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Short-, medium- and long-run performance persistence of investment funds in Poland

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Abstract

The author examines short-, medium- and long-run performance persistence in the assets of money, bond and stock funds listed on the Polish market in 2000–2012. It is a continuation of the author's previous work concerning long-run persistence of returns and investment risk in rolled five-year sub-periods. The safe, hybrid and stock fund portfolios are formed on the basis of tested funds. The persistence of returns and the revised Sharpe ratio are investigated in rolled 1-, 2-, 3-, 4- and 5-year sub-periods, with a one year step. Also, performance persistence is assessed using the classic CAPM as well as classic and modified Fama-French models, which allow for evaluating management skills. Four-year and five-year persistence of the revised Sharpe ratio of money and bond funds is found to occur. One can assume the occurrence of 4-year average return reversal for hybrid funds, and 2-year return and the revised Sharpe ratio persistence of stock fund portfolios. The CAPM and Fama-French model simulations of returns indicate stability management skills of stock and hybrid funds in 1-year sub-periods, as well as varying management skills of stock, hybrid and safe funds in 5-year sub-periods.

Keywords: performance persistence, investment funds performance, Fama-French model

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1 Introduction

Research on the performance persistence of fund investing on highly developed markets has been conducted since the late twentieth century.

Most of the work in this area relates to the equity funds on the US and EU markets. The findings of studies are also presented by Grinblatt and Titman (1993), Brown and Goetzmann (1995), Elton, Gruber and Blake (1996), Carhart (1997), Fletcher and Forbes (2002), Prater, Berlin and Henker (2004), Jan, Hung (2004), Kosowski et al. (2006), Huij and Verbeek (2007) and Cuthbertson, Nitzsche and O'Sullivan (2008). Most research indicates short-run performance persistence.

Bond and hedge funds have been researched less extensively. The findings of these studies on the US and EU markets are also shown by Philpot, Heath and Rimbey (2000), Agarwal and Naik (2000), Capocci and Hübner (2004), Silva, Cortem and Armada (2005), Droms and Walker (2006), Polwitoon and Tawatnuntachai (2006), and Du, Huang and Blanchfield (2009). The study also shows short-run persistence.

Hitherto research studies of all fund classes do not confirm long-term persistence in 5-year sub--periods on the US and EU markets.

Research on the performance persistence of funds investing on emerging markets has been conducted since the turn of the 20th and 21st centuries on a much narrower scale. Kang, Lee and Lee (2011) and Berggrun et al. (2014) present results of research on stock funds in Korea and Brazil, indicating performance persistence of stock funds investing in large companies.

The initial studies on short-run persistence in 2000–2013 of stock and hybrid funds on the Polish market were conducted by Gabryelczyk (2006), Jackowicz (2008), Jackowicz and Filip (2009), Swinkels and Rzezniczak (2009), Staniszewski and Smolarek (2010), Białkowski and Otten (2011), Perez (2012) and Pietrzyk (2014).[1] The authors document short-run persistence of returns in semi-annual and annual sub--periods, and show performance persistence of stock funds during periods of continuation of the trend.

Stanko (2003), Voronkova and Bohl (2005), and Karpio, Żebrowska-Suchodolska (2016) conduct studies of Polish pension funds. The results presented by Stanko (2003, p. iii) indicate that in 1999–2003, "…pension fund managers did produce additional value due to active management", while Voronkova and Bohl (2005) do not find any impact of pension funds on stock prices. Karpio and Żebrowska-Suchodolska (2016) studied the persistence of fourth performance measures of 14 pension funds quoted on the Polish market in 2000–2013. They tested persistence of Calmar ratio, Omega ratio, the ratio of the excess return and Sortino ratio in two, three, four, six and seven sub-periods (see Karpio, Żebrowska-Suchodolska 2016, p. 17 and pp. 21–22). Almost all cases of performance persistence have proven to be statistically insignificant.

Skrodzka (2014) initiated research of Polish bond funds. She tested (based upon the contingency table) the persistence of return and the classic Sharpe ratio of 10 mutual funds quoted in 2011. There are grounds for rejecting H_0 which states that persistence of return occurs only for one out of eleven examined monthly sub-periods. In the case of the Sharpe ratio, the performance persistence is stated for three out of eleven monthly sub-periods, and performance reversal scheme is stated for two out of eleven sub-periods.

[1] Hybrid fund portfolios, defined by Jackowicz and Filip (2009), combine stable growth funds and balanced funds. Polish stable growth funds invest 50–60% of assets in Treasury securities and 50-40% in stocks. Balanced funds may invest up to 70% in stocks. A Polish investment fund can invest up to 35% of its assets into OECD countries or in other international financial institutions in which Poland is a member.

Further and more detailed information on literature studies of performance persistence of funds investing on different markets are also shown in the paper of Urbański, Winiarz and Urbański (2016). They analyse the five-year persistence of returns and risk of investment in the assets of money, bond and stock funds recorded on the Polish market in 2000–2012. Persistence in performance is evaluated by the classic CAPM and classic 3-factor Fama and French model. The study shows the Sharpe ratio persistence of money and bond funds as well as varying management skills in the case of stock and hybrid funds.

The current analysis of Polish fund performance persistence is a continuation of the work of Urbański, Winiarz and Urbański (2016), and applies to a wider range of study. I examine the short-, medium- and long-run persistence of returns and risk of money, bond and stock funds on the Polish market in 1-, 2-, 3-, 4- and 5-year sub-periods. Also, this work aims to evaluate fund management in the presented cases. In this context, I evaluate persistence in performance using, additionally, the modified Fama and French (hereafter FF) model, which I briefly present in the Appendix. The application of the modified FF model, using indications of the further work of Fama and French (1995), and the author's own thoughts, additionally allow for the assessment of the phenomenon of performance persistence of tested funds. The proposed modified FF model is presented precisely in the monograph of Urbański (2011).

In order to refer the results of this work to the results presented by Urbański, Winiarz and Urbański (2016), the analysis is based on the same sample of funds listed in 2000–2012. Despite this, the results may be adjusted to the period of several subsequent years. It results from the commonly known fact of slow changes in betas estimating systematic risk. It can be confirmed by similar changes in systematic risk components in 1996–2005, 1996–2010, and 1996–2012, presented by Urbański (2011, 2012) and Urbański, Jawor and Urbański (2014).

The paper has the following structure. Section 2 presents input data and the range of research. Section 3 presents the methodology and analysis of calculation results. In Sub-section 3.1 I test persistence in n-year ($n = 1, \ldots, 5$) performance-sorted fund portfolios. In Sub-section 3.2 I employ the chosen ICAPM application for persistence in performance and an evaluation of fund management. Section 4 presents a summary and tips for investors.

2 Range of research

Research work is carried out on the basis of 161 Polish funds available in the database created by Notoria Serwis Company in 2000–2012. The analysed funds are divided into five portfolios. Portfolio 1 comprises 32 money funds, portfolio 2 – 29 bond funds, portfolio 3 – 30 stable growth funds, portfolio 4 – 26 balanced funds, and portfolio 5 – 44 stock funds. Because of the small number of funds in portfolios 1 and 2, and similar investment strategies, I merge portfolio 1 and portfolio 2, calling it a safe funds class portfolio. In a similar way, I merge portfolio 3 and portfolio 4, calling it a hybrid funds class portfolio. To conclude, I analyse 61 safe funds, 56 hybrid funds and 44 stock funds. The descriptive statistics of the investment fund portfolios and WIG are shown in Table 1.

A number of facts confirm that the Polish capital market can be the subject of in-depth analyses in the context of other European markets. In terms of the number of listed companies on the European market, the WSE ranked fourth after the London Stock Exchange, Euronext and Deutsche Börse. The capitalization of the WSE exceeded other East European stock exchanges.

Foreign and institutional investors have a great impact on the development of Poland's capital market. The results of the research conducted by WSE analysts indicate that the average percentages of the turnover of foreign and institutional investors in 2000–2013 amount to a total of 70% (see: www.gpw.pl/analizy_i_statystyki_pelna_wersja). Gurgul, Suliga and Wójtowicz (2012) show that decisions made by WSE investors are significantly correlated with US macroeconomic variables. Such data lead to the conclusion that foreign and institutional investors participating in the Polish capital market reflect a representative investor applying the principle of rational capital pricing.

This explains the choice of the Polish fund market[2] as a target for investigating funds returns in Central Europe's emerging markets.

3 Methodology and analysis of calculation results

In the study I apply two methods of testing short-, medium- and long-run fund performance persistence in *n*-year ($n = 1, \ldots, 5$) sub-periods.[3] The first method uses the procedures proposed by Collinet and Firer (2003) and Rayner and Little (1966), and is presented in Sub-section 3.1. The second method assumes the presence on the market of a representative investor who carries out transactions in accordance with the principle of rational capital pricing. Such an investor, then, applies the basic assumption of Arrow--Debreu, which state that market participants behave in a rational way, i.e. consumers maximize their utility, and producers – their profits (see: Arrow, Debreu 1954). On the other hand, CAPM is based on assumptions resulting from the Arrow-Debreu general equilibrium model and Markowitz model. This approach allows for the use of CAPM or ICAPM for company pricing and performance persistence in a given market.

The use of ICAPM for performance persistence and the evaluation of fund management skills is presented in Sub-section 3.2.

3.1 Persistence in *n*-year performance-sorted fund portfolios

I assess the *n*-year ($n = 1, 2, \ldots, 5$) persistence in subsequent rolled *n*-year sub-periods. Fund performance is measured by an average return and the revised Sharpe ratio (hereafter SR, see Sharpe 1994), on the basis of monthly investment periods. This method uses two procedures to test persistence.

The first one (see Collinet, Firer 2003) is based on the regression of percentile rankings $RP_{t,i}$ of fund i in sub-period t. The study focuses on funds existing in both consecutive sub-periods $t-1$ and t. Percentile ranking $RP_{t,i}$ is the transformed measure of fund performance into area <0; 1>. The estimation of parameter b of the regression below allows for persistence assessment.

$$RP_{t,i} = a + bRP_{t-1,i} + \varepsilon_i \tag{1}$$

[2] The Polish funds market is defined as a fund market filed in the public register of investment funds managed in Poland by the District Court of Warsaw.

[3] I identify short-run persistence by analyzing 1-year sub-periods. Medium-run persistence is analyzed on the basis of 2-year and 3-year sub-periods. Long-run persistence is identified on the basis of 4-year and 5-year sub-periods.

The null hypothesis is H_0: $b = 0$, persistence does not occur, and the alternative hypothesis is H_1: $b > 0$, determines persistence, and $b < 0$, determines inversion.

Table 2 presents estimated parameters of equation (1), constituting the regression of *n*-year ($n = 1, 2, \ldots, 5$) percentile rankings of average return and SR in subsequent *n*-year sub-periods.

The investigated sub-periods are rolled with a one year step if the overlapping sub-periods are analysed in conjunction. The investigated sub-periods are rolled with a *n* years step for the non--overlapping sub-periods.

Analysing the regressions of average return percentile rankings, it should be noted that the highest values of determination coefficient R^2 (above 30%) and large negative values of parameter *b* (about 0.50, with the corresponding *p*-values below 0.01) are recorded for 4-year sub-periods of hybrid and stock funds. In the case of stock funds R^2 is greater than 50% (R^2 = 53.94%) only for the non-overlapping sub-periods. However, for 1-, 2-, and 3-year sub-periods of safe and stock fund classes, coefficient R^2 assumes low values (below 10%). Also, parameter *b* assumes low but significant values (below 0.26) for safe funds, and insignificant values for stock funds. However, in the case of stock funds, if 1-year sub--periods are analysed, parameter *b* is significantly less than zero (corresponding *p*-value = 0.02), and R^2 = 1.78%).

In the case of hybrid funds, for 1-, and 2-year sub-periods, parameter *b* assumes low but significant values (below 0.19) and extremely low R^2 (below 3.18%). If 3-year sub-periods (of hybrid funds) are analysed, parameter *b* assumes higher, significantly negative values. Also, R^2 assumes two digital values: R^2 = 11.21%, b = -0.34 for the overlapping sub-periods, and R^2 = 27.35%, b = -0.48 for the non--overlapping sub-periods. If 5-year sub-periods are tested, parameter *b* assumes insignificant values for all investigated fund classes.

For regression of SR percentile rankings, R^2 is greater than 40% and large positive values of parameter *b* (from 0.52 to 0.66, with the corresponding *p*-values below 0.01) are recorded only for 4-year and 5-year sub-periods of safe fund class. However, in the case of non-overlapping 4-year sub-periods R^2 = 24.89%. Also, relatively high values of parameters *b* and R^2 appear for 1-year sub-periods of safe funds (b = 0.41 and R^2 = 16.62%), and if non-overlapping sub-periods are analysed, for 2-year sub-periods of hybrid funds (b = 0.47 and R^2 = 19.63%), and for 4-year sub-periods of stock funds (b = 0.50 and R^2 = 19.64%).

This means that there are unambiguous grounds for rejecting H_0, determining the 4-year average return reversal for the hybrid funds, and determining the 4-year and 5-year SR persistence for the safe fund class, at a level below 1%.

The other approach makes use of the regression of rankings $RANK_{t,i}$ of fund performance measures in the two neighbouring sub-periods *t* of fund *i*. As in the case of the first procedure, the study analyses funds existing in both consecutive sub-periods $t - 1$ and *t*. The estimation of parameter *b* of regression (2) allows for persistence assessment.

$$RANK_{t,i} = a + bRANK_{t-1,i} + \varepsilon_i \quad (2)$$

The null hypothesis is: H_0: $b = 0$, persistence does not occur, and the alternative hypothesis is H_1: $b > 0$, determines persistence, and $b < 0$, determines inversion.

Table 3 presents estimated parameters of equation (2), constituting the regression of *n*-year ($n = 1, 2, \ldots, 5$) rankings of average return and SR in subsequent *n*-year sub-periods. As in the case of regression (1), the investigated sub-periods are rolled with a one year step if the overlapping sub-periods are analysed in conjunction, and with an *n*-year step for the non-overlapping sub-periods.

The regressions of average return rankings are characterized by significantly greater than zero parameter *b* for 1-, 2- and 3-year sub-periods of safe and stock funds, as well as for 1- and 2-year sub--periods of hybrid funds. The loadings *b* for 4- and 5-year sub-periods of all tested fund classes are insignificant. However, the determination coefficient R^2 assumes low values in most of the tested cases, except the 2-year sub-periods of stock funds. R^2 is greater than 25% for 2-year sub-periods of stock funds if the non-overlapping sub-periods are analysed.

The regressions of SR rankings are characterized by significantly greater than zero parameter *b* for 1-, 2-, 3-, 4- and 5-year sub-periods of safe and hybrid funds, as well as for 1-, 2- and 3-year sub-periods of stock funds. However, R^2 is greater than 30% and 40% only for 4-year and 5-year sub-periods of safe fund class, and parameter *b* assumes values from 0.56 to 0.72 with the corresponding *p*-values below 0.01. Also, R^2 is about 20% for 2-year sub-periods of stock funds.

This means that there are unambiguous grounds for rejecting H_0, determining the 4-year and 5-year SR persistence for the safe fund class, at a level below 1%.

One can expect 2-year persistence of the SR and average return for stock funds. However, it requires further studies. There is no reason for rejecting H_0 in the other tested cases.

The changes of persistence loading *b*, and R^2 in regressions (1) and (2) for different *n*-year sub--periods ($n = 1, \ldots, 5$) of safe funds are shown in Figures 1 and 2.

Figure 3 presents the regression of SR percentile rankings of safe funds in the subsequent rolled 5-year sub-periods, assuming monthly investments. If the overlapping sub-periods are analysed in conjunction, the first sub-periods are 2000–2004, 2001–2005, 2002–2006, and 2003-2007, and the second sub-periods are 2005–2009, 2006–2010, 2007–2011, and 2008–2012. If the non-overlapping sub-periods are analysed, the first sub-period is 2003–2007, and the second sub-period is 2008–2012.

On the basis of the results presented in Tables 2 and 3 as well as Figures 1, 2 and 3, one can conclude about the persistence of SR of safe funds in 4- and 5-year sub-periods.

Most of the other tested regressions are characterized by low slopes and R^2 parameters, and do not indicate clearly persistence or reversal of tested performances. The symptoms of 4-year return and SR persistence are found for stock funds. If the non-overlapping sub-periods are analysed, parameters *b* of regression (1) of returns and SR are equal to 0.79 and 0.50, respectively, with corresponding *p*-values below 0.02. The values of R^2 are 53.94% and 19.64% (see Table 2). Also, the symptoms of 2-year return and SR persistence are found for stock funds. Parameters *b* of regression (2) of returns and SR are about 0.50 with corresponding *p*-values below 0.01. The values of R^2 are about 20% (see Table 3). The symptoms of 4-year return reversal are found for hybrid funds. Parameter *b* of regression (1) is about -0.48, with corresponding *p*-values below 0.01 (also, for overlapping and non-overlapping sub-periods). The value of R^2 is about 33% (see Table 2).

3.2 Performance persistence employing the chosen ICAPM application

The measure of fund performance is the average excess return assuming monthly investment periods. Excess return is calculated as the excess of the Polish 91-day Treasury bill return. The average excess return is calculated at the end of 2000 (on the basis of previous 12 months) and quintile portfolios are formed. Returns on given portfolios are average funds returns, linearly weighted so the weights are readjusted whenever a fund disappears. Funds with the highest performances include portfolio 1, and funds with the lowest – portfolio 5. I hold the portfolios for *n*-years (n = 1,2,…, 5) and calculate the monthly excess returns throughout the year beginning *n* years later, because persistence in *n*-year performance-sorted fund portfolios is examined. This procedure is rolled several times with a one year step, e.g. if n = 1, quintile portfolios are formed on the basis of average excess return at the end of the successive years from 2000 to 2011. The constructed portfolios are held for one year and the monthly excess returns throughout 2001–2012 are calculated. The procedures of portfolios forming and calculation of post-formation excess returns are rolled twelve times. Post-formation portfolios yield 144 time series of monthly excess returns. Consequently, if n = 5, quintile portfolios are formed on the basis of average excess return at the end of the successive years from 2000 to 2007. The constructed portfolios are held for five years, and the monthly excess returns throughout 2008–2012 are calculated. The procedures of portfolios forming and calculation of post-formation excess returns are rolled eight times. Post-formation portfolios yield the 96 time series of monthly excess returns which are subject to tests. A similar procedure of decile portfolios forming on lagged 1-year return, and persistence testing is applied by Carhart (1997).

I estimate excess return on formed portfolios, relative to the classic CAPM, modified FF model proposed by Urbański (2011), and the classic FF model, using the method proposed by Carhart (1997). My research is different from Carchart's research because he estimates excess return relative to the classic CAPM and 4-factor Carhart (1995) model.

Tables 4 and 5 present the values of estimated parameters of regressions testing the stock funds in light of the classic CAPM, modified FF model, and the classic FF model: Urbański (2012) presents the pricing of stock listed on the WSE in 1995–2010, by modified FF model.

Research on stock funds show that the classic CAPM does not completely describe returns on the portfolios formed on lagged *n*-year (n = 1, …, 5) excess return. The values of betas $\beta_{i,M}$ are similar, and intercepts are significantly less than zero for 18 out of 25 tested cases. The classic and modified FF models allow for a better explanation of returns.

Most of the factor loadings are significantly different from zero. The intercepts (alphas) of regression, testing the classic FF model, are significantly less than zero for 14 out of 25 tested cases. However the alphas of regression, testing the modified FF model, are significantly less than zero only for 6 out of 25 tested cases. This indicates that the factors of the modified FF model take into account the most information on return description. The adjusted determination coefficient (Adjusted R^2) assumes high and similar values both for CAPM (from 83.3% to 96.7%), the classic FF model (from 83.1% to 96.8%) and the modified FF model (from 83.9% to 96.7%).

The alpha (in regressions, testing both the classic CAPM, modified FF model and classic FF model for stock funds) assumes the highest values in quintiles 1 for 1-, 3- and 4-year persistence and decreases in subsequent quintiles. For quintile 1, estimates from the modified FF model indicate positive abnormal return of 5 basis points per month for 1-year persistence, negative abnormal return of 4 basis points for 3-year persistence, and negative abnormal return of 10 basis points for 4-year persistence. Estimates from the classic FF model (for quintile 1) indicate negative abnormal return of 22 basis points per month for 1-year persistence, negative abnormal return of 4 basis points for 3-year persistence, and positive abnormal return of less than 1 basis point for 4-year persistence. Estimates from the classic CAPM (for quintile 1) indicate negative abnormal return of 15 basis points per month for 1-year persistence, negative abnormal return of 7 basis points for 3-year persistence, and negative abnormal return of 9 basis points for 4-year persistence. For quintile 5, estimates from the modified FF model indicate negative abnormal return of 28 basis points for 1-year persistence, negative abnormal return of 39 basis points for 3-year persistence, and negative abnormal return of 22 basis points for 4-year persistence. Estimates from the classic FF model (for quintile 5) indicate negative abnormal return of 57 basis points per month for 1-year persistence, negative abnormal return of 51 basis points for 3-year persistence, and negative abnormal return of 31 basis points for 4-year persistence. Estimates from the classic CAPM (for quintile 5) indicate negative abnormal return of 55 basis points per month for 1-year persistence, negative abnormal return of 49 basis points for 3-year persistence, and negative abnormal return of 36 basis points for 4-year persistence. For estimation of the classic CAPM and classic FF model, alpha spreads are significantly greater than zero for 1- and 3-year persistence, which indicates lower average returns for the bottom-quintile funds and a persistence of average returns on portfolios formed on lagged 1- and 3-year fund performance. Also, this reflects stability management skills of stock funds in 1- and 3-year sub-periods.

The alpha in regressions, testing all analysed models for 5-year persistence of stock funds, assumes the lowest value in quintile 1, which increases in subsequent quintiles. For quintile 1, estimation from the modified FF model indicates negative abnormal return of 59 basis points per month, classic FF model estimation indicates negative abnormal return of 84 basis points, and classic CAPM estimation indicates negative abnormal return of 75 basis points. For quintile 5, estimation from the modified FF model indicates negative abnormal return of 22 basis points per month, classic FF model estimation indicates negative abnormal return of 27 basis points, and classic CAPM estimation indicates negative abnormal return of 40 basis points. Alpha spreads are lower than zero at the significance levels of 5%, 19% and 22% for estimations of the classic FF model, CAPM, and modified FF model, respectively. Therefore, it suggests a reversal scheme of average returns (on portfolios formed on lagged 5-year returns) and varying management skills of stock funds in 5-years sub-periods.

Tables 6 and 7 present the values of estimated parameters of regressions testing the hybrid funds in light of the classic CAPM, modified FF model, and the classic FF model.

Research on hybrid funds shows that the classic CAPM, modified and classic FF models provide a good explanation of returns on the formed portfolios. The values of Adjusted R^2 are lower compared to stock funds, and range from 50.9% to 87.6% for the CAPM, from 50.4% to 87.6% for the classic FF model, and from 50.5% to 85.2% for the modified FF model. The factor parameters for the majority of portfolios are significantly different from zero, and intercepts are insignificant for most portfolios.

For estimation of the CAPM, alpha spreads are significantly greater than zero for 1- and 4-year persistence, which indicates lower average returns for the bottom-quintile funds and persistence of average returns on portfolios formed on lagged 1- and 4-year fund performance. For estimation of the classic and modified FF model, alpha spreads are greater than zero, for 1- and 4-year persistence, at the significance level about 14%. Also, this reflects stability management skills in 1- and 4-year sub-periods. However, in the case of 5-year persistence, alpha spreads are lower than zero for estimations for CAPM as well as the classic and modified FF models. Therefore, similarly to the stock fund class, it suggests a reversal scheme of average returns, and varying management skills of stock funds in 5-year sub-periods.

Tables 8 and 9 present the values of estimated parameters of regressions testing the safe funds in light of the classic CAPM, modified FF model, and the classic FF model.

Research on safe funds shows that for 1-, 2-, 3- and 4-year persistence, neither the classic CAPM nor modified and classic FF models fully explain returns on the formed portfolios. The values of Adjusted R^2 are lower compared to stock and hybrid funds, and range from -0.7% to 25.6% for the CAPM, from -1.7% to 28.2% for the classic FF model, and from -1.3% to 29.6% for the modified FF model. It should be noted, however, that Fama and French (1993, p. 20 and 25) also found low values of Adjusted R^2 on the American bond market (about 18% for Aaa bounds and 30% for LG bounds). FF models do not explain returns better than CAPM for 1-, 2-, 3- and 4-year persistence. In this study the loadings on *HML* and *SMB* as well as on *HMLN* and *LMHD* factors are insignificant.

However, in the case of 5-year persistence, *HML*, *SMB*, *HMLN* and *LMHD* loadings are significant for most quintiles. Alpha spreads are negative at the levels of 9% and 8% for CAPM, and modified FF model simulations, which indicates a reversal scheme of average returns and varying management skills in 5-year sub-periods. The post-formation monthly excess returns on the quintile portfolios for 1-, 3- and 4-year persistence decrease in portfolio rank, and increase for 2- and 5-year persistence, but indicated spreads are insignificant.

4 Summary

The conducted research explicitly shows 4-year persistence of SR, and confirms 5-year persistence of SR (determined by Urbański, Winiarz and Urbański 2016) for safe funds. The assessment of returns and SR persistence for hybrid and stock funds is different, depending on the length of tested sub-periods and test methods.

Collinet and Firer's (2003) procedure shows 4-year average return reversal for the hybrid funds. However, on the basis of Rayner and Little's (1966) procedure, one can expect the SR and average return 2-year persistence for stock funds.

The study proves 4- and 5-year persistence of SR for safe funds because, in the long run, managers effectively optimize returns and risk simultaneously. The study does not prove the following:

– the 1-, 2- and 3-year persistence of SR for safe funds,

– the persistence of SR for hybrid and stock funds,

– the persistence of returns for any funds because managers optimize relations of return to risk, but not only returns.

Estimation of excess return on stock funds, relative to the classic CAPM and classic FF model, indicating a positive alpha spread and return persistence, reflects stability management skills in 1- and 3-year sub-periods. However, the results of simulation (by classic FF model) indicate a negative alpha spread and a reversal scheme of average returns on portfolios formed on lagged 5-year fund performance. This reflects varying management skills of stock funds in 5-year sub--periods.

Estimation of excess return on hybrid funds, relative to the classic CAPM, indicating a positive alpha spread and return persistence, reflects stability management skills in 1- and 4-year sub-periods. However, the results of simulation (by CAPM as well as the classic and modified FF models) indicate, similarly to the stock fund class, a negative alpha spread and a reversal scheme of average returns on portfolios formed on lagged 5-year fund performance. This reflects the varying management skills of hybrid funds, in 5-year sub-periods.

Neither CAPM nor classic and modified FF models explain the returns on safe funds satisfactorily. Factor loadings are significant for most quintiles only in the case of 5-year sub-periods. Also, negative alpha spreads reflect a reversal scheme of returns, and varying management skills in 5-year sub-periods.

All the results of the research lead to the following conclusions:

1 The 4-year and 5-year persistence of the SR for money and bond funds recorded on the Polish market is found in 2000–2012.

2 One can assume the occurrence of 4-year average return reversal for hybrid funds, and 2-year average return and SR persistence of stock fund portfolios on the Polish market in 2000–2012.

3 The estimation of excess return on stock funds, reflecting a positive alpha spread, indicates stability management skills in 1- and 3-year sub-periods, and (reflecting a negative alpha spread) varying management skills in 5-year sub-periods.

4 The estimation of excess return on hybrid funds, reflecting a positive alpha spread, indicates stability management skills in 1- and 4-year sub-periods, and (reflecting a negative alpha spread) varying management skills in 5-year sub-periods.

5 The estimation of excess return on safe funds, reflecting a negative alpha spread, indicates varying management skills in 5-year sub-periods.

In the context of world literature, the achievement of the presented studies is the presentation of the possibility of the combined optimization of long-term return and risk involved in investing in Polish money and bond funds. Such a possibility is not confirmed in the case of hybrid or share funds. Also, the study indicates the possible application of the classic CAPM model and the classic and modified Fama and French models in the analysis of fund performance persistence, and the evaluation of fund management methods on the Polish market. The correct specification of return changes of stocks and hybrid funds tested by ICAPM applications indicates the dominant influence of investors' rational behaviour on capital market changes.

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Appendix

Pricing in light of the modified Fama-French model

On the basis of Fama and French (1995, pp. 134–140, Figures 1 and 2, and Table 1), I modify the FF (1993) three factor model, expecting that the following conjecture is true:

Conjecture

The economic state variable that produces variation in the future earnings and returns related to size and *BV/MV* is a vector of structure of the past long-term differences in profitability.

The adopted general state variable can be reflected by functional *FUN*, defined by equations (1A), (2A) and (3A).

$$FUN = \frac{NUM}{DEN} = \frac{\text{nor}(ROE) \times \text{nor}(AS) \times \text{nor}(APO) \times \text{nor}(APN)}{\text{nor}(MV/E) \times \text{nor}(MV/BV)} \tag{1A}$$

where:

$$ROE = F_1;\ AS = F_2 = \frac{\sum_{t=1}^{i} S(Q_t)}{\sum_{t=1}^{i} \overline{S(nQ_t)}};\ APO = F_3 = \frac{\sum_{t=1}^{i} PO(Q_t)}{\sum_{t=1}^{i} \overline{PO(nQ_t)}};$$
$$APN = F_4 = \frac{\sum_{t=1}^{i} PN(Q_t)}{\sum_{t=1}^{i} \overline{PN(nQ_t)}};\quad MV/E = F_5;\ MV/BV = F_6 \tag{2A}$$

F_j (j = 1,…, 6) are transformed to normalized areas $<a_j;\ b_j>$, according to equation (3A):

$$\text{nor}(F_j) = \left[a_j + (b_j - a_j) \times \frac{F_j - c_j \times F_j^{\min}}{d_j \times F_j^{\max} - c_j \times F_j^{\min} + e_j}\right] \tag{3A}$$

In equations (2A) and (3A), the corresponding indications are as follows:

ROE is return on book equity;

$\sum_{t=1}^{i} S(Q_t)$, $\sum_{t=1}^{i} PO(Q_t)$, $\sum_{t=1}^{i} PN(Q_t)$ are values that are accumulated from the beginning of the year as net sales revenue (*S*), operating profit (*PO*) and net profit (*PN*) at the end of *i* quarter (Q_i);

$\sum_{t=1}^{i} \overline{S(nQ_t)}$, $\sum_{t=1}^{i} \overline{PO(nQ_t)}$, $\sum_{t=1}^{i} \overline{PN(nQ_t)}$ are average values, accumulated from the beginning of the year as *S, PO* and *PN* at the end of Q_i over the last *n* years (the present research assumes that n = 3 years);

MV/E is the market-to-earning value ratio;

E is the average earning for the last four quarters;

MV/BV is the market-to-book value ratio;

a_j, b_j, c_j, d_j, e_j are variation parameters.

In equilibrium modelling F_j $(j = 1,\ldots,6)$ can be transformed into equal normalized area <1; 2> (see Urbański 2011).

The constructed functional *FUN* represents an investor constructing a portfolio, using the structure of the past long-term differences in profitability, which consists of the best fundamental and undervalued stocks. *FUN* is dependent on company evaluation indicators, occurring in the numerator (*NUM*) and company market pricing indicators in the denominator (*DEN*). *NUM* represents an investor building a portfolio, comprising the best fundamental firms, while *DEN* represents an investor who purchases undervalued stocks (see, Urbanski 2011). *FUN* contains a clear economic interpretation and may constitute a criterion for selecting securities for the portfolio. The investment is more attractive if the *FUN* value is greater.

In the case of the proposed modification of FF model, the factors are defined as follows:

$$F_{1t} = HMLN_t \tag{4Aa}$$

$$F_{2t} = LMHD_t \tag{4Ab}$$

$$F_{3t} = RMOA_t \tag{4Ac}$$

where:

$HMLN_t$ (high minus low) is the difference between the returns from the portfolio with the highest and lowest NUM_t values in period t,

$LMHD_t$ (low minus high) is the difference between the returns from the portfolio with the lowest and highest DEN_t values in period t,

$RMOA_t$ is the market factor, defined as excess market return over the risk-free rate, not correlated with $HMLN_t$ and $LMHD_t$.

The basic pricing equation of any assets can be presented as follows: $p_{it} = E_t(m_{t+1} x_{i,t+1})$, where p_{it} is the current assets price i, m_{t+1}, is the stochastic discount factor, and $x_{i,\,t+1}$ is a future pay-out (see e.g. Cochrane 2001, pp. 63–65, and Balvers 2001, pp. 136–137). Considering (4A), it can be shown that the basic pricing equation of any assets and the representation (5A) are equivalent:

$$r_{it} - RF_t = \beta_{i,HMLN} HMLN_t + \beta_{i,LMHD} LMHD_t + \beta_{i,MOA} RMOA_t \tag{5A}$$

The proposed financial pricing model (5A) can be tested by statistical model in two passes (6Aa) and (6Ab).

$$r_{it} - RF_t = \alpha_i + \beta_{i,HMLN}\, HMLN_t + \beta_{i,LMHD}\, LMHD_t + \beta_{i,MOA} RMOA_t + e_{it};\; t = 1, \ldots, T;\; \forall i = 1,\ldots, m \tag{6Aa}$$

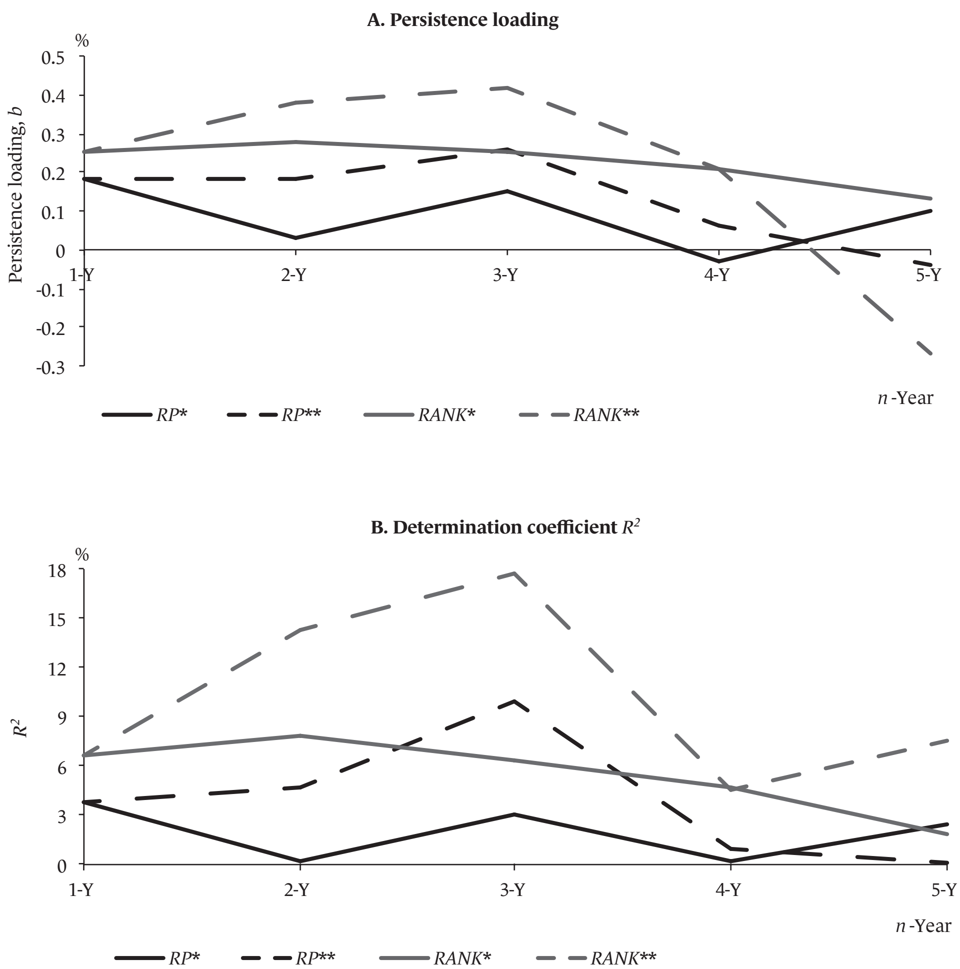
$$r_{it} - RF_t = \gamma_0 + \gamma_{HMLN}\, \hat{\beta}_{i,HMLN} + \gamma_{LMHD}\, \hat{\beta}_{i,LMHD} + \gamma_{MOA}\, \hat{\beta}_{i,MOA} + \varepsilon_{it}; \quad i = 1, \ldots m;\; t = 1, \ldots T \tag{6Ab}$$

where $\beta_{i,k}$ $(k = HMLN, LMHD, MOA)$ is a vector of systematic risk components), and γ_k $(k = HMLN, LMHD, MOA)$ is a vector of risk price components.

Figure 1

Regressions of average return rankings of safe funds in the subsequent sub-periods

$$RP_{t,i} = a + bRP_{t-1,i} + \varepsilon_i,\ RANK_{t,i} = a + bRANK_{t-1,i} + \varepsilon_i$$



Notes:

n-Y refers to the persistence in subsequent n-year sub-periods, $RANK_{t,i}$ refers to the average monthly return ranking of fund i in sub-period t. $RP_{t,i}$ is the transformed measure of fund performance into area <0; 1>, and refers to the percentile ranking of the average monthly return of fund i in sub-period t.

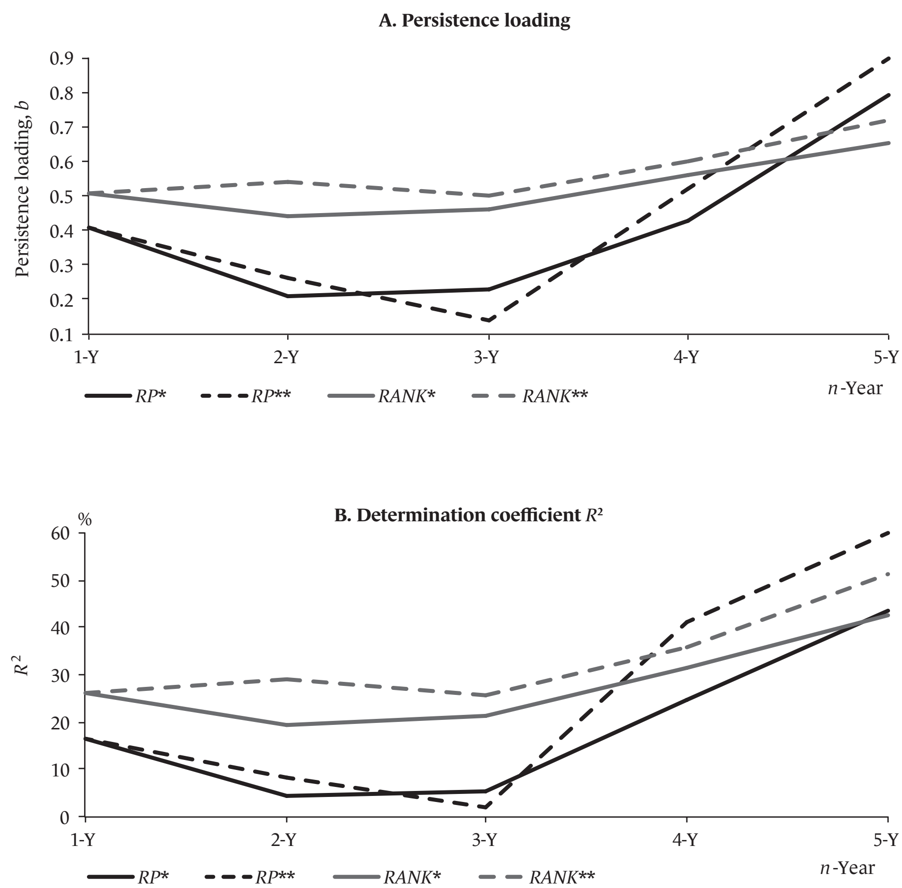
* The overlapping sub-periods are analysed in conjunction, and the investigated sub-periods are rolled with a one year step.

** The non-overlapping sub-periods are analysed in conjunction, and the investigated sub-periods are rolled with a n years step.

Figure 2

Regressions of revised Sharpe ratio rankings of safe funds in the subsequent sub-periods

$RP_{t,i} = a + bRP_{t-1,i} + \varepsilon_i$, $RANK_{t,i} = a + bRANK_{t-1,i} + \varepsilon_i$



Notes:

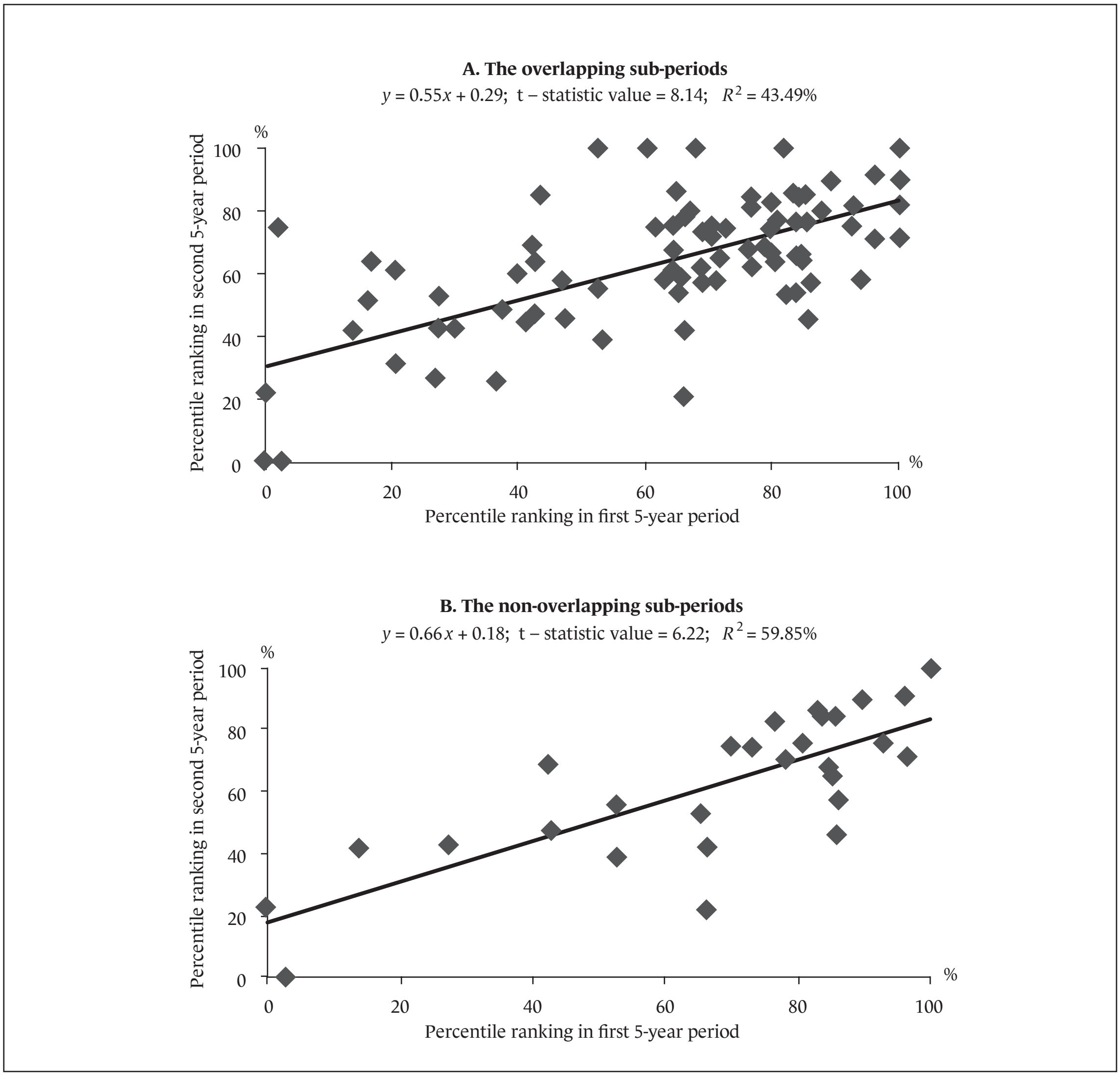
n-Y refers to the persistence of subsequent *n*-year sub-periods. $RANK_{t,i}$ refers to the revised Sharpe ratio ranking of fund *i* in sub-period *t*. $RP_{t,i}$ is the transformed measure of fund performance into area <0; 1>, and refers to the percentile ranking of the revised Sharpe ratio of fund *i* in sub-period *t*.

* The overlapping sub-periods are analysed in conjunction, and the investigated sub-periods are rolled with a one year step.

** The non-overlapping sub-periods are analysed in conjunction, and the investigated sub-periods are rolled with a *n* years step.

Figure 3

Regressions of SR percentile rankings of safe funds in the subsequent rolled 5-year sub-periods analysed in conjunction



Notes:

Percentile ranking is the transformed measure of fund revised Sharpe ratio into area <0; 1>. If the overlapping sub-periods are analysed in conjunction, the first sub-periods are 2000–2004, 2001–2005, 2002–2006, and 2003–2007, and the second sub-periods are 2005–2009, 2006–2010, 2007–2011, and 2008–2012. If the non-overlapping sub-periods are analysed in conjunction, the first sub-period is 2003–2007, and the second sub-period is 2008–2012. The safe funds class contains 32 money funds and 29 bond funds.

Table 1
The descriptive statistics of the investment funds and WIG index

	Monthly investments			Quarterly investments		
	$\bar{r}$ (st. dev.) (p-value) H_0: $r_e = 0$ H_1: $r_e > 0$	revised Sharpe ratio	t (p-value) H_0: $r_{eF} = r_{e\,WIG}$ H_1: $r_{eF} > r_{e\,WIG}$	$\bar{r}$ (st. dev.) (p-value) H_0: $r_e = 0$ H_1: $r_e > 0$	revised Sharpe ratio	t (p-value) H_0: $r_{eF} = r_{e\,WIG}$ H_1: $r_{eF} > r_{e\,WIG}$
WIG*	0.81% (6.75%) (0.14)	0.03	–	2.30% (11.82%) (0.17)	0.05	–
Safe funds	0.57% (0.55%) (0.00)	-0.01	-0.45 (0.33)	1.68% (1.27%) (0.00)	-0.05	-0.31 (0.38)
Hybrid funds	0.50% (2.35%) (0.01)	-0.03	-0.53 (0.30)	1.43% (4.26%) (0.02)	-0.06	-0.50 (0.31)
Stock funds*	0.55% (5.43%) (0.21)	-0.00	-0.38 (0.35)	1.54% (10.13%) (0.28)	-0.07	-0.35 (0.36)

Notes:
The sample period is from 2000 to 2012. 32 money funds, 29 bond funds, 30 stable growth funds, 26 balanced funds and 44 stock funds are analysed.
Safe fund portfolios combine money funds and bond funds. Polish money funds invest assets in Treasury debt securities, instruments of money market and other debt securities with a maturity period below one year. Polish bond funds invest assets in Treasury debt securities, mortgage and corporate bonds. Polish bond funds invest above 66% of assets in the Polish financial instruments. Hybrid fund portfolios combine stable growth funds and balanced funds. Polish stable growth funds invest 50–60% of assets in Treasury securities and 50–40% in stocks. Balanced funds may invest up to 70% in stocks. Polish stock funds invest 70–100% of assets in stocks. A Polish investment fund can invest up to 35% of its assets in OECD countries or in other international financial institutions in which Poland is a member. Investments in other foreign countries require the approval of the Polish Financial Supervision Authority.
$\bar{r}$ is mean return; r_e is expected return, $r_{e\,WIG}$ is expected return on WIG; r_{eF} is expected return on the tested fund.
* Source: Urbański, Winiarz, Urbański (2016).

Table 2
Regressions of percentile rankings of fund performance in the subsequent sub-periods

n-Year persistence	$RP_{t,i} = a + bRP_{t-1,i} + \varepsilon_i$					
	Safe funds		**Hybrid funds**		**Stock funds**	
	b (*p*-value)	R^2 (%)	*b* (*p*-value)	R^2 (%)	*b* (*p*-value)	R^2 (%)
Panel A. Percentile ranking of average return						
1-Y	**0.18 (0.00)**	3.74	**0.11 (0.02)**	1.33	**-0.14 (0.02)**	1.78
2-Y	0.03 (0.48)	0.14	**0.19 (0.00)**	2.92	0.02 (0.71)	0.07
2-Y*	**0.18 (0.00)**	4.77	**0.19 (0.02)**	3.18	0.03 (0.78)	0.08
3-Y	**0.15 (0.01)**	3.08	**-0.34 (0.00)**	11.21	0.24 (0.13)	5.56
3-Y*	**0.26 (0.00)**	9.99	**-0.48 (0.00)**	27.35	**0.18 (0.03)**	3.87
4-Y	-0.03 (0.56)	0.22	**-0.49 (0.00)**	32.59	0.24 (0.04)	5.44
4-Y*	0.06 (0.51)	0.96	**-0.46 (0.00)**	34.60	0.79 (0.00)	53.94
5-Y	0.10 (0.14)	2.45	-0.19 (0.08)	3.62	0.36 (0.04)	8.79
5-Y*	-0.04 (0.86)	0.11	-0.19 (0.24)	5.56	0.43 (0.28)	9.54

Table 2, cont'd

n-Year persistence	$RP_{t,i} = a + bRP_{t-1,i} + \varepsilon_i$					
	Safe funds		**Hybrid funds**		**Stock funds**	
	b (*p*-value)	R^2 (%)	*b* (*p*-value)	R^2 (%)	*b* (*p*-value)	R^2 (%)
Panel B. Percentile rankings of revised Sharpe ratio						
1-Y	**0.41 (0.00)**	16.62	**-0.10 (0.04)**	0.99	**-0.12 (0.03)**	1.71
2-Y	**0.21 (0.00)**	4.42	**0.15 (0.01)**	2.11	**0.28 (0.00)**	7.67
2-Y*	**0.26 (0.00)**	8.45	**0.47 (0.00)**	19.63	**0.30 (0.01)**	7.95
3-Y	**0.23 (0.00)**	5.49	**-0.18 (0.00)**	4.27	0.08 (0.60)	0.67
3-Y*	0.14 (0.21)	1.84	**-0.31 (0.00)**	11.03	**0.18 (0.03)**	3.69
4-Y	**0.43 (0.00)**	24.89	-0.25 (0.00)	6.91	**0.23 (0.04)**	5.55
4-Y*	**0.52 (0.00)**	41.18	0.15 (0.19)	3.63	**0.50 (0.02)**	19.64
5-Y**	**0.55 (0.00)**	43.49	-0.04 (0.79)	0.00	0.07 (0.54)	0.81
5-Y*	**0.66 (0.00)**	59.85	0.28 (0.12)	9.73	-0.12 (0.65)	1.81

Notes:
The persistence is investigated in rolled *n*-year (n = 1,…5) sub-periods. *n*-Y refers to the persistence in subsequent *n*-year sub-periods. Safe fund class combines 32 money and 29 bond funds. Hybrid fund class combines 30 stable growth and 26 balanced funds. Stock fund class consists of 44 funds. The study focuses on funds existing in both consecutive sub-periods $t - 1$ and t. $RP_{t,i}$ is the transformed measure of fund performance into area <0; 1> and refers to the percentile ranking of the fund performance measures (return in Panel A and revised Sharpe ratio in Panel B) in the two following *n*-year periods of fund *i*. The overlapping sub-periods are analysed in conjunction.
* The non-overlapping sub-periods are analysed in conjunction (see Figures 1 and 2).
H_0: $b = 0$, persistence does not occur; H_1: $b > 0$, determines persistence, and $b < 0$, determines reversal.
** Source: Urbański, Winiarz, Urbański (2016).
Bold type – the parameter is significantly different from zero at the level of 5%.

Table 3

Regressions of rankings of fund performance in the subsequent sub-periods

n-Year persistence	$RANK_{t,i} = a + bRANK_{t-1,i} + \varepsilon_i$					
	Safe funds		Hybrid funds		Stock funds	
	b (*p*-value)	R^2 (%)	*b* (*p*-value)	R^2 (%)	*b* (*p*-value)	R^2 (%)
Panel A. Rankings of average return						
1-Y	**0.25 (0.00)**	6.66	**0.10 (0.03)**	1.03	**0.28 (0.00)**	7.96
2-Y	**0.28 (0.00)**	6.38	**0.12 (0.03)**	1.39	**0.38 (0.00)**	14.37
2-Y*	**0.38 (0.00)**	14.29	**0.38 (0.00)**	14.41	**0.50 (0.00)**	25.38
3-Y	**0.25 (0.00)**	6.38	0.10 (0.12)	1.04	**0.31 (0.04)**	9.70
3-Y*	**0.42 (0.00)**	17.67	0.11 (0.30)	1.32	**0.26 (0.00)**	6.67
4-Y	**0.21 (0.01)**	4.70	0.02 (0.78)	0.05	**0.24 (0.03)**	5.66
4-Y*	0.21 (0.15)	4.48	-0.10 (0.49)	1.05	0.12 (0.55)	1.53
5-Y	0.13 (0.21)	1.78	-0.04 (0.68)	0.20	0.32 (0.03)	10.17
5-Y*	-0.27 (0.13)	7.52	-0.27 (0.18)	7.09	0.11 (0.71)	1.16
Panel B. Rankings of revised Sharpe ratio						
1-Y	0.51 (0.00)	26.23	**0.20 (0.00)**	4.00	**0.30 (0.00)**	8.74
2-Y	0.44 (0.00)	19.39	**0.28 (0.00)**	7.68	**0.43 (0.00)**	18.76
2-Y*	0.54 (0.00)	29.03	**0.39 (0.00)**	15.41	**0.48 (0.00)**	22.95
3-Y	0.46 (0.00)	21.52	**0.27 (0.00)**	7.53	0.27 (0.08)	7.46
3-Y*	0.50 (0.00)	25.48	**0.32 (0.00)**	9.96	**0.24 (0.01)**	5.51
4-Y	0.56 (0.00)	31.37	**0.36 (0.00)**	13.14	**0.29 (0.01)**	8.29
4-Y*	0.60 (0.00)	35.94	**0.36 (0.01)**	12.75	0.26 (0.20)	6.68
5-Y**	0.65 (0.00)	42.68	**0.30 (0.00)**	9.31	0.21 (0.14)	4.61
5-Y*	0.72 (0.00)	51.26	0.31 (0.13)	9.52	0.14 (0.63)	2.04

Notes:

The persistence is investigated in rolled *n*-year ($n = 1,\ldots 5$) sub-periods. *n*-Y refers to the persistence in subsequent *n*-year sub-periods. Safe fund class combines 32 money and 29 bond funds. Hybrid fund class combines 30 stable growth and 26 balanced funds. Stock fund class consists of 44 funds. The study focuses on funds existing in both consecutive sub-periods $t-1$ and t. $RANK_{t,i}$ refers to the ranking of the fund performance measures (return in Panel A and revised Sharpe ratio in Panel B) in the two following *n*-year periods of fund *i*. The overlapping sub-periods are analysed in conjunction.

* The non-overlapping sub-periods are analysed in conjunction (see Figures 1 and 2).

H_0: $b = 0$, persistence does not occur; H_1: $b > 0$, determines persistence, and $b < 0$ determines reversal.

** Source: Urbański, Winiarz, Urbański (2016).

Bold type – the parameter is significantly different from zero at the level of 5%.

Table 4
Parameters of models simulating the returns on stock fund portfolios formed on lagged *n*-year excess return; post-formation returns and intercepts

Response variable: monthly excess returns on stock fund portfolios										
Portfolio	$\bar{r}$ (p-value)[a] (p-value)[b]					Panel A. The classic CAPM, α_i (p-value)[a] $r_{it} - RF_t = \alpha_i + \beta_{i,M}(RM_t - RF_t) + e_{it}$				
	1-Y	2-Y	3-Y	4-Y	5-Y[c]	1-Y	2-Y	3-Y	4-Y	5-Y[c]
Quintile 1) r_{ex_1}	0.12% (0.80)[a]	-0.13% (0.80)[a]	0.62% (0.30)[a]	0.30% (0.63)[a]	-0.42% (0.58)[a]	-0.15% (0.30)	-0.57% (0.00)	-0.07% (0.65)	-0.09% (0.58)	-0.75% (0.00)
2) r_{ex_2}	-0.04% (0.94)[a]	0.29% (0.61)[a]	0.37% (0.54)[a]	0.24% (0.70)[a]	-0.13% (0.85)[a]	-0.32% (0.02)	-0.19% (0.21)	-0.33% (0.04)	-0.14% (0.25)	-0.44% (0.00)
3) r_{ex_3}	0.09% (0.86)[a]	0.34% (0.50)[a]	0.39% (0.47)[a]	0.08% (0.90)[a]	-0.12% (0.87)[a]	-0.20% (0.11)	-0.09% (0.40)	-0.25% (0.07)	-0.30% (0.03)	-0.43% (0.00)
4) r_{ex_4}	0.02% (0.97)[a]	0.12% (0.82)[a]	0.20% (0.72)[a]	-0.39% (0.52)[a]	-0.02% (0.98)[a]	-0.26% (0.10)	-0.34% (0.04)	-0.42% (0.03)	-0.78% (0.00)	-0.32% (0.04)
Quintile 5) r_{ex_5}	-0.30% (0.55)[a]	-0.03% (0.95)[a]	0.16% (0.78)[a]	0.00% (0.99)[a]	-0.10% (0.89)[a]	-0.55% (0.00)	-0.45% (0.02)	-0.49% (0.02)	-0.36% (0.11)	-0.40% (0.06)
1–5 spread	0.42% (0.04)[a] (0.27)[b]	-0.10% (0.55)[a] (0.45)[b]	0.46% (0.03)[a] (0.29)[b]	0.30% (0.16)[a] (0.36)[b]	-0.32% (0.23)[a] (0.38)[b]	0.41% (0.04)	-0.12% (0.48)	0.42% (0.05)	-0.28% (0.20)	-0.35% (0.19)
Mean Adjusted R^2, %						90.81	91.02	90.23	93.21	93.22

Table 4, cont'd

Portfolio	Panel B. Modified FF three-factor model, α_i (p-value)[a] $r_{it} - RF_t = \alpha_i + \beta_{i,HMLN} HMLN_t + \beta_{i,LMHD} LMHD_t + \beta_{i,MOA} RMOA_t + e_{it}$					Panel C. Classic FF three-factor model, α_i (p-value)[a] $r_{it} - RF_t = \alpha_i + \beta_{i,HML} HML_t + \beta_{i,SMB} SMB_t + \beta_{i,MOF} RMOF_t + e_{it}$				
	1-Y	2-Y	3-Y	4-Y	5-Y	1-Y	2-Y	3-Y	4-Y	5-Y[c]
Quintile 1) r_{ex_1}	0.05% (0.77)	-0.36% (0.06)	-0.04% (0.84)	-0.10% (0.64)	-0.59% (0.05)	-0.22% (0.12)	-0.63% (0.00)	-0.04% (0.80)	0.00% (0.98)	-0.84% (0.00)
2) r_{ex_2}	-0.22% (0.15)	-0.15% (0.39)	-0.27% (0.19)	-0.16% (0.37)	-0.39% (0.00)	-0.35% (0.01)	-0.17% (0.27)	-0.39% (0.03)	-0.15% (0.28)	-0.37% (0.00)
3) r_{ex_3}	-0.14% (0.32)	-0.14% (0.26)	-0.26% (0.16)	-0.36% (0.05)	-0.40% (0.00)	-0.26% (0.04)	-0.06% (0.60)	-0.20% (0.19)	-0.25% (0.10)	-0.39% (0.00)
4) r_{ex_4}	-0.09% (0.59)	-0.06% (0.75)	-0.27% (0.25)	-0.77% (0.00)	-0.26% (0.14)	-0.30% (0.06)	-0.42% (0.01)	-0.47% (0.03)	-0.75% (0.00)	-0.27% (0.11)
Quintile 5) r_{ex_5}	-0.28% (0.22)	-0.29% (0.21)	-0.39% (0.13)	-0.22% (0.42)	-0.22% (0.34)	-0.57% (0.01)	-0.46% (0.02)	-0.51% (0.02)	-0.31% (0.19)	-0.27% (0.21)
1–5 spread	0.33% (0.14)	-0.07% (0.72)	0.35% (0.16)	0.13% (0.60)	-0.37% (0.22)	0.35% (0.08)	-0.17% (0.34)	0.47% (0.05)	0.31% (0.19)	-0.56% (0.05)
Mean Adjusted R^2, %	91.04	91.23	89.24	90.95	93.11	91.14	91.33	91.12	93.62	93.41

Notes:
This table presents the parameters assessing the classic CAPM, modified FF and classic FF three-factor models. Stock funds are sorted on 1 January each year (2001–2012 for 1-Y, 2002–2012 for 2-Y, 2003–2012 for 3-Y, 2004–2012 for 4-Y and 2005–2012 for 5-Y) into quintile portfolios based on their lagged *n*-year excess return. *n*-Y refers to the persistence in subsequent *n*-year periods. The portfolios are equally weighted monthly so the weights are readjusted whenever a fund disappears. Funds with the highest past *n*-year excess return comprise quintile 1 and funds with the lowest comprise quintile 5. *RM* is the market return evaluated by the return on the WIG. *RF* is the 91-day Polish Treasury bill return. *HMLN* and *LMHD* are modified FF factors and defined by equation (4A). *HML* and *SMB* are classic FF factors. *RMOF* is the orthogonalized stock-market factor not correlated with *HML* and *SMB*. *RMOA* is the orthogonalized stock-market factor not correlated with *HMLN* and *LMHD*. $\bar{r}$ is a post-formation mean monthly excess return. Below $\bar{r}$ and α_1 their corresponding *p*-values are indicated in brackets.

[a] H_0: $r_e = 0$; H_1: $r_e \neq 0$.

[b] H_0: $r^e_{quintile\_1} = r^e_{quintile\_5}$; H_1: $r^e_{quintile\_1} > r^e_{quintile\_5}$. r_e is an expected excess return; $r^e_{quintile\_i}$ is an expected excess return on quintile *i*.

[c] Source: Urbański, Winiarz, Urbański (2016).

Table 5
Parameters of models simulating the returns on stock fund portfolios formed on lagged *n*-year excess return; factor loadings

Response variable: monthly excess returns on stock fund portfolios								
Portfolio		Panel A. CAPM	Panel B. Modified FF model			Panel C. Classic FF model		
		$\beta_{i,M}$ (*p*-value)	$\beta_{i,HMLN}$ (*p*-value)	$\beta_{i,LMHD}$ (*p*-value)	$\beta_{i,MOA}$ (*p*-value)	$\beta_{i,HML}$ (*p*-value)	$\beta_{i,SMB}$ (*p*-value)	$\beta_{i,MOF}$ (*p*-value)
Portfolios formed on average lagged *n*-year excess return, r_{ex_i}								
1-Y	Quintile 1	0.79 (0.00)	0.01 (0.83)	0.17 (0.00)	0.80 (0.00)	0.57 (0.00)	-0.45 (0.00)	0.77 (0.00)
	Quintile 5	0.75 (0.00)	-0.13 (0.13)	0.29 (0.00)	0.76 (0.00)	0.41 (0.00)	-0.37 (0.00)	0.75 (0.00)
2-Y	Quintile 1	0.82 (0.00)	-0.13 (0.07)	0.27 (0.00)	0.83 (0.00)	0.49 (0.00)	-0.21 (0.00)	0.81 (0.00)
	Quintile 5	0.78 (0.00)	-0.09 (0.29)	0.25 (0.00)	0.79 (0.00)	0.52 (0.00)	-0.32 (0.00)	0.77 (0.00)
3-Y	Quintile 1	0.89 (0.00)	-0.21 (0.02)	0.28 (0.00)	0.88 (0.00)	0.54 (0.00)	-0.47 (0.00)	0.87 (0.00)
	Quintile 5	0.83 (0.00)	-0.25 (0.02)	0.24 (0.00)	0.83 (0.00)	0.59 (0.00)	-0.46 (0.00)	0.81 (0.00)
4-Y	Quintile 1	0.91 (0.00)	-0.77 (0.00)	0.50 (0.00)	0.90 (0.00)	0.61 (0.00)	-0.52 (0.00)	0.89 (0.00)
	Quintile 5	0.85 (0.00)	-0.79 (0.00)	0.40 (0.00)	0.84 (0.00)	0.69 (0.00)	-0.51 (0.00)	0.81 (0.00)
5-Y	Quintile 1	0.94[b] (0.00)	-0.73 (0.00)	0.50 (0.00)	0.93 (0.00)	0.69[b] (0.00)	-0.40[b] (0.00)	0.93[b] (0.00)
	Quintile 5	0.87[b] (0.00)	-0.64 (0.00)	0.38 (0.00)	0.87 (0.00)	0.68[b] (0.00)	-0.58[b] (0.00)	0.84[b] (0.00)

Table 5, cont'd

Panel D. Carhart (1997, p. 64), period 1963–1993								
	1-Y CAPM			1-Y four-factor model				
	α_i (p-value)	$\beta_{i,M}$ (p-value)	Adj. R^2, %	α_i (p-value)	$\beta_{i,HML}$ (p-value)[a]	$\beta_{i,SMB}$ (p-value)	$\beta_{i,MOF}$ (p-value)	Adj. R^2, %
Decile 1 (high)	0.22% (0.04)[a]	1.03 (0.00)[a]	83.41	-0.12% (0.11)[a]	-0.05 (0.07)[a]	0.62 (0.00)[a]	0.88 (0.00)[a]	93.31
Decile 10 (low)	-0.45% (0.00)[a]	1.02 (0.00)[a]	85.12	-0.40% (0.00)[a]	-0.08 (0.03)[a]	0.32 (0.00)[a]	0.93 (0.00)[a]	88.72
1–10 spread	0.67% (0.00)[a]	0.01 (0.70)[a]	-0.23	0.29% (0.04)[a]	0.03 (0.60)[a]	0.30 (0.00)[a]	-0.05 (0.13)[a]	23.14

Notes:
Panels A, B and C present the parameter assessing:
the classic CAPM: $r_{it} - RF_t = \alpha_i + \beta_{i,M}(RM_t - RF_t) + e_{it}$,
modified FF three-factor model: $r_{it} - RF_t = \alpha_i + \beta_{i,HMLN} HMLN_t + \beta_{i,SMB} LMHD_t + \beta_{i,MOF} RMOA_t + e_{it}$,
Classic FF three-factor model: $r_{it} - RF_t = \alpha_i + \beta_{i,HML} HML_t + \beta_{i,SMB} SMB_t + \beta_{i,MOF} RMOF_t + e_{it}$.
Stock funds are sorted on 1 January each year (2001–2012 for 1-Y, 2002–2012 for 2-Y, 2003–2012 for 3-Y, 2004–2012 for 4-Y and 2005–2012 for 5-Y) into quintile portfolios based on their lagged n-year excess return. *n*-Y refers to the persistence in subsequent *n*-year periods. The portfolios are equally weighted monthly so the weights are readjusted whenever a fund disappears. Funds with the highest past *n*-year excess return comprise quintile 1 and funds with the lowest comprise quintile 5. *RM* is the market return evaluated by the return on the WIG. *RF* is the 91-day Polish Treasury bill return. *HMLN* and *LMHD* are modified FF factors and defined by equation (4A). *HML* and *SMB* are classic FF factors. *RMOF* is the orthogonalized stock-market factor not correlated with *HML* and *SMB. RMOA* is the orthogonalized stock-market factor not correlated with *HMLN* and *LMHD*. Panel D presents the parameters assessing the classic CAPM and Carhart 4-factor model on the American market: $r_{it} - RF_t = a_i + \beta_{i,HML} HML_t + \beta_{i,SMB} SMB_t + \beta_{i,MOF}(RM_t - RF_t) + \beta_{i,PR} PR + e_{it}$.
Parameter $\beta_{i,PR}$ is not reported.
[a] Own computing using Carhart (1997) data.
[b] Source: Urbański, Winiarz, Urbański (2016).

Table 6

Parameters of models simulating the returns on hybrid fund portfolios formed on lagged *n*-year excess return; post-formation returns and intercepts

Response variable: monthly excess returns on hybrid fund portfolios										
Portfolio	$\overline{r}$ (*p*-value)[a] (*p*-value)[b]					Panel A. The classic CAPM, α_i (*p*-value)[a] $r_{it} - RF_t = \alpha_i + \beta_{i,M}(RM_t - RF_t) + e_{it}$				
	1-Y	2-Y	3-Y	4-Y	5-Y[c]	1-Y	2-Y	3-Y	4-Y	5-Y[c]
Quintile 1) r_{ex_1}	-0.04% (0.87)[a]	-0.02% (0.96)[a]	0.32% (0.28)[a]	0.22% (0.56)[a]	-0.23% (0.66)[a]	-0.16% (0.31)	-0.28% (0.12)	0.00% (0.98)	0.03% (0.91)	-0.41% (0.18)
2) r_{ex_2}	-0.06% (0.78)[a]	0.08% (0.77)[a]	0.15% (0.64)[a]	-0.04% (0.92)[a]	-0.05% (0.91)[a]	-0.18% (0.06)	-0.14% (0.22)	-0.16% (0.34)	-0.24% (0.05)	-0.24% (0.20)
3) r_{ex_3}	-0.10% (0.75)[a]	0.18% (0.57)[a]	0.44% (0.17)[a]	0.22% (0.54)[a]	0.30% (0.55)[a]	-0.25% (0.15)	-0.06% (0.70)	0.11% (0.51)	0.02% (0.90)	0.09% (0.68)
4)r_{ex_4}	-0.06% (0.90)[a]	0.23% (0.53)[a]	0.74% (0.06)[a]	0.48% (0.27)[a]	0.33% (0.57)[a]	-0.26% (0.33)	-0.02% (0.94)	0.39% (0.15)	0.28% (0.36)	0.12% (0.75)
Quintile 5) r_{ex_5}	-0.45% (0.32)[a]	0.55% (0.22)[a]	0.40% (0.41)a	-0.38% (0,55)[a]	0.68% (0.20)[a]	-0.65% (0.02)	0.24% (0.37)	-0.05% (0.86)	-0.70% (0.08)	0.49% (0.16)
1–5 spread	0.40% (0.20)[a] (0.22)[b]	-0.57% (0.06)[a] (0.16)[b]	-0.07% (0.84)[a] (0.45)[b]	0.60% (0.16)[a] (0.21)[b]	-0.91% (0.00)[a] (0.11)[b]	0.49% (0.07)	-0.52% (0.08)	0.06% (0.87)	0.72% (0.06)	-0.90% (0.00)
Mean Adjusted R^2, %						68.81	71.13	66.21	67.55	68.21

Table 6, cont'd

Portfolio	Panel B. Modified FF three-factor model, α_i (p-value)[a] $r_{it} - RF_t = \alpha_i + \beta_{i,HMLN} HMLN_t + \beta_{i,LMHD} LMHD_t + \beta_{i,MOA} RMOA_t + e_{it}$					Panel C. Classic FF three-factor model, α_i (p-value)[a] $r_{it} - RF_t = \alpha_i + \beta_{i,HML} HML_t + \beta_{i,SMB} SMB_t + \beta_{i,MOF} RMOF_t + e_{it}$				
	1-Y	2-Y	3-Y	4-Y	5-Y	1-Y	2-Y	3-Y	4-Y	5-Y[c]
Quintile 1) r_{ex_1}	-0.25% (0.15)	-0.39% (0.06)	0.04% (0.84)	-0.09% (0.75)	-0.46% (0.16)	-0.09% (0.60)	-0.23% (0.23)	0.05% (0.76)	0.04% (0.87)	-0.35% (0.29)
2) r_{ex_2}	-0.14% (0.18)	-0.13% (0.33)	-0.16% (0.43)	-0.37% (0.02)	-0.14% (0.49)	-0.18% (0.06)	-0.08% (0.48)	-0.06% (0.77)	-0.17% (0.21)	-0.13% (0.52)
3) r_{ex_3}	-0.27% (0.19)	-0.20% (0.24)	-0.06% (0.78)	-0.16% (0.47)	0.19% (0.44)	-0.15% (0.40)	-0.03% (0.87)	0.11% (0.57)	0.17% (0.40)	0.02% (0.93)
4) r_{ex_4}	-0.63% (0.03)	-0.31% (0.25)	0.26% (0.41)	0.30% (0.40)	0.12% (0.76)	-0.21% (0.45)	0.02% (0.94)	0.49% (0.11)	0.17% (0.61)	0.25% (0.52)
Quintile 5) r_{ex_5}	-0.73% (0.02)	0.19% (0.54)	-0.23% (0.52)	-0.73% (0.12)	0.74% (-0.06)	-0.51% (0.07)	0.15% (0.60)	-0.01% (0.98)	-0.59% (0.18)	0.48% (0.20)
1–5 spread	0.47% (0.14)	-0.57% (0.09)	0.27% (0.51)	0.64% (0.15)	-1.20% (0.00)	0.43% (0.13)	-0.37% (0.22)	0.06% (0.88)	0.63% (0.14)	-0.83% (0.02)
Mean Adjusted R^2, %	69.54	72.27	64.38	65.54	57.74	69.01	71.03	66.14	67.23	68.81

Notes:
This table presents the parameters assessing the classic CAPM, modified and classic FF three-factor models. Hybrid funds are sorted on 1 January each year (2001–2012 for 1-Y, 2002–2012 for 2-Y, 2003–2012 for 3-Y, 2004–2012 for 4-Y and 2005–2012 for 5-Y) into quintile portfolios based on their lagged *n*-year excess return. *n*-Y refers to the persistence in subsequent *n*-year periods. The portfolios are equally weighted monthly so the weights are readjusted whenever a fund disappears. Funds with the highest past *n*-year excess return comprise quintile 1 and funds with the lowest comprise quintile 5. *RM* is the market return evaluated by the return on the WIG. *RF* is the 91-day Polish Treasury bill return. *HMLN* and *LMHD* are modified FF factors and defined by equation (4A). *HML* and *SMB* are FF factors. *RMOA* is the orthogonalized stock-market factor not correlated with *HMLN* and *LMHD*. $RMOF_t$ is the orthogonalized stock-market factor not correlated with *HML* and *SMB*. $\bar{r}$ is a post-formation mean monthly excess return. Below $\bar{r}$ and α_i their corresponding *p*-values are indicated in brackets.

[a] H_0: $r_e = 0$; H_1: $r_e \neq 0$.

[b] H_0: $r^e_{quintile\_1} = r^e_{quintile\_5}$; H_1: $r^e_{quintile\_1} > r^e_{quintile\_5}$; r_e is an expected excess return; $r^e_{quintile\_i}$ is an expected excess return on quintile *i*

[c] Source: Urbański, Winiarz, Urbański (2016).

Table 7

Parameters of models simulating the returns on hybrid fund portfolios formed on lagged n-year excess return; factor loadings

		Panel A. CAPM	Panel B. Modified FF model			Panel C. Classic FF model		
Portfolio		$\beta_{i,M}$ (p-value)	$\beta_{i,HMLN}$ (p-value)	$\beta_{i,LMHD}$ (p-value)	$\beta_{i,MOA}$ (p-value)	$\beta_{i,HML}$ (p-value)	$\beta_{i,SMB}$ (p-value)	$\beta_{i,MOF}$ (p-value)
Portfolios formed on average lagged n-year excess return, r_{ex_i}								
1-Y	Quintile 1	0.34 (0.00)	0.13 (0.05)	-0.10 (0.11)	0.34 (0.00)	0.09 (0.06)	-0.17 (0.00)	0.34 (0.00)
	Quintile 5	0.60 (0.00)	0.12 (0.27)	-0.11 (0.29)	0.60 (0.00)	0.13 (0.12)	-0.28 (0.00)	0.61 (0.00)
2-Y	Quintile 1	0.49 (0.00)	0.11 (0.15)	0.13 (0.04)	0.49 (0.00)	0.24 (0.00)	-0.20 (0.00)	0.49 (0.00)
	Quintile 5	0.59 (0.00)	0.21 (0.06)	-0.06 (0.56)	0.60 (0.00)	0.42 (0.00)	-0.15 (0.10)	0.57 (0.00)
3-Y	Quintile 1	0.41 (0.00)	-0.13 (0.08)	0.15 (0.01)	0.40 (0.00)	0.21 (0.00)	-0.21 (0.00)	0.40 (0.00)
	Quintile 5	0.58 (0.00)	0.08 (0.61)	0.10 (0.39)	0.57 (0.00)	0.44 (0.00)	-0.40 (0.00)	0.55 (0.00)
4-Y	Quintile 1	0.46 (0.00)	-0.27 (0.06)	0.23 (0.01)	0.45 (0.00)	0.28 (0.00)	-0.23 (0.03)	0.45 (0.00)
	Quintile 5	0.74 (0.00)	-0.59 (0.01)	0.38 (0.01)	0.75 (0.00)	0.33 (0.03)	-0.40 (0.02)	0.75 (0.00)
5-Y	Quintile 1	0.52[a] (0.00)	0.17 (0.33)	-0.15 (0.16)	0.53 (0.00)	0.26[a] (0.02)	-0.28[a] (0.03)	0.52[a] (0.00)
	Quintile 5	0.54[a] (0.00)	-0.17 (0.42)	-0.12 (0.33)	0.55 (0.00)	0.50[a] (0.00)	-0.30[a] (0.04)	0.52[a] (0.00)

Notes:
Panels A, B and C present the parameters assessing:
the classic CAPM: $r_{it} - RF_t = \alpha_i + \beta_{i,M}(RM_t - RF_t) + e_{it}$,
modified FF three-factor model: $r_{it} - RF_t = \alpha_i + \beta_{i,HML}HMLN_t + \beta_{i,SMB}LMHD_t + \beta_{i,MOF}RMOA_t + e_{it}$,
classic FF three-factor model: $r_{it} - RF_t = \alpha_i + \beta_{i,HML}HML_t + \beta_{i,SMB}SMB_t + \beta_{i,MOF}RMOF_t + e_{it}$.
Hybrid funds are sorted on January 1 each year (2001–2012 for 1-Y, 2002–2012 for 2-Y, 2003–2012 for 3-Y, 2004–2012 for 4-Y and 2005–2012 for 5-Y) into quintile portfolios based on their lagged n-year excess return. n-Y refers to the persistence in subsequent n-year periods. The portfolios are equally weighted monthly so the weights are readjusted whenever a fund disappears. Funds with the highest past n-year excess return comprise quintile 1 and funds with the lowest comprise quintile 5. *RM* is the market return evaluated by the return on the WIG. RF is the 91-day Polish Treasury bill return. *HMLN* and *LMHD* are modified FF factors and defined by equation (4A). *HML* and *SMB* are FF factors. *RMOF* is the orthogonalized stock-market factor not correlated with *HML* and *SMB*. *RMOA* is the orthogonalized stock-market factor not correlated with *HMLN* and *LMHD*.
[a] Source: Urbański, Winiarz, Urbański (2016).

Table 8

Parameters of models simulating the returns on safe fund portfolios formed on lagged *n*-year excess return; post-formation returns and intercepts

Response variable: monthly excess returns on bond fund portfolios										
Portfolio	$\overline{r}$ (*p*-value)[a] (*p*-value)[b]					Panel A. The classic CAPM, α_1 (*p*-value)[a] $r_{it} - RF_t = \alpha_i + \beta_{i,M}(RM_t - RF_t) + e_{it}$				
	1-Y	2-Y	3-Y	4-Y	5-Y[c]	1-Y	2-Y	3-Y	4-Y	5-Y[c]
Quintile 1) r_{ex_1}	0.09% (0.22)[a]	-0.06% (0.56)[a]	-0.01% (0.89)[a]	0.04% (0.76)[a]	-0.12% (0.24)[a]	0.08% (0.30)	-0.08% (0.45)	-0.04% (0.60)	0.01% (0.96)	-0.15% (0.10)
2) r_{ex_2}	0.02% (0.72)[a]	-0.05% (0.25)[a]	-0.12% (0.16)[a]	-0.01% (0.88)[a]	0.01% (0.89)[a]	0.01% (0.86)	-0.06% (0.17)	-0.16% (0.05)	-0.03% (0.65)	0.01% (0.96)
3) r_{ex_3}	0.00% (0.99)[a]	0.02% (0.52)[a]	-0.03% (0.44)[a]	-0.06% (0.13)[a]	-0.06% (0.28)[a]	-0.00 (0.93)	0.02% (0.63)	-0.04% (0.26)	-0.07% (0.07)	-0.07% (0.17)
4) r_{ex_4}	-0.01% (0.86)[a]	-0.04% (0.66)[a]	-0.07% (0.50)[a]	-0.03% (0.80)[a]	0.00% (0.99)[a]	-0.02% (0.72)	-0.06% (0.58)	-0.09% (0.40)	-0.04% (0.70)	-0.02% (0.87)
Quintile 5) r_{ex_5}	0.02% (0.83)[a]	0.00% (0.98)[a]	-0.06% (0.50)[a]	-0.06% (0.53)[a]	0.01% (0.93)[a]	0.01 (0.90)	-0.02% (0.81)	-0.07% (0.47)	-0.07% (0.38)	0.00% (0.98)
1–5 spread	0.07% (0.39)[a] (0.25)[b]	-0.06% (0.50)[a] (0.32)[b]	0.05% (0.59)[a] (0.35)[b]	0.09% (0.29)[a] (0.27)[b]	-0.13% (0.14)[a] (0.19)[b]	0.07% (0.44)	-0.06% (0.51)	0.02% (0.81)	0.08% (0.36)	-0.14% (0.09)
Mean Adjusted R^2, %						7.12	3.03	5.64	11.44	11.63

Table 8, cont'd

Portfolio	Panel B. Modified FF three-factor model, α_1 (p-value)[a] $r_{it} - RF_t = \alpha_i + \beta_{i,HMLN} HMLN_t + \beta_{i,LMHD} LMHD_t + \beta_{i,MOA} RMOA_t + e_{it}$					Panel C. Classic FF three-factor model, α_1 (p-value)[a] $r_{it} - RF_t = \alpha_i + \beta_{i,HML} HML_t + \beta_{SMB} SMB_t + \beta_{i,MOF} RMOF_t + e_{it}$				
	1-Y	2-Y	3-Y	4-Y	5-Y	1-Y	2-Y	3-Y	4-Y	5-Yc
Quintile 1) r_{ex_1}	0.05% (0.51)	-0.01% (0.92)	-0.03% (0.73)	-0.02% (0.90)	-0.18% (0.07)	0.12% (0.12)	-0.04% (0.69)	-0.02% (0.85)	-0.01% (0.94)	-0.09% (0.36)
2) r_{ex_2}	0.00% (0.95)	-0.07% (0.18)	-0.15% (0.09)	-0.01% (0.89)	-0.02% (0.85)	0.02% (0.55)	-0.03% (0.60)	-0.08% (0.35)	-0.03% (0.62)	0.03% (0.81)
3) r_{ex_3}	-0.02% (0.73)	-0.01% (0.89)	-0.02% (0.67)	-0.08% (0.06)	-0.12% (0.03)	0.02% (0.73)	0.04% (0.30)	-0.04% (0.37)	-0.06% (0.15)	-0.04% (0.44)
4) r_{ex_4}	-0.07% (0.31)	0.01% (0.92)	-0.07% (0.57)	-0.10% (0.41)	0.01% (0.96)	0.04% (0.55)	-0.02% (0.82)	-0.05% (0.64)	0.01% (0.90)	-0.04% (0.71)
Quintile 5) r_{ex_5}	0.04% (0.63)	0.01% (0.90)	-0.02% (0.82)	-0.13% (0.20)	-0.01% (0.94)	0.05% (0.52)	0.01% (0.87)	-0.03% (0.74)	-0.03% (0.78)	0.01% (0.96)
1–5 spread	0.01% (0.90)	-0.02% (0.83)	-0.01% (0.92)	0.11% (0.26)	-0.17% (0.08)	0.07% (0.46)	-0.06% (0.54)	0.02% (0.87)	0.02% (0.85)	-0.09% (0.31)
Mean Adjusted R^2, %	7.62	3.82	4.43	12.81	15.86	10.11	4.63	6.74	13.72	12.73

Notes:
This table presents the parameters assessing the classic CAPM, modified and classic FF three-factor model. Safe funds are sorted on 1 January each year (2001–2012 for 1-Y, 2002–2012 for 2-Y, 2003–2012 for 3-Y, 2004–2012 for 4-Y and 2005–2012 for 5-Y) into quintile portfolios based on their lagged *n*-year excess return. *n*-Y refers to the persistence in subsequent *n*-year periods. The portfolios are equally weighted monthly so the weights are readjusted whenever a fund disappears. Funds with the highest past *n*-year excess return comprise quintile 1 and funds with the lowest comprise quintile 5. *RM* is the market return evaluated by the return on the WIG. *RF* is the 91-day Polish Treasury bill return. *HMLN* and *LMHD* are modified FF factors and defined by equation (4A). *HML* and *SMB* are FF factors. *RMOF* is the orthogonalized stock-market factor not correlated with *HML* and *SMB*. *RMOA* is the orthogonalized stock-market factor not correlated with *HMLN* and *LMHD*. $\bar{r}$ is a post-formation mean monthly excess return. Below $\bar{r}$ and α_1 their corresponding *p*-values are indicated in brackets.

[a] $H_0: r_e = 0$; $H_1: r_e \neq 0$.

[b] $H_0: r^e_{quintile\_1} = r^e_{quintile\_5}$; $H_1: r^e_{quintile\_1} > r^e_{quintile\_5}$; r_e is an expected excess return; $r^e_{quintile\_i}$ is an expected excess return on quintile *i*.

[c] Source: Urbański, Winiarz, Urbański (2016).

Table 9

Parameters of models simulating the returns on safe fund portfolios formed on lagged *n*-year excess return; factor loadings

	Portfolio	Panel A. CAPM	Panel B. Modified FF model			Panel C. Classic FF model		
		$\beta_{i,M}$ (p-value)	$\beta_{i,HMLN}$ (p-value)	$\beta_{i,LMHD}$ (p-value)	$\beta_{i,MOA}$ (p-value)	$\beta_{i,HML}$ (p-value)	$\beta_{i,SMB}$ (p-value)	$\beta_{i,MOF}$ (p-value)
Response variable: monthly excess returns on bond fund portfolios								
Portfolios formed on average lagged *n*-year excess return, r_{ex_i}								
1-Y	Quintile 1	0.05 (0.00)	0.04 (0.15)	-0.04 (0.12)	0.05 (0.00)	-0.02 (0.30)	-0.03 (0.20)	0.05 (0.00)
	Quintile 5	0.02 (0.05)	0.01 (0.78)	-0.05 (0.12)	0.02 (0.03)	-0.05 (0.05)	-0.00 (0.88)	0.03 (0.02)
2-Y	Quintile 1	0.03 (0.05)	-0.04 (0.39)	-0.00 (0.93)	0.03 (0.04)	-0.03 (0.37)	-0.01 (0.86)	0.03 (0.03)
	Quintile 5	0.03 (0.01	0.01 (0.84)	-0.03 (0.24)	0.03 (0.00)	-0.03 (0.25)	-0.01 (0.83)	0.04 (0.00)
3-Y	Quintile 1	0.04 (0.00)	-0.01 (0.74)	0.01 (0.74)	0.04 (0.00)	-0.03 (0.24)	-0.00 (0.98)	0.05 (0.00)
	Quintile 5	(0.01) (0.62)	-0.03 (0.44)	-0.03 (0.44)	0.01 (0.51)	-0.02 (0.47)	-0.02 (0.66)	0.01 (0.53)
4-Y	Quintile 1	0.07 (0.00)	0.01 (0.93)	-0.03 (0.40)	0.08 (0.00)	-0.04 (0.31)	0.01 (0.77)	0.08 (0.00)
	Quintile 5	0.04 (0.00)	0.03 (0.57)	-0.00 (0.93)	0.04 (0.00)	-0.03 (0.29)	-0.05 (0.20)	0.05 (0.00)
5-Y	Quintile 1	0.07[a] (0.00)	0.08 (0.10)	-0.06 (0.04)	0.08 (0.00)	0.01[a] (0.74)	-0.08[a] (0.03)	0.07[a] (0.00)
	Quintile 5	0.03[a] (0.02)	0.06 (0.35)	-0.06 (0.07)	0.04 (0.01)	-0.04[a] (0.25)	-0.00[a] (0.92)	0.04[a] (0.01)

Notes:
Panels A, B and C present the parameters assessing:
the classic CAPM: $r_{it} - RF_t = \alpha_i + \beta_{i,M}(RM_t - RF_t) + e_{it}$,
modified FF three-factor model: $r_{it} - RF_t = \alpha_i + \beta_{i,HML} HMLN_t + \beta_{i,SMB} LMHD_t + \beta_{i,MOF} RMOA_t + e_{it}$,
FF three-factor model: $r_{it} - RF_t = \alpha_i + \beta_{i,HML} HML_t + \beta_{i,SMB} SMB_t + \beta_{i,MOF} RMOF_t + e$.
Bond funds are sorted on 1 January each year (2001–2012 for 1-Y, 2002–2012 for 2-Y, 2003–2012 for 3-Y, 2004–2012 for 4-Y and 2005–2012 for 5-Y) into quintile portfolios based on their lagged *n*-year excess return. *n*-Y refers to the persistence in subsequent *n*-year periods. The portfolios are equally weighted monthly so the weights are readjusted whenever a fund disappears. Funds with the highest past *n*-year excess return comprise quintile 1 and funds with the lowest comprise quintile 5. *RM* is the market return evaluated by the return on the WIG. *RF* is the 91-day Polish Treasury bill return. *HMLN* and *LMHD* are modified FF factors and defined by equation (4A). *HML* and *SMB* are FF factors. *RMOF* is the orthogonalized stock-market factor not correlated with *HML* and *SMB*. *RMOA* is the orthogonalized stock-market factor not correlated with *HMLN* and *LMHD.*
[a] Source: Urbański, Winiarz, Urbański (2016).