Performance of international and global equity mutual funds: Do country momentum and sector momentum matter?

Bernhard Breloer [a], Hendrik Scholz [a,*], Marco Wilkens [b]

[a] School of Business and Economics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Lange Gasse 20, 90403 Nürnberg, Germany
[b] University of Augsburg, Universitätsstraße 16, 86159 Augsburg, Germany

A B S T R A C T

This is the first paper analyzing the impact of index momentum factors on the performance of international and global equity funds. Extending an international, index-based version of the Fama and French (1993) three-factor model by adding the factors of country momentum and sector momentum, we find that more than 50% of funds exhibit significant exposure to at least one of these factors. Including both new factors in performance evaluation clearly impacts results when analyzing (i) the risk-adjusted performance, (ii) the performance persistence of funds, and (iii) luck versus skill in the cross-section of funds. Our main results are robust against models which additionally cover a stock-based momentum factor as well as single country, regional and sector factors.

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1. Introduction

For measuring the performance of mutual funds, the choice of the appropriate set of risk factors is essential and therefore still extensively discussed. At present, the majority of academic studies on the performance of equity funds still rely on the Carhart (1997) four-factor model which includes a market, a size, a value and a momentum factor. Following the seminal work of Fama and French (1993), these factors are frequently created by sorting stocks into style portfolios and taking the return difference between the respective top and bottom portfolios. In contrast to these stock-based factor models, an alternative approach uses return differences between style indices to construct size and value factors as conducted by, among others, Faff (2003), Huij and Derwall (2011), and Cremers et al. (2013b). However, to the best of our knowledge, no study discusses and applies a pure index-based factor model which also includes momentum factors when evaluating the performance of equity funds with an international investment focus.

In particular, our paper contributes to the literature by analyzing the impact of country and sector momentum factors on the performance of international and global equity funds. Adding these index-based momentum factors to an index-based version of the Fama and French (1993) three-factor model considerably impacts empirical findings when studying the performance and performance persistence of international and global funds. Compared to an international stock-based four-factor model recently used in the literature, we find our pure index-based model better explains variation in fund returns. Moreover, including these factors changes our main results when analyzing luck versus skill in the cross-section of funds.

Since the seminal paper of Jegadeesh and Titman (1993), the profitability of stock momentum strategies has been broadly documented. Based on a sample of domestic equity funds, Grinblatt et al. (1995) find many fund managers follow momentum strategies in stock investments. As these strategies do not require superior investment abilities, a momentum factor should be considered in the analysis of fund performance. Carhart (1997) shows that adding a stock-based momentum factor to the three-factor model of Fama and French (1993) has an impact on the measured performance and on the measured persistence in the performance of domestic equity funds. Alternatively, Cremers et al. (2013b) construct the Fama and French factors of size and value based on

* Corresponding author. Tel.: +49 911 5302 649; fax: +49 911 5302 466.
E-mail addresses: bernhard.breloer@fau.de (B. Breloer), hendrik.scholz@fau.de (H. Scholz), marco.wilkens@wiwi.uni-augsburg.de (M. Wilkens).

indices, but the momentum factor based on stocks. Applying their partially index-based model to domestic equity funds, they show an improved performance evaluation compared to a pure stock-based factor model.

The literature reports abnormal returns for stock-based momentum strategies in numerous countries worldwide (see, e.g., Rouwenhorst, 1998; Antoniou et al., 2007; Hou et al., 2011; Fama and French, 2012; and Asness et al., 2013). Moreover, findings by Asness et al. (1997), Chan et al. (2000), and Bhojraj and Swaminathan (2006), among others, reveal that momentum strategies based on country indices earn remarkable, abnormal returns. Similarly, the profitability of momentum strategies based on sector indices has been shown by Moskowitz and Grinblatt (1999), Swinkels (2002), Scowcroft and Sefton (2005), and Chen et al. (2012).

So far, many empirical studies analyzing the performance of international and global equity funds do not take any momentum factor into account (see, e.g., Gallo and Swanson, 1996; Detzler and Wiggins, 1997; Redman et al., 2000; Arugaslan et al., 2008; Mazumder et al., 2010). Recently, using stock-based models, Ferreira et al. (2012, 2013), Busse et al. (2013), and Cremers et al. (2013a) apply a stock-based momentum factor in their studies. In contrast, Huij and Derwall (2011) and Comer and Rodriguez (2012) use index-based models for the evaluation of international and global funds, respectively, but do not consider a momentum factor. Only Banegas et al. (2013) apply index-based size and value factors as well as an index-based sector momentum factor when studying European equity funds. We contribute to the literature by analyzing the impact of simultaneously used country and sector momentum factors on the performance of international and global equity funds.

Considering a momentum strategy based on indices in performance analysis can be justified for several reasons. First, fund managers may use a top-down approach when allocating their clients' capital by selecting countries or sectors before stock picking (see, e.g., Chan et al., 2000). Therefore, they might invest directly in market indices, using exchange-traded funds (Miffre, 2007) or futures (Asness et al., 2013). Second, as Bhojraj and Swaminathan (2006) point out, indices are regularly more liquid than individual stocks. In contrast, stock momentum strategies frequently incorporate small illiquid stocks and impose relatively high transaction costs (see, e.g., Grinblatt and Moskowitz, 2004; and Lesmond et al., 2004). Third, there is empirical evidence that index momentum largely captures stock momentum. For example, Asness et al. (1997) observe that country momentum mirrors stock-based momentum in an international context. Moreover, Scowcroft and Sefton (2005) find that momentum effects are primarily driven by indices, not by individual stocks.

For our empirical analysis, we construct several country and sector momentum factors, following to some extent Jegadeesh and Titman (1993), Scowcroft and Sefton (2005), and Bhojraj and Swaminathan (2006). We then incorporate these factors into an international index-based version of the Fama and French (1993) three-factor model. Since the literature shows an ongoing debate as to whether country effects dominate sector effects or vice versa (see, e.g., Beckers et al., 1992; Heston and Rouwenhorst, 1994; Griffin and Karolyi, 1998; Bekaert et al., 2009), we include the country momentum and the sector momentum factors simultaneously in our model. Applying this five-factor model, we evaluate the performance of international and global equity funds for the period January 1996 to December 2009 using the survivorship bias-free CRSP database.

Our empirical results reveal that more than 50% of all international and global funds show a significant exposure to at least one of these additional factors. Moreover, our funds regularly show lower five-factor alphas compared to three-factor alphas. On average, the funds underperform their corresponding benchmark. Sorting funds according to their country momentum and sector momentum exposures reveals a positive relationship between these index momentum exposures and the risk-adjusted performance. On average, funds with relatively high index momentum exposures exhibit lower rank positions based on five-factor alphas compared to rankings based on three-factor alphas. We calculate implied factor returns for actual funds associated with unit exposure to index momentum factors. On this basis, we show that international and global funds partly harvest premiums of these factors. Moreover, we find that the persistence in the fund performance is largely driven by the weakest performing funds. Finally, studying luck versus skill in the cross-section of fund alphas, we find weaker results with respect to skill when we use the index-based five-factor model instead of the index-based three-factor model.

Augmenting our five-factor model by additional factors, e.g., an international (global) stock momentum factor, we find fund exposures to the country and sector momentum factors to be largely robust. This suggests that the stock momentum factor does not capture additional information not already covered by the index momentum factors. Moreover, splitting the fund data into two sub-periods, our main results are robust even if the impact of either the country or the sector momentum factor weakens during the second sub-period.

The remainder of this paper is organized as follows. Section 2 examines several momentum strategies based on country and sector indices. Section 3 describes our methodology for including country and sector momentum factors in performance evaluation. Section 4 presents our fund data and contains the empirical analysis revealing the impact of the momentum factors on the performance of international and global funds. Section 5 reports several robustness tests, and Section 6 concludes.

2. Country and sector momentum strategies

To implement country momentum strategies, we use monthly returns of MSCI Investable Market Indices (IMI) of 23 developed and 22 emerging market countries from June 1994 through December 2009.[1] To examine sector momentum strategies, we use monthly returns of ten MSCI sector indices from January 1995 through December 2009.[2] We distinguish between international sector indices, excluding the United States, and global sector indices, including the United States.

Table 1 contains descriptive statistics of developed and emerging countries in Panels A and B, respectively. On average, emerging country returns in US dollars have a higher mean and standard deviation compared to developed markets. In addition, emerging countries show a lower first-order autocorrelation of 0.1206 compared to 0.1974 for developed countries. These relations prevail when measuring country returns in local currency. Panel C provides respective statistics for sector index returns in US dollars. Autocorrelation measures 0.1774 and 0.1449 for international and global sectors, respectively. Thus country and sector index returns exhibit positive autocorrelation which, among other factors, is considered to be a potential driver of momentum profits (see, e.g., Moskowitz and Grinblatt, 1999).

Focusing on country indices, Bhojraj and Swaminathan (2006) find positive abnormal returns for country momentum strategies lasting longer than one year. In particular, they find sizeable momentum profits for strategies based on past returns in local

[1] Almost all return series of country indices are available since June 1994 or earlier. Exceptions are return series for the Czech Republic and Peru, which start in June 1995, and for Mexico, Jordan and Russia starting in June 1996. The return series of Taiwan and Morocco are available since October 1996 and June 1997, respectively.

[2] Many country and sector indices are tradable as future or ETFs and therefore exhibit low transaction costs. Further information is available, e.g., from the MSCI Barra homepage (http://www.msci.com/products/indices/licensing/).

Table 1
Descriptive statistics on MSCI country and sector index returns.

	Country index returns (USD)			Country index returns (local)			
	Mean	STD	ρ	Mean	STD	ρ	Observations
Panel A: Developed market indices							
Australia	0.0115	0.0606	0.1651	0.0092	0.0376	0.1140	168
Austria	0.0086	0.0683	0.3165	0.0077	0.0604	0.2994	168
Belgium	0.0070	0.0639	0.3434	0.0063	0.0583	0.2879	168
Canada	0.0119	0.0630	0.1798	0.0095	0.0476	0.2168	168
Denmark	0.0105	0.0587	0.1848	0.0099	0.0566	0.0902	168
Finland	0.0135	0.0920	0.2323	0.0131	0.0916	0.2406	168
France	0.0089	0.0583	0.1804	0.0083	0.0558	0.1606	168
Germany	0.0076	0.0671	0.1231	0.0071	0.0638	0.0997	168
Greece	0.0098	0.0949	0.2142	0.0094	0.0918	0.2092	168
Hong Kong	0.0088	0.0774	0.1728	0.0088	0.0775	0.1719	168
Ireland	0.0062	0.0673	0.3097	0.0048	0.0645	0.2626	168
Italy	0.0095	0.0664	0.0990	0.0083	0.0640	0.0413	168
Japan	0.0002	0.0574	0.2270	−0.0007	0.0520	0.2187	168
Netherlands	0.0079	0.0607	0.1466	0.0075	0.0589	0.1316	168
New Zealand	0.0077	0.0626	0.0612	0.0060	0.0425	−0.0498	168
Norway	0.0117	0.0774	0.2228	0.0103	0.0667	0.2167	168
Portugal	0.0087	0.0647	0.2318	0.0080	0.0606	0.1922	168
Singapore	0.0070	0.0810	0.1425	0.0063	0.0720	0.1298	168
Spain	0.0124	0.0645	0.1763	0.0118	0.0605	0.1382	168
Sweden	0.0112	0.0765	0.1809	0.0110	0.0680	0.1410	168
Switzerland	0.0076	0.0496	0.1615	0.0069	0.0487	0.1964	168
United Kingdom	0.0068	0.0462	0.3189	0.0064	0.0422	0.1044	168
USA	0.0064	0.0481	0.1501	0.0064	0.0481	0.1501	168
Average	0.0087	0.0664	0.1974	0.0079	0.0604	0.1636	
Panel B: Emerging market indices							
Brazil	0.0208	0.1169	0.0780	0.0209	0.0838	0.0285	168
Chile	0.0095	0.0656	0.1557	0.0100	0.0523	0.0662	168
China	0.0099	0.1112	0.0852	0.0099	0.1112	0.0846	168
Columbia	0.0161	0.0884	0.2272	0.0194	0.0759	0.1678	168
Czech Republic	0.0162	0.0844	0.1624	0.0130	0.0727	0.0731	168
Hungary	0.0194	0.1062	0.1337	0.0201	0.0964	0.0982	168
India	0.0150	0.0955	0.1317	0.0159	0.0869	0.0953	168
Indonesia	0.0111	0.1405	0.2064	0.0146	0.0994	0.1488	168
Israel	0.0102	0.0703	0.1229	0.0107	0.0647	0.1039	168
Jordan	0.0091	0.0585	0.2642	0.0157	0.0651	0.0229	163
Korea	0.0107	0.1277	0.0685	0.0102	0.1010	0.1520	168
Malaysia	0.0049	0.0936	0.2160	0.0058	0.0825	0.1583	168
Mexico	0.0134	0.0797	0.0718	0.0091	0.0583	0.2654	163
Morocco	0.0087	0.0564	0.0779	0.0072	0.0501	0.0133	151
Peru	0.0144	0.0854	−0.0232	0.0160	0.0831	−0.0636	168
Philippines	0.0017	0.1000	0.2197	0.0037	0.0848	0.1862	168
Poland	0.0136	0.1072	0.0496	0.0127	0.0906	−0.0068	168
Russia	0.0271	0.1528	0.1509	0.0263	0.1506	0.1417	163
South Africa	0.0098	0.0820	0.0909	0.0124	0.0601	0.0086	168
Taiwan	0.0040	0.0896	0.1190	0.0043	0.0819	0.1028	159
Thailand	0.0039	0.1182	0.0771	0.0041	0.1064	0.0156	168
Turkey	0.0234	0.1636	−0.0332	0.0404	0.1535	−0.0137	168
Average	0.0124	0.0997	0.1206	0.0137	0.0869	0.0840	
	International sector returns (USD)			Global sector returns (USD)			
	Mean	STD	ρ	Mean	STD	ρ	Observations
Panel C: Sector indices							
Consumer Discretionary	0.0040	0.0532	0.1947	0.0052	0.0517	0.1932	168
Consumer Staples	0.0072	0.0394	0.2012	0.0077	0.0356	0.2014	168
Energy	0.0094	0.0651	0.0474	0.0112	0.0580	0.0217	168
Financials	0.0047	0.0654	0.2013	0.0057	0.0609	0.1973	168
Health Care	0.0062	0.0388	0.0995	0.0083	0.0392	0.0410	168
Industrials	0.0038	0.0562	0.2544	0.0053	0.0510	0.2029	168
IT	0.0071	0.0834	0.2002	0.0091	0.0807	0.0695	168
Materials	0.0081	0.0661	0.2299	0.0086	0.0626	0.2001	168
Telecom Services	0.0067	0.0613	0.1913	0.0060	0.0566	0.1443	168
Utilities	0.0067	0.0418	0.1544	0.0069	0.0386	0.1781	168
Average	0.0064	0.0571	0.1774	0.0074	0.0535	0.1449	

This table shows descriptive statistics for the returns of 45 MSCI country indices and 10 MSCI sector indices from January 1996 to December 2009. Panels A and B refer to developed and emerging market indices, respectively. Initial reporting dates of some emerging market indices may vary (Czech Republic, Jordan, Mexico, Morocco, Peru, Russia and Taiwan). The column 'Country index returns (USD)' provides summary statistics measured in US dollars. The column 'Country index returns (local)' provides summary statistics measured in the respective local currency. Panel C contains the descriptive statistics of MSCI international sectors (excluding the United States) and global sectors (including United States). Mean refers to the average monthly returns. STD refers to the standard deviation of monthly returns. ρ describes the first-order autocorrelation in monthly returns.

Table 2
Descriptive statistics of selected index-based momentum strategies.

	Mean	Median	STD	Skewness	Kurtosis	J–B stat.	ρ	Turnover ratio (%)
Panel A: Country momentum (past returns in US $, future returns in US $)								
$J = 6, K = 1$	0.0064	0.0107	0.0616	−0.1695	1.0851	26.47	0.1330	65.97
$J = 6, K = 6$	0.0076	0.0118	0.0505	−0.0200	1.7316	11.27	0.1869	26.82
$J = 12, K = 1$	0.0077	0.0137	0.0625	−0.1475	0.8708	32.34	0.1745	46.29
$J = 12, K = 6$	0.0039	0.0104	0.0560	−0.4144	1.8044	14.81	0.2659	20.19
Panel B: Country momentum (past returns in local currency, future returns in US $)								
$J = 6, K = 1$	0.0101	0.0111	0.0587	−0.2290	2.1828	6.14	0.1526	62.24
$J = 6, K = 6$	0.0094	0.0094	0.0497	−0.0102	2.0308	6.58	0.1849	25.70
$J = 12, K = 1$	0.0110	0.0107	0.0618	0.1989	1.6633	13.61	0.2315	44.86
$J = 12, K = 6$	0.0068	0.0111	0.0561	−0.2508	2.7014	2.39	0.3204	19.57
Panel C: International sector momentum (past returns in US $, future returns in US $)								
$J = 6, K = 1$	0.0085	0.0104	0.0452	0.1522	1.7599	11.41	0.1783	51.81
$J = 6, K = 6$	0.0035	0.0040	0.0390	−0.0901	2.1052	5.83	0.1764	22.26
$J = 12, K = 1$	0.0066	0.0090	0.0464	−0.0312	2.1497	5.09	0.2322	35.59
$J = 12, K = 6$	0.0020	0.0051	0.0413	−0.2034	2.0747	7.15	0.3397	16.92
Panel D: Global sector momentum (past returns in US $, future returns in US $)								
$J = 6, K = 1$	0.0057	0.0043	0.0461	−0.0379	2.4276	2.33	0.0617	53.79
$J = 6, K = 6$	0.0039	0.0053	0.0399	−0.5473	2.8932	8.47	0.0476	22.40
$J = 12, K = 1$	0.0084	0.0095	0.0497	−0.2580	2.1368	7.08	0.0476	35.79
$J = 12, K = 6$	0.0048	0.0060	0.0441	−0.2963	1.6854	14.55	0.1834	14.99

This table shows descriptive statistics of several J/K index momentum strategies. Returns are derived from a long-short portfolio with respect to each J/K momentum strategy. J refers to the number of months of the ranking period, whereas K refers to the number of months the portfolios are held. Country and sector indices are ranked based on J-month lagged returns, sorted into quintile and tercile portfolios, respectively, and are held for K month(s). The return of the long-short portfolio is the difference between the average return of K top portfolio(s) and the average return of K bottom portfolio(s). Country and sector momentum strategies are based on 45 MSCI country and 10 MSCI sector index returns from January 1996 to December 2009. Panel A refers to country momentum strategies based on past and future returns in US dollars. Panel B refers to country momentum strategies based on past returns in local currency and future returns in US dollars. Panels C and D refer to international and global sector momentum strategies based on past and future US dollar returns (excluding and including the United States, respectively). Mean and median refer to mean and median of monthly US dollar return time series of strategies, respectively. STD refers to the standard deviation of monthly returns. The Jarque–Bera statistics test whether the return of the J/K strategy follows a normal distribution. Values lower than 5.99 (9.21) indicate a normal distribution of return with respect to a 5% (10%) test level. ρ describes the first-order autocorrelation in monthly returns. The turnover ratio is calculated as the percentage of the portfolio value of a strategy which is rebalanced at the beginning of each month.

currency. Likewise Swinkels (2002), Scowcroft and Sefton (2005) and Chen et al. (2012) find abnormal returns for sector momentum strategies.

Based on these findings we apply several J/K momentum strategies similar to Jegadeesh and Titman (1993). In general, we rank all country (sector) indices according to their past J-month returns ("*ranking period*") and divide them into five (three) portfolios based on this ranking. We then hold these portfolios for K months ("*performance period*").

In detail, we apply four momentum strategies. For the first strategy, we sort the country indices monthly into portfolios based on their past six-month returns ($J = 6$) and hold these portfolios for one month ($K = 1$). We then record the difference between the monthly returns of the equal-weighted top and the equal-weighted bottom portfolio for each month over the evaluation period from January 1996 to December 2009.[3] For the second strategy, we also form a top and a bottom portfolio every month based on six-month returns ($J = 6$), but hold these for a performance period of six months ($K = 6$). Note that in this context we calculate the mean monthly return of the top (bottom) portfolio for K overlapping sub-portfolios, e.g., as in Jegadeesh and Titman (1993). For the third and fourth strategy, we proceed analogically for sorting indices based on their past twelve-month returns ($J = 12$) with respect to performance periods of $K = 1$ and $K = 6$.

Similarly to Barber et al. (2001), we calculate the monthly turnover ratio for these four strategies as the percentage of the portfolio value which is rebalanced at the beginning of each month. Monthly rebalancing is mainly due to indices entering or leaving a portfolio. Moreover, due to differences in monthly index returns, some rebalancing is necessary to maintain equal weights every month.

Table 2 reports descriptive statistics for these momentum strategies. Panel A shows US returns of country momentum strategies when rankings are based on past returns in US dollars, while Panel B refers to respective strategies based on past returns in local currency. Clearly, country momentum strategies based on past returns in local currency show higher means on average. In particular, the 12/1 strategy yields the highest average return of 1.10% per month based on returns in local currency. Moreover, $K = 6$ strategies show lower standard deviations and lower turnover ratios. Panels C and D refer to international and global sector momentum strategies. We observe similar patterns for sector momentum strategies for turnover ratio and average return. For international (global) sector strategies, a 6/1 (12/1) strategy yields the highest average return.

3. Factor models

To analyze the performance of international and global equity funds, we apply three factor models. When constructing the explanatory factors, we take into account the investment universe of the respective fund group studied. Thus we exclude the United States as an investable market when we determine the factors used in analyzing the performance of international funds. In contrast, we include the United States when we calculate the respective factors for global funds.

First, we use an international version of Jensen's (1968) one-factor model:

$$ER_{it} = \alpha_i^{1F} + \beta_i^{1F} WERM_t + \varepsilon_{it} \quad (1)$$

ER_{it} represents the monthly return of fund i, and $WERM_t$ is the monthly return of the MSCI All Country World (ACWI)[4] Investable

[3] This sample period is chosen with respect to a 12/1 strategy. For a 12/6 strategy the performance period starts in June 1996.

[4] While the MSCI World Index includes only stocks of developed markets, the MSCI ACWI additionally contains stocks of emerging markets. Thus the latter index better reflects the performance of the investment universe of our fund sample.

Table 3
Risk-adjusted performance of index-based momentum strategies.

	Alpha	Beta			adj. R^2
		WERM	WSMB	WHML	
Panel A: Country momentum (past returns in US $, future returns in US $)					
$J = 6, K = 1$	0.0077	−0.2817	0.0214	−0.3013	0.0270
	(1.47)	(−2.26)	(0.08)	(−1.36)	
$J = 6, K = 6$	0.0088	−0.2086	−0.0615	−0.2985	0.0257
	(1.98)	(−1.79)	(−0.30)	(−1.90)	
$J = 12, K = 1$	0.0102	−0.3542	−0.2265	−0.6516	0.0893
	(2.02)	(−3.26)	(−0.97)	(−3.75)	
$J = 12, K = 6$	0.0063	−0.2388	−0.2423	−0.4183	0.0484
	(1.21)	(−1.84)	(−1.10)	(−2.48)	
Panel B: Country momentum (past returns in local currency, future returns in US $)					
$J = 6, K = 1$	0.0113	−0.2640	0.0245	−0.2823	0.0255
	(2.29)	(−2.33)	(0.11)	(−1.47)	
$J = 6, K = 6$	0.0105	−0.2048	−0.0149	−0.2380	0.0199
	(2.33)	(−2.03)	(−0.07)	(−1.68)	
$J = 12, K = 1$	0.0131	−0.2634	−0.1888	−0.5591	0.0075
	(2.39)	(−2.46)	(−0.85)	(−2.73)	
$J = 12, K = 6$	0.0087	−0.2127	−0.1606	−0.4096	0.0336
	(1.57)	(−1.85)	(−0.74)	(−2.86)	
Panel C: International sector momentum (past returns in US $, future returns in US $)					
$J = 6, K = 1$	0.0070	−0.2647	−0.0055	−0.2937	0.1030
	(2.19)	(−3.03)	(−0.03)	(−0.85)	
$J = 6, K = 6$	0.0053	−0.2379	0.1038	−0.4374	0.1112
	(2.06)	(−2.61)	(0.58)	(−1.68)	
$J = 12, K = 1$	0.0103	−0.3336	0.0501	−0.5483	0.1557
	(3.47)	(−3.47)	(0.24)	(−1.82)	
$J = 12, K = 6$	0.0069	−0.2689	0.0407	−0.6945	0.2028
	(2.14)	(−2.67)	(0.21)	(−3.14)	
Panel D: Global sector momentum (past returns in US $, future returns in US $)					
$J = 6, K = 1$	0.0109	−0.2757	−0.1518	−0.4338	0.0544
	(3.16)	(−4.32)	(−0.94)	(−2.03)	
$J = 6, K = 6$	0.0057	−0.2054	−0.1934	−0.4904	0.0920
	(2.03)	(−2.51)	(−1.25)	(−3.56)	
$J = 12, K = 1$	0.0099	−0.2188	−0.1466	−0.8701	0.1053
	(3.20)	(−2.77)	(−0.78)	(−2.46)	
$J = 12, K = 6$	0.0056	−0.1484	−0.0795	−0.9640	0.1558
	(1.75)	(−1.79)	(−0.48)	(−3.54)	

This table shows regression results of the country and the sector momentum factors based on an index-based three-factor model. Panel A presents results for country momentum strategies using J-month past returns and K-month future returns, both denominated in US dollars. Panel B shows respective findings for country momentum strategies based on J-month past returns in local currency and K-month future returns in US dollars. Panels C and D refer to international and global sector momentum strategies based on J-month past returns and K-month future returns, both denominated in US dollars. Numbers in brackets represent Newey and West (1987) corrected t-statistics that are based on the null hypothesis H_0: $x = 0$.

Market index (IMI)[5] – both in excess of the risk-free rate in month t. As risk-free rate we use the one-month T-bill return provided by Ken French.[6] α_i^{1F} measures the abnormal risk-adjusted performance of fund i.

Second, in the spirit of Fama and French (1993) we incorporate a size and a value factor in our three-factor model. Similar to Cremers et al. (2013b) for domestic funds as well as Huij and Derwall (2011) for global and Comer and Rodriguez (2012) for international funds, we use indices to construct the monthly size and value factors:

$$ER_{it} = \alpha_i^{3F} + \beta_{1i}^{3F} WERM_t + \beta_{2i}^{3F} WSMB_t + \beta_{3i}^{3F} WHML_t + \varepsilon_{it} \quad (2)$$

Following Faff (2003), we determine the size factor $WSMB_t$ as the average return of the MSCI ACWI Small Value and the MSCI ACWI Small Growth index minus the average return of the MSCI ACWI Large Value and the MSCI ACWI Large Growth index in month t. Accordingly, the value factor $WHML_t$ is the average return of the MSCI ACWI Small Value and the MSCI ACWI Large Value index minus the average return of the MSCI ACWI Small Growth and the MSCI ACWI Large Growth index.

To analyze if returns of the country and sector momentum strategies presented in Section 2 are already captured by the market, size and value factors, we regress the monthly return time series of each strategy against the three-factor model according to Eq. (2). If a momentum strategy is sufficiently captured by the three-factor model, its three-factor alpha should not differ significantly from zero (see, e.g., Elton et al., 1993; Jegadeesh and Titman, 2001). Table 3 reports results for regressions of country momentum strategies which are constructed based on past returns in US dollars (Panel A) and in local currency (Panel B). Every strategy exposes a positive monthly alpha between 0.63% and 1.02% in Panel A and between 0.87% and 1.31% in Panel B. In particular, strategies based on past returns in local currency show positive and significant alphas except for the 12/6 strategy. For country momentum, the 12/1 strategy based on past returns in local currency yields the highest alpha. Panels C and D disclose alphas ranging from 0.53% to 1.09% for international and global sector momentum strategies. In respect to international sector momentum strategies, the 6/1 strategy shows the highest alpha which is also significant, whereas for the global sector momentum strategies, the 12/1 strategy reveals the highest alpha. Summing up, country and sector momentum factors are not sufficiently covered by the three-factor model.

Third, we augment the three-factor model by adding a country and a sector momentum factor which results in a pure index-based five-factor model:

[5] The MSCI ACWI IMI index contains large-, medium- and small-cap stocks and thus provides a broad coverage of international equity markets. Applying this IMI index in performance evaluation results in a higher adjusted R-squared compared to the use of the MSCI ACWI standard index, which does not include small-cap stocks.

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

Table 4
Descriptive statistics of explanatory factors.

	Mean	Median	STD	*t*-stat Mean	VIF	Cross-correlation				
						WERM	WSMB	WHML	CMOM	SMOM
Panel A: International factors										
WERM	0.0031	0.0084	0.0514	0.79	1.13	1				
WSMB	0.0007	0.0019	0.0224	0.38	1.05	−0.02	1			
WHML	0.0030	0.0025	0.0197	1.95	1.18	−0.21	0.19	1		
$CMOM^{12,1}$	0.0107	0.0106	0.0654	2.12	1.36	−0.15	−0.17	−0.24	1	
$SMOM^{6,1}$	0.0085	0.0104	0.0452	2.44	1.32	−0.20	−0.09	−0.17	0.46	1
Panel B: Global factors										
WERM	0.0031	0.0075	0.0480	0.83	1.28	1				
WSMB	0.0016	0.0030	0.0228	0.92	1.02	0.12	1			
WHML	0.0017	−0.0005	0.0263	0.85	1.26	−0.35	−0.06	1		
$CMOM^{12,1}$	0.0110	0.0107	0.0618	2.31	1.32	−0.13	−0.08	−0.16	1	
$SMOM^{12,1}$	0.0084	0.0095	0.0497	2.19	1.40	−0.22	0.00	−0.18	0.48	1

This table shows descriptive statistics and a correlation matrix for the explanatory factors. The factors' time series are based on a sample period from January 1996 through December 2009. Panel A refers to international factors (excluding the United States) whereas Panel B refers to global factors (including the United States). The country momentum factor is based on a 12/1 strategy (ranking based on past local returns) for the international and the global version. The sector momentum factor is based on a 6/1 and a 12/1 strategy for the international and the global version, respectively. STD refers to the standard deviation of monthly returns. VIF refers to the variance inflation factor.

$$ER_{it} = \alpha_i^{5F} + \beta_{1i}^{5F} WERM_t + \beta_{2i}^{5F} WSMB_t + \beta_{3i}^{5F} WHML_t + \beta_{4i}^{5F} CMOM_t^{J,K} + \beta_{5i}^{5F} SMOM_t^{J,K} + \varepsilon_{it} \quad (3)$$

Due to its superior mean return (see Table 2) and three-factor alpha (see Table 3), we apply a 12/1 strategy based on past returns in local currency to determine the country momentum factor $CMOM_t^{J,K}$. As sector momentum factor $SMOM_t^{J,K}$, we use a 6/1 sector strategy when evaluating international funds and a 12/1 sector strategy for global funds.

Table 4 contains descriptive statistics of all factors used in the international and the global version of the five-factor model (Panels A and B). Focusing on the international version, the country and sector momentum factors show significant mean monthly returns of 1.07% (*t*-stat: 2.12) and 0.85% (*t*-stat: 2.44), respectively. The means of *WERM*, *WSMB* and *WHML* are considerably lower, measuring 0.31%, 0.07% and 0.30%, respectively, and are partly not significant. The correlation between the applied momentum factors and the first three factors is quite low (−0.24 to −0.09) whereas the correlation between country and sector momentum measures 0.46. A variance inflation factor of less than 1.5 for each of the factors indicates that the simultaneous inclusion of both index momentum factors should not severely bias our results due to multicollinearity. With regard to the global factors, the pattern is similar apart from the mean of *WHML*, which is smaller and statistically not significant.

4. Empirical analysis

4.1. Fund data

As data source we use the CRSP Survivor-Bias-Free US Mutual Fund Database. We select international and global equity funds for an evaluation period from January 1996[7] to December 2009.[8] While global funds invest in domestic stocks as well as in international stocks, international funds are restricted to only investing in international stocks. Thus their investment universe excludes US securities. From this data sample, we eliminate funds with the description of ETF, Index, Long-Short, Alpha-Only, Fixed Income, Retirement, Variable Insurance or Target in their names (compare, e.g., Comer et al., 2009; Amihud and Goyenko, 2013). For the remaining funds we extract monthly returns,[9] as well as corresponding TNAs, expense ratios and turnover ratios.

Concerning TNA, we lack 7.21% of the monthly TNA data points needed to be complete. For data filling, we rely on a three-step procedure as proposed by Rohleder et al. (2011). However, the filled data points amount to less than 0.77% of the total TNA volume. Regarding expense ratio and turnover ratio, CRSP offers start and end dates for certain time periods for each fund. In cases where the expense ratio (turnover ratio) does not exist at the beginning of a fund's life, we fill in the missing data based on the earliest available information.

Furthermore, based on the portfolio number provided by CRSP and based on fund names, we merge share classes belonging to the same fund by value-weighting the corresponding share classes. Finally, we eliminate all funds with fragmentary return histories or with a reporting gap of more than two years between the funds' first offer date and the first return. Our final data set contains 704 international and 287 global equity funds.

Table 5 presents descriptive statistics of the funds. As shown in Panel A, the number of international funds increases almost continuously, starting with 230 funds in January 1996 and ending up with 431 funds in December 2009. Likewise, the number of global funds grows from 81 in January 1996 to 181 funds in December 2009 (see Panel B). More international funds start in the first sub-period (1996–2002) than in the second sub-period (2003–2009) of our sample. By contrast, slightly more global funds start in the second than in the first sub-period. Both international and global funds show a higher fund disappearance in the second sub-period. Moreover, the rise of the international fund industry is reflected by its strong growth in TNA, starting with 84.443 billion in January 1996 and ending with 609.448 billion in December 2009. We observe a similar development of TNA for global funds. With respect to the turnover ratio, international funds show slightly fewer trading activities than global funds on average (77.03% vs. 88.47%). Similarly, the mean expense ratio is lower for international funds than for global funds (1.53% vs. 1.72%). Furthermore, expense ratios for international and global funds are lower in the second sub-period.

In the end, our data sample contains 60,519 monthly returns of international funds and 20,385 monthly returns of global funds.

[7] The start date is chosen with respect to the availability of the sector indices.

[8] We select all funds with the following Strategic Insight objective codes (available from January 1993 to September 1998): Equity international growth (EIG), international small company (EIS), international total return (EIT), equity global growth (EGG), global small company (EGS), global total return (EGT), and global equity (GLE). Furthermore, we select funds with the following Lipper objective codes (available from December 1999 to December 2009): Global funds (GL), global small-cap funds (GS), international funds (IF), and international small-cap funds (IS). For separating funds into international and global funds, we rely on the most recent objective code.

[9] We do not include funds with unreliable returns and thus eliminate funds showing absolute monthly returns higher than 100%.

Table 5
Descriptive statistics of international and global equity funds.

Year	Fund starts		Fund disappearances		Total number of funds	TNA	Average turnover (%)	Average expense ratio (%)
	Absolute	Relative (%)	Absolute	Relative (%)				
Panel A: International funds								
1996	38	16.52	9	3.91	259	127,166	58.28	1.41
1997	47	18.15	5	1.93	301	156,971	65.60	1.48
1998	44	14.62	10	3.32	335	170,314	63.66	1.46
1999	39	11.64	1	0.30	373	249,374	75.03	1.53
2000	29	7.77	34	9.12	368	233,893	85.59	1.55
2001	47	12.77	25	6.79	390	187,657	90.72	1.63
2002	22	5.64	30	7.69	382	167,499	96.85	1.73
2003	16	4.19	40	10.47	358	250,351	89.95	1.75
2004	11	3.07	29	8.10	340	352,458	79.39	1.64
2005	24	7.06	14	4.12	350	479,922	72.25	1.55
2006	45	12.86	15	4.29	380	681,743	68.39	1.49
2007	48	12.63	16	4.21	412	845,794	65.47	1.43
2008	52	12.62	17	4.13	447	442,621	80.82	1.37
2009	12	2.68	28	6.26	431	609,448	86.44	1.38
Average 1996–2009	34	10.16	20	5.33	366	353,944	77.03	1.53
Sub-average 1996–2002	38	12.45	16	4.72	344	184,696	76.53	1.54
Sub-average 2003–2009	30	7.87	23	5.94	388	523,191	77.53	1.51
Panel B: Global funds								
1996	10	12.35	2	2.47	89	83,213	77.14	1.93
1997	14	15.73	3	3.37	100	111,455	74.57	1.96
1998	15	15.00	4	4.00	111	128,550	82.03	1.91
1999	10	9.01	1	0.90	120	185,844	100.70	1.78
2000	13	10.83	8	6.67	125	176,808	122.11	1.80
2001	17	13.60	18	14.40	124	140,915	125.02	1.70
2002	6	4.84	13	10.48	117	108,629	149.87	1.61
2003	8	6.84	12	10.26	113	144,424	93.22	1.71
2004	5	4.42	12	10.62	106	177,996	87.67	1.69
2005	11	10.38	4	3.77	113	219,401	63.15	1.64
2006	14	12.39	3	2.65	124	286,522	57.29	1.41
2007	20	16.13	3	2.42	141	343,015	52.91	1.56
2008	41	29.08	7	4.96	175	186,886	70.76	1.66
2009	23	13.14	17	9.71	181	233,793	82.20	1.68
Average 1996–2009	15	12.41	8	6.19	124	180,532	88.47	1.72
Sub-average 1996–2002	12	11.62	7	6.04	112	133,631	104.49	1.81
Sub-average 2003–2009	17	13.20	8	6.34	136	227,434	72.46	1.62

This table shows the absolute and relative numbers of annual fund starts and disappearances as well as the total net assets (TNA), average turnover and average expense ratio. The sample period is from January 1996 through December 2009. The total number of funds relates to the number of funds operating at the end of each year. Relative numbers refer to the total number of funds operating in December of the prior year. Turnover ratio and expense ratio refer to the mean of corresponding data of international and global funds at the end of each year. Panels A and B show results for international and global equity funds, respectively.

While the average international equity fund exists for 86 months, the average global fund does so for 71 months.

4.2. Fund portfolio and individual fund performance

We first calculate the return time series of an international fund portfolio and a global fund portfolio by equal-weighting the returns of all funds available at the beginning of each month. Furthermore, we determine the return time series of respective fund portfolios using a monthly value weighting which reflects the performance of the overall sector. Applying these monthly return time series, we estimate the performance of the fund portfolios based on the one-, three- and five-factor model according to (1)–(3).

Table 6 displays the results for the international fund portfolios in Panel A. Our models show high explanatory power for all conducted regressions. Indeed, regressions based on the one-factor model already yield an adjusted *R*-squared above 0.966, both for the equal- and for the value-weighted fund portfolio, which increases further when we apply the three- and the five-factor model. Based on the latter, the equal-weighted fund portfolio has a negative beta on the *WSMB* factor of −0.0484 (*t*-stat: −2.28), which is significant at the 5% level, indicating a slight tilt towards large stocks. In contrast, the negative *WHML* beta of −0.0670 (*t*-stat: −1.40) is not significant and thus should be interpreted with caution. Most importantly, the *CMOM* and *SMOM* betas amount to 0.0261 (*t*-stat: 2.52) and 0.0649 (*t*-stat: 3.72), respectively, and are both statistically significant. For the value-weighted international fund portfolio, the *WSMB* beta is lower and the *WHML* beta is somewhat higher. This indicates that larger funds tend to invest more in large-cap and less in growth stocks. The *CMOM* and *SMOM* betas are both positive and significant with 0.0186 (*t*-stat: 1.97) and 0.0667 (*t*-stat: 3.33), respectively. In this context, it is interesting to see how much rebalancing in the funds would have been necessary to reproduce these index momentum betas. For example, a *SMOM* beta of 0.0667 implies a turnover ratio of 3.46% per month (41.47% p.a.) in a pure sector momentum strategy.[10] Considering the average yearly turnover ratio of 77.03% for international funds (see Table 5), this result seems feasible.

In terms of international fund performance, the one- and three-factor alphas are positive, both for the equal- and the value-weighted international portfolio. However, when we add the country and the sector momentum factors, alpha becomes negative for the equal-weighted and remains only slightly above zero for the value-weighted portfolio. Thus including the index momentum factors clearly decreases the measured performance. Moreover, we like to stress that the performance of the value-weighted portfolio is higher than that of the equal-weighted portfolio, indicating that larger international funds exhibit a superior risk-adjusted

[10] We calculate the turnover ratio for international funds as the product of the strategy's monthly turnover ratio times the estimated exposure to the momentum factor.

performance. This finding is consistent with Ferreira et al. (2012, 2013) and Busse et al. (2013), who report a positive relation between size and alpha for international funds. Finally, adding index momentum factors leads to a slight increase in the adjusted *R*-squared.

Results for global funds are represented in Panel B. With regard to the five-factor model, the *WSMB* and *WHML* betas of the equal-weighted portfolio measure 0.0897 (*t*-stat: 3.70) and −0.1256 (*t*-stat: −2.75), respectively. This indicates a slight tilt towards small-cap and growth stocks. In addition, it shows a positive and significant *CMOM* beta of 0.0331 (*t*-stat: 4.10), while the *SMOM* beta is positive but not significant with 0.0128 (*t*-stat: 0.82). Again, introducing the index momentum factors decreases alpha in respect to global funds.

Next, we investigate alphas and betas for individual funds. In order to calculate reliable regression estimates, we eliminate funds with fewer than 24 consecutive monthly returns. This reduces our initial data set to 586 international and 209 global equity funds.

Panel A of Table 6 shows that 142 of 586 international funds (24.23%) exhibit a significant *CMOM* beta, which is positive for 103 and negative for 39 funds. Regarding *SMOM*, 237 international funds (40.44%) have a significant beta (231 positive vs. 6 negative). Moreover, 319 international funds (54.44%) exhibit a significant beta on at least one of these two momentum factors. On average, international funds show negative alphas, e.g., 162 international funds (27.65%) reveal a negative and significant five-factor alpha. Notably, when the country and sector momentum factors are included, the number of funds with negative and significant alphas increases by 50 compared to the three-factor model.

Panel B shows that global funds exhibit a lower share of significant *CMOM* betas (62 of 209 funds, 29.67%) compared to *SMOM* betas (74 funds, 35.41%). Of these, more funds show a positive than a negative beta on both index momentum factors. Furthermore, 111 global funds (53.11%) have a significant exposure to at least one of these two index momentum factors. Moreover, they show slightly higher five-factor alphas than international funds on average, but still 126 funds (60.29%) have a negative alpha which is significant for 35 funds (16.75%).

To sum up, on average, international and global funds deliver a negative risk-adjusted performance which is amplified by including the country and sector momentum factors. Therefore, index momentum factors should be taken into account when analyzing the performance of international and global funds.

We now compare our results to those of international stock-based factor models recently applied in the literature (see, e.g., Ferreira et al., 2012, 2013; Busse et al., 2013; Cremers et al., 2013a). Thus we replicate the previous analysis for fund portfolio and individual fund returns while using stock-based factor models. With respect to the momentum factor, we now apply one momentum factor in the stock-based four-factor model instead of a country and a sector momentum factor in the index-based five-factor model used before. The construction of the used market, size, value and momentum factors is described in Ferreira et al. (2012).[11] As before, we distinguish between international and global factors. Panels C and D of Table 6 report results for international and global funds, respectively. Both the index-based and the stock-based models yield quite impressive results in terms of explaining fund returns. The former shows a slightly higher explanatory power as measured by adjusted *R*-squared. One reason could be traced back to the underlying stock universe of the MSCI Investable Market indices applied in the index-based models, which may cover the stock universe of our fund sample more accurately. In contrast to the findings of our index-based five-factor model, we document the portfolios of international and global funds to exhibit statistically insignificant betas with respect to the stock-based momentum factor. For the following sections, we focus first on our index-based five-factor model and further analyze the impact of the country and the sector momentum factors on performance and performance persistence of funds, as well as on the evaluation of luck versus skill in the cross-section of funds.

[11] The factor returns are generously provided by Antonio Miguel. Notably, this updated version of the factors covers stocks from all countries we consider when we determine the country momentum factors in Section 2.

4.3. Relationship between index momentum exposures and characteristics of funds

Previous results gave us an initial impression regarding the performance of international and global funds. Now, we examine more intensively the relationship between funds' exposures to our index momentum factors and several fund characteristics. To do so, we sort funds into portfolios based on their country momentum and sector momentum exposures. First, we sort funds into quintile portfolios based on their country exposures (*CMOM* quintiles). Next, we replicate this sort for sector momentum exposures (*SMOM* quintiles). Following these two single sorts, we double sort funds into quintile portfolios based simultaneously on their country and sector momentum exposures. We thus end up with 10 single-sorted and 25 double-sorted fund portfolios. Table 7 reports for each portfolio the number of funds as well as average alphas, betas, expense and turnover ratios in Panel A for international funds and in Panel B for global funds, respectively.

Focusing on the distribution of international funds, we find that funds of the top *CMOM* quintile exhibit an uneven distribution regarding their exposure to *SMOM*. A large fraction of funds in the top *CMOM* quintile is allocated either to the double-sorted top *CMOM*/top *SMOM* portfolio (38 of 118 funds) or to the double-sorted top *CMOM*/bottom *SMOM* portfolio (30 of 118 funds). Moreover, we identify a similar U-shaped pattern for funds of the top *SMOM* quintile.

Turning to the relationship between index momentum and *WSMB* exposures, funds in the top *CMOM* (*SMOM*) quintile exhibit a positive *WSMB* beta on average. In contrast, the *WHML* betas are negative for the same top quintile portfolios. For example, the top *CMOM*/top *SMOM* portfolio exhibits average betas of 0.22 and −0.71 on the *WSMB* and the *WHML* factors, respectively. This indicates that funds with high index momentum exposure tend to be invested in small growth stocks.

Moreover, funds in the top *CMOM* (*SMOM*) quintile seem to be more profitable as they exhibit frequently higher alphas than those in the bottom *CMOM* (*SMOM*) quintile. In particular, we find that one- and three-factor alphas are the highest for the top *CMOM* (*SMOM*) quintile portfolios. Notably, the top *CMOM*/top *SMOM* portfolio exhibits an average monthly three-factor alpha of 0.44%. As seen for the average fund portfolios in Section 4.2, adding index momentum factors reduces alpha for all portfolios. Nevertheless, the top *CMOM*/top *SMOM* portfolio still exhibits a five-factor alpha of 0.10%. Furthermore, the structural pattern of decreasing alphas along with decreasing index momentum exposures remains. One possible explanation for this finding is that funds with relative high index momentum exposures may have better stock picking skills. We will return to this issue in Section 4.4.

Notably, the top *CMOM* (*SMOM*) quintile shows relatively high expense and turnover ratios. Among these, the top *CMOM*/top *SMOM* portfolio stands out with an expense ratio of 1.81% and an average turnover ratio of 168.21%. Assuming that realizing momentum strategies involves frequent trading and hence is associated with higher costs, this result is not surprising.

Finally, we investigate the relationship between index momentum exposures and rank changes of funds. We first rank funds on their three- and five-factor alphas. Then we calculate the rank

Table 6
Risk-adjusted performance of international and global equity funds: Fund portfolios and individual funds.

	1F-Model			3F-Model					5F-Model						
	1F-Alpha	Beta	Adj. R^2	3F-Alpha	Beta			Adj. R^2	5F-Alpha	Beta					Adj. R^2
		WERM			WERM	WSMB	WHML			WERM	WSMB	WHML	CMOM	SMOM	
Panel A: International funds															
Equal-weighted fund portfolio															
Estimate	0.0077	0.9684	0.9724	0.0515	0.9578	−0.0651	−0.1223	0.9757	−0.0556	0.9788	−0.0484	−0.0670	0.0261	0.0649	0.9810
t-Value	(0.12)	(76.76)		(0.64)	(84.40)	(−2.23)	(−1.61)		(−0.89)	(77.41)	(−2.28)	(−1.40)	(2.52)	(3.72)	
Value-weighted fund portfolio															
Estimate	0.0708	0.9578	0.9703	0.1040	0.9504	−0.1179	−0.0780	0.9742	0.0059	0.9697	−0.1037	−0.0285	0.0186	0.0667	0.9790
t-Value	(1.06)	(73.81)		(1.35)	(82.86)	(−3.70)	(−0.91)		(0.10)	(78.24)	(−4.43)	(−0.50)	(1.97)	(3.33)	
Individual funds															
Mean	−0.0624	0.9735	0.8730	−0.0299	0.9520	−0.0513	−0.0946	0.9074	−0.1192	0.9757	−0.0282	−0.0467	0.0106	0.0707	0.9165
Median	−0.0791	0.9684	0.8996	−0.0692	0.9507	−0.1441	−0.0644	0.9278	−0.1390	0.9740	−0.1160	−0.0225	0.0142	0.0600	0.9332
STD	0.0033	0.1149	0.1044	0.0037	0.0972	0.2874	0.4861	0.0797	0.0032	0.0945	0.2874	0.4442	0.0674	0.0932	0.0426
# Positive	227	586		227	586	145	261		157	586	166	270	368	486	
# Negative	359	0		359	0	441	325		429	0	420	316	218	100	
# Pos. & sign. (5%)	21	586		48	586	90	145		28	586	96	162	103	231	
# Neg. & sign. (5%)	91	0		112	0	279	180		162	0	266	175	39	6	
Panel B: Global funds															
Equal-weighted fund portfolio															
Estimate	−0.0221	0.9925	0.9743	0.0007	0.9585	0.0841	−0.1511	0.9818	−0.0557	0.9715	0.0897	−0.1256	0.0331	0.0128	0.9839
t-Value	(−0.31)	(63.89)		(0.01)	(94.98)	(3.47)	(−2.63)		(−1.05)	(83.77)	(3.70)	(−2.75)	(4.10)	(0.82)	
Value-weighted fund portfolio															
Estimate	0.1080	0.9785	0.9666	0.1288	0.9459	0.0852	−0.1435	0.9736	0.0715	0.9593	0.0906	−0.1174	0.0325	0.0144	0.9757
t-Value	(1.42)	(58.58)		(1.69)	(64.41)	(2.42)	(−1.83)		(1.23)	(65.03)	(2.52)	(−1.80)	(4.38)	(0.88)	
Individual funds															
Mean	−0.0694	0.9923	0.8522	−0.0171	0.9546	0.0689	−0.1320	0.8972	−0.0615	0.9670	0.0754	−0.1026	0.0385	0.0051	0.9041
Median	−0.0502	0.9883	0.8783	−0.0168	0.9596	0.0160	−0.0986	0.9156	−0.0803	0.9715	0.0192	−0.0589	0.0292	0.0082	0.9221
STD	0.0037	0.1958	0.1171	0.0036	0.1385	0.2936	0.4579	0.0802	0.0036	0.1347	0.2978	0.4575	0.0735	0.1096	0.0777
# Positive	90	209		98	209	113	82		83	209	115	88	166	112	
# Negative	119	0		111	0	96	127		126	0	94	121	43	97	
# Pos. & sign. (5%)	9	209		16	209	46	51		12	209	44	57	58	44	
# Neg. & sign. (5%)	23	0		32	0	30	84		35	0	29	74	4	30	

	1F-Model			3F-Model					4F-Model					
	1F-Alpha	Beta	Adj. R^2	3F-Alpha	Beta			Adj. R^2	4F-Alpha	Beta				Adj. R^2
		WERM			WERM	WSMB	WHML			WERM	WSMB	WHML	StockMOM	
Panel C: International funds														
Equal-weighted fund portfolio														
Estimate	−0.0420	0.9924	0.9457	0.0686	0.9658	−0.1527	−0.1683	0.9524	0.0255	0.9777	−0.1540	−0.1557	0.0363	0.9527
t-Value	(−0.39)	(45.62)		(0.55)	(54.86)	(−3.01)	(−2.08)		(0.22)	(41.36)	(−3.25)	(−2.19)	(1.23)	
Value-weighted fund portfolio														
Estimate	0.0217	0.9813	0.9430	0.1112	0.9503	−0.2157	−0.1500	0.9525	0.0746	0.9604	−0.2168	−0.1393	0.0307	0.9527
t-Value	(0.21)	(39.60)		(0.89)	(50.99)	(−3.93)	(−1.68)		(0.66)	(38.76)	(−4.21)	(−1.76)	(0.97)	
Individual funds														
Mean	−0.1225	1.0007	0.8499	−0.0916	0.9683	−0.1389	−0.0413	0.8835	−0.1257	0.9767	−0.1385	−0.0226	0.0281	0.8893
Median	−0.1323	0.9936	0.8749	−0.1303	0.9612	−0.2237	−0.0462	0.9065	−0.1283	0.9661	−0.2239	−0.0527	0.0191	0.9101
STD	0.0035	0.1249	0.1001	0.0053	0.1114	0.3038	0.4641	0.0814	0.0047	0.1176	0.3010	0.4346	0.1555	0.0755
# Positive	185	586		215	586	122	265		200	586	116	271	328	
# Negative	401	0		371	0	464	321		386	0	470	315	258	
# Pos. & sign. (5%)	9	586		55	586	64	167		40	586	64	169	133	
# Neg. & sign. (5%)	89	0		141	0	309	196		138	0	315	191	84	

change for each fund as the rank difference between the funds' rank based on the three-factor alpha and on the five-factor alpha. We find a negative relationship between average rank changes and index momentum exposures. That is, funds with high index momentum exposures receive lower rank positions when measured with five-factor alphas rather than three-factor alphas and vice versa. Furthermore, absolute mean rank changes are highest among top and bottom *CMOM* (*SMOM*) quintiles. Comparing these *CMOM* and *SMOM* quintile portfolios, the impact of sector momentum on rank changes is slightly higher, e.g., the top *CMOM* quintile shows a rank change of −32.86, while the rank change for the top *SMOM* quintile is −41.32.

In Panel B, we find similar results for global funds with respect to alphas and fund characteristics, even if structural patterns are less clear compared to international funds.

4.4. Implied versus hypothetical momentum profits of funds

At this point, we calculated return series of several country and sector momentum strategies and included one country and one sector momentum factor in our five-factor model. However, these factors do not incorporate the costs that investors would face. Literature often claims that stock momentum strategies are not profitable in reality mainly due to trading costs, liquidity issues and other restrictions (see, e.g., Grinblatt and Moskowitz, 2004; Lesmond et al., 2004). Given this criticism, especially the return of stock-based momentum strategies seems to be illusionary. In contrast to stock-based momentum strategies, index-based momentum strategies benefit from lower implementation costs when using futures or exchange traded funds. For example, Andreu et al. (2013) show that country and sector momentum strategies based on exchange traded funds are profitable, even after trading costs. Nevertheless, because an index momentum strategy also involves costs, its factor returns can be considered as somewhat hypothetical. We therefore analyze to what extent international and global funds managers can harvest momentum premiums by calculating implied factor returns for funds with unit exposure to the index momentum factors and compare these with their hypothetical counterparts.

Similarly to Huij and Verbeek (2009), we apply a Fama–MacBeth (1973) two-step regression. First, we run 36-month rolling regressions according to Eq. (3) to estimate betas of funds based on the five-factor model. Second, using these betas estimated up to month $t-1$ and fund returns in month t, we monthly estimate implied returns for each of the five factors ($r_{\beta 1,t}, r_{\beta 2,t}, r_{\beta 3,t}, r_{\beta 4,t}$, and $r_{\beta 5,t}$) by solving the following equation[12,13]:

$$\begin{bmatrix} r_{\beta 1,t} \\ r_{\beta 2,t} \\ r_{\beta 3,t} \\ r_{\beta 4,t} \\ r_{\beta 5,t} \end{bmatrix} = \left(\begin{bmatrix} \beta'^{5F}_{1,t-1} \\ \beta'^{5F}_{2,t-1} \\ \beta'^{5F}_{3,t-1} \\ \beta'^{5F}_{4,t-1} \\ \beta'^{5F}_{5,t-1} \end{bmatrix} \begin{bmatrix} \beta^{5F}_{1,t-1} \beta^{5F}_{2,t-1} \beta^{5F}_{3,t-1} \beta^{5F}_{4,t-1} \beta^{5F}_{5,t-1} \end{bmatrix} \right)^{-1} \begin{bmatrix} \beta'^{5F}_{1,t-1} \\ \beta'^{5F}_{2,t-1} \\ \beta'^{5F}_{3,t-1} \\ \beta'^{5F}_{4,t-1} \\ \beta'^{5F}_{5,t-1} \end{bmatrix} r_t \quad (4)$$

Panel D: Global funds

Equal-weighted fund portfolio														
Estimate	−0.0205	0.9693	0.8972	0.0768	0.9490	−0.0042	−0.1181	0.8993	0.1194	0.9333	−0.0039	−0.1305	−0.0342	0.8997
t-Value	(−0.18)	(32.67)		(0.51)	(30.47)	(−0.07)	(−1.34)		(0.76)	(20.85)	(−0.07)	(−1.45)	(−0.76)	
Value-weighted fund portfolio														
Estimate	0.1094	0.9558	0.8903	0.2041	0.9365	0.0150	−0.1134	0.8928	0.2456	0.9212	0.0152	−0.1255	−0.0334	0.8932
t-Value	(0.93)	(30.16)		(1.26)	(27.75)	(0.25)	(−1.13)		(1.47)	(19.22)	(0.24)	(−1.23)	(−0.71)	
Individual funds														
Mean	−0.0713	0.9693	0.7898	0.0207	0.9372	−0.0278	−0.0463	0.8235	0.0481	0.9293	−0.0304	−0.0592	−0.0262	0.8298
Median	−0.0602	0.9645	0.8227	−0.0109	0.9430	−0.0689	−0.0102	0.8492	0.0276	0.9270	−0.0761	−0.0268	−0.0315	0.8558
STD	0.0037	0.2194	0.1520	0.0051	0.1690	0.2635	0.3970	0.1274	0.0050	0.1711	0.2651	0.3824	0.1173	0.1238
# Positive	91	209		101	209	63	100		113	209	64	99	77	
# Negative	118	0		108	0	146	109		96	0	145	110	132	
# Pos. & sign. (5%)	6	209		18	209	18	46		17	209	21	44	22	
# Neg. & sign. (5%)	23	0		32	0	53	52		25	0	56	54	29	

This table shows alphas and betas for regressions of fund portfolio and individual fund returns using different index-based factor models based on an evaluation period from January 1996 to December 2009. On a fund portfolio level, results are reported for equal- and for value-weighted fund portfolio returns. The fund portfolios contain 704 international and 287 global funds. On the individual fund level, the data consists of funds with at least 24 months of consecutive returns. The samples of individual funds consist of 586 international and of 209 global funds. The number of funds exhibiting positive (negative) and statistically significant alphas and betas are based on a two-sided mean difference test at the 5% level. Panels A and B show results for international and global equity funds based on index-based factor models, respectively. The country momentum factor is based on a 12/1 strategy (ranking based on past local returns) for international and global funds. The sector momentum factor is based on a 6/1 and 12/1 strategy for international and global funds, respectively. Panels C and D report results for international and global equity funds based on stock-based factor models, respectively. Monthly alphas are reported in percent. Numbers in brackets represent Newey and West (1987) corrected *t*-statistics that are based on the null hypothesis H_0: $x = 0$.

[12] Using estimated betas of the first stage regression in the second stage cross-sectional regression could result in an "error in variable". As recommended by Blume (1970) and Fama and MacBeth (1973), Huij and Verbeek (2009) consider style-based fund portfolio returns in order to reduce this problem. In contrast, Ang et al. (2010) and Avramov and Chordia (2006) argue that using portfolio returns could result in a loss of information and hence in less efficient estimates of factor premiums. Therefore, we follow the approach of Huij and Verbeek (2009), but rely on individual fund returns instead of portfolio returns.

[13] For the estimation of the implied factor returns of *WERM* as well as *WSMB* and *WHML* we could consider Eqs. (1) and (2), respectively. However, these estimations lead to only minor changes. These results are available upon request.

Table 7
Relationship between index momentum exposures and fund characteristics.

SMOM quintiles	*CMOM* quintiles						*CMOM* quintiles					
	Top	2	3	4	Bottom	All	Top	2	3	4	Bottom	All
Panel A: International funds												
Number of funds							1F-Alpha					
Top	38	21	12	20	27	118	0.18	0.10	0.09	−0.11	−0.24	0.01
2	19	22	23	24	29	117	0.13	−0.04	−0.11	−0.03	−0.21	−0.07
3	13	21	30	27	26	117	0.01	−0.09	−0.01	0.00	−0.11	−0.04
4	18	30	31	23	15	117	−0.23	0.02	−0.06	−0.12	−0.18	−0.09
Bottom	30	23	21	23	20	117	−0.09	−0.11	−0.15	−0.11	−0.18	−0.13
All	118	117	117	117	117	586	0.02	−0.02	−0.06	−0.07	−0.19	−0.06
5F-Beta WERM							3F-Alpha					
Top	1.00	0.99	1.00	0.97	0.96	0.99	0.44	0.19	0.19	0.07	−0.21	0.16
2	1.03	0.99	0.94	0.93	0.96	0.97	0.25	0.06	−0.05	−0.03	−0.24	−0.02
3	0.99	0.98	0.96	0.94	0.96	0.96	0.10	−0.05	−0.01	0.01	−0.16	−0.03
4	1.01	0.97	0.95	0.98	0.95	0.97	−0.17	−0.03	−0.09	−0.14	−0.19	−0.11
Bottom	1.01	1.00	0.94	1.02	0.97	0.99	−0.08	−0.13	−0.17	−0.15	−0.22	−0.14
All	1.01	0.99	0.95	0.97	0.96	0.98	0.15	0.00	−0.05	−0.06	−0.21	−0.02
5F-Beta WSMB							5F-Alpha					
Top	0.22	0.01	−0.13	−0.04	0.08	0.07	0.10	−0.02	−0.01	−0.08	−0.32	−0.06
2	0.08	−0.06	0.03	−0.03	0.10	0.03	0.04	−0.07	−0.16	−0.10	−0.26	−0.12
3	0.02	−0.14	−0.13	−0.08	−0.01	−0.08	−0.08	−0.17	−0.09	−0.04	−0.16	−0.11
4	0.01	−0.09	−0.18	−0.16	−0.18	−0.12	−0.26	−0.11	−0.14	−0.15	−0.17	−0.16
Bottom	0.07	−0.09	−0.14	−0.08	0.00	−0.04	−0.14	−0.16	−0.17	−0.11	−0.18	−0.15
All	0.10	−0.08	−0.11	−0.08	0.02	−0.03	−0.04	−0.11	−0.12	−0.10	−0.23	−0.11
5F-Beta WHML							Expense ratio					
Top	−0.71	−0.26	−0.28	−0.35	−0.04	−0.37	1.81	1.45	1.49	1.32	1.28	1.51
2	−0.26	−0.18	−0.15	0.03	0.10	−0.08	1.60	1.48	1.44	1.31	1.32	1.42
3	−0.12	−0.10	0.06	0.15	0.12	0.05	1.56	1.89	1.35	1.36	1.24	1.45
4	−0.28	0.12	0.15	0.19	0.15	0.08	1.52	1.29	1.27	1.25	1.28	1.31
Bottom	0.02	0.13	0.02	0.16	0.14	0.09	1.56	1.52	1.46	1.47	1.45	1.50
All	−0.32	−0.04	0.00	0.05	0.08	−0.05	1.64	1.51	1.38	1.34	1.31	1.44
5F-Beta CMOM							Turnover ratio					
Top	0.10	0.04	0.02	−0.01	−0.12	0.01	168.21	98.63	98.50	104.08	114.76	125.79
2	0.08	0.04	0.01	−0.01	−0.07	0.00	76.01	110.37	77.24	72.61	51.69	76.19
3	0.10	0.04	0.01	−0.01	−0.07	0.00	104.32	84.47	71.61	55.60	98.42	79.27
4	0.10	0.04	0.01	−0.01	−0.06	0.02	103.62	73.17	56.86	44.67	41.29	63.76
Bottom	0.11	0.04	0.01	−0.01	−0.09	0.02	75.94	74.86	68.78	54.10	85.46	71.90
All	0.10	0.04	0.01	−0.01	−0.08	0.01	113.26	87.22	71.03	64.78	80.68	83.82
5F-Beta SMOM							Mean rank change (3F-Alpha minus 5F-Alpha)					
Top	0.21	0.17	0.17	0.17	0.18	0.18	−42.71	−79.05	−45.08	−33.20	−14.37	−41.32
2	0.09	0.10	0.09	0.10	0.11	0.10	−79.42	−34.23	−16.39	1.88	32.93	−13.88
3	0.06	0.06	0.06	0.06	0.06	0.06	−64.54	−51.38	−11.30	18.26	50.23	−3.03
4	0.03	0.02	0.03	0.03	0.03	0.03	−21.83	−7.93	19.39	47.96	62.40	16.83
Bottom	−0.04	−0.01	−0.01	−0.04	−0.02	−0.03	16.20	27.13	53.10	67.09	59.80	42.43
All	0.08	0.06	0.06	0.06	0.08	0.07	−32.86	−26.95	4.21	21.33	34.23	0.00
Panel B: Global funds												
Number of funds							1F-Alpha					
Top	9	12	8	6	7	42	−0.08	0.04	−0.14	−0.01	−0.16	−0.06
2	4	11	7	11	9	42	−0.14	0.05	0.03	0.02	0.02	0.02
3	7	9	7	8	10	41	−0.16	−0.04	−0.13	0.01	−0.01	−0.06
4	7	6	11	13	5	42	0.16	−0.24	−0.03	−0.05	0.01	−0.03
Bottom	15	4	8	4	11	42	−0.16	−0.47	−0.26	0.00	−0.22	−0.21
All	42	42	41	42	42	209	−0.09	−0.06	−0.10	−0.01	−0.08	−0.07
5F-Beta WERM							3F-Alpha					
Top	0.99	1.03	0.97	0.91	1.02	0.99	0.22	0.07	0.07	0.06	−0.07	0.08
2	0.88	0.93	0.95	0.94	1.00	0.95	0.00	0.13	0.05	0.04	0.04	0.06
3	0.92	0.96	0.94	0.95	0.96	0.95	−0.08	−0.03	−0.09	−0.05	−0.09	−0.07
4	0.99	1.00	0.98	0.92	1.00	0.97	0.45	−0.17	−0.03	−0.11	−0.02	0.01
Bottom	1.04	0.97	0.99	0.91	0.93	0.98	−0.09	−0.35	−0.16	−0.05	−0.25	−0.17
All	0.99	0.98	0.97	0.93	0.98	0.97	0.08	−0.01	−0.03	−0.03	−0.09	−0.02
5F-Beta WSMB							5F-Alpha					
Top	0.39	0.17	0.30	0.09	−0.17	0.18	0.07	−0.14	−0.11	−0.05	−0.12	−0.07
2	−0.07	0.09	0.13	−0.02	−0.05	0.02	−0.05	−0.01	−0.01	0.00	0.01	−0.01
3	0.11	0.10	0.06	0.03	−0.05	0.04	−0.15	−0.11	−0.14	−0.07	−0.08	−0.10
4	0.18	0.04	0.04	0.03	0.07	0.07	0.38	−0.21	−0.03	−0.10	0.06	0.00
Bottom	0.11	0.04	0.03	−0.01	0.08	0.07	−0.10	−0.33	−0.11	0.04	−0.17	−0.13
All	0.16	0.10	0.11	0.02	−0.02	0.08	0.02	−0.13	−0.08	−0.05	−0.07	−0.06

Table 7 (*continued*)

SMOM quintiles	*CMOM* quintiles						*CMOM* quintiles					
	Top	2	3	4	Bottom	All	Top	2	3	4	Bottom	All
5F-Beta WHML							Expense ratio					
Top	−0.47	−0.35	0.24	−0.03	−0.14	−0.18	2.03	1.98	2.23	1.58	1.48	1.87
2	−0.25	−0.30	−0.13	−0.03	−0.01	−0.13	1.63	1.74	1.43	1.70	1.28	1.57
3	−0.34	−0.04	−0.03	0.23	0.26	0.04	1.99	1.37	1.61	1.33	1.68	1.59
4	−0.61	−0.08	−0.01	0.17	−0.08	−0.07	1.41	1.66	1.35	1.15	1.88	1.41
Bottom	−0.43	−0.14	−0.13	0.10	0.09	−0.16	1.68	1.51	1.06	1.69	1.36	1.46
All	−0.44	−0.21	−0.01	0.09	0.05	−0.10	1.76	1.69	1.48	1.44	1.50	1.58
5F-Beta CMOM							Turnover ratio					
Top	0.14	0.06	0.03	0.01	−0.07	0.04	167.43	112.03	79.28	94.20	95.54	112.65
2	0.09	0.06	0.03	0.01	−0.03	0.04	99.00	93.43	110.21	86.36	79.68	91.96
3	0.09	0.06	0.03	0.01	−0.02	0.04	67.17	76.42	59.98	51.53	57.04	62.45
4	0.11	0.05	0.03	0.01	−0.07	0.04	63.63	99.00	55.73	51.43	230.66	82.72
Bottom	0.18	0.06	0.03	0.01	−0.04	0.06	153.23	46.97	43.32	68.74	61.41	89.22
All	0.14	0.06	0.03	0.01	−0.04	0.04	119.05	91.47	68.65	68.35	90.12	88.77
5F-Beta SMOM							Mean rank change (3F-Alpha minus 5F-Alpha)					
Top	0.12	0.15	0.13	0.12	0.14	0.13	−34.56	−27.50	−23.13	−17.00	−3.43	22.67
2	0.05	0.06	0.04	0.05	0.06	0.05	1.00	−24.27	−1.14	2.36	4.67	4.83
3	0.00	0.02	0.01	0.01	0.00	0.01	−0.43	−10.00	0.57	7.88	10.00	−1.80
4	−0.03	−0.03	−0.04	−0.03	−0.02	−0.03	−4.14	−1.50	13.36	14.77	9.00	−8.24
Bottom	−0.23	−0.11	−0.11	−0.13	−0.10	−0.14	13.93	0.00	27.00	19.25	21.18	−17.50
All	−0.06	0.05	0.00	0.01	0.01	−0.02	3.10	16.57	−4.24	−6.10	−9.43	0.00

This table shows results for single and double sorts of funds into portfolios based on their index momentum exposures. The evaluation period is from January 1996 to December 2009. For single sorts, funds are allocated separately into quintile portfolios based on their country momentum or sector momentum exposure (10 single-sorted portfolios). For double sorts, funds are allocated into quintile portfolios based simultaneously on their country and sector momentum exposures (25 double-sorted portfolios). For each single- and double-sorted portfolio, the number of funds, the average one-, three- and five-factor alpha, the average betas based on the five-factor model, the average expense and turnover ratio as well as the average rank changes are reported. Alphas and betas are estimated for each fund separately. The expense ratio and turnover ratio of a fund are calculated as the average over each fund's lifetime. Rank changes are calculated for each fund as the rank difference between a fund's rank based on the three-factor alpha and the five-factor alpha. The data sample consists of funds with a minimum of 24 consecutive monthly returns. Panels A and B present results for 586 international and 209 global equity funds, respectively.

with r_t being an $N \times 1$ vector of excess returns of N individual funds in month t; $\beta^{5f}_{1,t-1}, \beta^{5f}_{2,t-1}, \beta^{5f}_{3,t-1}, \beta^{5f}_{4,t-1}$, and $\beta^{5f}_{5,t-1}$ are $N \times 1$ vectors of funds' exposure to *WERM*, *WSMB*, *WHML*, *CMOM*, and *SMOM*, respectively. We run this procedure every month and hence obtain monthly implied factor returns over the period from January 1999 to December 2009.

Table 8 reports the means of the implied and the hypothetical factor returns as well as corresponding *t*-statistics. Moreover, we show deltas as the differences between the implied and the hypothetical factor returns and the ratios between implied and hypothetical factor returns. Focusing on international funds in Panel A, we find that the implied returns for *CMOM* and *SMOM* are much lower than their hypothetical counterparts. That is, international funds earn an implied return on *CMOM* of 0.23% per month (*t*-value of 0.47) compared to a monthly hypothetical return of 0.44% (*t*-value of 1.83). Similar, the implied factor return for *SMOM* measures 0.36% per month (*t*-value of 0.91) while the hypothetical factor *SMOM* exhibits a monthly return of 0.76% (*t*-value of 1.83). Indeed, international funds harvest 52% (47%) of the hypothetical country (sector) factor premium. However, for *CMOM* and for *SMOM* the deltas measure −0.21% and −0.40%, respectively, and are not significantly different from zero (*t*-values of −0.49 and −1.19, respectively).

For global funds the implied returns for *CMOM* and *SMOM* almost coincide with their hypothetical counterparts (see Panel B). That is, the deltas measure −0.01% (*t*-stat of −0.01) for *CMOM* and −0.15% (*t*-stat of −0.42) for *SMOM*. From an economic point of view, global funds harvest about 98% (77%) of the hypothetical country (sector) momentum premium.

Aside from these findings, we document a positive (negative) and significant delta between the implied and hypothetical size (value) factor returns for international funds. That is, international funds earn a higher (lower) size premium as stated by the hypothetical size (value) factor. In turn, fund managers investing in small growth stocks tend to earn a higher five-factor alpha given the hypothetical returns of the *WSMB* and *WHML* factors. As top *CMOM* and top *SMOM* portfolios described in Section 4.3 load positively on *WSMB* and negatively on *WHML*, this could partly explain the outperformance of these portfolios.

In addition, we estimate respective implied factor returns using the stock-based four-factor models and present those for international funds in Panel C and for global funds in Panel D. We find a comparable mismatch between implied and hypothetical factor returns for *WSMB* as well as *WHML* as described before. However, the ratio between the implied and the hypothetical returns for *WSMB* (*WHML*) is higher (lower) compared to those for our index-based five-factor model. Interestingly, the mean implied return for the stock-based international momentum factor is about zero, while its hypothetical counterpart measures 0.73%. Furthermore, the corresponding delta exhibits a *t*-value of −3.57. In other words, international funds harvest (almost) nothing of the hypothetical stock-based momentum premium. One reason for this finding could be due to higher costs of stock-based momentum strategies compared to index-based momentum strategies.

4.5. Performance persistence

In this Section, we study the persistence in fund performance. Our main goal is to discover whether adding the index momentum factors affects the model's ability to predict future performance. We analyze if the five-factor alphas are a better or a less accurate predictor of future abnormal performance of international and global funds compared to three-factor alphas. In the context of domestic equity funds, Carhart (1997) shows that adding a stock momentum factor to a three-factor model severely reduces fund performance persistence.

Regarding the analysis of persistence in fund performance we proceed as follows: Within a three-year ranking period, we first sort funds into deciles based on either their three- or five-factor alpha. We then record the average monthly mean excess returns

Table 8
Implied versus hypothetical factor returns.

	Implied factor returns		Hypothetical factor returns				
	Mean (%)	*t*-Value	Mean (%)	*t*-Value	Delta (%)	*t*-Value	Ratio
Panel A: International factor returns (index-based)							
WERM	0.31	0.67	0.38	0.82	−0.08	−1.36	0.80
WSMB	0.58	3.57	0.34	1.86	0.24	2.81	1.69
WHML	0.16	1.07	0.36	1.87	−0.19	−2.62	0.46
CMOM	0.23	0.47	0.44	0.98	−0.21	−0.49	0.52
SMOM	0.36	0.91	0.76	1.83	−0.40	−1.19	0.47
Panel B: Global factor returns (index-based)							
WERM	0.09	0.20	0.19	0.44	−0.10	−1.94	0.45
WSMB	0.62	3.59	0.48	2.52	0.14	1.45	1.30
WHML	0.16	0.73	0.24	0.97	−0.08	−0.80	0.68
CMOM	0.49	0.85	0.50	1.16	−0.01	−0.01	0.98
SMOM	0.50	1.28	0.64	1.39	−0.15	−0.42	0.77
Panel C: International factor returns (stock-based)							
WERM	0.31	0.68	0.46	1.03	−0.15	−1.77	0.67
WSMB	0.40	2.36	0.02	0.14	0.37	3.26	17.17
WHML	0.33	2.36	0.93	5.01	−0.59	−5.44	0.36
StockMOM	−0.00	−0.01	0.73	2.08	−0.73	−3.57	0.00
Panel D: Global factor returns (stock-based)							
WERM	0.18	0.39	0.24	0.56	−0.06	−0.49	0.74
WSMB	0.57	2.09	0.17	0.60	0.40	2.00	3.38
WHML	0.25	1.15	0.93	3.87	−0.68	−5.26	0.27
StockMOM	0.22	0.60	0.68	1.42	−0.46	−1.39	0.33

This table shows results for implied and hypothetical factor returns based on an evaluation period from January 1996 to December 2009. Implied factor returns are estimated using a two-stage regression. In the first stage, fund betas are estimated based on a four- or five-factor model using 36-month rolling window regressions. In the second stage, these betas estimated up to month $t-1$ and fund returns in month t are used to estimate monthly implied factor returns according to Eq. (4). Mean presents the time-series averages of monthly implied or hypothetical returns for each risk factor. Delta is the mean of the return difference between the implied and the hypothetical factor returns. Panels A and B present results for international and global factor returns with respect to an index-based five-factor model, respectively. Panels C and D present results for international and global factor returns with respect to a stock-based four-factor model, respectively.

of the funds in the top and bottom deciles over the following 12 months. This procedure is replicated at the end of each year, generating a return time series of yearly non-overlapping decile portfolios. Finally, we calculate the mean monthly excess return and estimate three- and five-factor alphas as well as respective factor betas for this stacked time series of equal-weighted decile returns.[14] Following Gruber (1996) and Carhart (1997), we include funds that disappear during the performance period and record their performance in the respective portfolio until they disappear.

Panel A of Table 9 shows the performance of top and bottom decile portfolios for international funds when we apply the three- and the five-factor alphas as ranking criteria. Based on three- and five-factor alpha rankings, the corresponding top minus bottom decile portfolios show positive three-factor alpha spreads which are significant at the 5% level. Hence, contrary to Droms and Walker (2001), our finding indicates performance persistence for international equity funds. Focusing on five-factor alpha for performance evaluation, we still find positive and significant spreads, but now the bottom deciles mostly contribute to the persistence in international fund returns. For example, the top and the bottom portfolio based on five-factor alpha rankings show a monthly five-factor alpha of 0.0958% (*t*-stat: 0.99) and of −0.2830% (*t*-stat: −3.73), respectively. This indicates that persistence is mostly driven by the most poorly performing funds, which are likely to continue their underperformance. Moreover, decreasing alpha spreads due to the inclusion of the momentum factors are in line with the findings in Carhart (1997) for domestic equity funds.

Interestingly, the three-factor alphas of the top decile portfolios of funds are positive and significant. That is, an investor would have achieved an outperformance allocating capital in the top deciles of international funds if performance had been measured based on the three-factor model. However, after including the country and sector momentum factors, the five-factor alphas of the top deciles portfolios are clearly lower and not significant.[15]

Considering factor exposures, we observe that top-ranked funds show a slight tilt towards small-cap and growth stocks. Moreover, the betas on our index momentum factors are always higher for top funds than for bottom funds. This finding is in line with previous results in Sections 4.2 and 4.3 as well as studies on domestic equity funds regarding the value and momentum exposure of top and bottom performing funds (see, e.g., Huij and Verbeek, 2007).

Panel B of Table 9 reveals similar results for global funds. Again, funds in the top decile show higher exposures for the country momentum factors compared to funds in the bottom decile. Also, we find positive and significant alpha spreads between the top and the bottom decile portfolios, which are mainly driven by the poor performance of the bottom decile portfolios.

The observed higher loadings on index momentum factors for top-ranked funds, as well as the findings of Section 4.3, suggest a positive relationship between risk-adjusted performance and index momentum exposures. Therefore, we now investigate whether fund managers persistently create exposures with regard to country and sector momentum and hence systematically harvest potential premiums. In this context, findings by Carhart (1997) indicate that US equity mutual funds in his sample do not systematically obtain stock-based momentum exposures.

To test persistence in index momentum exposures, we apply contingency tables. First, we focus on international funds and study their persistence in country momentum exposures. To do so, we construct a contingency table of initial and subsequent

[14] Additionally, we replicate this study for a two-year ranking and two-year performance period as well as apply past excess returns and one-factor alpha as ranking criterion. The findings only differ slightly from the presented results in the paper and are available upon request.

[15] Using stock-based models to measure persistence in international fund performance, we find the performance of top decile portfolios to persist regardless of the ranking and performance measure applied. More detailed results are available upon request.

Table 9
Persistence in international and global equity fund performance.

	3F-Model				Adj. R^2	5F-Model						Adj. R^2
	3F-Alpha	Beta				5F-Alpha	Beta					
		WERM	WSMB	WHML			WERM	WSMB	WHML	CMOM	SMOM	
Panel A: International funds												
3F-Alpha												
1 (Top)	0.3048	0.9324	0.0643	−0.5608	0.9370	0.1415	0.9662	0.0638	−0.4702	0.0301	0.1376	0.9528
	(2.44)	(39.80)	(1.09)	(−9.65)		(1.28)	(46.25)	(1.25)	(−8.82)	(1.25)	(5.41)	
10 (Bottom)	−0.2337	0.7982	−0.0307	−0.0132	0.9629	−0.2941	0.8131	−0.0382	0.0009	−0.0371	0.0901	0.9699
	(−3.12)	(56.67)	(−0.87)	(−0.38)		(−4.25)	(62.26)	(−1.20)	(0.03)	(−2.47)	(5.67)	
1–10 Spread	0.5385	0.1342	0.0950	−0.5476	0.5682	0.4356	0.1531	0.1020	−0.4710	0.0672	0.0474	0.6180
	(4.61)	(6.11)	(1.72)	(−10.06)		(3.86)	(7.20)	(1.96)	(−8.68)	(2.75)	(1.83)	
5F-Alpha												
1 (Top)	0.2191	0.9426	0.0541	−0.4160	0.9530	0.0958	0.9678	0.0545	−0.3454	0.0282	0.0994	0.9621
	(2.08)	(47.59)	(1.09)	(−8.47)		(0.99)	(52.82)	(1.22)	(−7.39)	(1.34)	(4.46)	
10 (Bot)	−0.2170	0.8192	−0.0216	−0.0825	0.9602	−0.2830	0.8348	−0.0277	−0.0616	−0.0266	0.0871	0.9664
	(−2.70)	(54.23)	(−0.57)	(−2.20)		(−3.73)	(58.31)	(−0.79)	(−1.69)	(−1.62)	(5.00)	
1–10 Spread	0.4361	0.1234	0.0758	−0.3335	0.4423	0.3787	0.1331	0.0823	−0.2838	0.0548	0.0123	0.4687
	(4.08)	(6.14)	(1.50)	(−6.69)		(3.54)	(6.58)	(1.67)	(−5.50)	(2.36)	(0.50)	
Panel B: Global funds												
3F-Alpha												
1 (Top)	0.2198	0.8828	0.1895	−0.4432	0.9221	0.1621	0.9095	0.1729	−0.4006	0.0291	0.0554	0.9260
	(1.68)	(31.77)	(3.17)	(−9.44)		(1.26)	(31.61)	(2.95)	(−8.31)	(0.92)	(1.84)	
10 (Bot)	−0.3243	0.8754	0.1006	−0.0657	0.9120	−0.3531	0.8915	0.0890	−0.0458	−0.0005	0.0416	0.9126
	(−2.63)	(33.37)	(1.78)	(−1.48)		(−2.84)	(32.09)	(1.57)	(−0.98)	(−0.02)	(1.43)	
1–10 Spread	0.5441	0.0074	0.0889	−0.3775	0.2304	0.5152	0.0180	0.0839	−0.3548	0.0296	0.0138	0.2253
	(3.05)	(0.19)	(1.09)	(−5.90)		(2.85)	(0.45)	(1.02)	(−5.24)	(0.67)	(0.33)	
5F-Alpha												
1 (Top)	0.1181	0.8791	0.2498	−0.3498	0.9455	0.0848	0.8921	0.2430	−0.3240	0.0297	0.0200	0.9465
	(1.12)	(39.24)	(5.19)	(−9.24)		(0.80)	(37.81)	(5.05)	(−8.20)	(1.14)	(0.81)	
10 (Bot)	−0.3538	0.8444	0.1651	−0.1906	0.9137	−0.3917	0.8657	0.1496	−0.1646	−0.0021	0.0558	0.9158
	(−2.88)	(32.32)	(2.94)	(−4.32)		(−3.19)	(31.58)	(2.67)	(−3.58)	(−0.07)	(1.95)	
1–10 Spread	0.4719	0.0347	0.0847	−0.1592	0.0836	0.4765	0.0264	0.0935	−0.1594	0.0318	−0.0358	0.0767
	(3.01)	(1.04)	(1.18)	(−2.83)		(2.99)	(0.74)	(1.29)	(−2.68)	(0.81)	(−0.96)	

This table shows the performance of the top and bottom decile portfolios as well as the top minus bottom decile portfolio, both for international and global funds. The evaluation period is from January 1996 to December 2009. Rankings are based on alphas estimated over the last 36 months using an index-based three- and five-factor model. Three- and five-factor alphas and betas reported in the table are estimated from a stacked time series based on monthly average returns of the top and the bottom portfolio as well as the top minus bottom decile portfolio. Monthly alphas stem from index-based factor models and are reported in percent. Numbers in brackets represent Newey and West (1987) corrected *t*-statistics that are based on the null hypothesis H_0: $x = 0$. Panels A and B show results for international and global equity funds, respectively.

two-year fund exposure rankings. In non-overlapping two-year periods from 1996–1997 to 2006–2007, funds are placed in quintiles based on their country momentum exposures. These initial quintile rankings are arranged in pairs with the subsequent two-year country momentum ranking of the funds. Funds that disappear during the subsequent period are allocated to a separate category ("dead"). We thus end up with 30 fund categories. Finally, we calculate the conditional probabilities Pr(subsequent ranking j | initial ranking i) for funds ranked in quintile j (or "dead") in the subsequent period, which had been given an initial rank position in quintile i.

For international funds, the bar plots on the left side of Panel A of Fig. 1 represent these conditional probabilities for rankings based on country momentum exposures. We find that 29.4% of funds remain in the top quintile after being initially ranked in the top quintile. The probability that top funds subsequently appear in the remaining four quintiles is 57.1% (13.5% of funds disappear during the subsequent period). Likewise, 22.3% of the initially bottom-ranked funds are also located in the bottom quintile within the subsequent ranking period. These findings show that most international funds do not systematically obtain their country momentum exposures. To test whether the distribution of funds in the contingency tables might be simply governed by chance, we apply a χ^2 test (see in connection with two-by-two contingency tables, e.g., Kahn and Rudd, 1995; Agarwal and Naik, 2000; and Huij and Derwall, 2008). The result of this test rejects the null of an independent distribution given a χ^2 value of 91.26 (p-value: 0.0000). Hence, it indicates a relationship between the country momentum exposures of international funds for the initial and for the subsequent ranking period.

Constructing a respective contingency table for international funds based on sector momentum exposures, we obtain similar findings (see right side of Panel A). In addition, the respective χ^2 value of 90.72 (p-value: 0.0000) also rejects the null of independence. For global funds, Panel B of Fig. 1 shows similar findings with respect to persistence in country and sector momentum exposures. Here, the χ^2 tests also reject the null of independence given χ^2 values of 57.66 (p-value: 0.0000) for rankings based on country momentum and 35.26 (p-value: 0.0187) for rankings based on sector momentum.

4.6. Luck versus skill in the cross-section of funds

Applying index-based factor models, we found positive and significant alphas for several international and global funds (Table 6). Moreover, we record positive alphas for fund portfolios that exhibit relatively high exposures to *CMOM* and *SMOM* (Table 7). To test whether managers of the best funds in the cross-section are able to achieve superior performance by skill or simply by luck, we now conduct bootstrap simulations following Fama and French (2010). We run simulations based on the three-factor and five-factor model. Eventually, we compare the results for both models to

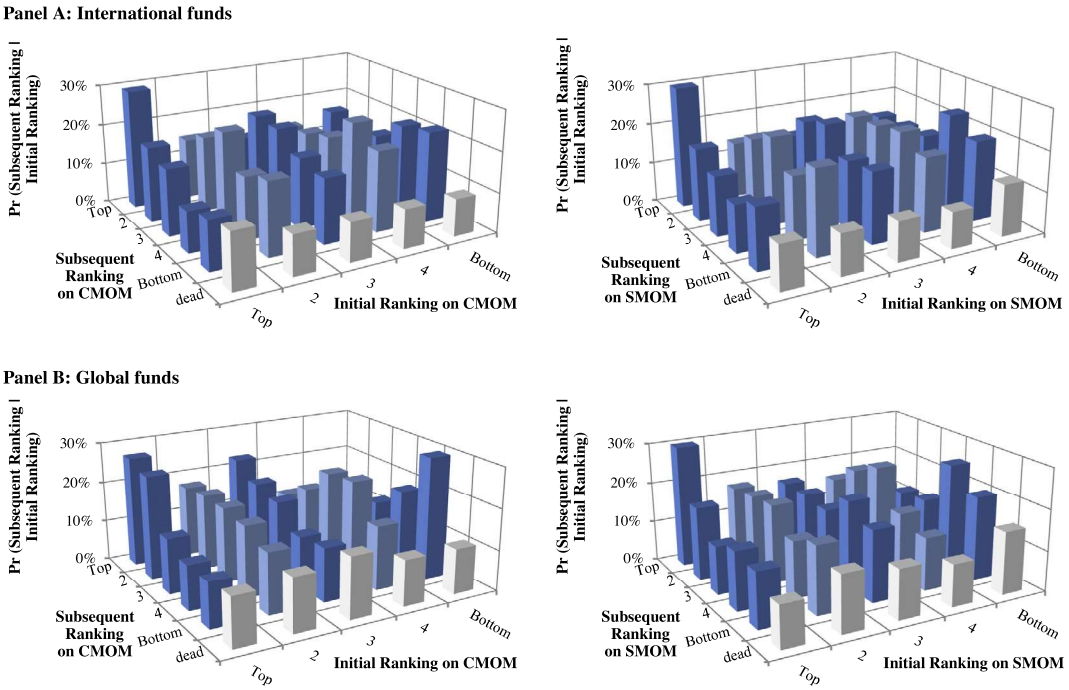

Fig. 1. Persistence in index momentum exposures of international and global equity funds. This figure shows contingency tables for initial and subsequent rankings of funds on index momentum exposures. In non-overlapping two-year initial periods from 1996–1997 to 2006–2007, funds are placed into quintiles based on their country (sector) momentum exposures. These initial quintile rankings are arranged in pairs with the subsequent two-year index momentum ranking of the funds. Funds that disappear during the subsequent periods are allocated to a separate category ("dead"). The bar plots (j,i) represent the conditional probabilities Pr(subsequent ranking j | initial ranking i) for funds ranked in quintile j (or "dead") in the subsequent period, which had been given an initial rank position in quintile i. The data sample consists of funds with 24 monthly returns in a respective initial ranking period. CMOM refers to rankings based on country momentum exposures. SMOM refers to rankings based on sector momentum exposures. Panels A and B show results for international and global equity funds, respectively.

highlight the importance of including the index momentum factors in the evaluation of fund performance.

The setup of the simulation is as follows: First, we adjust the monthly returns of each fund by subtracting the fund's estimated alpha. This creates so-called zero-alpha returns. Second, we bootstrap jointly zero-alpha returns and risk factor returns, thereby creating new fund return and factor return series. Since fund and factor returns are bootstrapped jointly, we maintain the cross-sectional dependencies. Third, we estimate alphas based on these bootstrapped zero-alpha fund return series and risk factor return series. Thus for each simulation run, we end up with a new cross-sectional alpha distribution, given the premise of zero-alpha fund returns. In our analysis, we carry out 2000 simulations. For a chosen percentile of the actual alpha distribution and of the simulated alpha distributions, we then compare how many "simulated" alphas achieve a value higher than the respective actual fund alpha. Accordingly, we can draw conclusions about the skill of fund managers in the cross-section of funds. Finally, we replicate our bootstrap analysis using t-values of alpha (t-alphas) instead of alpha to control for different lifetimes of funds and for different levels of idiosyncratic risk (see, e.g., Kosowski et al., 2006; Fama and French, 2010).

In Table 10, we report cross-sectional percentiles of actual alphas and t-alphas for international and global funds in Panel A and B, respectively. Considering the results of the bootstrap simulations, we outline the percentage of bootstrapped alphas (t-alphas) that are higher than the respective empirical alpha (t-alpha) at a given percentile (Act < Sim). Given the three-factor model, we observe for the 90th percentile that only 2.3% (2.0%) of simulated alpha (t-alpha) are higher than the empirical alphas (t-alphas). Thus we infer that among the top 10% of international funds, there are skilled managers at a 5% confidence level. However, based on five-factor alphas, we cannot identify skill in the cross-section of funds for the 90th percentile. Only for five-factor t-alphas do our results indicate some skilled managers among the top 1% of the international funds at the 5% level.

For global funds, we observe similar findings. Given actual alpha and t-alphas of the three-factor model, there is skill among the top 10% of managers at least at a 10% level. In contrast, applying the five-factor model we identify only some skill among the top 1% of managers at the 10% level based on the distribution of alphas.[16]

To sum up, including country and sector momentum factors clearly impacts the empirical findings when analyzing skill versus luck in the cross-section of international and global fund returns.

5. Robustness

5.1. Augmented factor models

In the previous sections, we examined the impact of country and sector momentum on the performance of international and global funds using an index-based five-factor model. Since our results could be driven by omitted factors, we now apply several augmented models in order to test our main results for robustness.

Ferreira et al. (2012, 2013), Busse et al. (2013) and Cremers et al. (2013a) extend the international (global) version of the stock-based three-factor model of Fama and French (1993) with a stock

[16] We replicate the same bootstrap simulation applying the stock-based three- and four-factor models. Based on these models, we identify skill in the cross-section of funds more often. For example, studying alpha and t-alpha based on the stock-based four-factor model, we would infer skill among the top 5% (top 10%) of international (global) funds managers at about 5% (10%) level. More detailed results are available upon request.

Table 10
Luck versus skill in the cross-section of international and global equity funds.

Percentile	3F-Model				5F-Model			
	3F-Alpha (%)	Act < Sim (%)	*t*-Alpha	Act < Sim (%)	5F-Alpha (%)	Act < Sim (%)	*t*-Alpha	Act < Sim (%)
Panel A: International funds								
99%	1.09	0.5	4.37	0.1	0.77	13.2	3.32	4.9
95%	0.62	0.4	2.91	0.4	0.40	17.8	2.03	18.2
90%	0.39	2.3	2.15	2.0	0.27	24.4	1.31	46.6
80%	0.18	24.9	0.91	39.9	0.07	88.1	0.36	90.8
70%	0.07	55.6	0.36	63.1	−0.02	97.6	−0.16	97.7
60%	−0.01	75.7	−0.03	75.2	−0.09	99.2	−0.49	98.3
Median	−0.07	88.1	−0.49	89.1	−0.14	99.7	−0.94	99.6
40%	−0.13	94.4	−0.88	94.1	−0.18	99.7	−1.31	99.8
30%	−0.19	96.7	−1.31	96.9	−0.24	99.9	−1.69	100.0
20%	−0.26	97.6	−1.70	97.2	−0.32	100.0	−2.16	100.0
10%	−0.40	98.0	−2.44	99.0	−0.45	99.9	−2.85	100.0
5%	−0.52	96.5	−2.88	98.4	−0.57	99.6	−3.28	100.0
1%	−0.90	95.5	−3.76	97.3	−1.08	99.8	−4.02	99.8
Panel B: Global funds								
99%	0.82	29.9	3.49	1.2	1.16	7.5	2.53	35.0
95%	0.46	11.5	2.10	9.6	0.46	15.0	1.70	44.9
90%	0.36	3.3	1.70	9.1	0.25	46.7	1.30	48.6
80%	0.21	7.9	1.21	10.4	0.13	58.8	0.89	43.9
70%	0.13	16.5	0.72	22.4	0.06	72.1	0.37	69.9
60%	0.06	29.8	0.39	28.9	0.00	83.9	−0.02	84.2
Median	−0.02	62.2	−0.14	65.7	−0.08	97.4	−0.45	95.7
40%	−0.11	91.4	−0.64	88.9	−0.13	98.0	−0.90	98.8
30%	−0.17	94.6	−0.94	90.2	−0.18	98.2	−1.19	98.9
20%	−0.23	92.5	−1.55	98.0	−0.26	98.9	−1.54	98.8
10%	−0.32	87.3	−2.23	99.2	−0.35	95.5	−2.27	99.7
5%	−0.55	97.0	−2.72	99.2	−0.63	99.7	−2.77	99.7
1%	−0.94	82.5	−3.44	97.8	−0.96	78.6	−3.36	97.5

This table shows values of alphas and *t*-values of alphas (*t*-alphas) at a selected percentile taken from the estimated alpha (*t*-alpha) distribution for actual fund returns. Alphas (*t*-alphas) are estimated for each fund's time series based on the index-based three- and five-factor model. Act < Sim refers to percentage of bootstrapped alphas (*t*-alphas) from 2,000 simulation runs with values higher than the actual alpha (*t*-alpha) at a selected percentile. Panels A and B present results for international and global equity funds, respectively.

momentum factor, which is commonly applied in the context of domestic funds. Therefore, Model 1 additionally applies the international (global) stock momentum factor to our basic index-based five-factor model to test if stock momentum contributes additional information or if it is largely covered by our index momentum factors.

Among others, Moskowitz and Grinblatt (1999), Bhojraj and Swaminathan (2006), and Behr et al. (2012) indicate that the performance of momentum strategies tends to be generated by the top portfolios. If certain country or sector indices often outperform the overall market and funds tend to invest in these indices, we may measure positive *CMOM* or *SMOM* exposures instead of measuring a positive exposure to the respective index. Thus we add several single country and sector indices as additional factors to our basic five-factor model. In Model 2, we include the top ten country indices and the top five sector indices most frequently selected in the top portfolio of our momentum strategies.[17] In Model 3, we add the top five emerging and the top five developed country indices as well as the top five sector indices to our basic model.[18]

Moreover, the estimated betas of the index momentum factors could also be driven by exposure of funds to certain regions. Hence Model 4 includes the following regional indices in addition to our basic model covering the prevailing investment regions of the world: MSCI EAFE + Canada index, MSCI Emerging Europe index, MSCI Latin America index, and the MSCI Emerging Asia index.[19] In Models 2 to 4, all single country, sector and regional indices are orthogonalized against the three-factor model (compare, e.g., Moskowitz and Grinblatt, 1999). In doing this, we account for commonalities with the factors of market, size and value without reducing the impact of the added factors on fund exposures to the country and sector momentum factors.

We apply the augmented models on individual funds and report the numbers of funds showing positive (negative) changes in measured regression coefficients in Table 11.[20] Moreover, we show differences in the number of funds with positive (negative) and significant coefficients caused by using the augmented models. For each regression coefficient, the column denoted as 'Number' shows the number of funds (or the change in the number of funds) while the column 'Relative' relates this quantity to the number of funds in the fund sample studied. Thus these relative numbers allow us to compare the results of international and global funds.

Panel A shows a clearly increasing number of international funds with positive and significant betas for Models 1, 2 and 3 with respect to sector momentum. Numbers for country momentum remain almost stable for Models 2 and 4, while for Model 1 we record a higher number of negative and significant betas. Apart from Model 1, we record a considerable increase in negative and

[17] When selecting top performing countries we consider return times series of indices that cover the sample period used, starting in January 1996. The top ten performing countries are Turkey, Columbia, Brazil, Indonesia, India, Hungary, Peru, Czech Republic, Finland and Chile.

[18] The top five performing developed countries are Austria, Finland, Greece, Norway and Ireland and the top five performing emerging countries are Turkey, Columbia, Brazil, Indonesia and India.

[19] For global funds we substitute the MSCI North America and MSCI EAFE indices for the MSCI EAFE + Canada index due to previously mentioned aspects.

[20] We also run these regressions for the fund portfolios. Our main finding is that throughout all models at least one of our index momentum factors shows a positive and significant beta. In contrast, the stock-based momentum factor (Model 1) remains statistically insignificant. Detailed results are available from the authors upon request.

Table 11
Robustness test of country and sector momentum factors for individual fund performance.

	Panel A: International funds							Panel B: Global funds						
	Alpha		CMOM		SMOM		Mean adj. R^2	Alpha		CMOM		SMOM		Mean adj. R^2
	Number	Relative (%)	Number	Relative (%)	Number	Relative (%)		Number	Relative (%)	Number	Relative (%)	Number	Relative (%)	
Model 1							0.9361							0.9058
Number of funds														
Positive changes	317	54	305	52	302	52		126	60	91	44	88	42	
Negative changes	269	46	281	48	284	48		83	40	118	56	121	58	
Change in number of funds														
Positive & significant (5)	−1	−0.17	2	0.34	13	2.22		0	0.00	2	0.96	−24	−11.48	
Negative & significant (5)	−4	−0.68	24	4.10	0	0.00		1	0.48	0	0.00	−2	−0.96	
Model 2							0.9426							0.9187
Number of funds														
Positive changes	274	47	284	48	346	59		80	38	128	61	104	50	
Negative changes	312	53	302	52	240	41		129	62	81	39	105	50	
Change in number of funds														
Positive & significant (5)	9	1.54	9	1.54	46	7.85		6	2.87	19	9.09	0	0.00	
Negative & significant (5)	14	2.39	7	1.19	7	1.19		20	9.57	0	0.00	1	0.48	
Model 3							0.9423							0.9189
Number of funds														
Positive changes	261	45	246	42	352	60		90	43	109	52	109	52	
Negative changes	325	55	340	58	234	40		119	57	100	48	100	48	
Change in number of funds														
Positive & significant (5)	14	2.39	−15	−2.56	37	6.31		10	4.78	10	4.78	−2	−0.96	
Negative & significant (5)	33	5.63	14	2.39	7	1.19		20	9.57	5	2.39	−5	−2.39	
Model 4							0.9370							0.9129
Number of funds														
Positive changes	127	22	288	49	203	35		66	32	88	42	133	64	
Negative changes	459	78	298	51	383	65		143	68	121	58	76	36	
Change in number of funds														
Positive & significant (5)	−12	−2.05	−2	−0.34	−6	−1.02		−2	−0.96	2	0.96	3	1.44	
Negative & significant (5)	52	8.87	5	0.85	4	0.68		21	10.05	−1	−0.48	−8	−3.83	

This table shows the number of funds with changes in alphas and in betas on the index momentum factors when the augmented models are applied compared to our basic index-based five-factor model. The evaluation period is from January 1996 to December 2009. Number of funds with positive (negative) changes refers to the number of funds showing positive (negative) changes in measured estimates when using the augmented models 1 to 4. Change in number of funds refers to the difference in the number of funds showing positive (negative) and significant estimates when using the augmented models 1 to 4 compared to the basic five-factor model. The columns denoted as 'Number' show the number of funds (or the change in the number of funds), while the column 'Relative' relates this quantity to the total number of funds studied for the respective fund group. In addition to the basic index-based five-factor model, Model 1 adds an international (global) stock momentum factor for international (global) funds. Model 2 (3) includes the top ten performing country indices (top five performing developed and top five emerging countries) and top-five sector indices. In Model 4, MSCI regional indices are added. The data sample consists of funds with a minimum of 24 consecutive monthly returns. Panels A and B present results for 586 international and 209 global equity funds, respectively.

Table 12
Robustness test: fund portfolio and individual fund performance in sub-periods.

	First sub-period: 01/1996–12/2002							Second sub-period: 01/2002–12/2009						
	5F-Alpha	Beta					Adj. R^2	5F-Alpha	Beta					Adj. R^2
		WERM	WSMB	WHML	CMOM	SMOM			WERM	WSMB	WHML	CMOM	SMOM	
Panel A: International funds														
Equal-weighted fund portfolio														
Estimate	0.0977	0.9911	−0.0236	−0.1021	0.0421	0.0592	0.9760	−0.2118	0.9700	−0.0118	0.0282	−0.0322	0.0784	0.9896
t-Value	(0.94)	(44.23)	(−0.78)	(−2.52)	(4.04)	(3.89)		(−5.55)	(67.21)	(−0.52)	(0.36)	(−2.00)	(4.13)	
Value-weighted fund portfolio														
Estimate	0.1687	0.9858	−0.0713	−0.0645	0.0343	0.0617	0.9736	−0.1554	0.9606	−0.0777	0.0774	−0.0352	0.0775	0.9880
t-Value	(1.73)	(46.01)	(−2.43)	(−1.26)	(3.91)	(3.37)		(−4.58)	(63.68)	(−3.15)	(0.94)	(−2.16)	(4.25)	
Individual funds														
Mean	0.0623	0.9922	−0.0237	−0.0941	0.0424	0.0622	0.8915	−0.2109	0.9737	−0.0108	0.0165	−0.0296	0.0799	0.9454
Median	−0.0150	0.9876	−0.0982	−0.0563	0.0389	0.0458	0.9111	−0.2099	0.9718	−0.1120	0.0228	−0.0411	0.0816	0.9572
STD	0.0048	0.0982	0.2775	0.5214	0.0507	0.1031	0.0872	0.0026	0.0949	0.3003	0.3768	0.0781	0.0805	0.0495
# Positive	194	399	122	174	342	299		63	449	138	237	132	388	
# Negative	205	0	277	225	57	100		386	0	311	212	317	61	
# Pos. & sign. (5%)	53	87	64	124	159	145		5	199	81	95	25	183	
# Neg. & sign. (5%)	45	0	163	155	6	12		201	0	177	61	117	3	
Panel B: Global Funds														
Equal-weighted fund portfolio														
Estimate	0.0190	0.9933	0.1191	−0.1216	0.0393	0.0208	0.9772	−0.1167	0.9569	0.0593	−0.0678	0.0199	−0.0083	0.9932
t-Value	(0.20)	(45.60)	(3.68)	(−2.27)	(3.97)	(1.06)		(−4.83)	(106.99)	(2.11)	(−1.55)	(2.45)	(−0.66)	
Value-weighted fund portfolio														
Estimate	0.1823	0.9619	0.1279	−0.1483	0.0329	0.0249	0.9711	−0.0070	0.9549	0.0100	0.0399	0.0467	−0.0218	0.9863
t-Value	(1.89)	(32.96)	(3.58)	(−2.11)	(4.07)	(1.25)		(−0.17)	(70.04)	(0.28)	(0.73)	(3.18)	(−1.25)	
Individual funds														
Mean	0.0439	0.9931	0.1070	−0.1289	0.0444	0.0337	0.8832	−0.0916	0.9560	0.0543	−0.0811	0.0266	−0.0205	0.9316
Median	0.0194	0.9914	0.0452	−0.0832	0.0429	0.0275	0.9059	−0.1141	0.9626	−0.0221	−0.0344	0.0213	−0.0125	0.9529
STD	0.0048	0.1447	0.3178	0.5057	0.0599	0.0984	0.0869	0.0027	0.1335	0.2764	0.3720	0.0781	0.1045	0.0543
# Positive	73	138	86	55	115	88		42	151	68	65	98	59	
# Negative	65	0	52	83	23	50		109	0	83	86	53	92	
# Pos. & sign. (5%)	17	47	39	40	53	33		4	81	30	33	30	18	
# Neg. & sign. (5%)	10	0	16	54	2	11		40	0	20	38	5	26	

This table shows alphas and betas for regressions of fund portfolio and individual fund returns against the index-based five-factor model. The sample is divided into two subsamples from January 1996 to December 2002 (first sub-period) and from January 2003 to December 2009 (second sub-period). On a fund portfolio level, results are reported for equal- and for value-weighted fund portfolio returns. The fund portfolios contain 431 international and 166 global funds in the first sub-period as well as 496 international and 237 global funds in the second sub-period. On the individual fund level, the data consists of funds with at least 24 months of consecutive returns. In the first sub-period the samples of individual funds consist of 399 international and 138 global funds while in the second sub-period there are 449 international and 151 global funds. The number of funds exhibiting positive (negative) and statistically significant alphas and betas are based on two-sided mean difference tests at the 5% level. The country momentum factor applies a 12/1 strategy (ranking based on past local returns) for international and global funds. The sector momentum factor applies a 6/1 and a 12/1 strategy for international and global funds, respectively. Monthly alphas are reported in percent. Numbers in brackets represent Newey and West (1987) corrected *t*-statistics that are based on the null hypothesis H_0: $x = 0$. Panels A and B show results for international and global equity funds, respectively.

significant alphas for international funds with respect to Models 3 and 4, as well as with respect to Models 2 to 4 for global funds in Panel B. This indicates that the performance results based on our basic five-factor model are rather conservative. Moreover, Panel B shows an increase in the number of global funds with positive and significant betas on the country momentum factor for Models 2 and 3. Regarding sector momentum, we only record a noteworthy decline in the number of positive and significant betas for Model 1. Eventually, for individual international and global funds, we conclude that the country and sector momentum betas are largely robust using augmented multi-factor models which additionally cover a global stock momentum factor, as well as single country, regional and sector factors.

5.2. Sub-periods

As a second robustness check, we split our data into two sub-periods from January 1996 to December 2002 and from January 2003 to December 2009, respectively. We replicate the performance analysis of our funds, applying the five-factor model for both fund portfolios as well as for individual funds.

Panel A in Table 12 shows the results for international funds for both sub-periods. In the first sub-period, the *CMOM* beta of the equal-weighted fund portfolio is 0.0421 (*t*-stat: 4.04) and the *SMOM* beta measures 0.0592 (*t*-stat: 3.89). More international funds show a significant exposure to country momentum (165 of 399 funds, 159 positive vs. 6 negative) compared to sector momentum (157 funds, 145 positive vs. 12 negative). Further, the equal-weighted international fund portfolio exhibits a positive five-factor alpha of 0.0977%, which is not significant (*t*-stat: 0.94). However, like in the full evaluation period, we observe superior performance for the value-weighted fund portfolio, measuring a five-factor alpha of 0.1687% (*t*-stat: 1.73) in the first sub-period.

In the second sub-period, we record a clearly increasing number of negative and significant exposures to country momentum for international funds (117 of 449 funds). Only 25 funds show a positive and significant exposure to this factor. Furthermore, five-factor alphas of international funds become negative and significant for the equal- and for the value-weighted fund portfolio. This shift in five-factor alpha is also reflected for individual funds, as only 5 of 449 international funds have a positive and significant five-factor alpha in the second sub-period, while 201 funds exhibit a negative and significant five-factor alpha.

Findings for global funds in Panel B are similar to those of international funds. The performance of global funds in the first sub-period is superior to the performance in the second sub-period, whereby the value-weighted portfolio shows higher alphas than the equal-weighted one. Moreover, we observe an increasing number of global funds with negative and significant exposures to *SMOM* in the second sub-period, but still more than 10% of funds have a positive and significant *SMOM* exposure. In the end, about 20% of the global funds still show a positive and significant exposure to *CMOM* in the second sub-period.

Finally, we conclude that international and global funds exhibit a weaker risk-adjusted performance during the second sub-period. In context with decreasing expense ratios (see Table 5), this finding may reflect an increasing market efficiency due to international market integration, making it difficult for funds to deliver an outperformance.

To sum up, in both sub-periods we find significant exposures to country and sector momentum for the international fund portfolios, while the global fund portfolios exhibit positive and significant exposures only to the country momentum factor.

6. Summary and conclusion

The profitability of stock and index momentum strategies has been documented for stock markets worldwide. However, when evaluating the performance of international and global equity funds, only some studies apply a stock-based momentum factor in respective performance models. Furthermore, to the best of our knowledge, the impact of country and sector momentum on the evaluation of risk-adjusted performance and performance persistence of funds, as well as on studying luck versus skill in the cross-section of funds, has not been analyzed so far.

To fill this gap, we construct several country and sector momentum factors and include the most profitable ones in the performance evaluation of international and global equity funds. For an evaluation period from January 1996 to December 2009, we apply pure index-based factor models and find that country and sector momentum clearly affect the performance of fund portfolios and individual funds. About 54% of international funds and about 53% of global funds have significant exposure either to the country or to the sector momentum factor. On average, international funds clearly show a lower alpha based on the five-factor model compared to the one- and the three-factor model. For global funds, five-factor alphas are regularly lower than three-factor alphas. Following Ferreira et al. (2012, 2013), Busse et al. (2013), and Cremers et al. (2013a), we apply the same performance analysis but use stock-based instead of index-based models. Comparing these results shows that the index-based models exhibit a somewhat higher explanatory power as measured by adjusted *R*-squared.

Sorting funds based on country and sector momentum exposures reveals a positive relationship between index momentum exposures and alphas. In addition, funds with relatively high index momentum exposures exhibit lower ranking positions based on five-factor alphas compared to rankings based on three-factor alphas. Moreover, we find international and global funds to partly harvest premiums on the country momentum and the sector momentum factors applied. Using our five-factor model for performance evaluation, we find persistence in the performance of international and global funds to be driven mainly by the most poorly performing portfolios. In particular, for international funds, the top decile portfolio shows performance persistence only if we do not consider the index momentum factors in the model. Analyzing whether fund managers persistently obtain exposures on country and sector momentum factors, our findings indicate that most funds only briefly maintain these exposures over time. Finally, studying luck versus skill in the cross-section of fund alphas, we find weaker results with respect to skill when we use the index-based five-factor model instead of the index-based three-factor model.

Using several augmented multi-factor models covering an international (global) stock momentum factor, as well as single country, regional and sector factors, we find fund exposures to the country and the sector momentum factors to be robust. Analyzing two sub-periods reveals weaker performance of international and global funds during the second sub-period. This indicates that the performance of international and global funds may have suffered from increasing market efficiency worldwide in recent years.

To sum up, our empirical results indicate that country and sector momentum factors clearly impact the evaluation of risk-adjusted performance and performance persistence of international and global funds, as well as change the empirical findings when analyzing luck versus skill in the cross-section of funds. Thus omitting these two index momentum factors may lead to biased findings in the evaluation of international and global fund performance. We therefore conclude that future studies on the performance of international and global equity mutual funds should consider country and sector momentum factors.

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