Performance Analysis of Equally weighted Portfolios: USA and Hungary

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Abstract: Investigating U.S. equally weighted portfolios, one can measure positive abnormal returns (Jensen alphas) according to the classical equilibrium models. Applying the Carhart four-factor model, we show that excess returns generated by the equally weighted multi-period investment strategy are neither caused by the small-firm effect, nor by the book-to-market equity, nor even by persistence. We document that this phenomenon cannot be observed in the Hungarian stock market, where the equally weighted rebalancing strategy neither achieves significant abnormal return, nor outperforms the value weighted index in terms of mean return. This latter result suggests that, from this point of view, the Hungarian capital market exhibits a higher level of efficiency than its US counterpart.

Keywords: equally weighted portfolio, performance measure, market efficiency

1 Introduction

We investigate a simple multi-period investment strategy using equally weighted portfolios by comparing the performance of a value weighted market index to equally weighted portfolios. An equally weighted portfolio takes every asset into account with the same weight, while in a value weighted portfolio, the market capitalization determines the weight of a stock. In the case of the U.S. stock market, we document positive abnormal returns for the equally weighted portfolios using the Capital Asset Pricing Model (CAPM) by Sharpe (1964), Lintner (1965), and Mossin (1966), and the Carhart (1997) Four-Factor Model. We argue that the excess return is neither due to the small firm effect documented by Banz (1981) and Reinganum (1980, 1981), nor the book to market equity factor documented by Basu (1983). This phenomenon cannot be observed in the Hungarian stock market; furthermore, the equally weighted portfolio does not outperform the value weighted market index in terms of mean return.

We even state that the negative autocorrelation caused by the mean reverting behavior of stock returns (see French and Roll (1986), Fama and French (1988), Poterba and Summers (1989) or De Bondt and Thaler (1985, 1987)) has no effect on the return of the equally weighted portfolios. Rather, holding a portfolio compiled by rebalancing different random processes gains higher returns by the nature of the stochastic processes. Opposite to the Budapest Stock Exchange (BSE), on equally weighted portfolios formed from U.S. stocks, one can measure much higher returns than that of a value weighted portfolio. A large number of explanations can be found in the literature which try to give some theoretical background for the significant difference. If an equally weighted portfolio is investigated, the first argument is connected to small firm effect. As Roll (1981) states, "a value weighted index such as the S&P 500 is obviously more heavily invested in large firms than is an equally weighted index. Thus, comparing the behavior of two such indexes will enable us to study, with very little effort, the size effect." In other words he argues that the difference between the returns of similar risky portfolios in that the behavior comes from the size differences. Roll argues that the small firm effect is the result of a measurement problem and trading infrequency seems to be a powerful cause of bias in risk assessments with short-interval data. Rather horrendous bias is induced in daily data and the bias is still large and significant with returns measured over intervals as long as one month. In our analysis, we use monthly returns instead of daily ones. This argument is similar to Banz's (1981) results.

The other reasoning according to the higher return is concentrated on the autocorrelation in the process; however, the autocorrelation of data has a time varying behavior (see Li and Yen, 2011). In the short run, one can measure a mean reverting price behavior, which in turn means negative serial autocorrelation; see e.g. Dyl and Maxfield (1987), Bremer and Sweeney (1988) or Brown et al. (1988). On longer time intervals, for weekly returns, Howe (1986) or Lehmann (1988) measures also negative autocorrelations. Similarly, for monthly returns, Rosenberg et al. (1985), Jagedeesh (1990), Brown and Harlow (1988) measure negative autocorrelation. For even longer intervals, for twelve months, Jagedeesh (1990) documents positive autocorrelation. However, investigating much longer intervals, e.g. DeBondt and Thaler (1985, 1987), Poterba and Summers (1989) or Fama and French (1988) report again a negative serial correlation in market returns over observation intervals of three to five years. In the case of an equally weighted portfolio, like e.g. the S&P equally weighted index (S&P EWI), which is compiled from the largest 500 U.S. stocks, these autocorrelations have a high impact on the return. However, the studies state that the abnormal return of the S&P EWI is due to the small firm effect, neglecting the findings according to the autocorrelations. The S&P EWI is a quarterly rebalanced portfolio; therefore, the negative autocorrelation measured for this interval has a positive effect on the return because the equally weighted portfolio increases the weights of the "past losers" and at the same time decreases the weights of the "past winners", where the past means three months' performance. However, if the process is mean-reverting, the return generated by this contrarian investment strategy must be higher than the return of the value weighted index. Of course, because of its nature, it is not difficult to see that it would be helpful to have such processes to achieve better performance. However, regarding Mulvey and Kim (2008), the truth is that mean-reversion is not necessary for the fixed mix to accomplish superior performance. Stein et al. (2009) investigate the diversification and rebalancing of Emerging Market countries' portfolios. They show that even though Emerging Markets suffer high transaction costs and unreliable information, pragmatic portfolio implementations such as equally weighted rebalancing with relatively little trading still promise excess performance. However, our findings on BSE stock portfolio does not support this issue.

The remaining question is whether the difference in the return, if it exists, can be explained by the standard equilibrium models (the CAPM and Four-Factor Model) or not. If not, i.e., significant positive alpha can be measured especially by the four factor model, this means that the strategy promises excess return, above the equilibrium, where the small-firm-effect, the book-to-market equity effect and the effect of persistency is already managed. In fact, our results for survivorship biased dataset using the components of the Standard and Poor's 500 index components in the rebalancing strategy gains significant positive or non-significant but positive alphas. The same strategy formed from BUX index (the main Hungarian equity index) components only provide non-significant positive alpha.

2 Stock Market Model

The model of stock market investigated in this section is the one considered, among others, by Luenberger (1998), Mulvey and Kim (2008). Consider a market of d assets whose mean return vector is $\mathbf{r}$ where $\mathbf{r} \in R^d$. Let $\mathbf{S} \in R^{d \times d}$ be a covariance matrix. Assuming normality for the return's joint distribution, a static portfolio's return according to the portfolio vector $\mathbf{w} \in R^d$ is also normal with mean $\langle \mathbf{w},\mathbf{r} \rangle$ and variance $\langle \mathbf{w},\mathbf{Sw} \rangle$, where $\langle \bullet,\bullet \rangle$ denotes inner product. Let us investigate a constantly rebalanced portfolio made of the same stocks and rebalanced in each instantaneous moment according to $\mathbf{w}$. We can write the following stochastic differential equation for the price process of asset i as

$$\frac{dp_t}{p_t} = (r_i + \frac{1}{2}\sigma_i^2)dt + dB_i^t, \tag{1}$$

where r_i and σ_i^2 are the return and variance of asset i, respectively. B is a geometric Brownian motion. Thus, for the value of a constantly rebalanced portfolio we have

$$\frac{dP_t}{P_t} = \sum_{i=1}^{d} w_i \frac{dp_t}{p_t} = \sum_{i=1}^{d} w_i \left\{ (r_i + \frac{1}{2}\sigma_i^2)dt + dB_i^t \right\}. \tag{2}$$

The portfolio's growth rate is the weighted average of the individual asset's rate, that is, we can write

$$\frac{dP_t}{P_t} = \left(\langle \mathbf{w}, \mathbf{r} \rangle + \frac{1}{2} \langle \mathbf{w}, \sigma^2 \rangle \right) dt + \sigma_P^2 \, dW^t \tag{3}$$

for the portfolio's growth rate, where $\sigma_P{}^2$ denotes the portfolio's variance and W^t is an element of a standardized Wiener process. Thus, for the constantly rebalanced portfolio's mean return for a unit period we have

$$r_P = \langle \mathbf{w}, \mathbf{r} \rangle + \frac{1}{2} \langle \mathbf{w}, \sigma^2 \rangle - \frac{1}{2}\sigma_P^2 = \langle \mathbf{w}, \mathbf{r} \rangle + \frac{1}{2} \langle \mathbf{w}, \sigma^2 \rangle - \frac{1}{2} \langle \mathbf{w}, \mathbf{Sw} \rangle, \tag{4}$$

that is, the constantly rebalanced portfolio's mean is larger than the static case by the factor of ½($\langle \mathbf{w},\sigma^2 \rangle$-$\langle \mathbf{w},\mathbf{Sw} \rangle$), which is the so-called *rebalancing gain* (see Mulvey and Kim (2008)). Since $\langle \mathbf{w},\sigma^2 \rangle$ is the weighted sum of the portfolio constituents' variances, its value is equal to the portfolio's variance ($\langle \mathbf{w},\mathbf{Sw} \rangle$) if and only if the constituents are absolutely correlated. In any other case, the constantly rebalanced portfolio outperforms its static counterpart in terms of mean return respect to that (1) both portfolios consist of the same stocks and (2) the static portfolio's initial capital allocation vector is identical to the rebalancing strategies' **w**. Furthermore, the constantly rebalanced portfolio's returns are also normal with the same variance as the static portfolio ($\langle \mathbf{w},\mathbf{Sw} \rangle$).

In the next section we investigate two types of equally weighted portfolios to get empirical evidence whether these attractive theoretical properties are manifested in abnormal returns in terms of an equilibrium model or not, and whether these excess returns infer higher risks.

3 Empirical Results

3.1 Portfolio Construction

We investigate 25 portfolios which are formed on the basis of Standard & Poor's 500 large-cap index for 10-year-long periods. We launch a new portfolio at the beginning of each year from 1975 to 1999 in the following way: The portfolios are reviewed each month to map exactly the actual Standard & Poor's 500 constituents. Stocks included or excluded from the index not at the beginning of a month are considered for the whole month. These portfolios are not free of survivorship bias (NFB) since they follow the performance of the actually largest companies. To ease the notation of these portfolios, we refer to them as S&P500

EW. We rebalance all portfolios on the first trading day of each month according to a weight vector which divides the accumulated wealth equally among constituents. For each portfolio a 10-year-long holding period is investigated. The first portfolio is launched in January 1975 and ends in December 1984. Similarly, new portfolios are formed at the beginning of each year until January 1999. We use data of U.S. stock returns from Center for Research in Security Prices (CRSP) database. The returns are merged to Standard & Poor's 500 constituents list from the Compustat North America dataset.

Similarly we form an equally weighted portfolio on the basis of the BUX index. Due to the limited availability of data, five-year-long periods are investigated; that is, we launch a new portfolio at the beginning of each year from 1999 to 2005 in the following way: The portfolios are reviewed each month to map exactly the actual BUX constituents. Although the BSE reopened in 1990, the maturity of the market and the limited availability of consistent data provide the facility to form portfolios in the above-mentioned way. For better comparison, we launch each portfolio in exactly the same way as that of the S&P500; however, in statistical terms, the outcome of this analysis is not representative. Before the analysis we modify by splits, dividends and we recalculate the returns in U.S. dollars, by which we get results that are comparable to the U.S. market. The applied methodology, as in the previous case, is also not free of survivorship bias. The BSE equally weighted portfolio is referred as BUX EW. In this case the capitalization weighted BUX index is used for the comparison of the equally and capitalization weighted portfolios.

3.2 Analysis of Past Performance

In Figures 1 and 2 we present the wealth levels of the introduced S&P500 EW and BUX EW strategies against time. The solid lines are the EW portfolios' wealth. The capitalization weighted indices' wealth are captured by dashed lines. On the U.S. market one can see that both types of the proposed portfolios outperform the capitalization weighted S&P500 index in the sense of final wealth (and almost always in sense of any intertemporal wealth level); however, the equally weighted strategies are more volatile.

The more volatile return induces higher expected return in an equilibrium setting; therefore, if one would like to compare the two styles of portfolio creation, the difference between the returns should be extended with systematic risk measures. Formalizing the method of performance measurement, two equilibrium models are constructed, the classical Capital Asset Pricing Model (CAPM) (see Sharpe 1964, Linter 1965, Mossin 1966), and a Four-Factor Model (see Carhart [6]). More precisely, one can estimate the return of the strategies in the following ways sequentially:

$$r_l^t - r_f^t = \alpha_l + \beta_l (r_m^t - r_f^t) + \varepsilon_l^t \tag{5}$$

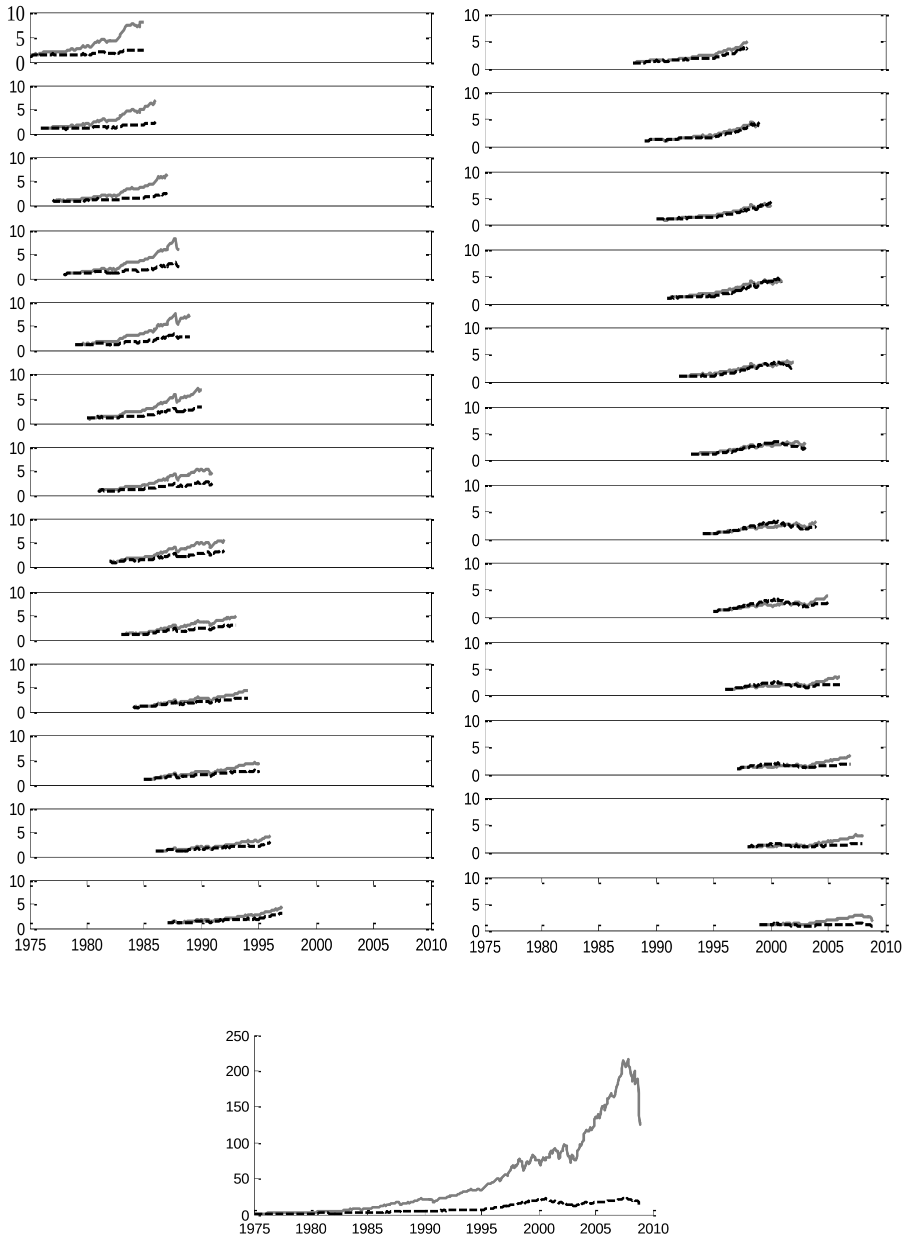

Figure 1
Wealth levels accumulated by the S&P500

Notes: EW portfolios and the capitalization weighted S&P500 market proxy. EW portfolios are launched each January from 1975 until 1999, and rebalanced on the first trading day of each month according to a weight vector which divides the accumulated wealth equally among Standard & Poor's

500 index constituents which appear in the index anytime in the month for the 10-year long period. CRSP-VW is a capitalization based index and needs no rebalancing.

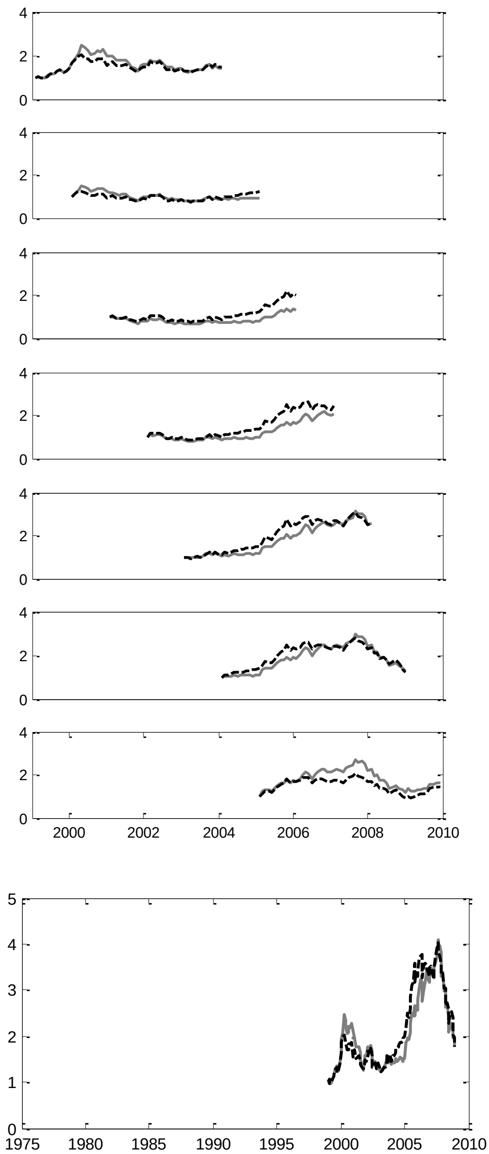

Figure 2
Wealth level accumulated by the BUX

Notes: Figure 2 shows the EW and the capitalization weighted BUX portfolio. BUX index portfolio is launched in January 1999, and rebalanced on the first trading day of each month according to a weight vector which divides the accumulated wealth equally among BUX index constituents which appear in the index anytime in the month for the 10-year long period. The pure BUX index is a capitalization weighted and needs no rebalancing.

$$r_l^t - r_f^t = \alpha_l + \beta_l (r_m^t - r_f^t) + s_l SMB^t + h_l HML^t + mom_l MOM^t + \varepsilon_l^t, \tag{6}$$

where l, t, r_f, $(r_m{}^t - r_f{}^t)$, ε stand for asset l, time, risk free rate, market premium and estimation residuals, respectively. The risk free rate is the rate of return of the one-month Treasury-bill obtained from Ibbotson and Associates. We use the capitalization weighted S&P500 index as market proxy. According to Fama and French (1993) *SMB* (small-minus-big) measures the average return difference between small and large capitalization assets, while *HML* (high-minus-low) is the average return difference between high and low book-to-market equity (*B/M*) companies. *MOM* is the one-year momentum factor (see Carhart 1997), which shows the average excess return of the last one year's winners above the return of last one year's loser securities[1]. The regression coefficients α, β, *SMB*, *HML* and *MOM* were estimated based on equation (5) and (6).

The alpha parameter measures the excess return of an investment above or below the risk adjusted equilibrium value. According to the Efficient Market Hypothesis of Fama (1965, 1970) and Jensen's (1968) research on abnormal performance of mutual funds, one can achieve repeatedly positive alpha only by chance. Thus, a significant alpha in the model is against the market equilibrium assumptions since it implies systematic abnormal performance in the past returns. We investigate 10-year-long periods in the case of the S&P500 and 5-year-long periods for the Budapest Stock Exchange BUX, because on the one hand, the return anomalies in this long periods are diminishing, i.e. these intervals are as long that the probability of beating the equilibrium return only by chance is small, and on the other hand, we have the opportunity to run statistical analyses on the returns comparing the periods investigated.

Tables 1 and 2 present the results of the regression analysis based on equations (5) and (6) for all EW portfolios and for various periods. Although each period covered different economic environments, the coefficients do not show remarkable differences in the various periods for the U.S. market except in the case of the small-firm factor loading, which is much smaller in the more recent periods. As the tables show, the majority of sensitivity coefficients are significant at 0.05 level; that is, each factor has unambiguous loading on the EW

[1] *SMB*, *HML* and *MOM* factor portfolio returns are obtained from Kenneth French's homepage

performance. This is not the case in the Hungarian market, where only the β is significant. Regarding our analysis, however, the most important observations are the values of the alphas, which are not always significant, but their significant values are always positive. The monthly abnormal returns in the CAPM are between -0.09% and 0.4%. Regarding the Four-Factor Model their values in the U.S. scatter from monthly 0.04% to 0.29%, where the latter is 3.48% in annum. An interesting fact is that the R^2-s are consistently lower on the closer investing intervals as the portfolios excess returns are also lower for the more recent periods.

Table 1

S&P500 EW and BUX EW Summary Statistics for the CAPM

			CAPM for USA			
Period	$r_{SP500\ EW}-r_f$	Std Dev	β	α	R^2	adj R^2
1975-1984	1.10%	5.19%	1.1	**0.40%**	0.928	0.928
1976-1985	0.93%	4.76%	1.06	**0.32%**	0.941	0.941
1977-1986	0.80%	4.77%	1.05	**0.28%**	0.95	0.95
1978-1987	0.90%	5.56%	1.07	**0.29%**	0.959	0.959
1979-1988	0.98%	5.37%	1.06	**0.30%**	0.957	0.957
1980-1989	0.97%	5.27%	1.06	**0.26%**	0.956	0.956
1981-1990	0.69%	5.40%	1.11	**0.26%**	0.968	0.967
1982-1991	0.98%	5.47%	1.12	0.16%	0.974	0.974
1983-1992	0.92%	5.19%	1.13	0.12%	0.975	0.974
1984-1993	0.85%	5.13%	1.14	0.09%	0.977	0.977
1985-1994	0.87%	5.02%	1.13	0.09%	0.976	0.975
1986-1995	0.88%	4.91%	1.13	0.06%	0.973	0.973
1987-1996	0.90%	4.72%	1.12	0.02%	0.97	0.97
1988-1997	1.02%	3.81%	1.1	-0.02%	0.954	0.953
1989-1998	1.01%	4.16%	1.05	-0.08%	0.944	0.943
1990-1999	0.94%	4.18%	1.01	-0.09%	0.909	0.908
1991-2000	1.14%	3.93%	0.86	0.28%	0.76	0.758
1992-2001	0.91%	4.08%	0.85	0.34%	0.766	0.764
1993-2002	0.66%	4.60%	0.9	0.28%	0.796	0.794
1994-2003	0.87%	4.82%	0.92	0.32%	0.803	0.801
1995-2004	1.02%	4.78%	0.92	0.35%	0.8	0.799
1996-2005	0.87%	4.82%	0.93	0.36%	0.804	0.802
1997-2006	0.84%	4.76%	0.92	0.36%	0.799	0.798
1998-2007	0.63%	4.68%	0.93	0.35%	0.789	0.788
1999-2008	0.14%	5.08%	0.99	0.32%	0.817	0.815
Average	0.87%	4.82%	1.03	0.22%	0.907	0.906

			CAPM for Hungary			
Period	$r_{BUX\ EW}-r_f$	Std Dev	β	α	R^2	adj R^2
1999-2008	0.74%	7.30%	0.23	0.62%	0.181	0.172
1999-2003	0.82%	7.50%	0.22	0.60%	0.239	0.232
2000-2004	0.11%	6.93%	0.14	-0.01%	0.2	0.193
2001-2005	0.69%	6.82%	0.59	0.21%	0.181	0.172
2002-2006	1.44%	6.52%	0.5	1.20%	0.1	0.091
2003-2007	1.80%	6.36%	0.6	1.63%	0.046	0.037
2004-2008	0.66%	7.15%	0.29	0.64%	0.118	0.109
2005-2009	1.18%	7.55%	0.2	1.15%	0.085	0.076

Notes: Table 1 presents the S&P500 EW and BUX EW Summary Statistics for the CAPM. Portfolios are launched each January from 1975 until 1999. We rebalance the portfolios on the first trading day of each month according to a weight vector which divides the accumulated wealth equally among Standard & Poor's 500 and BUX index constituents which appear in the index anytime in the month. $r_{SP500\,EW} - r_f$ and $r_{BUX\,EW} - r_f$ are the average U.S. Dollar denominated return of the S&P EW and BUX EW portfolios in excess of the one-month U.S. Treasury-bill return. Std Dev refers to the standard deviation of the excess return. β and α are parameters of the OLS regression model (5). Parameter α measures the average abnormal return (significant alphas at 0.05 level are in bold). R^2 is the coefficient of determination. The model selection criteria is the adjusted R^2.

Table 2

S&P500 EW and BUX EW Summary Statistics for the Four-Factor Model

Four-Factor Model for USA									
Period	$r_{SP500\,EW}$-r_f	Std Dev	β	SMB	HML	MOM	α	R^2	adj R^2
1975-1984	1.10%	5.19%	1.08	0.27	0.17	-0.15	0.18%	0.971	0.97
1976-1985	0.93%	4.76%	1.07	0.23	0.14	-0.13	**0.18%**	0.967	0.966
1977-1986	0.80%	4.77%	1.09	0.18	0.12	-0.13	**0.23%**	0.968	0.966
1978-1987	0.90%	5.56%	1.09	0.19	0.09	-0.12	**0.27%**	0.972	0.971
1979-1988	0.98%	5.37%	1.08	0.17	0.08	-0.12	**0.29%**	0.97	0.969
1980-1989	0.97%	5.27%	1.09	0.16	0.08	-0.12	**0.29%**	0.969	0.968
1981-1990	0.69%	5.40%	1.13	0.19	0.11	-0.06	**0.25%**	0.977	0.976
1982-1991	0.98%	5.47%	1.13	0.15	0.09	-0.06	**0.18%**	0.981	0.98
1983-1992	0.92%	5.19%	1.14	0.14	0.08	-0.09	**0.15%**	0.983	0.983
1984-1993	0.85%	5.13%	1.15	0.13	0.07	-0.09	**0.15%**	0.985	0.984
1985-1994	0.87%	5.02%	1.15	0.13	0.07	-0.1	**0.16%**	0.984	0.984
1986-1995	0.88%	4.91%	1.15	0.13	0.07	-0.12	**0.15%**	0.984	0.983
1987-1996	0.90%	4.72%	1.14	0.12	0.09	-0.12	0.10%	0.981	0.98
1988-1997	1.02%	3.81%	1.13	0.1	0.12	-0.13	0.04%	0.974	0.973
1989-1998	1.01%	4.16%	1.1	0.08	0.18	-0.18	0.08%	0.972	0.971
1990-1999	0.94%	4.18%	1.09	0.08	0.22	-0.22	0.10%	0.966	0.965
1991-2000	1.14%	3.93%	1.09	0.04	0.34	-0.24	**0.22%**	0.933	0.93
1992-2001	0.91%	4.08%	1.05	0.06	0.4	-0.19	0.19%	0.932	0.93
1993-2002	0.66%	4.60%	1.05	0.06	0.42	-0.2	**0.26%**	0.95	0.948
1994-2003	0.87%	4.82%	1.06	0.07	0.44	-0.19	**0.24%**	0.953	0.952
1995-2004	1.02%	4.78%	1.06	0.08	0.45	-0.19	0.20%	0.953	0.951
1996-2005	0.87%	4.82%	1.07	0.08	0.45	-0.19	**0.20%**	0.954	0.952
1997-2006	0.84%	4.76%	1.06	0.08	0.45	-0.19	0.15%	0.95	0.949
1998-2007	0.63%	4.68%	1.06	0.08	0.46	-0.19	**0.21%**	0.951	0.949
1999-2008	0.14%	5.08%	1.05	0.06	0.43	-0.17	**0.24%**	0.955	0.953
Average	0.87%	4.82%	1.09	0.12	0.22	-0.15	0.19%	0.965	0.964

Four-Factor Model for Hungary									
Period	r_{BUXEW}-r_f	Std Dev	β	SMB	HML	MOM	α	R^2	adj R^2
1999-2008	0.74%	7.30%	0.64	0.02	-0.08	-0.01	0.89%	0.182	0.174
1999-2003	0.82%	7.50%	0.61	0.05	-0.11	-0.05	0.93%	0.246	0.239
2000-2004	0.11%	6.93%	0.53	-0.02	-0.11	-0.08	0.41%	0.208	0.2
2001-2005	0.69%	6.82%	0.64	0.32	-0.27	0.15	0.51%	0.211	0.203
2002-2006	1.44%	6.52%	0.67	0.17	-0.05	0.22	0.97%	0.123	0.114
2003-2007	1.80%	6.36%	0.45	0.28	0.16	0.34	1.18%	0.085	0.076
2004-2008	0.66%	7.15%	0.7	-0.28	0.32	0.2	0.61%	0.133	0.124
2005-2009	1.18%	7.55%	0.56	-0.14	-0.29	0.03	1.23%	0.1	0.091

Notes: Table 2 shows the S&P500 EW and BUX EW Summary Statistics for the Four-Factor Model. Portfolios are launched each January from 1975 until 1999. We rebalance the portfolios on the first trading day of each month according to a weight vector which divides the accumulated wealth equally among Standard & Poor's 500 and BUX index constituents which appear in the index anytime in the month. $r_{SP500\ EW} - r_f$ and $r_{BUX\ EW} - r_f$ are the average U.S. Dollar denominated return of the S&P EW and BUX EW portfolios in excess of the one-month U.S. Treasury-bill return. Std Dev refers to the standard deviation of the excess return. β, *SMB*, *HML*, *MOM* and α are parameters of the OLS regression model (6). Parameter α measures the average abnormal return (significant alphas at 0.05 level are in bold). R^2 is the coefficient of determination. The model selection criteria is the adjusted R^2.

The betas are slightly higher than one for each portfolio; that is, over-weighting relatively smaller firms against the about 50 giants which dominated the value weighted index appreciably raised the portfolio risk, although the CAPM's betas are slightly lower in more recent periods. According to the model selection criteria (adjusted R^2) the additional factors raise the explanatory power of model (6), especially in the more recent dates. It is worth noting, however, that these portfolios consisted of large-cap firms; the SMB factor had a small, but significantly positive loading on EW premia. Positive HML coefficients imply that over-weighting smaller companies also supports investing in high book-to-market equity stocks. The negative loading on return momentum is the natural attendant of an equally weighted strategy, which gives relatively larger portions for stocks which performed below the average in the previous investment period. First and last, investors who had preferred an equally weighted mixture of U.S. large-cap stocks could achieve extra yield on every 10-year-long period in contrast to the value weighted index, which is not the case in the Hungarian market. For the BUX EW portfolio, both models have very low explanatory power, the factor loadings are insignificant, and the equally weighted index slightly underperforms the capitalization weighted BUX index in terms of final wealth. On the one hand, we argue that the Hungarian capital market exhibits a higher level of market efficiency from this point of view, as the rebalancing strategy gains no significant abnormal returns. This result may contradict its US counterpart; however it confirms the weak form of market efficiency. On the other hand, as the explanatory power of the equilibrium model is very low, one would suggest that besides the BUX value weighted returns, other parameters should have been used to proxy the market. However, if we accept the arbitrage pricing theory by Ross (1976) all efficient portfolio can be used as a reference.

Conclusions and Further Research Directions

We show that the equally weighted portfolios' higher return compared to the capitalization weighted market index cannot be explained by the well-known equilibrium model. We use survivorship biased portfolio setting, and these significantly over-perform the equilibrium models. Using the Four-Factor Model, we show that the excess return generated by the U.S. equally weighted multi-period investment strategy is neither caused by the small-firm effect, nor by the book-to-market equity, nor by the persistence. Contrary to the results for the U.S. markets, on the Budapest Stock Exchange we cannot measure excess return with the periodically equally weighting rebalancing strategy. Although the explanatory power of the Four-Factor model is low, we state that, from this point of view, a very high level of market efficiency can be measured on the Hungarian capital market.

There are several directions from which the equally rebalanced portfolio strategy can be further investigated. On the one hand, one can argue that the variance or standard deviation or any other risk parameter which is compiled by using these measures is not adequate. One may use the variance of the log returns for calculating the variance, because in this setup the "penalty", i.e. the increase in the variance in the case of a positive trigger, is lower than that of a negative one. This assumption is even more reasonable if, instead of utility maximization, one would use the loss-aversion approach. On the other hand the equilibrium model set up suggests a one-period world. The goal of the one-period portfolio theory (Markowitz 1952) and the rival equilibrium models (like CAPM, APT, Fama-French, or Carhart model), is the optimization of the asset allocation in order to achieve the optimal trade-off between expected one-period return and risk. This supposes a world where the investors optimize their consumptions and investment strategies for that given one period. However, most of the mean-variance analysis handles only static models, contrary to the expected utility models, whose literature is rich in multi-period models, supposing an individual with longer interval than simply one-period thinking. One could suppose that a Data Envelopment Analysis (see Gȯkgöz, 2010) or fractal analyses (see Bohdalová and Greguš, 2010) would increase the accuracy of our estimations. In the multi-period models the investors are allowed to rebalance their portfolios in each trading period, and therefore their investments may be characterized in different ways in one and multiple periods due to the multiplicative effect of consecutive reinvestments. There is a third direction which seems to be worth a closer look; this is the volatility. The question arises as to what is the mathematical connection in a discrete world between the volatility of the single securities and the return of the portfolio.

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References

[1] Bohdalová, M and Greguš, M.: Fractal Analysis of Forward Exchange Rates, *Acta Polytechnica Hungarica*, Vol. 7, 2010, pp. 57-69

[2] Bremer, M. A. and Sweeney R. J.: The Reversal of Large Stock-Price Decreases, *Journal of Finance*, Vol. 46, 1991, pp. 747-754

[3] Brown, K. C., Harlow, W. V. and Tinic S. M.: Risk Aversion, Uncertain Information, and Market Efficiency, *Journal of Financial Economics*, Vol. 22, 1988, pp. 355-385

[4] Brown, K. C. and Harlow W. V.: Market Overreaction: Magnitude and Intensity, *Journal of Portfolio Management*, Vol. 14, 1988, pp. 6-13

[5] Banz, R.: The Relationship between Return and Market Value of Common Stocks, *Journal of Financial Economics*, Vol. 9, 1981, pp. 3-18

[6] Basu, S.: The Relationship between Earnings Yield, Market Value, and Return for NYSE Common Stocks: Further evidence, *Journal of Financial Economics*, Vol. 12, 1983, pp. 129-156

[7] Carhart, M. M.: On Persistence in Mutual Fund Performance, *Journal of Finance*, Vol. 52, 1997, pp. 57-82

[8] De Bondt, W. F. M. and Thaler R. H.: Does the Stock Market Overreact, *Journal of Finance*, Vol. 40, 1985, pp. 793-805

[9] De Bondt, W. F. M. and Thaler R. H.: Further Evidence on Investor Overreaction and Stock Market Seasonality, *Journal Finance*, Vol. 42, 1987, pp. 557-581

[10] Dyl, E. A. and Maxfield K.: Does the Stock Market Overreact? Additional Evidence, working paper, University of Arizona, 1987, June

[11] Fama, E. F.: The Behavior of Stock Market Prices, *Journal of Business*, Vol. 38, 1964, pp. 34-105

[12] Fama, E. F.: Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance*, Vol. 25, 1970, pp. 383-417

[13] Fama, E. F., and French K. R.: Permanent and Temporary Components of Stock Prices, *Journal of Political Economy*, Vol. 98, 1988, pp. 246-74

[14] Fama, E. F. and French, K. R.: Common Risk Factors in the Returns on Stocks and Bonds, *Journal of Financial Economics*, Vol. 33, 1993, pp. 3-56

[15] French, K. R., and Roll R.: Stock Return Variances: The Arrival of Information and the Reaction of Traders, *Journal of Financial Economics*, Vol. 17, 1986, pp. 5-26

[16] Gökgöz, F.: Measuring the Financial Efficiencies and Performances of Turkish funds, *Acta Oeconomica*, Vol. 60, 2010, pp. 295-320

[17] Howe, J. S.: Evidence on Stock Market Overreaction, *Financial Analysts Journal*, Vol. 42, 1986, pp. 74-77

[18] Jegadeesh N.: Evidence of Predictable Behavior of Security Returns, *Journal of Finance*, Vol. 45, 1990, pp. 881-898

[19] Jegadeesh, N. and Titman, S.: Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency, *Journal of Finance*, Vol. 48, 1993, pp. 65-91

[20] Jensen, M.: The Performance of Mutual Funds in the Period 1945-1964, *Journal of Finance*, Vol. 23, 1968, pp. 389-416

[21] Lehmann, B. N.: Fads, Martingales, and Market Efficiency, *Quarterly Journal of Economics*, Vol. 105, 1990, pp. 1-28

[22] Li, M. Y. L. and Yen, S. M. F.: Re-Examining Covariance Risk Dynamics in International Stock Markets Using Quantile Regression Analysis, *Acta Oeconomica*, Vol. 61, 2011, pp. 33-59

[23] Lintner, J.: The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets, *Review of Economics and Statistics*, Vol. 47, 1965, pp. 13-37

[24] Markowitz, H.: Portfolio Selection, *Journal of Finance*, Vol. 7, 1952, pp. 77-91

[25] Merton, R. C.: Portfolio Selection under Uncertainty: The Continuous-Time Case, *Review of Economics and Statistics*, Vol. 51, 1969, pp. 247-257

[26] Merton, R. C.: An Intertemporal Capital Asset Pricing Model, *Econometrica*, Vol. 41, 1973, pp. 867-887

[27] Meir, K.: Financial Institutions and Markets, Oxford University Press, USA; 2 edition, 2003

[28] Mossin, J.: Equilibrium in a Capital Asset Market, *Econometrica*, Vol. 34, 1966, pp. 468-483

[29] Mulvey, J. M. and Kim, W. C.: Constantly Rebalanced Portfolios - Is Mean-Reverting Necessary?, working paper Princeton University, Princeton, NJ, USA, 2008

[30] Poterba, J. M. and Summers L. H.: Mean Reversion in Stock Prices: Evidence and Implications, *Journal of Financial Economics*, Vol. 22, 1988, pp. 27-59

[31] Reinganum, M. R.: A Simple Test of the Arbitrage Pricing Theory, Graduate School of Business, University of Southern California, 1980

[32] Reinganum, M. R.: Misspecification of Capital Asset Pricing: Empirical Anomalies Based on Earnings' Yields and Market Values, *Journal of Financial Economics*, Vol. 9, 1981, pp. 19-46

[33] Rosenberg, B., Reid K., and Lanstein R.: Persuasive Evidence of Market Inefficiency, *Journal of Portfolio Management*, Vol. 11, 1985, pp. 9-16

[34] Ross, S.: The Arbitrage Theory of Capital Asset Pricing, *Journal of Economic Theory*, Vol. 13, 1976, pp. 341-360

[35] Stein, D. M., Nemtchinov, V. and Pittman S.: Diversifying and Rebalancing: Emerging Market Countries, *Journal of Wealth Management*, Vol. 11, 2009, pp. 79-88

[36] Sharpe, W. F.: Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk, *Journal of Finance*, Vol. 19, 1964, pp. 425-442