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Analysis of Firm Risk around S&P 500 Index Changes

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Abstract

In this study we extend the work of Vijh (1994), Barberis, Shleifer, and Wurgler (2005), Denis, McConnell, Ovtchinnikov and Yu (2003) and Geppert, Ivanov and Karels (2011) by examining the effects of the addition to or deletion from the S&P 500 index on the firm's Fama - French four factor model loadings before and after the event. We find that added to and deleted from the S&P 500 index firms experience unique sensitivity to the Small cap minus Big cap (SMB) and momentum (UMD) factors. This finding and robustness tests indicate that addition to and deletion from the S&P 500 index have a unique and profound fundamental effect on the added and deleted firm.

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1. Introduction

In this study we attempt to extend the work of Vijh (1994), Barberis, Shleifer, and Wurgler (2005), Denis, McConnell, Ovtchinnikov and Yu (2003) and Geppert, Ivanov and Karels (2011). The contribution of this study is in that we examine the effects of the addition to or deletion from the S&P 500 index on the firm's Fama - French four factor model loadings before and after the event, which has not been performed before. We find that added to and deleted from the S&P 500 index firms have unique sensitivity not only to the market factor as documented by Vijh (1994) and Barberis, Shleifer, and Wurgler (2005) but also to the Small cap minus Big cap (SMB) and momentum (UMD) factors. This finding indicates that addition to and deletion from the S&P 500 index has a unique fundamental effect on the added and deleted firms and as such is not an information free event.

Additions and deletions from an index are considered in the literature not to have any company specific information about the added or deleted firm (Harris and Gurel, 1986). Additions and deletions are "company specific information free" because the S&P U.S. Index Committee clearly states in their index methodology that the changes to the indexes that they produce do not imply assessment of changes in the added or deleted firms' fundamentals. Naturally, there should not be any changes in the systematic risk measures of a company due to the event of addition or deletion because systematic risk varies only due to changes in the fundamentals of this company. However, Vijh (1994) documents an increase in beta of firms added to the S&P 500 index in the period 1975-1989 and so do Barberis, Shleifer, and Wurgler (2005). Barberis, Shleifer, and Wurgler (2005) document statistically and economically significant increases in betas of stocks added to the S&P 500 index in the period 1976-2000, and a decrease in betas of stocks deleted from the S&P 500 index.

Additionally, Denis, McConnell, Ovtchinnikov and Yu (2003) document in their study that the selection of firms' for inclusion to or deletion from the S&P 500 index does suggest changes in the firms' fundamentals and thus the firms' underlying risk characteristics. They examine earnings of firms added to the S&P 500 only and find that the addition is not an information free event. Geppert, Ivanov and Karels (2011) also document that the addition to or deletion from the S&P 500 index is not an information free event. They utilize total derivative of beta and Campbell and Vuolteenaho (2004) "good-beta and bad-beta" decompositions to find support for the fact that the additions and deletions do contain company specific information.

This study is the first to utilize the Fama-French four-factor (Carhart) model in the analysis of the information hypothesis of additions and deletions from the S&P 500 index. In the next section the methodology and data are discussed.

2. Methodology and Data

We extend Vijh (1995) and Barberis, Shleifer, Wurgler (2005), Denis, McConnell, Ovtchinnikov and Yu (2003) and Geppert, Ivanov and Karels (2011) studies of the

systematic risk behavior during index changes by examining the effects of the addition or deletion on the firm's Fama - French four factor model loadings before and after the event.

The Fama and French four factor model also known as the Carhart model includes not only the market factor but also the Small cap minus Big cap (SMB), High Book-to-Market (BTM) minus Low BTM (HML) and momentum (UMD) factors as identified by Carhart (1997). The regression model is:

$$(PR_{pt} - RF_t) = \alpha_{jt} + \beta_1(MKT_t - RF_t) + \beta_2SMB_t + \beta_3HML_t + \beta_4UMD_t + \varepsilon_{jt}, \quad (1)$$

where: $(PR_{pt} - RF_t)$ is the excess stock return over the risk free rate (US 30-day T-bill yield); $(MKT - RF)$ is the NYSE, AMEX and NASDAQ value weighted index (including distributions) return minus the risk free rate (US 30-day T-bill yield);

SMB is the Fama & French factor defined as (Small cap minus Big cap) return measuring premium for size, HML is the Fama & French factor defined as (High BTM minus Low BTM) ratios measuring premium for growth UMD is the momentum factor developed by Carhart based on portfolio performance in the previous year.

The data in this study are over the period June 1963 to December 2009. Barberis, Shleifer, and Wurgler (2005) pre-event and post-event estimation period methodology is used for the analysis. Factor loadings are computed over 3 year periods of daily and monthly data. Barberis, Shleifer, and Wurgler (2005) use [-36,-1] and [+1,+36] months of data around the event.

The Center for Research in Security Prices (CRSP) daily S&P 500 constituents from 1926 to 2009 are used to identify additions and deletions. The data for the NYSE, AMEX and NASDAQ value weighted index (including distributions), the risk-free rate, SMB, HML and UMD factors are obtained from Professor Kenneth R. French.¹ The Fama-French data are available since June 1963 thus limiting us in analyzing the period June 1963 to December 2009.

We examine all deletions from the S&P 500 index which can be both discretionary and non-discretionary. Non-discretionary deletions are result of a major corporate event such as bankruptcy, merger, spin-off, discretionary removal from the index, etc. or an anticipation of such major corporate event. Discretionary deletions require special treatment because they are result of a decision of the S&P index committee. The S&P US index committee is comprised of eight members who meet every month and decide when a firm violates one or few of the index inclusion criteria and whether to replace the firm. Discretionary and non-discretionary deletions are discussed in detail in Chen, Noronha and Singal (2004, 2006a, 2006b).

¹ The data are obtained from Professor Kenneth R. French's website:
http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

The next section provides the empirical results based on the specified model and provides analysis of these results.

3. Empirical Results and Analysis

In this article we examine the behavior of the Fama - French four factor model loadings before and after the event of changes in the S&P 500 index. Before we examine the four-factor loading changes we examine our sample for consistency with the earlier studies by Vijh (1995) and Barberis, Shleifer, Wurgler (2005), Denis, McConnell, Ovtchinnikov and Yu (2003) and Geppert, Ivanov and Karels (2011). Table I presents the results of beta changes for additions and deletions based on the single factor model, CAPM, based on daily and monthly data. Indeed, statistically and economically significant increases in betas of added firms and statistically significant decreases in betas of deleted firms are documented in the sample of 552 added firms and 156 deleted firms. The beta of added firms increases from 1.0966 to 1.1604, and the beta of deleted firms decreases from 0.9050 to 0.8464.

Table I. Daily and Monthly Betas of Added and Deleted S&P 500 Firms

Betas are computed over 3 year periods of daily and monthly data. The data in this study is over period June 1963 to December 2009. The data for the NYSE, AMEX and NASDAQ value weighted index (including distributions) and the risk-free rate are obtained from Professor Kenneth R. French. The t-statistics are computed cross-sectionally, as in Vijh (1994), by using the distribution of the increases or decreases in the factors. Barberis, Shleifer, and Wurgler (2005) pre-event and post-event estimation period methodology is used for the analysis, [-36,-1] and [+1,+36] months. Significant difference from zero at the 10 percent, 5 percent and 1 percent level is denoted with *, ** and ***, respectively.

Variable	ADDITIONS			ADDITIONS		
	(only Beta, Daily)			(only Beta, Monthly)		
	Mkt_RF Before	Mkt_RF After	Chge Beta	Mkt_RF Before	Mkt_RF After	Chge Beta
N	552	552	552	992	992	992
Mean	1.0966	1.1604	0.0638	1.2015	1.2067	0.0052
Std Dev	0.5145	0.5048	0.3892	0.5965	0.6333	0.6220
Minimum	-0.2713	-0.4285	-1.3699	-0.7416	-0.4698	-2.3734
Maximum	2.8178	3.2257	1.7687	3.6003	4.7042	2.8253
T-test p-value			0.0001			0.7913
Variable	DELETIONS			DELETIONS		
	(only Beta, Daily)			(only Beta, Monthly)		
	Mkt_RF Before	Mkt_RF After	Chge Beta	Mkt_RF Before	Mkt_RF After	Chge Beta
N	156	156	156	182	182	182
Mean	0.9050	0.8464	-0.0586	1.1368	1.1679	0.0311
Std Dev	0.4995	0.4948	0.4361	0.7605	0.8696	0.8893
Minimum	-0.3787	-0.4266	-1.1863	-0.3245	-1.0874	-2.9333
Maximum	2.3833	2.3107	1.0503	4.2257	5.7368	4.5603
T-test p-value			0.0950			0.6382

There was a structural change in the way the index was created in December of 1989. At that time the S&P US Indexes committee, which chooses who will be deleted from and added to the S&P 500 index started pre-announcing the index changes a week before the event. Before that time the committee made the changes and after the fact made the

announcement of the constituent change. Thus, we examine if this structural change had an impact on the systematic risk measures of added and deleted firms.

Table II reports the changes in CAPM beta in the periods before and after the committee started pre-announcing the changes. The table shows that indeed the pre-announcing of index changes had a structural impact on the beta of added and deleted firms. After the structural change the statistical significance of the beta changes increased, but also in the pre-announcement sample the changes in beta became positive for deleted firms on daily and monthly basis, from negative in the non-pre-announcement sample. Thus, in all subsequent analysis we perform additional tests to account for this structural break.

Table II. Daily and Monthly Betas of Added and Deleted S&P 500 Firms

Betas are computed over 3 year periods of daily and monthly data. The data in this study is over period June 1963 to December 2009. The data for the NYSE, AMEX and NASDAQ value weighted index (including distributions) and the risk-free rate are obtained from Professor Kenneth R. French. The t-statistics are computed cross-sectionally, as in Vijh (1994), by using the distribution of the increases or decreases in the factors. Barberis, Shleifer, and Wurgler (2005) pre-event and post-event estimation period methodology is used for the analysis, [-36,-1] and [+1,+36] months. Significant difference from zero at the 10 percent, 5 percent and 1 percent level is denoted with *, ** and ***, respectively.

	Daily		Monthly	
	ADDITIONS	ADDITIONS	ADDITIONS	ADDITIONS
	before 12/31/1989	after 12/31/1989	before 12/31/1989	after 12/31/1989
Variable	chgebeta	chgebeta	chgebeta	chgebeta
N	295	257	705	287
Mean	0.0304	0.1021	-0.0253	0.0803
Std Dev	0.3542	0.4234	0.5275	0.8049
Minimum	-1.1131	-1.3699	-2.2204	-2.3734
Maximum	1.2922	1.7687	2.0581	2.8253
p-value	0.1415	0.0001	0.2030	0.0923
	DELETIONS	DELETIONS	DELETIONS	DELETIONS
	before 12/31/1989	after 12/31/1989	before 12/31/1989	after 12/31/1989
Variable	chgebeta	chgebeta	chgebeta	chgebeta
N	73	83	87	95
Mean	-0.1787	0.0470	-0.1774	0.2219
Std Dev	0.4188	0.4259	0.6117	1.0505
Minimum	-1.1863	-1.0650	-1.9482	-2.9333
Maximum	0.9236	1.0503	1.3062	4.5603
	0.0005	0.3180	0.0082	0.0422

Carhart (1997) finds in his study of mutual fund performance that all mutual funds experience positive SMB loadings and negative HML loadings, whereas past winners experience positive UMD loadings and past losers experience negative UMD loadings. Table III shows that added firms experience factor loadings similar to the mutual funds factor loadings, but not deleted firms. Deleted firms have positive SMB and HML loadings and negative UMD loadings. These results suggest that momentum plays an important role in the behavior of added and deleted firms.

Table III. Daily Fama-French Four Factor Loadings of Added and Deleted S&P 500 Firms

Betas are computed over 3 year periods of daily data. The data in this study is over period June 1963 to December 2009. AMEX and NASDAQ value weighted index (including distributions), the risk-free rate, SMB, HML and UMD factors are from Kenneth R. French. The t-statistics are computed cross-sectionally, as in Vijh (1994), by using the distribution of the increments of the factors. Barberis, Shleifer, and Wurgler (2005) pre-event and post-event estimation period methodology is used for the [+1,+36] months. Significant difference from zero at the 10 percent, 5 percent and 1 percent level is denoted with *, ** and ***.

ADDITIONS										
Variable	Beta Before	Mkt_RF after	Chge beta	SMB before	SMB after	Chge SMB	HML before	HML after	Chge HML	UMD after
N	552	552	552	552	552	552	552	552	552	552
Mean	1.1483	1.1710	0.0227	0.4297	0.1746	-0.2552	-0.0977	-0.0646	0.0331	-0.1571
Std Dev	0.3846	0.3754	0.3963	0.4839	0.4838	0.5159	0.8470	0.8766	0.7894	0.4567
Minimum	-0.4004	-0.2954	-1.7293	-1.0601	-1.5779	-2.3427	-4.2128	-4.7264	-4.4796	-2.2727
Maximum	2.5505	2.2856	1.4758	1.7276	2.0910	1.4658	1.9876	2.3557	2.7559	2.1123
T-test (p-value)			0.1797			<.0001			0.3250	
DELETIONS										
Variable	Beta before	Mkt_RF after	Chge beta	SMB before	SMB after	Chge SMB	HML before	HML after	Chge HML	UMD before
N	156	156	156	156	156	156	156	156	156	156
Mean	1.1278	1.0983	-0.0295	0.4667	0.7434	0.2768	0.5299	0.5390	0.0091	-0.2537
Std Dev	0.4791	0.4904	0.4713	0.5507	0.5869	0.7070	0.5719	0.5882	0.7767	0.3794
Minimum	-0.4496	-0.2964	-1.5216	-1.2949	-0.6559	-2.0025	-1.4992	-3.3537	-4.3526	-2.1258
Maximum	2.4448	2.4906	1.0618	2.5136	2.6046	3.5442	2.7100	2.0418	2.2863	0.9282
T-test (p-value)			0.4351			<.0001			0.8841	

The table also shows that the beta changes are positive for additions and negative for deletions but they are not statistically significant any longer when the Carhart model and daily data are used. Only the changes in SMB and UMD Fama-French four factor loadings are statistically significant. The SMB and UMD factor loadings changes for added firms are negative and statistically significant, -0.2552 and -0.1833, respectively; and the SMB and UMD loadings changes for deleted firms are statistically significant and positive, 0.2768 and 0.1280, respectively. The same is true when the sample is split into before and after pre-announcement by the committee started in December of 1989. The split sample results are presented in Table IV.

Table IV. Daily Fama-French Four Factor Loadings of Added and Deleted S&P 500 Firms before and after Pre-announcement

Betas are computed over 3 year periods of daily data. The data in this study is over period June 1963 to December 2009. The data for the NYSE, AMEX and NASDAQ value weighted index (including distributions), the risk-free rate, SMB, HML and UMD factors are obtained from Professor Kenneth R. French. The t-statistics are computed cross-sectionally, as in Vijh (1994), by using the distribution of the increases or decreases in the factors. Barberis, Shleifer, and Wurgler (2005) pre-event and post-event estimation period methodology is used for the analysis, [-36,-1] and [+1,+36] months. Significant difference from zero at the 10 percent, 5 percent and 1 percent level is denoted with *, ** and ***, respectively.

Variable	ADDITIONS				ADDITIONS			
	before 12/31/1989				after 12/31/1989			
	chgebeta	chgeSMB	chgeHML	chgeUMD	chgebeta	chgeSMB	chgeHML	chgeUMD
N	295	295	295	295	257	257	257	257
Mean	0.0083	-0.2368	0.0613	-0.1268	0.0391	-0.2763	0.0007	-0.2482
Std Dev	0.3462	0.5400	0.7067	0.5483	0.4471	0.4870	0.8751	0.6837
Min	-0.9272	-2.3427	-1.9038	-2.3524	-1.7293	-1.5491	-4.4796	-3.3161
Max	1.4758	1.4639	2.7559	1.2626	1.0687	1.4658	2.4424	2.1382
p-value	0.6794	<.0001	0.1375	<.0001	0.1621	<.0001	0.9891	<.0001
Variable	DELETIONS				DELETIONS			
	before 12/31/1989				after 12/31/1989			
	chgebeta	chgeSMB	chgeHML	chgeUMD	chgebeta	chgeSMB	chgeHML	chgeUMD
N	73	73	73	73	83	83	83	83
Mean	-0.1124	0.0252	-0.0741	0.1355	0.0433	0.4980	0.0822	0.1213
Std Dev	0.4781	0.6378	0.8139	0.5947	0.4557	0.6941	0.7397	0.4844
Min	-1.5216	-2.0025	-4.3526	-2.0003	-0.9272	-0.9624	-3.1871	-1.5450
Max	0.9609	2.2987	2.2863	2.1493	1.0618	3.5442	2.1119	1.3078
p-value	0.0484	0.7365	0.4395	0.0554	0.3888	<.0001	0.3143	0.0251

Table V shows that the SMB and UMD factor loadings changes for added firms are negative and significant and the SMB and UMD loadings changes for deleted firms are positive and significant when monthly data are used, which is consistent with the daily frequency results. The respective SMB and UMD factor loadings for added firms are -0.1561 and -0.0711, and the respective SMB and UMD factor loadings for deleted firms are 0.1084 and 0.150. The same is true when the sample is split into before and after pre-announcement by the committee started in December of 1989. The split sample results are presented in Table VI.

Table V. Monthly Fama-French Four Factor Loadings of Added and Deleted S&P 500 Firms

Betas are computed over 3 year periods of monthly data. The data in this study is over period June 1963 to December 2009. The data for the NYSE, AMEX and NASDAQ value weighted index (including distributions), the risk-free rate, SMB, HML and UMD factors are obtained from Professor Kenneth R. French. The t-statistics are computed cross-sectionally, as in Vijh (1994), by using the distribution of the increases or decreases in the factors. Barberis, Shleifer, and Wurgler (2005) pre-event and post-event estimation period methodology is used for the analysis, [-36,-1] and [+1,+36] months. Significant difference from zero at the 10 percent, 5 percent and 1 percent level is denoted with *, ** and ***, respectively.

ADDITIONS												
Variable	Mkt_RF before	Mkt_RF after	Chge beta	SMB before	SMB after	Chge SMB	HML before	HML after	Chge HML	UMD before	UMD after	Chge UMD
N	992	992	992	992	992	992	992	992	992	992	992	992
Mean	1.075	1.133	0.058	0.353	0.197	-0.156	-0.024	0.013	0.037	-0.064	-0.135	-0.071
Std Dev	0.563	0.608	0.737	0.810	0.738	0.954	1.005	0.985	1.253	0.711	0.619	0.922
Min	-0.969	-0.514	-2.731	-2.759	-2.275	-4.519	-5.144	-4.614	-4.355	-2.964	-3.673	-4.106
Max	3.681	3.934	3.148	5.664	3.565	3.719	3.518	4.284	5.806	3.866	4.465	4.775
T-test p-value			0.013			<.0001			0.352			0.015
DELETIONS												
Variable	Mkt_RF before	Mkt_RF after	Chge beta	SMB before	SMB after	Chge SMB	HML before	HML after	Chge HML	UMD before	UMD after	Chge UMD
N	182	182	182	182	182	182	182	182	182	182	182	182
Mean	1.115	1.127	0.012	0.564	0.672	0.108	0.445	0.517	0.072	-0.312	-0.161	0.151
Std Dev	0.713	0.831	0.978	0.919	1.746	1.875	1.145	1.424	1.683	0.665	1.059	1.214
Min	-0.387	-0.710	-2.473	-1.393	-3.807	-5.190	-3.006	-5.450	-4.587	-2.770	-5.502	-6.044
Max	3.942	5.047	3.125	3.872	18.654	18.470	3.978	10.009	12.889	1.185	2.749	3.471
T-test p-value			0.870			0.436			0.563			0.096

Therefore, it is fair to conclude that added to and deleted from the S&P 500 index firms have unique sensitivity not only to the market factor but also to the SMB and UMD factors around the event. This finding indicates that addition to and deletion from the S&P 500 index has a significant fundamental effect on the added and deleted firms and that momentum plays a role in these firms' stock performance. However, the significant sensitivity around the addition or deletion event might not be unique to the added or deleted firms but might be true for all firms in the examined period. Robustness tests are performed next.

Table VI. Monthly Fama-French Four Factor Loadings of Added and Deleted S&P 500 Firms before and after Pre-announcement

Betas are computed over 3 year periods of monthly data. The data in this study is over period June 1963 to December 2009. The data for the NYSE, AMEX and NASDAQ value weighted index (including distributions), the risk-free rate, SMB, HML and UMD factors are obtained from Professor Kenneth R. French. The t-statistics are computed cross-sectionally, as in Vijh (1994), by using the distribution of the increases or decreases in the factors. Barberis, Shleifer, and Wurgler (2005) pre-event and post-event estimation period methodology is used for the analysis, [-36,-1] and [+1,+36] months. Significant difference from zero at the 10 percent, 5 percent and 1 percent level is denoted with *, ** and ***, respectively.

Variable	ADDITIONS				ADDITIONS			
	before 12/31/1989				after 12/31/1989			
	chgebeta	chgeSMB	chgeHML	chgeUMD	chgebeta	chgeSMB	chgeHML	chgeUMD
N	705	705	705	705	287	287	287	287
Mean	0.0279	-0.1761	0.0108	-0.0366	0.1329	-0.1070	0.1014	-0.1559
Std Dev	0.6549	0.9656	1.1577	0.9093	0.9044	0.9230	1.4614	0.9482
Min	-1.9333	-4.5194	-4.3549	-4.1060	-2.7310	-3.7710	-3.9522	-2.8646
Max	2.5793	3.7186	5.8063	4.7754	3.1483	2.4343	5.3541	3.4856
p-value	0.2584	<.0001	0.8046	0.2851	0.0134	0.0506	0.2406	0.0057
Variable	DELETIONS				DELETIONS			
	before 12/31/1989				after 12/31/1989			
	chgebeta	chgeSMB	chgeHML	chgeUMD	chgebeta	chgeSMB	chgeHML	chgeUMD
N	87	87	87	87	95	95	95	95
Mean	-0.1514	-0.0207	-0.1367	0.3863	0.1614	0.2266	0.2635	-0.0655
Std Dev	0.7869	1.2786	1.2766	1.3020	1.1079	2.2903	1.9706	1.0889
Min	-2.1450	-5.1904	-3.5455	-6.0439	-2.4727	-3.8173	-4.5867	-3.2348
Max	2.0412	3.0693	3.8693	3.4708	3.1249	18.4704	12.8893	2.2425
	0.0763	0.8804	0.3208	0.0069	0.1590	0.3373	0.1957	0.5593

4. Random Sample Robustness Tests

Barberis, Shleifer, and Wurgler (2005) suggest that the results in their analysis of comovement might not be unique to the added or deleted firms but rather to changes affecting all firms. The same argument applies in this study because the factor loadings changes might exist for all firms. To assess whether this is the case we perform robustness tests. We randomly select firms, which have never been in the S&P 500 index and assign to each random firm a random addition to the S&P 500 or deletion from the S&P 500 date.

Table VII shows results for the CAPM beta of the random sample. The random sample beta changes are negative for both daily and monthly data samples for both additions and deletions, with the exception of the monthly additions, which is positive but statistically insignificant. These results suggest that in the sample period there is a pronounced pressure in firms to experience a decrease in the systematic risk metric.

Table VII. Daily and Monthly Betas of Random Sample of Firms

Betas are computed over 3 year periods of daily and monthly data. The data in this study is over period June 1963 to December 2009. The data for the NYSE, AMEX and NASDAQ value weighted index (including distributions) and the risk-free rate are obtained from Professor Kenneth R. French. The t-statistics are computed cross-sectionally, as in Vijh (1994), by using the distribution of the increases or decreases in the factors. Barberis, Shleifer, and Wurgler (2005) pre-event and post-event estimation period methodology is used for the analysis, [-36,-1] and [+1,+36] months. Significant difference from zero at the 10 percent, 5 percent and 1 percent level is denoted with *, ** and ***, respectively.

ADDITIONS - RANDOM SAMPLE				DELETIONS - RANDOM SAMPLE		
(only Beta, Daily)				(only Beta, Daily)		
Variable	Mkt_RF before	Mkt_RF after	Chge beta	Mkt_RF before	Mkt_RF after	Chge beta
N	1314	1314	1314	2204	2204	2204
Mean	0.6498	0.6390	-0.0108	0.6511	0.6453	-0.0058
Std Dev	0.5274	0.5201	0.4368	0.5158	0.5303	0.4257
Minimum	-1.2857	-0.4650	-1.7792	-2.9323	-3.2871	-2.0024
Maximum	2.9366	2.6317	1.6763	2.9929	3.2760	1.8962
T-test p-value			0.3721			0.5220
ADDITIONS - RANDOM SAMPLE				DELETIONS - RANDOM SAMPLE		
(only Beta, Monthly)				(only Beta, Monthly)		
Variable	Mkt_RF before	Mkt_RF after	Chge beta	Mkt_RF before	Mkt_RF after	Chge beta
N	2602	2602	2602	2786	2786	2786
Mean	1.1646	1.2019	0.0373	1.0553	0.9968	-0.0585
Std Dev	0.9702	1.1832	1.2955	0.9490	0.9984	1.1673
Minimum	-4.7719	-19.0583	-20.0908	-4.9299	-6.5645	-11.9122
Maximum	11.6582	21.3099	18.9984	9.4339	10.4383	10.1887
T-test p-value			0.1423			0.0082

Table VIII presents results of robustness tests based on random sample of firms and daily data using the Carhart model. The Carhart model betas are statistically significant in contrast to the added and deleted firms' insignificant betas when the four-factor model is used. Also, in the random sample results the SMB factor loading changes are statistically significant but not the UMD loadings changes. Even though the SMB loadings changes are significant they are both negative, whereas for added and deleted firms only added firms experience negative SMB factor loadings. These results suggest that the factor loading sensitivities of added and deleted firms are unique to these firms and do not apply to firms which have never been in the S&P 500 index.

Results of robustness tests based on monthly data are provided in Table IX for the changes in Fama-French four factor model before and after the US indexes committee started pre-announcing the index changes. In support of our added and deleted firms findings none of the random sample results are statistically significant. The robustness tests results reiterate our conclusion of unique sensitivity to Carhart model factors of added to and deleted from the S&P 500 index firms.

Table VIII. Daily Fama-French Four Factor Loadings of Random Sample of Firms

Betas are computed over 3 year periods of daily data. The data in this study is over period June 1963 to December 2009. AMEX and NASDAQ value weighted index (including distributions), the risk-free rate, SMB, HML and UMD factors are from Kenneth R. French. The t-statistics are computed cross-sectionally, as in Vijh (1994), by using the distribution of the increments of the factors. Barberis, Shleifer, and Wurgler (2005) pre-event and post-event estimation period methodology is used for the [+1,+36] months. Significant difference from zero at the 10 percent, 5 percent and 1 percent level is denoted with *, ** and ***.

ADDITIONS - RANDOM SAMPLE										
Variable	Beta before	Beta after	Chge beta	SMB before	SMB after	Chge SMB	HML before	HML after	Chge HML	UMD before
N	1314	1314	1314	1314	1314	1314	1314	1314	1314	1314
Mean	0.8410	0.7947	-0.0463	0.7748	0.6950	-0.0798	0.1828	0.1937	0.0109	-0.0816
Std Dev	0.5467	0.5764	0.5206	0.6378	0.6626	0.6550	0.6267	0.6783	0.7986	0.4083
Minimum	-1.7482	-4.9449	-3.4423	-1.4982	-4.7522	-4.0629	-3.5492	-8.4679	-4.9187	-2.8777
Maximum	3.7767	5.0041	3.0562	4.5905	3.7044	3.2453	2.9688	3.2477	3.6126	1.5781
T-test (p-value)			0.0013			<.0001			0.6214	
DELETIONS - RANDOM SAMPLE										
Variable	Beta before	Beta after	Chge beta	SMB before	SMB after	Chge SMB	HML before	HML after	Chge HML	UMD before
N	2204	2204	2204	2204	2204	2204	2204	2204	2204	2204
Mean	0.8704	0.8489	-0.0215	0.7891	0.7436	-0.0455	0.2297	0.2483	0.0186	-0.0716
Std Dev	0.5693	0.5629	0.5110	0.6105	0.6325	0.6351	0.6714	0.6497	0.8415	0.4187
Minimum	-2.4131	-2.3896	-6.1096	-1.5396	-2.0770	-3.0017	-2.9725	-3.6118	-10.2276	-2.4140
Maximum	8.1952	3.3038	3.0185	4.8171	4.0809	3.3484	12.3230	3.8895	3.7955	3.4501
T-test (p-value)			0.0484			0.0008			0.2997	

Table IX. Monthly Fama-French Four Factor Loadings of Random Sample of Firms

Betas are computed over 3 year periods of monthly data. The data in this study is over period June 1963 to December 1999. The market return is the NYSE, AMEX and NASDAQ value weighted index (including distributions), the risk-free rate, SMB, HML and UMD factors are from the work of Professor Kenneth R. French. The t-statistics are computed cross-sectionally, as in Vijh (1994), by using the distribution of the factors. Significant difference from zero at the 10 percent, 5 percent and 1 percent level is denoted by *, **, and *** respectively.

ADDITIONS - RANDOM SAMPLE										
Variable	Mkt_RF before	Mkt_RF after	Chge beta	SMB before	SMB after	Chge SMB	HML before	HML after	Chge HML	UMD before
N	2602	2602	2602	2602	2602	2602	2602	2602	2602	2602
Mean	0.8590	0.8727	0.0137	1.0948	1.2108	0.1160	0.2551	0.1931	-0.0620	-0.1511
Std Dev	1.1570	1.9240	2.1251	2.8423	8.9289	9.2884	1.8172	2.3205	2.7904	1.4821
Minimum	-17.1025	-16.2984	-13.4621	-87.3427	-40.4283	-56.1402	-13.2175	-60.8814	-63.8410	-17.8911
Maximum	15.3657	61.8163	59.6884	44.3586	438.4116	435.7226	26.1191	27.4332	24.2031	13.7011
T-test p-value			0.7416			0.5243			0.2569	
DELETIONS - RANDOM SAMPLE										
Variable	Mkt_RF before	Mkt_RF after	Chge beta	SMB before	SMB after	Chge SMB	HML before	HML after	Chge HML	UMD before
N	2786	2786	2786	2786	2786	2786	2786	2786	2786	2786
Mean	0.9968	0.8667	-0.1301	0.5832	0.6716	0.0883	0.2977	0.2333	-0.0644	-0.0621
Std Dev	3.3585	1.1934	3.5869	10.2528	11.2395	15.2416	3.0468	2.1122	3.6954	1.8221
Minimum	-47.7886	-9.1073	-108.8227	-359.4139	-576.9231	-579.4596	-26.2976	-15.9373	-107.2318	-34.5711
Maximum	108.8227	24.3590	49.4101	103.6872	94.3161	359.4139	107.6395	72.6799	74.2938	35.3811
T-test p-value			0.0557			0.7597			0.3579	

5. Conclusion

It is a well-documented fact in the finance literature that systematic risk increases for firms added to the S&P 500 index and decreases for firms removed from the S&P 500 index. In this study we address another relevant question: what are the effects on the Fama - French four factor model loadings before and after a firm is added or deleted from the S&P 500 index. We find that added to and deleted from the S&P 500 index firms have unique sensitivity not only to the market factor as documented by Vijh (1994) and Barberis, Shleifer, and Wurgler (2005) but also to the SMB and UMD factors. This finding indicates that addition to and deletion from the S&P 500 index has a fundamental effect on the added and deleted firms. Robustness tests confirm that the added and deleted firms four factor sensitivities are unique to these firms and do not apply to firms which have never been in the S&P 500 index.

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