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Determinants of the performance of investment funds managed in Hungary

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ABSTRACT
We investigate the performance and time varying risk behaviour of Hungarian equity mutual funds by applying modified versions of the four-factor model applying different market proxies. We classify the funds according to their target markets (Hungary, Central and Eastern Europe [CEE], developed markets) and separate bullish and bearish periods. We find no significant excess returns for any circumstances; however, market betas are significantly different for bullish and bearish periods as well as the explanatory power of book-to-market ratio and market capitalisation. After taking into account the daily percentage changes in the number of shares outstanding we find investors' relation to risk to be different in bearish and bullish periods.

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Mutual funds; asset pricing; time varying beta; home bias

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1. Introduction

The performance of mutual funds has attracted much attention in recent decades. However, there is a lack of scholarly investigation of mutual funds' performance from post-communist Central and Eastern European (CEE) countries. This article intends to fill this gap by investigating the performance and time varying risk behaviour of Hungarian equity mutual fund returns for the period from January 2001 to February 2013. Based on market returns we separate bullish and bearish periods, and examine the modified version of Carhart (1997) equilibrium model whether the estimated risk parameters are constant or the return generating process is different in distinct market circumstances.

We also investigate performance and the risk in a regional manner as the 30 mutual funds in our analysis invest in equities of Hungarian, or CEE or developed capital markets. Furthermore we extend our model with an additional variable of the percentage change of the number of shares outstanding to capture the reactions of investors to increasing or decreasing market changes.

The main scholarly papers about mutual funds often examine their performance as a test for market efficiency and their general conclusion is that funds can not outperform the market on average (Gruber, 1996; Jensen, 1968; Malkiel, 1995). Grinblatt, Titman, and Wermers (1995) find that funds investing in past winner stocks providing higher returns

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Table 1. Explanatory power of models with different set of parameters.

	a	Mkt	C20	SMB	HML	MOM	Full sample	HUN	CEE region	Developed markets
CAPM	x	x					0.132	0.101	0.116	0.161
CAPM - CEE	x		x				0.484	0.525	0.651	0.323
FF 3-factor	x	x		x	x		0.143	0.110	0.130	0.170
Carhart 4-factor	x	x		x	x	x	0.145	0.112	0.131	0.173
FF for CEE	x		x	x	x		0.490	0.532	0.654	0.331
Carhart for CEE	x		x	x	x	x	0.494	0.534	0.656	0.338
FF + C20	x	x	x	x	x		0.516	0.534	0.656	0.389
Carhart + CEE	x	x	x	x	x	x	0.518	0.536	0.657	0.391

Notes: This table shows the variables of the applied regression models and the average R^2 values of the estimations for the whole sample and the regional breakdown of the funds.

than others. Fung, Xu, and Yau (2002) measure sizeable and positive excess returns in case of the 115 funds invest in global equity markets between 1994–2000. Kosowski (2011) argues that average underperformance of mutual funds is appropriate only for expansion periods but not during recessions. Ferreira, Keswani, Miguel, and Ramos (2013) find that in the 27 investigated countries equity funds underperform the market over the period 1997–2007. They also detect a positive relation between mutual fund performance and level of financial market development and liquidity in the country.

Another direction of research investigates the performance of investors with local knowledge compared to others and the results show that market analysts (Bae, Stulz, & Tan, 2008; Tóth & Jónás, 2012) or hedge funds in Asia (Teo, 2009) with local presence outperform others. Shukla and van Inwegen (1995) examine whether local knowledge can result in superior performance by comparing the performance of UK- and US-based fund managers investing in the US market and find local (US) mutual funds perform better. On the other hand Otten and Bams (2007) find no evidence of under-performance of UK equity funds investing in the US stock market compared to their local (US) counterparts, furthermore in some segments they detect a slight out-performance for foreign (UK) funds. Hau and Rey (2008) find different levels of home bias across mutual funds in the examined 16 countries and they report a positive correlation between the degree of home bias and the size of funds. Banegas, Gillen, Timmermann, and Wermers (2013) measure significant excess returns for the investigated mutual funds investing in European (both country specific and pan-European) over the period 1988–2008. Their results suggest that there are fund managers with superior country-specific skills, however their performance depend on the state of the economy. After investigating the stock preferences of domestic and foreign fund managers from 11 developed countries Covrig, Lau, and Ng (2006) find that geographic location of the managers do not influence their stock preferences. Chan, Covrig, and Ng (2005) argue that mutual fund managers in 26 developed and developing countries allocate a disproportionately larger fraction of investment to domestic stocks.

The rest of the article is organised as follows. In Section 2 we introduce the data set used in this research and review the methodology, in Section 3 we present the results of different regressions and in Section 4 we conclude.

2. Data and methodology

To examine the time varying performance and risk of Hungarian publicly offered open-ended mutual funds investing in equities, we collect 30 different mutual fund share prices. These funds invest in three different regions: Hungary (6), CEE (11), and developed markets (13).[1] The source of the data is the Association of Hungarian Investment Fund and Asset Management Companies. Daily returns of funds and the local and regional indices are calculated in US dollars (USD) terms using WM/Reuters closing spot rates. The source of the factors for the Fama–French (FF) (1992, 1993, 1996) model and momentum factor is the Center for Research in Security Prices (CRSP) from Kenneth French's website.[2] We have calculated all returns in USD as the funds themselves are denominated in various currencies, not only in Hungarian Forint (HUF). CEE and Hungarian stock markets are dominated by foreign institutional investors whose interest concentrates on returns measured in USD reflecting the risk they are taking in these countries. Bóta and Ormos (2015) find that CEE stock markets show higher efficiency for the indexes calculated in USD than their counterparts calculated in local currencies. Furthermore the FF factors and the Carhart momentum factor are determined in USD.

We apply eight different equilibrium models to capture the difference in excess returns and in risk parameters. We use the standard single-factor Capital Asset Pricing Model (CAPM) with two different market proxies which capture the relevant risk through the market beta. The market is defined in two distinct ways: (1) we use the Central European Blue Chip Index: CETOP20 regional index for CEE; and (2) the CRSP value weighted index return is also applied as market proxy.

$$r_i = \alpha + \beta_M r_M + \varepsilon$$

where r_i stands for the return of the investigated (i-th) fund, β_M represents the sensitivity for the market returns, which is captured by r_M as the CETOP 20 (C20) or by the CRSP value weighted return (Mkt), and ε is the error term of the regression.

We apply the FF (1996) three-factor model with both market proxies in the form:

$$r_i = \alpha + \beta_M r_M + \beta_{SMB} SMB + \beta_{HML} HML + \varepsilon,$$

where the β variables represent the regression coefficients and r_M, SMB, and HML are the market (C20 or Mkt), size, and value premiums, respectively.[3]

We also investigate the Carhart (1997) model to capture the persistency of mutual funds. Carhart (1997) extends the three-factor model by a momentum (MOM) parameter that measures the tendency for the mutual fund's share price to continue increasing if it was previously increasing and its tendency to continue decreasing if it was previously decreasing. Therefore, the model can be written in as:

$$r_i = \alpha + \beta_M r_M + \beta_{SMB} SMB + \beta_{HML} HML + \beta_{MOM} MOM + \varepsilon$$

where β_{MOM} captures the excess return of the i-th mutual fund gained by the persistency of the previous month's return and MOM stands for the momentum factor.

Furthermore we run the FF three-factor model and the Carhart four-factor model incorporating both of the market proxies in the form:

$$r_i = \alpha + \beta_{C20} r_{C20} + \beta_{Mkt} r_{Mkt} + \beta_{SMB} SMB + \beta_{HML} HML + \varepsilon,$$

$$r_i = \alpha + \beta_{C20} r_{C20} + \beta_{Mkt} r_{Mkt} + \beta_{SMB} SMB + \beta_{HML} HML + \beta_{MOM} MOM + \varepsilon.$$

Table 2. Carhart four-factor model with C20 market proxy for the 30 funds.

Fund	const	C20	SMB	HML	MOM	R^2
CE1	0.0002	0.7840***	0.0003	0.0015***	0.0002	0.77
CE2	0.0000	0.8030***	0.0005**	0.0013***	0.0003**	0.83
CE3	0.0001	0.9389***	0.0007**	0.0006*	−0.0002	0.92
CE4	0.0000	0.6965***	−0.0002	0.0010***	0.0006***	0.69
CE5	0.0000	0.7229***	0.0007***	0.0010***	0.0006***	0.80
CE6	0.0001	0.4527***	0.0023***	0.0016***	0.0012***	0.36
CE7	0.0002	0.3141***	0.0013***	0.0012***	0.0005**	0.21
CE8	0.0001	0.7890***	0.0000	−0.0002	−0.0001	0.89
CE9	0.0000	0.8349***	0.0007***	0.0018***	0.0002	0.80
CE10	0.0000	0.6960***	0.0007**	0.0017***	0.0007***	0.67
CE11	0.0001	0.3745***	0.0013***	0.0009**	0.0006***	0.27
Dev1	−0.0002	0.4594***	0.0008**	0.0008***	−0.0024***	0.47
Dev2	−0.0001	0.5502***	0.0006*	0.0021***	−0.0014***	0.57
Dev3	0.0000	0.3621***	0.0020***	0.0032***	−0.0031***	0.35
Dev4	−0.0002	0.4745***	0.0007**	0.0001	−0.0006***	0.51
Dev5	−0.0001	0.3946***	0.0004	0.0003	0.0007***	0.23
Dev6	−0.0003	0.3222***	0.0028***	0.0018***	0.0008***	0.15
Dev7	−0.0001	0.3702***	0.0008*	0.0016***	0.0009***	0.19
Dev8	−0.0002	0.2873***	0.0025***	0.0009*	0.0005**	0.12
Dev9	0.0001	0.6025***	0.0000	−0.0011	0.0004	0.65
Dev10	−0.0001	0.4147***	0.0018***	0.0014***	0.0003	0.32
Dev11	0.0000	0.4390***	−0.0003	0.0019***	−0.0004*	0.31
Dev12	−0.0001	0.3765***	−0.0006	0.0013***	−0.0008***	0.25
Dev13	−0.0001	0.3987***	0.0005	0.0000	0.0009***	0.26
HU1	−0.0002	0.9871***	0.0016***	0.0017***	0.0002	0.77
HU2	0.0003*	0.6715***	0.0006**	0.0015***	0.0000	0.71
HU3	0.0001	0.7053***	0.0034***	0.0016***	0.0017***	0.63
HU4	0.0000	0.4332***	0.0011	−0.0016**	−0.0003	0.19
HU5	0.0001	0.4959***	0.0034***	0.0021***	0.0014***	0.26
HU6	0.0000	0.7237***	0.0015***	0.0011***	0.0007***	0.66
Average R^2 for the full sample						0.49
Average R^2 for funds investing in Hungary						0.53
Average R^2 for funds investing in CEE region						0.66
Average R^2 for funds investing in developed markets						0.34

Notes: This table shows the results of the modified Carhart (1997) four-factor model, using CETOP20 as a market proxy for the full sample period of January 2001 and February 2013. *, **, *** denote significance levels of 10%, 5% and 1% respectively.

To capture the regime dependency of risk and risk premiums we collect returns from the bullish (increasing market prices) and bearish (decreasing market prices) periods from January 2001 to February 2013. We run ordinary least squares regressions with different set of explanatory variables. Table 1 shows the coefficients of determination (R^2) for different models. The average results are presented for our full sample (30 funds) and for the different regions these funds are investing in (Hungary, CEE, developed markets). We apply arithmetic averages contrary to the suggestion of harmonic averages of Andor and Dülk (2013). According to our estimates a one-factor model using the CETOP20 regional index has better explanatory power than a model using the CRSP market proxy (Mkt) not only for the Hungarian and CEE funds but for the funds investing in developed markets as well, which seems to be surprising in a globalised capital market; however verify the hypothesis of Errunza and Losq (1985).

From the models presented we have chosen the modified version of the Carhart (1997) four-factor model, using CETOP20 index as a market proxy instead of CRSP.

Table 3. Carhart four-factor model with C20 market proxy for the 30 funds in bullish periods.

	const	C20	SMB	HML	MOM	R^2
CE1	0.0003*	0.7217***	0.0008***	0.0021***	0.0000	0.69
CE2	0.0000	0.7681***	0.0005*	0.0017***	0.0001	0.77
CE3	0.0001	0.9353***	0.0002	0.0007	−0.0002	0.91
CE4	0.0000	0.6430***	0.0005	0.0019***	0.0002	0.63
CE5	0.0000	0.7075***	0.0005**	0.0014***	0.0004**	0.75
CE6	0.0003	0.5226***	0.0006	0.0020***	0.0006**	0.41
CE7	0.0005**	0.3198***	0.0001	0.0015***	−0.0001	0.21
CE8	0.0002	0.7518***	−0.0001	0.0002	−0.0001	0.86
CE9	0.0001	0.7889***	0.0008***	0.0022***	0.0000	0.73
CE10	0.0002	0.6819***	0.0006	0.0022***	0.0004*	0.62
CE11	0.0004*	0.3622***	−0.0001	0.0011***	0.0002	0.24
Dev1	−0.0001	0.4241***	0.0013***	0.0006*	−0.0024***	0.42
Dev2	0.0000	0.5098***	0.0013***	0.0024***	−0.0014***	0.53
Dev3	0.0000	0.3262***	0.0036***	0.0035***	−0.0026***	0.33
Dev4	−0.0003	0.4438***	0.0012***	0.0007**	−0.0009***	0.45
Dev5	0.0000	0.3787***	−0.0003	0.0007	0.0001	0.20
Dev6	−0.0002	0.3457***	0.0027***	0.0035***	0.0002	0.21
Dev7	0.0000	0.4091***	0.0010**	0.0025***	0.0002	0.25
Dev8	0.0000	0.3238***	0.0005	0.0021***	−0.0002	0.16
Dev9	0.0000	0.6074***	0.0002	−0.0011	0.0003	0.65
Dev10	0.0000	0.4276***	0.0005	0.0015***	−0.0004	0.33
Dev11	0.0001	0.3751***	0.0000	0.0025***	−0.0007***	0.23
Dev12	0.0000	0.3051***	0.0002	0.0017***	−0.0008***	0.17
Dev13	0.0000	0.3663***	0.0001	0.0007	0.0005*	0.22
HU1	−0.0002	1.0168***	0.0007	0.0018***	0.0007**	0.77
HU2	0.0004***	0.6147***	0.0009***	0.0019***	0.0001	0.65
HU3	−0.0001	0.8656***	0.0008	0.0014*	0.0010**	0.68
HU4	0.0006	0.4240***	−0.0007	−0.0021**	−0.0014***	0.17
HU5	0.0004	0.5769***	0.0011**	0.0023***	0.0008**	0.30
HU6	0.0000	0.7458***	0.0008**	0.0014***	0.0007***	0.64
Average R^2 for the full sample						0.56
Average R^2 for funds investing in Hungary						0.71
Average R^2 for funds investing in CEE region						0.65
Average R^2 for funds investing in developed markets						0.40

Notes: This table shows the results of the modified Carhart (1997) four-factor model, using CETOP20 as a market proxy for bullish periods. *, **, *** denote significance levels of 10%, 5% and 1% respectively.

3. Determinants of mutual fund returns

3.1. Performance analyses

If we look at the explaining power of the chosen model for the three set of funds separated geographically and for the whole examined period (Table 2) and then separated bullish (Table 3) and bearish periods (Table 4) as well, the first result worth mentioning is that the model has higher coefficient of determination for both the bullish (0.556) and bearish periods (0.554) than for the whole period (0.494).

We have obtained opposing results for the funds investing in Hungary and in the CEE region as in the former case the model has a better explaining power in the bullish period (0.707 vs 0.558 in the bearish period) while in the latter case the model fitted better for the bearish period (0.732 vs 0.655 in the bullish period). For the funds investing in developed countries there was no such difference between bullish and bearish periods (0.403 and 0.401 respectively); however the R^2s are still higher than for the full sample.

For the whole period we have measured significant excess return at only a 10% level for one fund, for the bullish period there are four cases with significant (and positive) Jensen (1968) alphas (two only at 10% and one only at 5% level) and in the bearish period there

Table 4. Carhart four-factor model with C20 market proxy for the 30 funds in bearish periods.

	const	C20	SMB	HML	MOM	R^2	ΔC20
CE1	0.0003	0.8911***	0.0006	0.0000	−0.0001	0.91	−23%
CE2	0.0001	0.8702***	0.0014***	0.0007	0.0004*	0.94	−13%
CE3	0.0001	0.9513***	0.0014***	0.0006	−0.0001	0.94	−2%
CE4	−0.0003	0.7810***	−0.0004	−0.0008	0.0006	0.82	−21%
CE5	−0.0001	0.7564***	0.0017***	0.0005	0.0008***	0.91	−7%
CE6	−0.0011	0.3505***	0.0048***	0.0025**	0.0025***	0.29	33%
CE7	−0.0014*	0.3280***	0.0045***	0.0030**	0.0023***	0.24	−3%
CE8	−0.0001	0.8407***	0.0009**	−0.0004	0.0000	0.94	−12%
CE9	0.0000	0.9210***	0.0017***	0.0008	0.0000	0.93	−17%
CE10	−0.0007	0.7226***	0.0014**	0.0014*	0.0010**	0.77	−6%
CE11	−0.0011	0.4314***	0.0056***	0.0022*	0.0021***	0.36	−19%
Dev1	−0.0003	0.5168***	0.0003	0.0016	−0.0020***	0.57	−22%
Dev2	−0.0001	0.6098***	−0.0004	0.0012	−0.0018***	0.65	−20%
Dev3	−0.0002	0.3831***	−0.0010	0.0013	−0.0044***	0.40	−17%
Dev4	0.0000	0.5202***	0.0002	−0.0010	−0.0005	0.66	−17%
Dev5	−0.0009	0.4388***	0.0026**	0.0016	0.0022***	0.32	−16%
Dev6	−0.0013	0.2617***	0.0019	−0.0021	0.0000	0.08	24%
Dev7	−0.0014	0.2788***	−0.0009	0.0012	0.0017*	0.11	32%
Dev8	−0.0017*	0.2547***	0.0070***	−0.0005	0.0012	0.10	21%
Dev9	0.0003	0.5703***	−0.0034*	0.0011	0.0037**	0.68	6%
Dev10	−0.0008	0.4245***	0.0054***	0.0047***	0.0031***	0.33	1%
Dev11	−0.0002	0.5543***	0.0006	0.0010	−0.0002	0.52	−48%
Dev12	−0.0001	0.4938***	−0.0010	−0.0004	−0.0013*	0.43	−62%
Dev13	−0.0006	0.4668***	0.0023**	−0.0009	0.0013*	0.37	−27%
HU1	−0.0005	0.9550***	0.0023**	0.0009	−0.0007	0.77	6%
HU2	−0.0001	0.7700***	0.0012*	0.0001	−0.0005	0.80	−25%
HU3	−0.0002	0.5229***	0.0031***	0.0018**	0.0021***	0.63	40%
HU4	−0.0020*	0.4894***	0.0051***	0.0015	0.0023**	0.24	−15%
HU5	−0.0018*	0.3882***	0.0075***	0.0045***	0.0034***	0.20	33%
HU6	−0.0005	0.6946***	0.0029***	0.0003	0.0005	0.70	7%
Average R^2 for the full sample						0.55	
Average R^2 for funds investing in Hungary						0.56	
Average R^2 for funds investing in CEE region						0.73	
Average R^2 for funds investing in developed markets						0.40	

Notes: This table shows the results of the modified Carhart (1997) four-factor model, using CETOP20 as a market proxy for bearish periods. *, **, *** denote significance levels of 10%, 5% and 1% respectively. In column ΔC20 the difference of market beta in bullish and bearish period is presented.

Table 5. Carhart four-factor model for the full period with C20 market proxy extended with the trade volume.

	const	C20	SMB	HML	MOM	Vol %	R^2
CE1	0.0002	0.7840***	0.0003	0.0015***	0.0002	0.0019	0.77
CE2	0.0000	0.8031***	0.0005**	0.0013***	0.0003**	−0.0101	0.83
CE3	0.0001	0.9384***	0.0007**	0.0006*	−0.0002	−0.0104**	0.92
CE4	0.0000	0.6965***	−0.0002	0.0010***	0.0006***	0.0026	0.69
CE5	0.0000	0.7231***	0.0007***	0.0010***	0.0006***	0.0254	0.80
CE6	0.0001	0.4522***	0.0023***	0.0016***	0.0012***	−0.0263	0.36
CE7	0.0002	0.3141***	0.0013***	0.0012***	0.0005***	−0.0035	0.21
CE8	0.0001	0.7890***	0.0000	−0.0002	−0.0001	0.0011	0.89
CE9	0.0000	0.8349***	0.0007***	0.0018***	0.0002	0.0010	0.80
CE10	0.0000	0.6952***	0.0007**	0.0018***	0.0007***	0.0569***	0.67
CE11	0.0001	0.3745***	0.0013***	0.0009**	0.0006***	0.0225	0.27
Dev1	−0.0002	0.4594***	0.0008**	0.0008**	−0.0024***	0.0011	0.47
Dev2	−0.0001	0.5501***	0.0006*	0.0022***	−0.0014***	−0.0075	0.57
Dev3	0.0000	0.3622***	0.0020***	0.0032***	−0.0031***	−0.0009	0.35
Dev4	−0.0002	0.4729***	0.0008***	0.0000	−0.0006***	0.0791***	0.52
Dev5	−0.0001	0.3948***	0.0004	0.0003	0.0007***	0.0096	0.23
Dev6	−0.0003	0.3219***	0.0028***	0.0018***	0.0008***	0.0131	0.15
Dev7	−0.0001	0.3703***	0.0008*	0.0016***	0.0009***	−0.0056	0.19
Dev8	−0.0002	0.2873***	0.0025***	0.0009*	0.0005**	−0.0007	0.12
Dev9	0.0002	0.6023***	0.0000	−0.0011	0.0004	0.8683	0.65
Dev10	−0.0001	0.4147***	0.0018***	0.0014***	0.0003	0.0001	0.32
Dev11	0.0000	0.4395***	−0.0003	0.0019***	−0.0004*	0.0147**	0.32
Dev12	−0.0001	0.3766***	−0.0006	0.0013***	−0.0008***	0.0091	0.25
Dev13	−0.0001	0.3985***	0.0005	0.0000	0.0009***	0.0059	0.26
HU1	−0.0002	0.9878***	0.0016***	0.0018***	0.0002	0.0125	0.77
HU2	0.0003*	0.6715***	0.0006**	0.0015***	0.0000	−0.0012	0.71
HU3	0.0001	0.7051***	0.0034***	0.0016***	0.0017***	0.0093	0.63
HU4	0.0000	0.4332***	0.0011	−0.0016**	−0.0003	−0.0100	0.19
HU5	0.0001	0.4959***	0.0034***	0.0021***	0.0014***	0.0021	0.26
HU6	0.0000	0.7239***	0.0015	0.0011***	0.0007***	−0.0268	0.66
Average R^2							0.49

Notes: This table shows the results of the modified Carhart (1997) four-factor model, using CETOP20 as a market proxy extended with daily percentage changes in the number of shares outstanding for the full sample period of January 2001 and February 2013. *, **, *** denote significance levels of 10%, 5% and 1% respectively.

are four significant (negative) alphas (at 10% significance). The statistically non-significant results of excess returns are also interesting from an economist's point of view. We find 25 funds in the bullish period with positive excess returns and 24 funds in the bearish period with negative excess return. This result shows that the portfolio managers exaggerate and somehow amplify the market circumstances, or they simply regenerate the portfolios containing more risk.

CETOP20 index is significant as a market proxy for all the funds and periods, however there are substantial differences in the betas in different periods which sign depends on the geographic focus of the funds. For all the funds investing in the CEE region and for most (eight of the 13) funds investing in developed markets the betas in the bearish period were significantly higher. Four out of the six funds investing in Hungary (and tracking the Hungarian market index) show higher beta in the bullish period. This opposing result for the Hungarian market suggests that when the market is falling fund managers reduce the exposure of the funds to equities and invest more in bonds, which is confirmed by the high R^2 results for the regressions containing the CMAX (Hungarian government bond benchmark) index as a variable.

Table 6. Carhart four-factor model for bullish periods with C20 market proxy extended with the trade volume.

	const	C20	SMB	HML	MOM	Vol %	R^2
CE1	0.0003	0.7217***	0.0009***	0.0021***	0.0000	0.0021	0.69
CE2	0.0000	0.7681***	0.0005*	0.0017***	0.0001	−0.0115	0.77
CE3	0.0001	0.9352***	0.0002	0.0007	−0.0002	0.0032	0.91
CE4	0.0000	0.6429***	0.0005	0.0019***	0.0002	0.0056	0.63
CE5	0.0000	0.7077***	0.0005**	0.0014***	0.0004**	0.0317	0.75
CE6	0.0003	0.5221***	0.0006	0.0020***	0.0006***	−0.0200	0.41
CE7	0.0005**	0.3199***	0.0001	0.0015***	−0.0001	−0.0035	0.21
CE8	0.0002	0.7517***	−0.0001	0.0002	−0.0001	−0.0056	0.86
CE9	0.0001	0.7889***	0.0008***	0.0022***	0.0000	0.0012	0.73
CE10	0.0002	0.6817***	0.0006	0.0022***	0.0004*	0.0191	0.62
CE11	0.0004*	0.3621***	−0.0001	0.0011***	0.0001	0.0205	0.24
Dev1	−0.0001	0.4241***	0.0013***	0.0006*	−0.0024***	0.0047	0.42
Dev2	0.0000	0.5098***	0.0013***	0.0024***	−0.0014***	0.0012	0.53
Dev3	0.0000	0.3263***	0.0036***	0.0035***	−0.0026***	0.0043	0.33
Dev4	−0.0002	0.4431***	0.0013***	0.0006*	−0.0009***	0.0768***	0.46
Dev5	0.0000	0.3790***	−0.0002	0.0007	0.0001	0.0113	0.20
Dev6	−0.0002	0.3452***	0.0027***	0.0035***	0.0002	0.0097	0.21
Dev7	0.0000	0.4092***	0.0010**	0.0025***	0.0002	−0.0197	0.25
Dev8	0.0000	0.3239***	0.0005	0.0021***	−0.0002	−0.0010	0.16
Dev9	0.0001	0.6068***	0.0002	−0.0011	0.0003	0.6697	0.65
Dev10	0.0000	0.4276***	0.0005	0.0015***	−0.0004	−0.0005	0.33
Dev11	0.0001	0.3752***	0.0000	0.0025***	−0.0007***	0.0016	0.23
Dev12	0.0000	0.3055***	0.0002	0.0017***	−0.0008***	0.0080	0.17
Dev13	0.0000	0.3659***	0.0001	0.0007*	0.0005*	0.0061	0.22
HU1	−0.0002	1.0178***	0.0007	0.0018***	0.0007**	0.0111	0.77
HU2	0.0004***	0.6146***	0.0009***	0.0018***	0.0001	−0.0010	0.65
HU3	−0.0001	0.8656***	0.0008	0.0014*	0.0010**	0.0002	0.68
HU4	0.0006	0.4240***	−0.0007	−0.0021**	−0.0014***	−0.0139	0.17
HU5	0.0004	0.5767***	0.0011*	0.0023***	0.0008**	−0.0119	0.30
HU6	0.0000	0.7459***	0.0008**	0.0014***	0.0007***	−0.0230	0.64
Average R^2							0.47

Notes: This table shows the results of the modified Carhart (1997) four-factor model for the bullish periods, using CETOP20 as a market proxy extended with daily percentage changes in the number of shares outstanding. *, **, *** denote significance levels of 10%, 5% and 1% respectively.

The results for the funds investing in Hungarian shares are surprising (see Table 2 and Table 3) especially given the fact that these are index-linked funds. The C20 betas are far from being equal to 1, their average value for the full investigated period is only 0.67. Comparing the market beta for the bullish and bearish markets (see Table 4**Δ**C20 column) we find a 20% difference in absolute terms and find that altogether the market betas are decreasing at 7% on average. This result suggests that when the market is falling these funds invest in other, lower risk assets as well. To verify this hypothesis we run a simple regression for the fund returns explaining with C20 and CMAX (Hungarian government bond benchmark) index. In this setting we get an even higher explanatory (0.596 for the full period) than for the Carhart (1997) four-factor CEE model.

The HML factor is significant for 25 funds for the whole period, 25 for the bullish period and only seven for the bearish period (at 10% significance, at 1% the results are 21, 21 and 2 respectively). So it seems that during a recession the book-to-market equity ratio behind the HML factor has no explaining power.

Based on our results SMB factor has more explaining power in recession than expansion as the SMB factor is significant at 10% in 21, 13 and 20 cases for the whole, bullish and bearish periods respectively (at 1% significance the results are 13, 8 and 13).

Table 7. Carhart four-factor model for bearish period with C20 market proxy extended with the trade volume.

	const	C20	SMB	HML	MOM	Vol %	R^2
CE1	0.0003	0.8912***	0.0006	0.0000	−0.0001	−0.0038	0.91
CE2	0.0001	0.8704***	0.0014***	0.0007	0.0004	−0.0099	0.94
CE3	0.0003	0.9504***	0.0015***	0.0006	−0.0001	−0.0122**	0.94
CE4	−0.0003	0.7810***	−0.0004	−0.0008	0.0006	−0.0185	0.82
CE5	−0.0001	0.7563***	0.0017***	0.0005	0.0008***	−0.0087	0.91
CE6	−0.0011	0.3503***	0.0048***	0.0025**	0.0025***	−0.0496	0.29
CE7	−0.0015**	0.3284***	0.0045***	0.0030**	0.0023***	−0.1096	0.24
CE8	−0.0001	0.8410***	0.0009**	−0.0004	0.0000	0.0136	0.94
CE9	0.0000	0.9205***	0.0016***	0.0008	0.0000	−0.0064	0.93
CE10	−0.0005	0.7174***	0.0013*	0.0015*	0.0010**	0.2049***	0.77
CE11	−0.0012*	0.4318***	0.0056***	0.0022*	0.0021***	0.0522	0.36
Dev1	−0.0004	0.5195***	0.0003	0.0016	−0.0020***	−0.2003	0.57
Dev2	−0.0002	0.6077***	−0.0004	0.0011	−0.0018***	−0.0556**	0.65
Dev3	−0.0002	0.3843***	−0.0009	0.0013	−0.0045***	−0.0210	0.40
Dev4	0.0002	0.5154***	0.0002	−0.0010	−0.0005	0.1078**	0.66
Dev5	−0.0009	0.4382***	0.0026**	0.0016	0.0022***	−0.0224	0.32
Dev6	−0.0013	0.2627***	0.0019	−0.0021	0.0000	0.0308	0.08
Dev7	−0.0013	0.2772***	−0.0009	0.0014	0.0018*	0.0628	0.11
Dev8	−0.0019*	0.2551***	0.0070***	−0.0005	0.0013	−0.1635	0.11
Dev9	0.0005	0.5720***	−0.0034*	0.0011	0.0037**	1.4486	0.68
Dev10	−0.0007	0.4244***	0.0054***	0.0048***	0.0031***	0.0284	0.33
Dev11	−0.0001	0.5527***	0.0004	0.0014	−0.0003	0.1299***	0.55
Dev12	−0.0001	0.4940***	−0.0010	−0.0004	−0.0013*	−0.0073	0.43
Dev13	−0.0006	0.4666***	0.0023**	−0.0009	0.0013*	−0.0132	0.37
HU1	−0.0005	0.9550***	0.0023**	0.0008	−0.0007	0.0388	0.77
HU2	−0.0001	0.7717***	0.0011	0.0003	−0.0004	−0.1161**	0.81
HU3	−0.0001	0.5235***	0.0031***	0.0017**	0.0022***	0.0544**	0.64
HU4	−0.0020**	0.4897***	0.0051***	0.0015	0.0023**	−0.0098	0.24
HU5	−0.0019*	0.3905***	0.0075***	0.0044***	0.0033***	0.0940	0.20
HU6	−0.0005	0.6980***	0.0030***	0.0003	0.0005	−0.1759	0.71
Average R^2							0.56

Notes: This table shows the results of the modified Carhart (1997) four-factor model for bearish periods, using CETOP20 as a market proxy extended with daily percentage changes in the number of shares outstanding. *, **, *** denote significance levels of 10%, 5% and 1% respectively.

For the momentum factor we have measured no substantial difference for bullish and bearish periods, at 10% level it was significant for 15 funds in the former and 18 funds in the latter case (at 1% 8 and 11 funds). The significant momentum factor underlines the fact the persistence in mutual fund performance is a relevant risk factor as Bollen and Busse (2005) show for the US and Dariusz Filip (2011) argues for the Hungarian mutual funds.

3.2. Fund flows and returns

We have incorporated an additional variable into our model; the percentage change of the number of shares outstanding, in order to separate the changes in the net asset value of the funds caused by the change of the price and by the purchase of new shares or redemption of existing ones by the investors.

The trade volume variable is significant for four funds for the whole investigated period, for one fund in the bullish and for seven funds in the bearish period (at 5% level, while at 1% level these numbers are 2, 1 and 2 respectively). This result suggests that when prices are falling on the given trading day the reactions of the investors are more intense, however

Table 8. Carhart four-factor model for the full period with C20 market proxy extended with the trade volume on the following day.

	const	C20	SMB	HML	MOM	Vol %	R^2
CE1	0.0002	0.7844***	0.0003	0.0016***	0.0002	0.0010	0.77
CE2	−0.0002	0.4597***	0.0008**	0.0009***	−0.0024***	0.0106	0.48
CE3	−0.0001	0.5495***	0.0006*	0.0021***	−0.0014***	0.0203***	0.57
CE4	−0.0002	0.9874***	0.0015***	0.0017***	0.0002	−0.0392***	0.77
CE5	0.0000	0.8037***	0.0005**	0.0013***	0.0003**	−0.0024	0.83
CE6	0.0001	0.9389***	0.0007**	0.0006*	−0.0002	−0.0034	0.92
CE7	0.0000	0.3625***	0.0020***	0.0032***	−0.0031***	0.0001	0.35
CE8	0.0003*	0.6715***	0.0006**	0.0015***	0.0000	−0.0009	0.71
CE9	0.0001	0.7055***	0.0034***	0.0016***	0.0017***	0.0061	0.63
CE10	0.0000	0.6963***	−0.0002	0.0010***	0.0006***	0.0072	0.69
CE11	0.0000	0.4281***	0.0010	−0.0018**	−0.0004	0.0255**	0.18
Dev1	−0.0002	0.4743***	0.0007**	0.0000	−0.0006***	−0.0334***	0.51
Dev2	0.0000	0.7228***	0.0008***	0.0010***	0.0006***	0.0074	0.80
Dev3	−0.0002	0.3946***	0.0003	0.0003	0.0007***	−0.0105	0.23
Dev4	−0.0003	0.3215***	0.0028***	0.0019***	0.0008***	−0.0273**	0.16
Dev5	0.0001	0.4523***	0.0023***	0.0016***	0.0012***	−0.0216	0.36
Dev6	0.0001	0.4920***	0.0035***	0.0021***	0.0013***	−0.0032	0.26
Dev7	−0.0001	0.3720***	0.0008	0.0016***	0.0009***	0.1468***	0.20
Dev8	0.0001	0.3148***	0.0014***	0.0013***	0.0004**	−0.0066	0.21
Dev9	−0.0002	0.2874***	0.0026***	0.0009*	0.0005*	0.0022	0.13
Dev10	0.0002	0.6014***	0.0000	−0.0009	0.0004	0.6822	0.65
Dev11	0.0001	0.7887***	0.0000	−0.0002	−0.0001	0.0252*	0.89
Dev12	−0.0001	0.4149***	0.0018***	0.0014***	0.0004*	0.0008	0.32
Dev13	0.0000	0.8357***	0.0007***	0.0018***	0.0002	0.0005	0.80
HU1	0.0000	0.6972***	0.0007***	0.0018***	0.0007***	−0.0122	0.67
HU2	0.0000	0.7244***	0.0016***	0.0011***	0.0007***	−0.0026	0.66
HU3	0.0000	0.4403***	−0.0003	0.0019***	−0.0004*	−0.0140**	0.32
HU4	−0.0001	0.3766***	−0.0007	0.0013***	−0.0008***	−0.0167**	0.25
HU5	−0.0001	0.3987***	0.0004	0.0000	0.0009***	−0.0027	0.26
HU6	0.0001	0.3740***	0.0014***	0.0009**	0.0006***	0.1118***	0.27
Average R^2							0.49

Notes: This table shows the results of the modified Carhart (1997) four-factor model, using CETOP20 as a market proxy extended with daily percentage changes in the number of shares outstanding on the following day for the full sample period of January 2001 and February 2013. *, **, *** denote significance levels of 10%, 5% and 1% respectively.

the signs are positive in four, and negative in three cases, so investors react by purchasing new shares in the former and redeeming existing shares in the latter case (see Tables 5, 6, 7).

In the next version of our model we have used the percentage change in the number of shares outstanding on the day following the day of which return we wanted to explain (see Tables 8, 9, 10). At first glance this may seem a bit odd, as we want to explain the return with a next day data; these regressions can not be used to forecast returns, we just aim to measure the strength of the relationship between the variables (and not the causality between them). So the problem we address is whether daily returns of the funds influence investors' decisions about purchasing new shares or redeeming existing ones, or to put it another way, after a significant positive or negative return whether they change their investment in the fund or not.

The percentage change in the number of shares outstanding the following day shows significant relationship with the actual day return in the case of 10 funds out of the 30 for the whole period, 10 funds for the bullish and six funds for the bearish period (at the 10% level). So investors are more likely to change their position in the fund after a day resulting in a positive return than after a day when prices are falling. However, the direction of these changes in their positions are mixed in both periods: in exactly half of the cases they increase and in half of the cases they decrease their position during both periods.

Table 9. Carhart four-factor model for bull periods with C20 market proxy extended with the trade volume on the following day.

	const	C20	SMB	HML	MOM	Vol %	R^2
CE1	0.0003*	0.7223***	0.0008**	0.0021***	0.0001	0.0014	0.69
CE2	−0.0001	0.4243***	0.0013***	0.0007*	−0.0024***	0.0129	0.42
CE3	−0.0001	0.5101***	0.0013***	0.0024***	−0.0015***	0.0155**	0.53
CE4	−0.0002	1.0155***	0.0006	0.0018***	0.0006*	−0.0404***	0.77
CE5	0.0000	0.7687***	0.0005**	0.0018***	0.0001	0.0017	0.78
CE6	0.0001	0.9350***	0.0002	0.0007	−0.0002	−0.0176*	0.91
CE7	0.0000	0.3271***	0.0036***	0.0035***	−0.0026***	0.0046	0.33
CE8	0.0004***	0.6147***	0.0009***	0.0019***	0.0001	−0.0009	0.65
CE9	−0.0002	0.8661***	0.0008	0.0014*	0.0010**	0.0073	0.68
CE10	0.0000	0.6429***	0.0005	0.0019***	0.0002	0.0092	0.63
CE11	0.0006	0.4280***	−0.0007	−0.0021**	−0.0014***	0.0237*	0.17
Dev1	−0.0003	0.4424***	0.0012***	0.0006*	−0.0009***	−0.0353***	0.45
Dev2	0.0000	0.7073***	0.0006**	0.0014***	0.0004**	−0.0006	0.74
Dev3	0.0000	0.3790***	−0.0003	0.0007	0.0001	−0.0077	0.20
Dev4	−0.0002	0.3439***	0.0028***	0.0036***	0.0003	−0.0291***	0.22
Dev5	0.0002	0.5222***	0.0006	0.0020***	0.0006**	−0.0111	0.41
Dev6	0.0004	0.5710***	0.0012**	0.0023***	0.0008**	−0.0035	0.30
Dev7	0.0000	0.4104***	0.0010**	0.0024***	0.0003	0.0889***	0.26
Dev8	0.0005**	0.3214***	0.0001	0.0016***	−0.0001	−0.0070*	0.21
Dev9	0.0000	0.3249***	0.0005	0.0021***	−0.0002	0.0016	0.17
Dev10	0.0000	0.6059***	0.0002	−0.0008	0.0003	0.1571	0.65
Dev11	0.0002	0.7513***	−0.0001	0.0002	−0.0001	0.0544***	0.86
Dev12	0.0000	0.4285***	0.0004	0.0016***	−0.0004	0.0007	0.34
Dev13	0.0001	0.7898***	0.0008**	0.0023***	0.0000	0.0004	0.73
HU1	0.0002	0.6825***	0.0006*	0.0022***	0.0004	0.0065	0.63
HU2	0.0000	0.7467***	0.0008**	0.0014***	0.0007***	−0.0023	0.64
HU3	0.0001	0.3758***	0.0000	0.0025***	−0.0007***	−0.0086	0.23
HU4	0.0000	0.3054***	0.0002	0.0017***	−0.0008***	−0.0109	0.17
HU5	0.0000	0.3663***	0.0001	0.0008*	0.0005*	−0.0028	0.22
HU6	0.0004*	0.3620***	−0.0001	0.0011***	0.0001	0.0628**	0.24
Average R^2							0.47

Notes: This table shows the results of the modified Carhart (1997) four-factor model, using CETOP20 as a market proxy extended with daily percentage changes in the number of shares outstanding on the following day for bullish periods. *, **, *** denote significance levels of 10%, 5% and 1% respectively.

So we have found the variable of percentage change of the shares outstanding on the following day to be a significant factor when prices are increasing in 10 cases, while it is significant in six cases when prices are falling. These results suggest that after a substantial price change, investors are more likely to change their position if this change was positive, than after a day resulting in a substantial loss. So their relation to risk seems to be different in bearish and bullish periods confirming the Kahneman and Tversky (1979) prospect theory.

Conclusion

By applying the modified version of Carhart (1997) model using the CEE index as a market proxy we find that mutual fund managers can neither beat the market for the full period nor in bullish or bearish market circumstances. We find significant difference in the market beta for the bullish and bearish markets, with lower betas for the bearish periods. Although book-to-market ratio proved to be significant explanatory power for the whole investigated period and for the bullish market; however, in bearish market circumstances the estimated coefficients are not significant. Conversely the market cap as an explanatory variable has higher power in recession than in expansion. For persistence parameter we detect no difference

Table 10. Carhart four-factor model for bull periods with C20 market proxy extended with the trade volume on the following day.

	const	C20	SMB	HML	MOM	Vol %	R^2
CE1	0.0003	0.8914***	0.0006	0.0000	−0.0001	−0.0022	0.91
CE2	−0.0004	0.5172***	0.0003	0.0016	−0.0020***	−0.0592	0.57
CE3	0.0000	0.6067***	−0.0003	0.0010	−0.0019***	0.0502*	0.65
CE4	−0.0005	0.9556***	0.0023**	0.0009	−0.0007	−0.0120	0.77
CE5	0.0001	0.8717***	0.0015***	0.0007	0.0004**	−0.0274	0.94
CE6	0.0002	0.9515***	0.0014***	0.0006	−0.0001	−0.0014	0.94
CE7	−0.0002	0.3823***	−0.0010	0.0013	−0.0045***	−0.0210	0.40
CE8	−0.0001	0.7706***	0.0011*	0.0001	−0.0005	−0.0073	0.80
CE9	−0.0002	0.5219***	0.0031***	0.0018**	0.0021***	0.0141	0.63
CE10	−0.0003	0.7807***	−0.0005	−0.0008	0.0006	0.0004	0.82
CE11	−0.0021**	0.4696***	0.0046***	0.0007	0.0019**	0.0173	0.23
Dev1	0.0000	0.5221***	0.0002	−0.0010	−0.0005	−0.0285	0.66
Dev2	−0.0002	0.7551***	0.0018***	0.0005	0.0008***	0.0408	0.91
Dev3	−0.0009	0.4382***	0.0025**	0.0016	0.0022***	−0.0342	0.32
Dev4	−0.0015	0.2623***	0.0020	−0.0021	−0.0001	−0.0117	0.08
Dev5	−0.0012*	0.3508***	0.0049***	0.0024**	0.0024***	−0.1038	0.29
Dev6	−0.0019*	0.3883***	0.0076***	0.0045***	0.0033***	−0.0158	0.20
Dev7	−0.0008	0.2789***	−0.0010	0.0015	0.0018*	0.4059***	0.14
Dev8	−0.0016**	0.3255***	0.0047***	0.0029**	0.0022***	−0.1325	0.24
Dev9	−0.0019*	0.2512***	0.0070***	−0.0005	0.0012	−0.2151	0.10
Dev10	0.0007	0.5885***	−0.0041**	0.0012	0.0040**	3.3603	0.69
Dev11	−0.0001	0.8414***	0.0009**	−0.0004	0.0000	−0.0250	0.94
Dev12	−0.0008	0.4237***	0.0054***	0.0048***	0.0031***	0.0020	0.33
Dev13	0.0000	0.9214***	0.0017***	0.0008	0.0000	0.0036	0.93
HU1	−0.0008*	0.7361***	0.0013*	0.0015*	0.0010**	−0.2200***	0.78
HU2	−0.0005	0.6956***	0.0028***	0.0003	0.0005	−0.0035	0.70
HU3	−0.0002	0.5709***	0.0006	0.0007	−0.0004	−0.1039***	0.54
HU4	−0.0001	0.4955***	−0.0010	−0.0005	−0.0015**	−0.1296***	0.44
HU5	−0.0006	0.4671***	0.0022**	−0.0009	0.0013*	−0.0144	0.37
HU6	−0.0012*	0.4294***	0.0058***	0.0022*	0.0019***	0.4915***	0.38
Average R^2							0.56

Notes: This table shows the results of the modified Carhart (1997) four-factor model, using CETOP20 as a market proxy extended with daily percentage changes in the number of shares outstanding on the following day for bearish periods. *, **, *** denote significance levels of 10%, 5% and 1% respectively.

for distinct market conditions. Concerning the actual trading day fund flows we find that when prices are falling the reactions of the investors are more intense. Furthermore after a substantial price change investors are more likely to change their position if this change was positive, while after a day resulting in a substantial loss they are less likely to change their investment. So their relation to risk seems to be different in bearish and bullish periods confirming the Kahneman and Tversky (1979) prospect theory.

Notes

1. We denote these funds by HUx, CEx and Devx resppectively.
2. Throughout the article we use SMB and HML for the size and value factors proposed by Fama and French (FF) and MOM for the momentum factor by Carhart. Mkt denotes the FF market factor, C20 the CETOP20 regional index for CEE.
3. All the factors used are derived mainly from CRSP data and based on the US markets, we use these factors for explaining European returns with reference to the results of Schmidt, Von Arx, Schrimpf, Wagner, and Ziegler (2011) who find 'astonishingly' high correlations between European and US momentum, size and value risk factors.

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