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APPLICATION OF MULTIFACTORIAL MARKET-TIMING MODELS TO ASSESS RISK AND EFFECTIVENESS OF EQUITY-LINKED INSURANCE FUNDS IN POLAND

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Abstract

Traditionally, models developed by Treynor and Mazuy (T-M) and also by Henriksson-Merton (H-M), which are called market-timing models, are applied to assess effectiveness of investment funds. The objective of the presented study is an application of the T-M and H-M models and their T-M-FF and H-M-FF modifications with additional Fama-French factors to assess effectiveness and risk of equity insurance connected with unit-linked insurance. Estimation and verification of the models for the subject group of equity funds were performed and the significance of the impact of particular factors on returns on reference portfolios was discussed.

Key words: market-timing model, Fama-French factor, equity funds.

1. Introduction

According to a classical capital asset pricing model (CAPM) the skill of managers described as microforecasting is assessed. Such skill covers identification of single assets, which are undervalued or overvalued compared to assets in general at a particular market situation. The fund manager will possess it if during the selection of securities to a portfolio s/he considers risk analysis characteristic for particular securities, not focusing only on the risk of the entire market at the same time. Market timing, on the other hand, is understood the skill to forecast short-term increases or inclines in security prices and proper responding to such changes. A proper response of an investor, who uses market-timing techniques, ought to assure proper proportions within the investment portfolio between risk and safe assets in such a manner to obtain a higher level of portfolio risk during the increase periods and a lower risk level on declining markets. In this case we assess the investor's skill, that is a proper forecasting with the difference that it concerns

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movements of the entire market. The introduction of additional variables, the so-called Fama-French factors (Fama, French, 1996), was proposed as far as classical market-timing models are concerned. The task of such variables was to explain the part of inaccurate indications in a classical capital asset pricing model arising from the property of fundamental companies.

The utility of such models was investigated on the example of the Polish stock market. Attempts to apply a three-factor model for the Polish market was made, among others, by Kowerski (Kowerski 2008), the utility of such a model was verified by Czapkiewicz and Skalna in 2011. Within the scope of selectivity of assets and application of market-timing techniques to investment funds, the models were applied by Olbryś, and also when taking into consideration the construction of the Fama-French factors, she verified hybrid market-timing models along with the assessment of the skill to manage equity investment funds management and stability of parameters (Olbryś 2008a,b,c, 2009, 2011a and Mościbrodzka 2014).

The application of classical and hybrid multifactorial market-timing models to assess the risk and effectiveness of unit-linked insurance (UFK) are proposed in the thesis. Their utility was verified and it was investigated whether managers of unit-linked insurance in Poland possess skills within the scope of:

- forecasting of price changes of single assets, that is selectivity of securities,
- forecasting of changes in the market globally, that is, changes of a market factor (application of market-timing techniques).

Thus, it was demonstrated that market-timing models may constitute a new and supportive tool allowing the insured to make a proper decision concerning investment strategy of resources into specific capital funds.

2. The essence of unit-linked insurance

The unit-linked insurance is a product of hybrid character, the structure of which is based on classical life insurance or pure endowment insurance with investment into selected insurance capital funds. So, this is a contract between the insured and the insurer according to which the insured pays premiums and the insurer in return assures a benefit in the amount equal or greater than the value of:

- G_{Π} - the guaranteed amount,
- $b(S_t)$ - the amount arising from the value of a reference portfolio dependent on the determination of fund price.

So, the unit-link insurance differs fundamentally from classical life insurance and pure endowment insurance in that it is related to investment of resources coming from premiums into segregated funds. In contrast to traditional life insurance within unit-linked insurance, not only payment of the benefit is random, but also is the amount of the benefit paid. At the moment of occurrence of the event the insurer will pay the insured sum which is equal: a minimum of the guaranteed amount insured or the market value of the insurance portfolio. So, the payment is

dependent on a development of a certain index or the value of a certain specified insurance portfolio. In accordance with such construction of the unit-linked insurance the payment (future benefits) with the guaranteed insurance sum is equal to:

$$b(t) = \max\{X(t), g(t)\} = g(t) + \max\{0, X(t) - g(t)\} \quad (1)$$

where $X(t)$ – the value of insurance portfolio (a reference one) at the *t*-moment,

$g(t)$ – the guaranteed sum at the *t*-moment.

So, the value of the insurance portfolio connected with insurance is random and it is a proper function of accumulated investment dependant on unit prices of a selected fund arising from the strategy accepted by the insured. The unit-linked insurance contracts, which are offered in Poland, are the products allowing the insured to accumulate savings in insurance capital funds, which are run by external societies independently of investment funds. An additional value of policies of this type is not only the possibility of selection of different funds out of a wide market offer, but also the fact that they are managed by different companies. So, such funds differ within the scope of risk and investment policy, which from the viewpoint of the investment risk diversification are of high significance. Since unit-linked insurance policies are transparent and of open structure, it gives the insured the opportunity to systematically adjust investment strategy depending on a changeable market situation, influencing the final amount of payment at the same time. So, when deciding about the choice of the capital fund, the insured takes responsibility for possible negative consequences of his decisions and is encumbered with financial risk (Homa, 2013).

3. Multifactorial market-timing models

3.1. The CAPM model

The *Capital Asset Pricing Model (CAPM*) warrants explanation of the achieved rates of return on securities as market risk function (Reilly, Brown, 2001). This is founded on an assumption that the formation of rates of return of shares is determined by a factor that reflects changes on the capital market. The equation of such a model can be written in the following form:

$$r_{i,t} = \alpha + \beta \cdot r_{M,t} + \varepsilon_{i,t}, \quad (2)$$

where $r_{i,t}$ - vector of excess rates of return of portfolio at the *t*-moment over a risk-free rate,

$r_{M,t}$ - denotes an excess rate of return on the market index at the t-moment over a risk-free rate.

In practice, we most frequently assume that a risk-free rate is a profitability index of treasury bills or inter-bank market rate (e.g. WIBOR) (Jajuga, Jajuga 2006). Yet, one ought to remember that even treasuries are not riskless, so when

speaking of a risk-free rate one ought to mean the rate that is accompanied by the lowest risk possible at a particular time among different classes of financial assets.

The idea of the *CAPM* model is based on the thesis that an additional rate of return ought to arise from the selection of securities, i.e. during the selection of securities to a portfolio the fund manager will consider risk analysis characteristic for particular securities for particular papers not focusing only on the risk of the entire market. So, a positive and significant α parameter means that the manager makes attempts of a detailed market analysis and his expectations of price behaviour of particular securities are accurate. A market portfolio is of key significance for the investment value within the capital asset pricing model. This is a portfolio which consists of all shares and other securities of positive risk occurring on the market and contribution of particular shares in such a portfolio are equal to the contribution of such shares on the market. So, the beta coefficient within this model is treated as a risk measure showing approximately by how many units a rate of return on portfolio will increase if a rate of return of the market index will increase by one unit (Jajuga, Jajuga, 2006). When making the decision concerning the selection of securities to a portfolio the investor is often influenced by the value of the beta coefficient as the value of premium for the risk of the capital involved.

3.2. Classical models of market timing

The market-timing idea concerns identification of market trends and the manager possessing such skills will adapt the composition of the fund managed to a market situation. So, in order to test the skills of the portfolio manager within the scope of the so-called market timing, we should adopt classical parametric market-timing models, with occurring variable represents the market. In practice, most frequently this is a rate of return on market portfolio where a corresponding stock exchange index or excess rate of return on market portfolio over a risk-free rate is a substitute. Classical market-timing models include:

- the Treynor-Mazuy model (T-M),
- the Henriksson-Merton model (H-M).

Both the model developed by Treynor and Mazuy and also the one developed by Henriksson and Merton serve to test the skills within the scope of application of market-timing techniques and selectivity of assets by managers of investment portfolios. They described market sensing as a proper reaction to changes of rate of return on the stock exchange index, but they defined it in a different manner. The regression model (Treynor, Mazuy, 1966), denoted as the T-M model, has the following form:

$$r_{i,t} = \alpha + \beta_1 \cdot r_{M,t} + \beta_2 \cdot r_{M,t}{}^2 + \varepsilon_{i,t} \tag{3}$$

while the model proposed by Henriksson and Merton (1981) denoted as the H-M model, is:

$$r_{i,t} = \alpha + \beta_1 \cdot r_{M,t} + \beta_2 \cdot \max[0; -r_{M,t}] + \varepsilon_{i,t} \tag{4}$$

In both models the β_2 parameter shows the skills of application of market-timing techniques (short-term market trends), the value of which constitutes the adjustment by possible pessimistic expectations of the fund manager as far as future formation of market rate is concerned. If it assumes values greater than zero, then the portfolio managers accurately forecast market movements and the value of such a coefficient shows the level of such a skill. The authors of the model recommend applying it both during the periods of a huge increase and the periods of heavy decrease in stock exchange indices because reactions on small market movements with the use of such a model are not observable. If the β_2 coefficient is close to zero, then the investor does not show any prognostic capabilities concerning the market. A significant fault of a parametric version of the Henriksson-Merton model is the assumption concerning permanency at the time of probability of an accurate forecast, which cannot be fulfilled if an investor forecasts the movements of bigger markets than the movements of smaller markets more easily (Czekaj et al. 2000). A significantly negative value of the β_2 parameter estimator denotes a negative impact of the market-timing technique on the portfolio value.

3.3. Hybrid market-timing models

The T-M and H-M models underwent further modifications arising from the fact that their incorrect indications within the scope of explanation of effective interest rate differential were observed. It was shown that balance indices such as a book/market value and a company's size impact the value of the expected value of a rate of return on equity portfolio (Bhandari, 1988). So, classical market-timing models were extended by additional factors on the basis of which the managers make allocation decisions. Fama and French in their theses (Fama, French, 1992, 1993) investigated monthly rates of return of American companies from 1963 to 1991 quoted on NYSE, AMEX and NASDAQ (since 1972). In the first step they divided such companies in terms of their capitalisation volume into groups of companies above and under median, creating portfolios of big companies (B-Big) and small ones (S-Small). Another criterion of the division of companies was the size of the BV/MV index, that is a quotient of a book value to a company's market value. From an investigated sample, Fama and French sectioned off two groups of companies: companies with growth potential and companies with value potential. The first ones are the companies of a low BV/MV index and within this group market estimate considerably exceeds balance value, which proves that the investors expect very good results and increase in assets from such companies in the future. The companies with value potential are characteristic of a high BV/MV ratio. All the investigated companies were divided into three groups. Namely 30% of companies of the lowest index value within population were counted among the groups of companies with growth potential and created the Low (L) portfolio, 30% of companies of the greatest index value were counted among the groups of companies with value potential and created the High (H) portfolio, the remaining 40% of companies landed in the Medium (M) portfolio. After such division the

authors constructed 6 portfolios which are a cross section of a group of sets of big and small companies, and the ones with low and high BV/BM: BL, BM, BH, SL, SM, SH index. The portfolios, which were created according to the above procedure, were used to calculate values of variables within the Fama-French model: *SMB* (Small-minus-Big) and *HML* (High-minus-Low). Namely, the *SMB* factor constituted arithmetic mean of differences between returns on a portfolio of small companies (SL,SM,SH) and big companies (BL,BM,BH), while *HML* constituted arithmetic mean of differences between returns on companies' portfolios with value potential (SH, BH) and growth potential (SL,BL), that is,

$$SMB_t = \tfrac{1}{3} \cdot \left(R_{SL,t} + R_{SM,t} + R_{SH,t} - R_{BL,t} - R_{BM,t} - R_{BH,t} \right) \quad (5)$$

$$HML_t = \tfrac{1}{2} \cdot \left(R_{SH,t} + R_{BH,t} - R_{SL,t} - R_{BL,t} \right) \quad (6)$$

where R denotes weighted average with capitalisation of a rate of return on a corresponding portfolio of the companies.

As a result, the two FF factors were considered within models and in such manner the hybrid models (T-M-FF) and (H-M-FF) were obtained respectively in the following form:

$$r_{i,t} = \alpha + \beta_1 \cdot r_{M,t} + \beta_{SMB} \cdot r_{SMB,t} + \beta_{HML} \cdot r_{HML,t} + \beta_2 \cdot r_{M,t}^{\ 2} + \varepsilon_{i,t}, \quad (7)$$

$$r_{i,t} = \alpha + \beta_1 \cdot r_{M,t} + \beta_{SMB} \cdot r_{SMB,t} + \beta_{HML} \cdot r_{HML,t} + \beta_2 \cdot \max[0, -r_{M,t}] + \varepsilon_{i,t}, \quad (8)$$

where $r_{SMB,t}$ is an excess rate of return on a portfolio simulating *SMB* over a risk-free rate of return in the *t*-period,

$r_{HML,t}$ is an excess rate of return on a portfolio simulating *HML* over a risk-free rate of return in the *t*-period.

The β_{SMB} and β_{HML} coefficients are measures of sensitivity of a rate of return on investment to changes of rates of return on portfolios simulating respectively *SMB* and *HML*. So, their loads constitute the additional premium for the risk connected with investment in companies of low capitalisation and the ones of a high value of the balance index respectively, which is a quotient of a book value to company's market value.

4. The results of empirical research

4.1. The construction of the Fama-French factors

The investigation covered the period from March 2009 to October 2014 and selected 34 insurance capital funds[3]. The analysis was based on weekly data coming from the period considered. The Insurance Capital Funds were divided into 6 groups: balanced mixed, absolute rate mixed, stable growth mixed, active allocation mixed, shares of small and medium-sized companies (SMEs) and shares. Such division was dictated by a suggested division of funds by insurance companies according to investment risk. Any fundamental data and company quotations

[3] Availability of data determined the selection of unit-linked insurance.

present on the Warsaw Stock Exchange in Warsaw were taken from the Warsaw Stock Exchange Statistical Bulletins and from the stooq.pl portal, data concerning the Insurance Capital Funds was taken from their placing memoranda, reports and also fund cards and from web pages of particular funds.

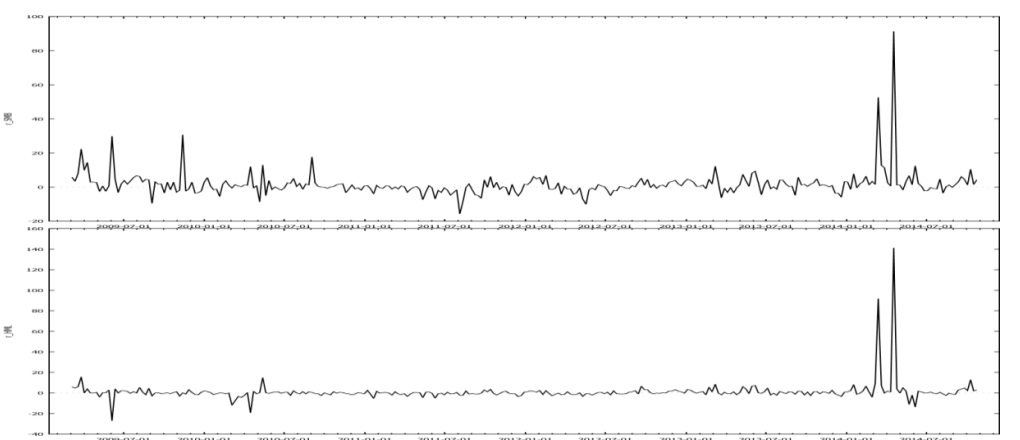
In the first stage of the research coefficient values of the so-called portfolios stimulating SMB and HML were determined. Monthly balance data covering the period from February 2009 until October 2014 was used to construct the Fama-French factors. The research considered quotations of all the companies listed on the Stock Exchange Market, the number of which during the period covered by the research amounted to the level of 266 companies at the end of February 2009 and 463 in October 2014. The construction of factors was achieved analogically as in the Fama-French thesis in the following manner:

STEP 1. At the end of each month the companies were divided into six disjunctive portfolios: BH,BM,BL and SH,SM,SL according to their balance indices.

STEP 2. Such division was maintained during a consecutive month and the *SMB* and *HML* factors were determined during the week of a particular month. Namely, the difference between a rate of return on portfolios of big companies (BL, BM, BH) and a rate of return on portfolios of small companies (SL, SM, SH) was the basis for creation of the *SMB* factor, according to the formula (5), whereas the difference between a rate of return on portfolios of companies with value potential (BH, SH) and a rate of return on portfolios of companies with growth potential (BL, SL) according to the formula (6), served to create the *HML* factor.

STEP 3. Determined *SMB* and *HML* factors were reduced by a risk-free rate.

Formation of the factors within the Fama-French models from the beginning of 2009 until the end of October 2014 was depicted in the drawings below.



Drawing 1. Cleaned Fama-French factors: SMB and HML

Source: own elaboration.

4.2. Risk assessment and selectivity of assets

In the next stage the assessment of unit-linked insurance was carried out as regards the risk and skills of the managers within the scope of forecasting of price behaviour of particular securities, namely the so-called selectivity of assets. Depending on the type of the fund investment zone and its benchmark as a market rate of return, the following were considered respectively: the Warsaw Stock Exchange Index (WIG), a rate on index of small and medium enterprises - InvestorMS or a corresponding benchmark of the WIG rate with the rate of treasury bond market TBSP.Index (Treasury BondSpot Poland). Due to the fact that from 2012 the issue of treasury bonds was stopped, the profitability of which was most frequently indicated as a risk-free rate, WIBOR, which is an inter-bank rate, is assumed as a risk-free rate of interest (see Jajuga, Jajuga, 2006, p.224). The results of estimation of the least squares method for the CAPM model for unit-linked insurance in Poland (ULIP) are presented in Table 1.

Table 1. The estimation results of the CAPM parameters for ULIP

BALANCED MIXED	**α**	**β**	**R^2**
UniKorona Balanced	0.0762	0.6324***	0.8210
Active Investing	0.0661	0.5924***	0.7319
Balanced Portfolio	0.1423*	0.4820***	0.5242
AXA of Business Cycle	0.0655	0.6516***	0.7216
AXA Mixed	0.0860	0.4016***	0.5323
ABSOLUTE RATE MIXED	**α**	**β**	**R^2**
Noble Fund Global	0.0411	0.5352***	0.5305
Quercus Selective	0.1749***	0.4622***	0.5241
STABLE GROWTH MIXED	**α**	**β**	**R^2**
PKO Stable Growth	0.1019*	0.4705***	0.6786
Stable Growth	0.1049*	0.4538***	0.6105
AXA Optimal	0.1115*	0.4543***	0.6117
Stable Growth Portfolio	0.1574**	0.3920***	0.4694
AXA Stable Growth	0.1317*	0.5287***	0.6409
ACTIVE ALLOCATION MIXED	**α**	**β**	**R^2**
Legg Mason of Strategy	0.0079	0.5959***	0.8000
Noble Fund Timing	0.0238	0.7644***	0.7406
SMES SHARES	**α**	**β**	**R^2**
UniAkcje SM	0.0014	0.6782***	0.4579
Noble Fund Stock SM	0.0929	0.8191***	0.6491
SHARES	**α**	**β**	**R^2**
Uni Korona Stock	0.0375	0.8682***	0.8559
Skarbiec Stock	-0.0899*	0.9041***	0.9112
PKO Stock	0.0013	0.7731***	0.9131
Investor Stock BM	-0.0129	0.8224***	0.7337
Legg Mason Stock	0.0157	0.8260***	0.9418
Stock	0.0330	0.8281***	0.7652
Noble Fund Stock	-0.0005	0.8927***	0.9489
AXA Stock Portfolio	0.1175	0.6417***	0.5072
Quercus Agrressive	0.0639	0.8123***	0.7437
AXA Stock BM	0.0186	0.8666***	0.7422
AXA Stock	0.0222	0.8238***	0.7345

*** - relevance at a level of 0.01 ** - relevance at a level of 0.05 * - relevance at a level of 0.10

Source: own elaboration.

One ought to focus on the fact that within all the fund groups, the parameter which is liable for systematic risk was statistically significant and its value explicitly indicates that stable growth funds are distinguished by the lowest risk. The group of share funds was the group of the greatest risk was. However, it should be emphasised that none of the funds within this group belonged to the so-called groups of aggressive funds. From among all the discussed groups, only one fund of a significantly negative α parameter occurred in this group, which implies that the manager of such fund randomly selected assets to a portfolio. But it is worth to take into consideration the fact that this fund was the most risky and share funds are burdened with the greatest financial risk. In the case of the remaining groups, the results are not so explicit any more. When assessing the skills of managers within the scope of selection of assets, the only group where the managers of all the funds took risk analysis characteristic for particular securities, not only focusing on the risk of the entire market and accurately selected assets to the fund, is the group of stable growth funds. Within the remaining groups, only in few situations the parameter concerning assessment of asset selectiveness was positive and statistically significant. The greatest surprise was the results of the active allocation fund group, whose managers ought to accurately forecast price behaviour of particular securities. However, according to Jensen's interpretation (Jensen 1972), a positive but statistically unimportant estimator value of such a parameter may be the result of a positive load of estimator and not necessarily it reflects the skills of the portfolio manager. Within the group of share funds, only in one fund of the greatest risk a significant but negative value of coefficient was observed, which means that the manager of this fund randomly allocates the funds into instruments offered on the market.

4.3. Assessment of abilities within the scope of application of market-timing techniques

In the next stage of research the assessment of skills of the managers of unit-linked insurance within the scope of application of market-timing techniques was made and parameters of classical T-M and H-M[4] market–timing models were estimated. The results of the Treynor-Mazuy model estimation are presented in Table 2.

Table 2. The estimation results of parameters of the Treynor-Mazuy model for ULIP

BALANCED MIXED	α	β_1	β_2	R^2
UniKorona Balanced	0.0073	0.6191***	0.0081***	0.8256
Active Investing	-0.0222	0.5754***	0.0104***	0.7397
Balanced Portfolio	-0.0522	0.4445***	0.0230***	0.5688
AXA of Business Cycle	-0.0744	0.6441***	0.0195***	0.7449
AXA Mixed	-0.0808	0.3694***	0.0197***	0.5805

[4] Due to restrictions connected with the number of pages and the fact that the results of the H-M estimation model were analogous to the results of the T-M model, the results for the H-M model are not included in the thesis.

Table 2. The estimation results of parameters of the Treynor-Mazuy model for ULIP (cont.)

ABSOLUTE RATE MIXED	**α**	**β_1**	**β_2**	**R^2**
Noble Fund Global	-0.0782	0.5287***	0.0166***	0.5502
Quercus Selective	-0.0137	0.4520***	0.0262***	0.5845
STABLE GROWTH MIXED	**α**	**β_1**	**β_2**	**R^2**
PKO Stable Growth	-3.48E-06	0.4509***	0.0120***	0.6947
Stable Growth	-0.0137	0.4310***	0.0140***	0.6317
AXA Optimal	-0.0060	0.4316***	0.0139***	0.6326
Stable Growth Portfolio	-0.0452	0.3529***	0.0239***	0.5356
AXA Stable Growth	-0.0570	0.5185***	0.0262***	0.6968
ACTIVE ALLOCATION MIXED	**α**	**β_1**	**β_2**	**R^2**
Legg Mason of Strategy	-0.0316	0.5883***	0.0047*	0.8012
Noble Fund Timing	-0.0713	0.7592***	0.0132**	0.7494
SMES SHARES	**α**	**β_1**	**β_2**	**R^2**
UniAkcje SM	-0.1352	0.6708***	0.0190**	0.4680
Noble Fund Stock SM	0.0062	0.8144***	0.0121*	0.6555
SHARES	**α**	**β_1**	**β_2**	**R^2**
Uni Korona Stock	0.0551	0.8716**	-0.0021	0.8555
Skarbiec Stock	-0.0459	0.9126***	-0.0052**	0.9121
PKO Stock	0.0144	0.7756***	-0.0015	0.9130
Investor Stock BM	-0.0162	0.8218***	0.0004	0.7328
Legg Mason Stock	0.0285	0.8285***	-0.0015	0.9418
Stock	-0.0365	0.8146***	0.0082*	0.7673
Noble Fund Stock	0.0366	0.8999***	-0.0044**	0.9496
AXA Stock Portfolio	-0.0699	0.6056***	0.0221**	0.5290
Quercus Agrressive	-0.0238	0.8075***	0.0122**	0.7507
AXA Stock BM	-0.0742	0.8615***	0.0129**	0.7490
AXA Stock	-0.0621	0.8192***	0.0117**	0.7408

*** - relevance at a level of 0,01 ** - relevance at a level of 0,05 * - relevance at a level of 0,1

Source: own elaboration.

The obtained results show that the majority of the managers of the unit-linked insurance possess the skill to use short-term market trends. In all the analysed groups, except the group of share insurance funds, a significant and positive value of the coefficient means that the managers try to adapt the composition of a managed fund to a current market situation and appropriately react by increasing or reducing the fund's exposure to market risk, for instance, through decreasing or increasing contribution of security instruments such as bonds or treasury bills. Simultaneously, a positive value of the coefficient indicates that managers benefit from their own expectations as far as changes of a market rate of return in the future are concerned, although to a different extent, which is inversely proportional to the risk of a systematic portfolio.

In the funds of shares of the greatest risk, a significant but negative value of the β_2 coefficient was recorded, which means that the application of market-timing strategies by managers in this particular case has a negative influence on a rate of return of such funds.

4.3. Assessment of premium for the risk of investment into aggravated risk companies

In the last stage of the analysis it was investigated whether the managers of unit-linked insurance make allocation decisions taking into consideration publicised additional information and the ones arising from fundamental property of companies. In order to assess the impact of balance factors on the value of the funds, the parameters of hybrid models were estimated, which considered variables introduced by Fama and French based on the following theses:

1. The shares of companies with a small capitalisation are more risky than the shares of the companies with a high capitalisation (SMB).
2. Companies with value potential are more risky than the companies with growth potential (HML).

The parameters of the T-M-FF and H-M-FF hybrid models were estimated and results for the T-M-FF[5] model are shown in Table 3.

Table 3. The estimation results of the T-M-FF model parameters for the unit-linked insurance in Poland (ULIP)

BALANCED MIXED	**α**	**β_1**	**β_2**	**β_{SMB}**	**β_{HML}**	**R^2**
UniKorona Balanced	0.0169	0.6450***	0.0077***	-0.0255**	0.0185**	0.8271
Active Investing	-0.0223	0.5835***	0.0101***	-0.0076	0.0093	0.7388
Balanced Portfolio	-0.0468	0.4690***	0.0224***	-0.0236	0.0217	0.5698
AXA of Business Cycle	-0.0713	0.6517***	0.0192***	-0.0090	0.0053	0.7451
AXA Mixed	-0.0685	0.4160***	0.0187***	-0.0453***	0.0390***	0.5960
ABSOLUTE RATE MIXED	**α**	**β_1**	**β_2**	**β_{SMB}**	**β_{HML}**	**R^2**
Noble Fund Global	-0.0693	0.5856***	0.0138**	-0.0650*	0.0499**	0.5600
Quercus Selective	-0.0167	0.4686***	0.0252***	-0.0182	0.0187	0.5877
STABLE GROWTH MIXED	**α**	**β_1**	**β_2**	**β_{SMB}**	**β_{HML}**	**R^2**
PKO Stable Growth	0.0130	0.5019***	0.0109***	-0.0495***	0.0432***	0.7136
Stable Growth	-0.0025	0.4725***	0.0131***	-0.0405***	0.0345***	0.6420
AXA Optimal	0.0050	0.4730***	0.0130***	-0.0402***	0.0345***	0.6430
Stable Growth Portfolio	-0.0338	0.3980***	0.0229***	-0.0437**	0.0383***	0.5489
AXA Stable Growth	-0.0497	0.5575***	0.0243***	-0.0447*	0.0334*	0.7021
ACTIVE ALLO-CATION MIXED	**α**	**β_1**	**β_2**	**β_{SMB}**	**β_{HML}**	**R^2**
Legg Mason of Strategy	-1.63E-02	0.6379***	0.0037	-0.0485***	0.0390***	0.8124
Noble Fund Timing	-0.0602	0.7576***	0.0137**	0.0003	-0.0100	0.7517

[5] Due to restrictions connected with the number of pages and the fact that the results of the H-M-FF estimation model were analogous to the results of the T-M-FF model, the results for the H-M-FF model are not included in the thesis.

Table 3. The estimation results of the T-M-FF model parameters for the unit-linked insurance in Poland (ULIP) (cont.)

SMES SHARES	**α**	**β_1**	**β_2**	**β_{SMB}**	**β_{HML}**	**R^2**
UniAkcje SM	-0.1517	0.5937***	0.0227***	0.0886*	-0.0642*	0.4812
Noble Fund Stock SM	-0.0017	0.7274***	0.0166**	0.0986**	-0.0806***	0.6702
SHARES	**α**	**β_1**	**β_2**	**β_{SMB}**	**β_{HML}**	**R^2**
Uni Korona Stock	0.0541	0.8628***	-0.0018	0.0084	-0.0089	0.8549
Skarbiec Stock	-0.0352	0.9217***	-0.0050*	-0.0100	-0.0019	0.9124
PKO Stock	0.0218	0.8021***	-0.0021	-0.0258**	0.0216***	0.9150
Investor Stock BM	-0.0287	0.8351***	-0.0007	-0.0107	0.0293*	0.7381
Legg Mason Stock	0.0321	0.8422***	-0.0018	-0.0133	0.0116*	0.9420
Stock	-0.0591	0.7608***	0.0090**	0.0535***	-0.0355**	0.7716
Noble Fund Stock	0.0381	0.8982***	-0.0043**	0.0013	-0.0036	0.9494
AXA Stock Portfolio	-0.0770	0.5870***	0.0224***	0.0183	-0.0129	0.5266
Quercus Agrressive	-0.0349	0.7473***	0.0151***	0.0690**	-0.0515**	0.7569
AXA Stock BM	-0.0732	0.8317***	0.0146**	0.0331	-0.0304	0.7517
AXA Stock	-0.0662	0.7878***	0.0133**	0.0358	-0.0281	0.7427

*** - relevance at a level of 0,01 ** - relevance at a level of 0,05 * - relevance at a level of 0,1

Source: own elaboration.

The results of estimation of the β_{SMB} and β_{HML} parameters show that additional factors such as capitalisation and market value index to book value are significant in the case of all the funds from the group of stable growth funds and shares of small and medium-sized companies, i.e. in a significant manner they determine their rate of return but investment risk into other companies is compensated. In the case of stable growth funds, a positive value of the β_{HML} coefficient proves that investment risk of companies with value potential is compensated, while in the case of share funds of SMEs a positive value of the β_{SMB} estimator proves that investment risk of low capitalisation companies was compensated by the additional premium. For remaining groups which are considered situation is not clear. It is observed unit-linked insurance for which considering of additional balance factors does not have a significant impact on the value of the rate of return or else only one of considered factors had a significant impact on its rate of return.

SUMMARY

In this thesis, classical and hybrid market-timing models to assess the risk and efficiency of unit-linked insurance were used for the first time. The obtained results confirm that such models may form the basis for assessment of both the risk of unit-linked insurance and also their efficiency through investigation of the managers' skills within the scope of:

- a proper selection of securities,
- analysis of short-term trends dominating the market (market timing),
- using additional information concerning companies.

The results revealed that market-timing hybrid models may constitute an effective tool during the strategic decision-making process the insured go through. In addition, the discussed models can also be successfully used to assess the effectiveness and risks of other financial instruments available on the market, e.g. investment funds or equity.

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