6	-17.5	11.7	-26.0	-40.2	-31.6	-17.2	12.0	-26.9	-40.2
2001	-22.0	-4.8	5.3	42.3	-29.2	-21.9	-2.9	7.9	38.5	-29.1
2002	19.2	-19.8	54.9	14.9	13.3	19.2	-19.6	54.9	14.0	13.3
2003	72.7	3.5	35.9	39.3	67.9	72.7	3.9	36.7	42.1	67.9
2004	18.7	15.2	30.9	20.4	14.1	18.7	15.6	31.9	19.2	14.2
2005	34.5	30.2	17.8	25.1	29.3	34.5	30.2	17.9	25.0	29.3
2006	26.9	3.4	3.1	32.2	20.8	26.9	3.5	3.2	30.5	20.8
2007	54.9	20.6	49.0	15.5	48.0	54.9	20.6	49.0	15.4	48.0
2008	-84.7	-30.9	-18.9	-11.2	-92.3	-84.7	-30.9	-18.9	-11.2	-92.3
2009	66.9	14.1	12.0	-11.4	63.3	66.9	14.1	12.0	-11.5	63.3
2010	10.9	6.8	0.1	16.2	5.7	10.9	6.8	0.1	16.1	5.7
2011	-31.8	8.7	-25.1	48.4	-39.5	-31.8	8.7	-25.1	48.3	-39.5
2012	13.1	-0.9	-1.0	-4.2	9.0	13.1	-0.9	-0.9	-4.3	9.0
Cumulative	208.6	-15.7	117.6	414.2	69.1	208.8	-10.0	125.4	406.1	69.4
Mean	10.4	-0.8	5.9	20.7	3.5	10.4	-0.5	6.3	20.3	3.5
Max	72.7	35.2	54.9	59.6	67.9	72.7	35.2	54.9	61.3	67.9
Min	-84.7	-45.4	-25.4	-26.0	-92.3	-84.7	-45.3	-25.1	-26.9	-92.3
SD	40.5	23.2	22.9	24.2	41.6	40.5	23.1	22.8	24.2	41.6
Skewness	-0.4	-0.2	0.6	-0.1	-0.4	-0.4	-0.2	0.6	-0.1	-0.4

The table shows the annual logarithmic market and four-factors returns (in percentage). The values for 2012 are only until June.

Table 6: Size-Value and Size-Momentum portfolios' returns (adjusted for survivorship bias)

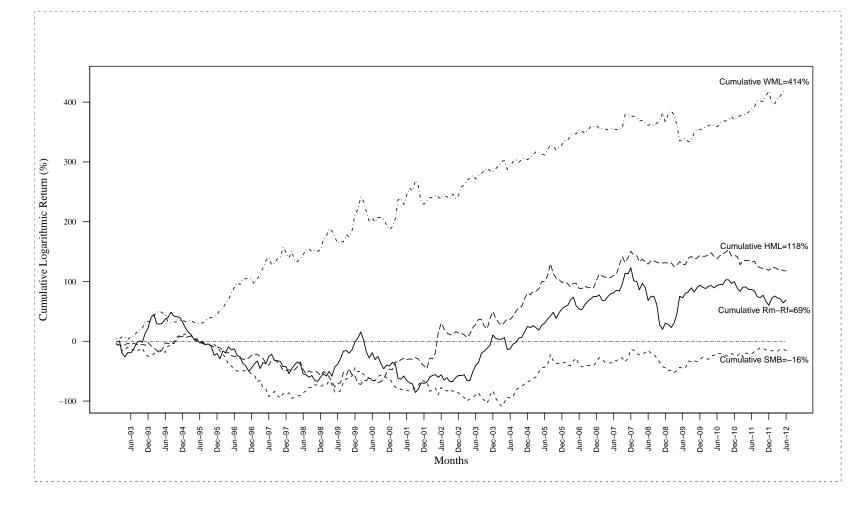| Year	Size-Value portfolios						Size-momentum portfolios			
	BV	BN	BG	SV	SN	SG	WB	WS	LB	LS
1993	31.3	39.2	36.2	11.7	8.0	10.7	34.7	19.2	-2.9	-14.4
1994	15.0	11.2	12.0	58.6	43.6	41.9	13.5	52.1	-0.4	40.0
1995	-55.2	-41.7	-33.2	-68.7	-63.4	-55.7	-38.0	-58.5	-47.4	-68.5
1996	-2.1	-18.8	-1.6	-64.4	-57.0	-37.2	-2.0	-40.1	-79.3	-83.8
1997	-23.0	7.9	12.3	-43.5	-33.6	-27.8	16.7	-30.5	-46.9	-55.7
1998	5.6	-23.4	-11.0	-11.0	-0.2	17.1	1.3	20.5	19.4	-7.1
1999	-0.6	42.4	69.0	92.9	77.2	84.0	101.1	106.5	23.6	65.0
2000	-18.6	-30.2	-32.4	-43.3	-37.3	-53.0	-30.3	-63.1	-5.3	-36.1
2001	-23.5	2.0	-28.4	-25.0	-8.7	-30.7	-16.1	-22.4	-72.4	-50.8
2002	74.6	72.4	1.9	48.3	34.7	21.8	20.3	27.8	-2.7	21.1
2003		107.4	67.5	106.5	92.7	73.7	93.6	89.2	57.9	46.4
2004		32.1	16.4	52.5	39.1	26.8	11.8	43.3	-3.5	17.8
2005		23.6	33.7	61.3	61.7	53.4	42.0	72.2	31.8	32.2
2006		15.0	31.0	35.2	10.8	33.2	38.4	30.7	4.8	-1.6
2007	17.4	80.4	44.8	115.6	67.6	50.9	70.7	68.5	59.7	48.5
2008	-73.2	-74.8	-82.2	-118.0	-119.3	-108.2	-92.2	-117.2	-67.9	-119.1
2009	6.9	61.5	66.0	82.2	83.6	72.1	56.5	64.9	55.8	88.4
2010	8.8	15.7	9.4	18.1	18.8	17.3	12.9	23.7	-1.6	5.7
2011	-59.0	-46.5	-28.8	-38.7	-48.2	-36.5	-16.0	-27.4	-65.3	-74.8
2012		17.2	12.7	13.1	13.9	15.4	12.5	15.3	17.8	18.5
Cumulative	-95.5	292.8	195.4	283.2	184.2	169.1	331.4	274.7	-124.8	-128.2
Mean	-6.4	14.6	9.8	14.2	9.2	8.5	16.6	13.7	-6.2	-6.4
Max	74.6	107.4	69.0	115.5	92.7	84.0	101.1	106.5	59.7	88.4
Min	-73.2	-74.8	-82.2	-118.0	-119.3	-108.2	-92.2	-117.2	-79.3	-119.1
SD	37.8	45.8	38.8	64.5	56.2	50.6	45.2	57.3	43.8	55.4
Skewness	0.0	0.1	-0.3	-0.2	-0.4	-0.4	-0.2	-0.4	-0.2	-0.3

The table shows the annual logarithmic returns (in percentage) of various size-value and momentum portfolios after adjustment for survivorship bias. The values for 2012 are only until June.

Table 7: Correlation matrix of monthly four-factors' returns (adjusted for survivorship bias)

	SMB	HML	WML	Rm-Rf
SMB	100%			
HML	32%	100%		
WML	-14%	-21%	100%	
Rm-Rf	4%	22%	-12%	100%

Figure 1: Cumulative log-returns of the four factors (adjusted for survivorship bias)