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## Article

# Study of the skills of balanced fund managers in Poland

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# Study of the Skills of Balanced Fund Managers in Poland

Dorota Żebrowska-Suchodolska and Andrzej Karpio

## ABSTRACT

The market timing is one of the active methods used by portfolio managers to do their investments more effective. It allows to separate management skills on a micro and macro scale. The market timing applies to the appropriate selection of assets for the portfolio and the right moment to change its structure. The aim of the presented research was to check whether the managers of balanced open-end mutual funds operating on the Polish market apply market timing skills. Nine balanced funds have been accepted for the research, which have existed since at least 2003 year. The research period covered the years 2003-2019. WIBOR 1M was used as the risk-free rate, and the market factors were the main WSE indexes. The research was first conducted based on basic market timing research models, i.e. the Henriksson-Merton and Treynor-Mazuy. Then, these models were expanded to include factors related to the bond market. The Henriksson-Merton and Treynor-Mazuy models and their extensions with additional factors were compared among themselves. Studies show that models with additional factors have proven to be more appropriate for balanced open-end mutual funds. It has occurred that regardless of the model used, market timing skills were similar. In most cases the fund managers did not achieve higher results than the results of the relevant benchmark. Managers tried to follow the trend rather than anticipate it. In most cases, there was also no ability to select assets or market-timing. Most of the parameters standing by these variables were not statistically significant.

**KEY WORDS:** balanced mutual funds, management skills, market timing, selectivity.

**JEL Classification:** C01, C22, G14.

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## 1. Introduction

The issues related to the functioning of collective investment institutions are very important from the point of view of individual investors. Investment funds give them access to the financial market, and thus the opportunity to increase their savings and accumulate funds for future pensions. From a scientific point of view, the analysis of the market of funds allows to formulate conclusions on the performance of the functioning of funds, and thus to answer the question to what extent the expectations of their clients can be met. It should be remembered that very

often advertisements emphasize the professionalism of managers and in this way sometimes justify the high costs that customers must bear when joining the funds. Managing skills are manifested in achieving good investment results in relation to the risk incurred and in comparison with market benchmarks and investments in risk-free instruments. This aspect is affected by classic performance measures such as Sharpe, Treynor, Jensen, and others. However, customers expect much more for the costs incurred. In particular, portfolio managers should demonstrate the ability to select companies for portfolios correctly, based not only on the economic situation on the stock market listed on the stock exchange. In the literature, this skill is called selectivity. The second aspect of fund asset management is the selection of

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appropriate moments for transactions and the allocation of assets between the stock market and the bond market (due to the specifics of the Polish market at work, it is identified with the debt instruments market). This skill is called market-timing. Therefore, the purpose of the work is to examine the extent to which managers of open-end balanced funds portfolios are able to demonstrate the skills of selective selection of assets for portfolios as well as effective market-timing. Of course, due to the structure of the models used, following the market (correlation with benchmarks) appears to be the basic explanatory variable. The authors consider open-end balanced funds, i.e., assets in which 30% to 40% of assets are invested in debt instruments, and the rest in shares of Polish companies listed on the Warsaw Stock Exchange. Equity funds were examined both by the authors of the presented work (Żebrowska-Suchodolska et al., 2020) and others (Olbrzyś, 2011; Pietrzyk, 2013). Funds continuously operating on the Polish market in 2003-2019 are taken into account. This period covers both the bull market (2003-2006) and the changing market situation initiated by the global financial crisis - the remaining years 2007-2019. Thus, the answer to the question about the ability to performance the management of fund assets in various market situations was obtained. The basis of the research are the Henriksson-Merton, Weigel, Treynor-Mazuy and Bello-Janjigian models. The latter appears in the work in two variants, as a 3- and 4-factor model. These models allow to take into account various segments of the stock market, bond market, as well as various aspects of market-timing. The market factors used in the models are the WIG broad market index and the indexes: large fundamental companies WIG20, medium mWIG40, small sWIG80. The debt instruments market is described by the TBSP index calculated by the Warsaw Stock Exchange since 2007 and this was the second reason for dividing the entire research period into two subperiods. Therefore, the models, in which this index appears, were considered only in 2007-2019. The basic working hypothesis are the weak skills of portfolio managers of open-end balanced funds for the use of selectivity and market-timing. In addition, there are grounds to suppose that in the case of these funds, the dominant strategy is following the stock

market, i.e., a passive strategy, which is why this aspect of asset management will be analyzed in detail in this paper. The study covers the net assets value of the funds (NAV), which tells us how much one share of the fund is worth. Taking costs into account is an issue in which the profitability of investing funds in units is analysed. On the other hand, the authors' interest is not the client, but the manager and the assessment of their skills. Finally, it is worth emphasizing that the purpose of the work is not to select the best and worst investment funds, but to characterize the entire market.

## 2. Open-end Funds in Poland

The history of collective investment institutions in post-war Poland began shortly after the creation of the Warsaw Stock Exchange. The first listing took place on April 16, 1991 and concerned only five companies. For obvious reasons, it was necessary to wait for a greater number of listed securities to give Poles the opportunity to purchase shares in specialized institutions investing on the stock exchange. That is why the first such capital market entity began operations in July 1992 and was called Pioneer. The first Polish Pioneer Trust Fund. It operated on the basis of the Act on public trading in securities, which in principle only stated the possibility of the existence of such entities without specific legal regulations. For the first few years it was the only entity of this type in Poland. The situation changed in 1995 and more collective investment funds began to arise. As a consequence, in 1997 the Act on investment funds was adopted. It has been amended many times as the capital market developed, and in connection with Poland's accession to the European Union. At present, the law allows open, closed, specialized, and mixed funds to operate. This work concerns balanced open-end investment funds, which are one of the types of open-end investment funds. Nevertheless, it is worth looking at the entire investment fund market in Poland. First of all, it should be added that in the Polish legal system, investment fund management companies which are joint-stock companies are the entity managing investment funds. Each society has different funds, in particular from different risk classes. At the end

of 2019, 42 investment fund societies operated in Poland, but not all of them started operating. Societies managed assets with a value exceeding PLN 264 billion. The largest of them, Ipopema TFI managed PLN 57.077 million, the smallest Opi TFI only managed PLN 178 million. Four companies were in the process of starting their business. Figure 1 shows the assets of individual societies.

Considering the types of open-end investment funds, the share of balanced and equity funds has been decreasing in recent years in favour of debt funds and the money market. In 2013, balanced funds accounted for the largest share of open-end funds. In subsequent years, there was a decrease in the share in the overall structure of assets, reaching 12% at the end of 2018. At the end of 2018, the assets of mixed funds amounted to PLN 30.8 billion.

During the period considered in the research, the number and assets of the balanced funds changed. In 2003, there were 10 funds investing

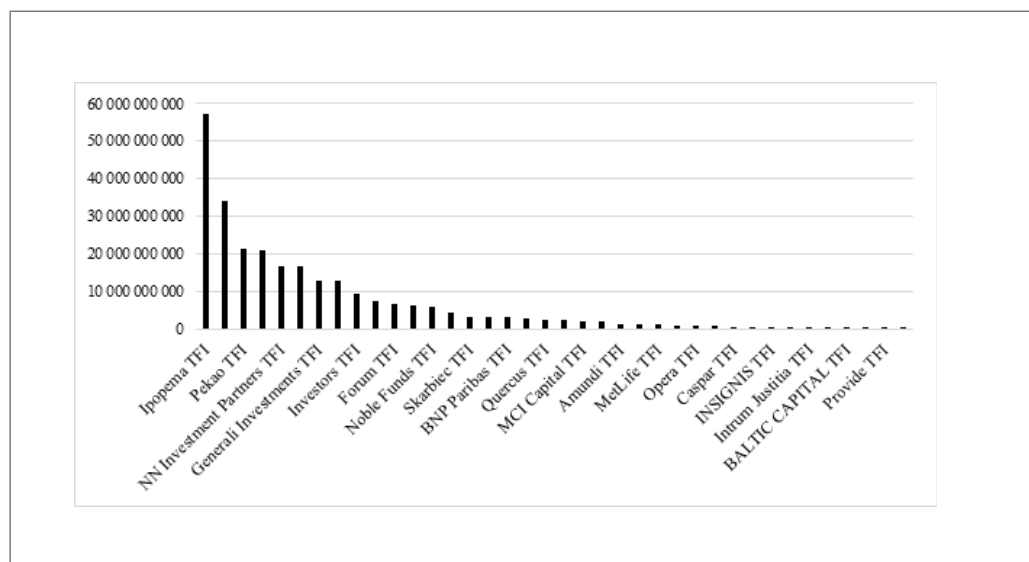
on the Polish market, and in 2019 their number increased to 16. As a result, in the years 2003-2019 one fund ceased operations and seven were established. However, the share in the total assets of entities that did not operate throughout the entire period considered in the research accounted for a small percentage of assets of all balanced funds. The assets of 9 funds continuously operating in the years 2003-2019 successively decreased, constituting almost 100% in 2003 and 89.2% in 2019. As a result, it was assumed that the analysed funds can be considered definitely dominant on the market of balanced investment funds, and therefore they constitute the survivorship bias.

### 3. Literature Review

Research on the investment fund market focuses largely on assessing their effectiveness. It is examined whether fund managers are able to obtain investment results better than those created by a market identified with an appropriate benchmark. It is therefore

**Figure 1**

*Net Assets of Investment Fund Societies (as at December 31, 2019)*



Source: Chamber of Fund and Asset Management

checked whether various types of active strategies are able to bring better results than using a passive strategy based on following the market.

Market timing is one of the active investment management methods. Its components are market timing and sensitivity. Managers' possession of these skills means the ability to choose the right assets for the portfolio and the right moment to make a choice. Treynor and Mazuy (1966) proposed models for these skills. When carrying out research for 57 funds from 1983-1995, they listed only one fund that showed statistically significant results due to market timing. Another model that separates selectivity from market timing was proposed by Henriksson and Merton in 1981 (Henriksson, 1984).

The models proposed by Treynor and Mazuy as well as Henriksson and Merton were tested in different markets in later years, often showing completely different results. Henriksson himself, in his 1984 study examining 116 funds from 1968-1980, observed negative values of market timing. Only 3 out of 116 funds had the desired values of parameters indicating skilful asset management by their managers. On this basis, he concluded that managers are not able to achieve good investment results. Negative market timing values were also received by Chang and Lewellen (1984). Using the Henriksson-Merton model for research from 1971-1979, they pointed to the inability for managers to obtain better results than from a passive strategy. When examining 67 funds, only four of them were characterized by statistically significant parameters responsible for market timing, and five - had statistically significant properties of selectivity. Lee and Rahman (1990) applying the Treynor-Mazuy model to the monthly rates of return from 1977-1984, observed positive market timing values for 14 out of 37 funds. However, none of these values were statistically significant. The inability to beat the market was also confirmed by Ramesh and Dhume (2014).

Poor selectivity and market timing abilities were noticed by Abdullah et al. (2007) and Elfakhani et al. (2005) for the market in Malaysia. Pilbeam and Preston (2019) examining 355 Japanese funds operating in the years 2011-2016 found that only 33 funds had positive statistically significant market timing while 31 had a significantly negative. Gupta (2001), researching the Indian funds market, found few cases

of market timing. Kao et al. (1998) indicated in their research on funds from the American market that managers use selectivity and, to a small extent, market timing. The monthly data used for the study, according to Goetzmann et. al. (2000), may have been the cause for poor market timing results.

In the literature there can also be found cases indicating skillful use by market managers of timing. Kiyamaz (2015), conducting research for the Chinese market, pointed to the existence of significant capacity of managers to achieve results exceeding the market, and thus the use of market timing. Rao et al. (2017) by researching Chinese funds confirmed the use of market timing skills and achieving results exceeding the market index.

Oliveira (2019) pointed to better fund performance when using market timing strategies. Research conducted by Vandell and Stevens (1989) and Weigel (1991) also showed that such actions can bring better profits in the long run than a passive strategy.

Differences in the results, even for the same data, were noted by Bollen and Busse (2001), using daily and monthly data for the study. Research carried out for 230 investment funds showed better market timing properties for daily data. They pointed out that the frequency of data is important here and can bring a difference in the assessment of fund managers. Better market timing results for daily data may result from the fact that decisions are made more often than on a monthly basis.

Dellva et al. (2001), in turn, pointed to differences in results when using a different benchmark. Research conducted for funds in the period 1989-1998 showed differences in results depending on the benchmark. Only a properly selected benchmark showed positive selectivity and negative market timing. One of the first works that takes into account the stock and bond market at the same time, but in the application of pension funds, is that of Andreu and Swinkels (2012). The authors analysed the balanced Spanish pension plans (two samples), one from the Euro zone and one worldwide.

In the case of research on the Polish market, there are many works using Treynor-Mazuy and Henriksson-Merton models. They relate to different types of funds, different periods of operation, different data frequency, and often even various modifications to

these models. The classic forms of these models were used in research by Olbryś (2011), Zamojska (2009), Witkowska et al. (2009), Swinkels and Rzezniczak (2009) and Jamróz (2011, 2014). Alpha and gamma parameters in Treynor-Mazuy and Henriksson-Merton models insignificantly different from zero for equity funds were indicated by both Olbryś (2011) and Zamojska (2009). However, Witkowska et al. (2009) observed statistically significant gamma values in the Treynor-Mazuy model. Zamojska (2009) also pointed to the existence of market timing values in the Treynor-Mazuy model for selected equity and balanced funds. Swinkels and Rzezniczak (2009) studied 38 equity funds, balanced funds and bond funds in 2000-2007 using both models. The results indicated the occurrence of statistically insignificant properties of selectivity and a lack of market timing skills for bonds and equity funds. Jamróz (2011) studied both equity and socially responsible funds. In the case of equity funds, none of the funds showed selectivity or market timing skills, while in the case of socially responsible funds one fund in the case of the Henriksson-Merton model, and two in the case of Treynor-Mazuy proved to be statistically significant. However, these values were negative.

The own contribution of this work consists in applying the Weigel model to sustainable funds. Admittedly, in the case of the Polish market there is one work in which Pietrzyk (2014) used this model. However, the data end in 2013 and presented research for 8 sustainable funds. There is therefore a need to extend the time horizon and compare the results obtained. In addition, the work uses a model proposed by Bello and Janjigian, which has not been used so far for the Polish market.

#### 4. Theoretical Basics

The work uses four models to assess various aspects of the skills of collective investment institution portfolio management. In particular, they are: the Henriksson-Merton, Weigel, Treynor-Mazuy model and two generalizations of the latter, namely: two versions of the Bello-Janjigian model, one uses two market indicators and the other three. In all cases, the coefficients describe managerial skills, but different market segments are taken into account. The free word in the equations describing the models can be

interpreted as the ability to choose assets regardless of the market situation on the basis of fundamental analysis of individual companies and the macroeconomic situation. If the model includes investment in bonds, and this is the case here, then of course its interpretation extends to the ability to choose debt instruments. That is why we talk about the ability to select portfolio items selectively. On the other hand, the other coefficients describe the correlations of results achieved by investment portfolio managers with market segments, not only those of the stock market. That is why they are market-timing measures consisting in the current change of portfolio compositions depending on the market situation. Weigel and Bello-Janjigian models include the bond market. This is particularly important from the point of view of this work, which concerns the balanced funds. These entities have in their portfolios debt instruments, primarily bonds, representing about 30% to 40% of assets. A short review of the models used will be carried out, along with interpretation of market-timing coefficients.

The Henriksson-Merton model describes the equation (Henriksson, 1984):

$$r_{A,t} - r_{f,t} = \alpha_A^{HM} + \beta_A^{HM}(r_{M,t} - r_{f,t}) + \gamma_A^{HM} \max\{0, r_{M,t} - r_{f,t}\} + \varepsilon_{A,t} \quad (1)$$

In this case, as well as the others,  $r_{A,t}$ ,  $r_{M,t}$  are average rates of return of fund A portfolio and market factor respectively in period  $t$ , while  $r_{f,t}$  is the risk-free rate in this same time period. The word  $\varepsilon_{A,t}$  is a error term. The variable  $\max\{0, r_{M,t} - r_{f,t}\}$  describes the positive part of the excess rate of return on the portfolio  $r_{M,t} - r_{f,t}$ . Structural coefficient  $\beta_A^{HM}$  characterizes the managerial skills in the appropriate use of the economic situation measured by the  $M$  stock market index. It should be emphasized that during a bull market this ratio leads to good investment results when it is positive. On the other hand, during a bear market, the situation is opposite, negative value is good for the portfolio. The coefficient  $\gamma_A^{HM}$  should always be positive because it describes the skill of managers in avoiding losses.

Including bonds in the model leads to the Weigel model, which is based on the assumption that managers effectively use the market situation if they

allocate portfolio components between shares and bonds. The appropriate equation takes the form (Weigel, 1991):

$$r_{A,t} - r_{f,t} = \alpha_A^W + \beta_A^W(r_{M,t} - r_{f,t}) + g_{bond,A}^W(r_{bond,t} - r_{f,t}) + \gamma_A^W \max\{(r_{M,t} - r_{f,t}), (r_{bond,t} - r_{f,t}), 0\} + \varepsilon_{A,t} \quad (2)$$

The interpretation of the coefficient  $\beta_A^W$  is as before. The remaining words in the model take into account the correlation of portfolio changes with the bond market (the word  $g_{bond,A}^W$ ), with a similar remark regarding its sign, as in the case of the  $\beta_A^W$  factor. However, the negative value of  $r_{bond,t} - r_{f,t}$  is rare due to the fact that the majority of bonds, which dominate in balanced fund portfolios, can be classified as safe financial instruments. The last factor  $\gamma_A^W$ , as in the previous model, describes the skill of managers to avoid losses, but this time the manager can do this by allocating assets between shares and bonds.

The Treynor-Mazuy model is related to the equation (Treynor, Mazuy, 1966):

$$r_{A,t} - r_{f,t} = \alpha_A^{TM} + \beta_A^{TM}(r_{M,t} - r_{f,t}) + \delta_A^{TM}(r_{M,t} - r_{f,t})^2 + \varepsilon_{A,t} \quad (3)$$

When dealing only with the equity portion of the investment portfolio, as in the Henriksson-Merton model, the interpretation of  $\beta_A^{TM}$  is identical. The difference lies in the definition of market-timing, which this time is measured by the factor  $\delta_A^{TM}$ . In this case, the increase or decrease in the value of the surplus  $r_{M,t} - r_{f,t}$  leads to an increase in the rate of return on fund participation units  $r_{A,t} - r_{f,t}$ , which mathematically means that the trend is described by a convex curve. An entity characterized by a greater and positive value of the  $\delta_A$  ratio than another, better selects the moments of making transactions, more increasing the return on investment with changes in the market situation and both with its improvement ( $r_{M,t} - r_{f,t} > 0$ ) and deterioration ( $r_{A,t} - r_{f,t} < 0$ ). Thus, it can be said that the manager, by skillfully selecting moments of portfolio composition change, increases investment efficiency when the portfolio has a greater positive factor  $\delta_A^{TM}$ . Of course, the situation is unfavorable when this ratio is negative, because then the manager inefficiently chooses the moments of making the transaction. As a consequence, the as-

essment of investment efficiency in terms of market sense comes down to examining the significance of this parameter and its sign in the case when it is statistically different from zero.

The generalization of the model given by Bello and Janjigian (1997) involves taking into account a larger number of benchmarks. In the first case, when we take into account the main market index that has existed so far and an additional one describing another segment of the market and additionally take into account the bond market index, we obtain the equation (Bello & Janjigian, 1997):

$$r_{A,t} - r_{f,t} = \alpha_{1A}^{BJ} + \beta_{1A}^{BJ}(r_{M,t} - r_{f,t}) + \delta_{1A}^{BJ}(r_{M,t} - r_{f,t})^2 + d_{1A}^{BJ}(r_{m1,t} - r_{f,t}) + g_{1bond,A}^{BJ}(r_{bond,t} - r_{f,t}) + \varepsilon_{A,t} \quad (4)$$

Where  $r_{m1,t}$  is the rate of return on the  $m1$  benchmark other than  $M$ . On the other hand,  $r_{bond,t}$  is the rate of return on the bond index. It should be noted that the square word is associated with the  $M$  index, which plays the role of the dominant benchmark. This means that the managers of the equity portfolio build primarily on the basis of the assets included in this market indicator. On the other hand, shares from the  $m1$  index a "secondary" role in the sense that they constitute a smaller part of the portfolio. This does not necessarily mean that the first of them contains large foundation companies. There are funds on the market that specialize in investing in small companies, and large fundamental ones play a secondary role. Therefore, using this model, you should carefully analyze the investment policy of the funds and on this basis select the appropriate market factors as  $M$  and  $m1$ . The  $g_{1bond,A}^{BJ}$  ratio is a measure of the correlation of percentage changes in the value of the fund portfolio  $r_{A,t} - r_{f,t}$  with the debt instruments market. Adding another index with returns equal to  $r_{m2,t}$  leads to the equation:

$$r_{A,t} - r_{f,t} = \alpha_{2A}^{BJ} + \beta_{2A}^{BJ}(r_{M,t} - r_{f,t}) + \delta_{2A}^{BJ}(r_{M,t} - r_{f,t})^2 + d_{2A}^{BJ}(r_{m1,t} - r_{f,t}) + e_{2A}^{BJ}(r_{m2,t} - r_{f,t}) + g_{2bond,A}^{BJ}(r_{bond,t} - r_{f,t}) + \varepsilon_{A,t} \quad (5)$$

The interpretation of structural coefficients is analogous to the previous one. The extension of the



Bello-Janjigian model by another market factor allows to include a broader set of shares that are in fund portfolios. Therefore, the benchmarks M, m1 and m2 should describe other market segments, they cannot be modified versions of one and the same index. In practice, this is not difficult, as stock exchanges calculate many different indices, in particular industry ones, as well as indexes of segments of large, medium, and small companies. This is also the case at the Warsaw Stock Exchange in Warsaw, which is used in the presented work.

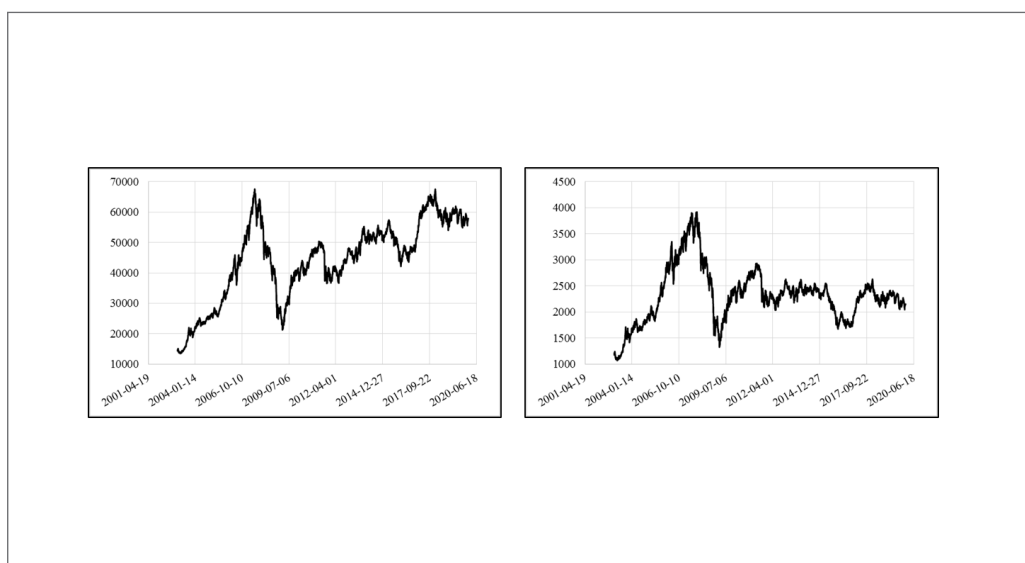
## 5. Methodological Assumptions

The subject of the research is the investment efficiency of open-end balanced funds in the years 2003-2019. Considering the functioning throughout the entire period, 9 funds participated in the research, namely: Generali Fundusze Fundusz Inwestycyjny Otwarty Subfundusz Generali Korona Zrównoważony (Gen), Investor Parasol Fundusz Inwestycyjny Otwarty Subfundusz Investor

Zrównoważony (Inv), NN Parasol Fundusz Inwestycyjny Otwarty Subfundusz Zrównoważony (NN), Novo Fundusz Inwestycyjny Otwarty Subfundusz Zrównoważonego Wzrostu (Novo), Pekao Fundusz Inwestycyjny Otwarty Subfundusz Zrównoważony (Pekao), PKO Parasolowy Fundusz Inwestycyjny Otwarty Subfundusz Zrównoważony (PKO), Rockbridge Fundusz Inwestycyjny Otwarty Parasolowy Rockbridge Subfundusz Zrównoważony (Rock), Santander Fundusz Inwestycyjny Otwarty Subfundusz Santander Zrównoważony (Sant), Skarbiec Fundusz Inwestycyjny Otwarty Subfundusz Skarbiec – Waga (Skarb). Abbreviated names, used later in the work, were given in brackets. Calculations were made for monthly percentage changes of participation units. The risk-free rate in a given month  $r_{f,t}$  was the average of WIBOR 1M daily quotations. In the Henriksson-Merton and Treynor-Mazuy models, market factors (benchmarks) were WIG and WIG20. The first of them currently takes into account the quotations of 336 companies (as at December 20, 2019).

**Figure 2**

*WIG Index (Left Figure) and WIG20 (Right Figure) in the Years 2003-2019*



Source: own study based on data from stooq.pl



The WIG20 index includes 20 largest companies limited to 5 from one sector. The course of listing of both indices is presented in Figure 2.

The research period was divided into two subperiods: 2003-2006 and 2007-2017. There were two reasons for this. First, the initial period concerned almost monotonous growth of the stock market, while the second covered a volatile situation. The short growth in 2007 quickly turned into a strong bear market due to the global financial crisis. In subsequent years, we were dealing with a changing economic situation with a clear upward trend in the case of WIG and no trend in the segment of large companies included in the WIG20 index. The second reason for dividing the study period was for a technical reason. The only available TBSP bond index has been calculated since the beginning of 2007. That is why Weigel and Bello-Janjigian models were built for the second subperiod. The first model includes both stock indices and the TBSP index, its course is shown in Figure 3. One drawback of this indicator is the fact that it is calculated on the basis of zero-coupon and fixed coupon treasury bonds. The index includes changes in

bond rates, interest accrued and income from interest reinvestment. At the end of 2019, the index included 18 series of bonds.

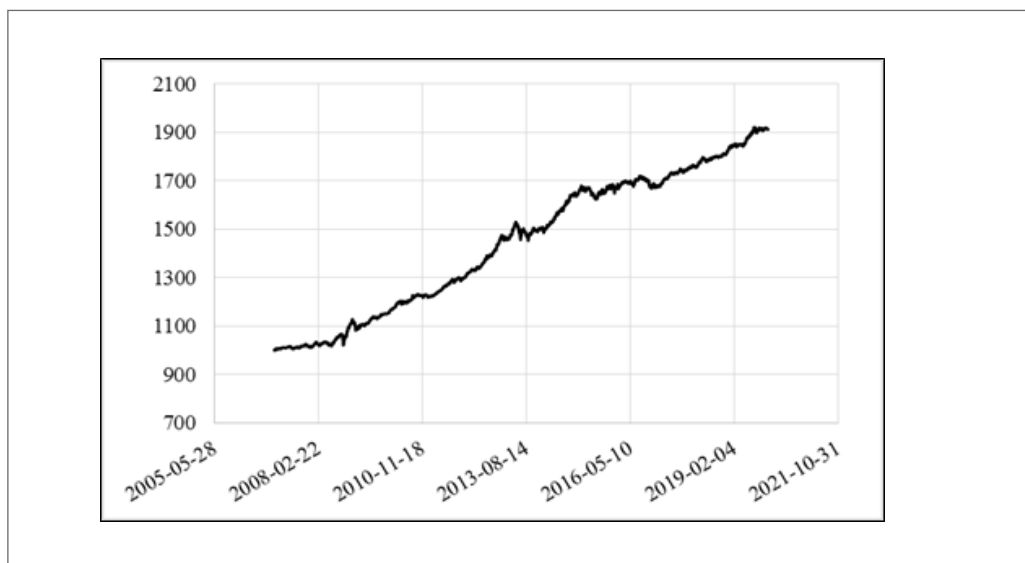
The Bello-Janjigian model appears in two variants: the first market factors are WIG20 and mWIG40, and in the second variant sWIG80 is additionally included. Quotations for both indexes are shown in Figure 4.

The mWIG40 index includes 40 next companies in the order in which they appear in the ranking creating indexes, of which the first 20 are formed by the WIG20 index. The next 80 companies are the basis for calculating the sWIG80 index. From the point of view of the Bello-Janjigian model, it is important that market indicators taken into account are disjointed, they must describe other market segments. This is the case with the three indices used: WIG20, mWIG40, sWIG80. For these reasons, the WIG index model, which includes companies from the three listed indices, has not been included.

In the first subperiod, the WIG and WIG20 indices were taken into account, although the correlation of the rates of return is large, it exceeds 90%, but the indicators take into account different numbers of companies. There-

**Figure 3**

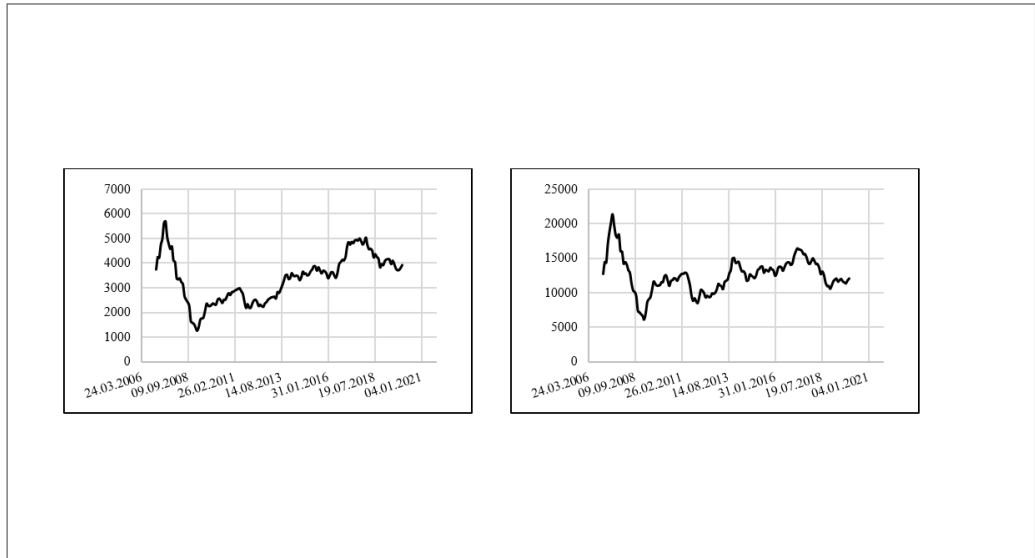
*Bond Index Prices in the Years 2007-2019*



Source: own study based on data from stooq.pl

**Figure 4**

Quotations of the mWIG40 index (Left Chart) and sWIG80 (Right Chart) in 2007-2019



Source: own study based on data from stooq.pl

fore, the measures of management skills provide information on the composition of portfolios. Namely, to what extent managers only consider large fundamental companies (WIG20) or build portfolios taking into account less and more risky stocks in search of profitable investments (WIG). In the second sub-period, the correlation between

the WIG20, mWIG and SWIG indices is also high, it ranges from 71% to 90%. However, the model only needs to take into account disjoint market segments, which is exactly the case and therefore the WIG index is not included. Additionally, in 2007-2019, the TBSP index describing the bond market was taken into account. Corre-

**Table 1**

Identification of Structural Coefficients with Market Indices

Description				
Henriksson-Merton model		$\beta_A^{HM}$ WIG, WIG20		
Model Weigel model	$\beta_A^W$ WIG, WIG20		$g_{bond,A}^W$ TBSP	
Treynor-Mazuy model		$\beta_A^{TM}$ WIG, WIG20		
3-factor Bello-Janjigian model	$\beta_{1A}^{BJ}$ WIG20	$d_{1A}^{BJ}$ mWIG40	$g_{1bond,A}^{BJ}$ TBSP	
4-factor Bello-Janjigian model	$\beta_{2A}^{BJ}$ WIG20	$d_{2A}^{BJ}$ mWIG40	$e_{2A}^{BJ}$ sWIG80	$g_{2bond,A}^{BJ}$ TBSP

lation coefficients with other indices do not exceed 27%. Table 1 links the structural coefficients in the models used with market indexes. Estimations of the structural coefficients of the used models were obtained by the classic least squares method. To emphasize that we are dealing with estimators, a roof over the coefficient symbol was used. In the hypotheses regarding the significance of estimators ( $H_0$ : the estimator is statistically insignificant), the level of significance was 5%, this applies to both one-sided and two-sided alternative hypothesis.

6. Empirical Analysis of the Effectiveness of Management of Portfolios of Open-End Funds

6.1. Henriksson-Merton and Weigel Models

The Henriksson-Merton model, in the methodology adopted by the authors taking into account the WIG and WIG20 stock market indices, describes only the share of the portfolio of investment funds. The same will be the case with the Treynor-Mazuy model. The work concerns balanced funds, which contain a part of assets invested in debt instruments, mainly bonds. Therefore, in the analysis of results, it will be important to compare the results obtained for the equity part of the portfolios with the results including debt securities. Table 2 presents the estimators

of structural parameters in the Henriksson-Merton model. It should be noted that bold numbers indicate statistically significant parameters at a significance level of 5%. In the first subperiod, the coefficients of determination  $R^2$  ranged from 76% to 93%, most of which were closer to the larger value of the given range. In the second subperiod, the situation was analogous, with the range from 67% to 91%. Consequently, these values can be considered satisfactory and testify to the adequate selection of explanatory variables for the model. The first conclusion that comes after the analysis of the presented results is the domination, in terms of statistical significance, of beta coefficients in all funds. Because they are measures of the correlation of the investment portfolio with stock market indices (WIG and WIG20), the dominant strategy of managers is to follow the market situation. All statistically significant coefficients  $\hat{\beta}_A^{HM}$  are positive, therefore the portfolios reflect the market situation. The average value of beta coefficients for the years 2003-2006 and the WIG index was 0.478, while for the WIG20 index it was 0.387 (excluding the NN fund, where the coefficient was insignificant). The analogous values for the 2007-2019 subperiod were as follows: 0.619 and 0.598 (this time all the coefficients were statistically significant). The first subperiod is the bull market, so you could expect higher values of these coefficients, closer to 1 and even exceeding them because managers should try to beat

Table 2  
Estimation Results of Structural Parameters in the Henriksson-Merton model

Fund	2003-2006						2007-2019					
	$\hat{\alpha}_A^{HM}$		$\hat{\beta}_A^{HM}$		$\hat{\gamma}_A^{HM}$		$\hat{\alpha}_A^{HM}$		$\hat{\beta}_A^{HM}$		$\hat{\gamma}_A^{HM}$	
	WIG	WIG20	WIG	WIG20	WIG	WIG20	WIG	WIG20	WIG	WIG20	WIG	WIG20
Gen	-0.0007	0.0035	<b>0.4064</b>	<b>0.3939</b>	0.0806	0.0233	0.0007	<b>0.0030</b>	<b>0.5252</b>	<b>0.5028</b>	-0.0397	-0.0713
Inv	-0.0006	0.0023	<b>0.4706</b>	<b>0.4297</b>	-0.0472	-0.0501	<b>0.0081</b>	<b>0.0106</b>	<b>0.6824</b>	<b>0.6326</b>	<b>-0.2915</b>	<b>-0.3102</b>
NN	-0.0016	<b>0.0022</b>	<b>0.4840</b>	0.4525	0.0070	-0.0230	0.0016	<b>0.0106</b>	<b>0.5960</b>	<b>0.6326</b>	<b>-0.1308</b>	<b>-0.3102</b>
Novo	0.0028	<b>0.0057</b>	<b>0.4047</b>	<b>0.3748</b>	-0.0595	-0.0750	<b>-0.0037</b>	-0.0006	<b>0.6294</b>	<b>0.6146</b>	-0.0499	-0.0960
Pekao	-0.0025	0.0001	<b>0.5411</b>	<b>0.4845</b>	-0.0560	-0.0319	-0.0028	0.0003	<b>0.7514</b>	<b>0.7147</b>	-0.0857	-0.1179
PKO	-0.0001	0.0025	<b>0.4660</b>	<b>0.4169</b>	-0.0661	-0.0543	<b>0.0024</b>	<b>0.0047</b>	<b>0.5941</b>	<b>0.5646</b>	<b>-0.2261</b>	<b>-0.2440</b>
Rock	-0.0013	0.0015	<b>0.4369</b>	<b>0.4014</b>	-0.0176	-0.0220	<b>-0.0019</b>	0.0007	<b>0.5164</b>	<b>0.4980</b>	-0.0268	-0.0706
Sant	<b>0.0070</b>	<b>0.0104</b>	<b>0.6576</b>	<b>0.5829</b>	-0.1397	-0.1142	<b>0.0032</b>	<b>0.0067</b>	<b>0.7378</b>	<b>0.7094</b>	<b>-0.2472</b>	<b>-0.2978</b>
Skarb	0.0001	0.0028	<b>0.4340</b>	<b>0.3973</b>	-0.0177	-0.0200	-0.0013	0.0012	<b>0.5361</b>	<b>0.5153</b>	-0.0329	-0.0709

the market. The assessment of management skills is deteriorated by alpha coefficients, almost all are irrelevant when we consider WIG, and only three statistically significant when WIG20 (NN, Novo and Sant). Therefore, the equity part of the portfolios does not take into account the fundamental factors taken into account when selecting companies that are not related to market conditions. This demonstrates the lack of ability to select assets for the equity part of portfolios selectively. Unfortunately, all the coefficients  $\hat{\gamma}_A^{HM}$  are equal to zero from a statistical point of view, i.e., managers do not show the ability to shape the portfolio composition in such a way as to avoid losses.

Conclusions from the analysis of the results obtained for the second subperiod (2007-2019) are slightly different. First of all, the average beta value is higher than in the previous subperiod and they are all statistically significant. In addition, significant alpha coefficients appear in five cases. However, they are not always positive, which results from the verification of a two-sided alternative hypothesis. Noteworthy funds Inv, PKO and Sant in their case alpha coefficients are significant and positive both when the market factor is WIG and WIG20. Unfortunately, the gamma coefficients for these funds and for both stock indices are negative (statistically significant). Thus, it can be said that the managers of these funds attach some importance to the appropriate selection of shares to

the portfolio on the basis of non-market considerations (in the sense of the situation on the stock market), but they are completely unable to avoid losses.

As mentioned earlier, the Henriksson-Merton model concerns the equity portion of the investment fund portfolio. Therefore, the drawn conclusions should be confronted with the analysis supplemented with a portfolio of debt instruments. This is possible thanks to the Weigel model, which takes into account the bond market index (in Poland only for fixed-rate treasury). In addition, the  $\hat{\gamma}_A^W$  ratio is related to the ability to allocate assets between the part of the portfolio containing shares and bonds. The results of parameter estimation are presented in Table 3. It should be recalled that the TBSP index has been calculated since 2007, therefore the interpretation of the results applies only to the second subperiod of 2007-2019.

The coefficients of determination were in the range from 75.6% to 93.6% for WIG and in the range from 67% to 91.9% for WIG20. Thus, they indicate a satisfactory selection of explanatory variables for the model. In this case, all beta coefficients are statistically significant for both indices, and their average are: 0.596 for WIG and 0.568 for WIG20, respectively. So, they are close to each other. It should be noted that they slightly differ from the values obtained in the Henriksson-Merton model. The situation is slightly different if you look at the ratios at the bond index. When the stock market is described by

**Table 3**

*The Results of the Estimation of Structural Parameters in the Weigel Model*

Fund	2007-2019							
	$\hat{\alpha}_A^W$		$\hat{\beta}_A^W$		$\hat{\theta}_{bond,A}^W$		$\hat{\gamma}_A^W$	
	WIG	WIG20	WIG	WIG20	WIG	WIG20	WIG	WIG20
Gen	-0.0003	0.0022	<b>0.4985</b>	<b>0.4788</b>	<b>0.3589</b>	<b>0.3352</b>	-0.0186	-0.0546
Inv	<b>0.0077</b>	<b>0.0101</b>	<b>0.6499</b>	<b>0.5988</b>	<b>0.3305</b>	0.3442	<b>-0.2671</b>	<b>-0.2854</b>
NN	0.0005	<b>0.0025</b>	<b>0.5582</b>	<b>0.5293</b>	<b>0.5119</b>	<b>0.4725</b>	<b>-0.1034</b>	<b>-0.1106</b>
Novo	-0.0033	-0.0004	<b>0.6332</b>	<b>0.6132</b>	-0.0237	-0.0741	-0.0587	-0.0906
Pekao	<b>-0.0034</b>	-0.0003	<b>0.7306</b>	<b>0.6938</b>	<b>0.2319</b>	0.1920	-0.0667	-0.0963
PKO	<b>0.0022</b>	<b>0.0044</b>	<b>0.5695</b>	<b>0.5392</b>	<b>0.3391</b>	<b>0.3218</b>	<b>-0.2163</b>	<b>-0.2323</b>
Rock	<b>-0.0026</b>	0.0001	<b>0.4964</b>	<b>0.4799</b>	<b>0.2907</b>	<b>0.2747</b>	-0.0117	-0.0612
Sant	0.0031	<b>0.0065</b>	<b>0.7143</b>	<b>0.6837</b>	<b>0.3014</b>	0.2913	<b>-0.2374</b>	<b>-0.2855</b>
Skarb	-0.0021	0.0005	<b>0.5148</b>	<b>0.4950</b>	<b>0.2956</b>	<b>0.2731</b>	-0.0159	-0.0563

the WIG index, only one of the coefficients  $\hat{g}_{bond,A}^W$  is insignificant, while when we consider the WIG20 index, as many as four coefficients  $\hat{g}_{bond,A}^W$  are insignificant. Their average values (insignificant coefficients replaced by zeros) are respectively: 0.296 with WIG and 0.186 with WIG20. Because balanced funds are analyzed, the skilful use of the opportunities offered by the debt instruments market has a significant impact on the value of investment results obtained. Because in the portfolios of these entities, the latter assets constitute about 30% to 40%, therefore it can be expected that the coefficients  $\hat{g}_{bond,A}^W$  will be smaller than the coefficients  $\hat{\beta}_A^W$  and it really is.

However, the key factor is  $\hat{\rho}_A^W$ , which informs about the ability to limit losses by allocating assets between the stock and bond market. Only four of them are relevant regardless of whether we include in the WIG or WIG20 model. Unfortunately, they take negative values (after verification of alternative one-sided hypotheses with a negative value of coefficients). As a consequence, it can be unequivocally stated that managers of open-end balanced funds portfolios do not use the opportunities offered by the bond market. They are unable to skilfully allocate assets between the stock market and the bond market. Consequently, the coefficients  $\hat{\rho}_A^W$  in all funds are either equal to zero or negative, which of course has a negative impact on the rate of return on the fund participation units.

In the summary of both models, it can be stated that the Henriksson-Merton and Weigel models indicate a low skill of managers in using the market situation in the equity part of the portfolios as well as the part containing bonds. The ability to allocate assets between both market segments (shares and bonds) is even "harmful" to portfolios because it has no effect on them, and if it does, it leads to a reduction in the rate of return instead of increasing it. In both models, it can be seen, at least for most funds, that managers are not able to selectively choose assets for the portfolio. Most alpha coefficients are zero from a statistical point of view. Significant values are very small, and among them there are negative ones, testifying to the negative impact of selectivity on the portfolio value.

6.2. Treynor-Mazuy and Bello-Janjigian Models

For the same reasons as before, the first model includes two subperiods: 2003-2006 and 2007-2019. The second period includes only the years 2007-2019. The Bello-Janjigian model will be used in two versions: with three and four factors. The results of the estimation of structural parameters in the Treynor-Mazuy model are presented in Table 4.

The determination coefficients in the years 2003-2006 ranged from 85.7% to 93.1% when the market factor was WIG and in the range from 81.4% to 93.3% when it was

Table 4  
The Results of the Estimation of Structural Parameters in the Treynor-Mazuy Model

Fund	2003-2006						2007-2019					
	$\hat{\alpha}_A^{TM}$		$\hat{\beta}_A^{TM}$		$\hat{\delta}_A^{TM}$		$\hat{\alpha}_A^{TM}$		$\hat{\beta}_A^{TM}$		$\hat{\delta}_A^{TM}$	
	WIG	WIG20	WIG	WIG20	WIG	WIG20	WIG	WIG20	WIG	WIG20	WIG	WIG20
Gen	0.0010	0.0040	<b>0.4572</b>	<b>0.4074</b>	0.0092	0.0062	0.0001	0.0020	<b>0.5042</b>	<b>0.4664</b>	-0.0790	-0.1660
Inv	-0.0010	0.0018	<b>0.4517</b>	<b>0.4058</b>	-0.2402	-0.1880	<b>0.0042</b>	<b>0.0065</b>	<b>0.5315</b>	<b>0.4718</b>	<b>-0.6804</b>	<b>-0.8419</b>
NN	-0.0015	0.0018	<b>0.4893</b>	<b>0.4401</b>	-0.0174	-0.0395	-0.0001	<b>0.0020</b>	<b>0.5280</b>	<b>0.4939</b>	<b>-0.3237</b>	<b>-0.3924</b>
Novo	0.0026	<b>0.0052</b>	<b>0.3873</b>	<b>0.3423</b>	-0.4425	-0.3944	<b>-0.0040</b>	-0.0019	<b>0.6019</b>	<b>0.5645</b>	-0.2284	-0.2758
Pekao	<b>-0.0035</b>	-0.0006	<b>0.5093</b>	<b>0.4663</b>	-0.0829	-0.0183	<b>-0.0041</b>	-0.0014	<b>0.7081</b>	<b>0.6545</b>	-0.1336	-0.2769
PKO	-0.0010	0.0017	<b>0.4330</b>	<b>0.3896</b>	-0.1949	-0.1563	-0.0001	<b>0.0019</b>	<b>0.4746</b>	<b>0.4356</b>	<b>-0.6880</b>	<b>-0.7825</b>
Rock	-0.0009	0.0014	<b>0.4399</b>	<b>0.3925</b>	-0.3048	-0.1378	<b>-0.0023</b>	-0.0003	<b>0.5027</b>	<b>0.4621</b>	-0.0577	-0.1590
Sant	<b>0.0052</b>	<b>0.0087</b>	<b>0.5895</b>	<b>0.5255</b>	-0.4490	-0.3259	0.0006	<b>0.0032</b>	<b>0.6066</b>	<b>0.5516</b>	<b>-0.7881</b>	<b>-0.9660</b>
Skarb	0.0003	0.0026	<b>0.4337</b>	<b>0.3882</b>	-0.2339	-0.0883	-0.0017	0.0026	<b>0.5188</b>	<b>0.3882</b>	-0.0958	-0.0883

WIG20. In the second subperiod (2007-2019), the corresponding values ranged from 74.9% to 93.1% (WIG) and from 66.7% to 90.6% (WIG20).

The Treynor-Mazuy model differs from the Henrikson-Merton model by another way of "measuring" the ability to allocate assets when market conditions change. In this case, there is a delta coefficient, whose positive value means the convexity of the trend line in the profits from the investment portfolio as compared to the fund's characteristic line (straight line). Because it is a proportionality coefficient with the variable  $(r_{M,t} - r_{ft})^2$ , which does not depend on the sign  $r_{M,t} - r_{ft}$ , so the skill manifests itself in allocation between equity and risk-free assets. And their impact on return on assets will be beneficial when the delta is positive. The results in Table 4 show that in the first subperiod the delta coefficients are statistically insignificant, while in the second four are statistically significant but negative. This is true regardless of whether the market factor was WIG or WIG20. Consequently, it can be unequivocally stated that the managers of all analyzed funds do not have the ability to profitably allocate assets depending on the market situation, and some even harm the fund.

Beta coefficients in all cases are statistically significant and positive. Their average values are 0.466 and 0.418 respectively for WIG and WIG20 in 2003-2006 and

analogously equal 0.533 and 0.499 for WIG and WIG20 respectively in 2007-2019. It is worth emphasizing that their values are similar even though the first subperiod is a bull market. In this case, managers could be expected to make much better use of the market.

The extension of the Treynor-Mazuy model is the Bello-Janjigian model, which takes into account several market factors. In this work, two variants of this model are included, one with the WIG20 and mWIG40 indices, and the other with the WIG20, mWIG40 and sWIG80 indexes, in both cases the bond market is characterized by the TBSP index. It is worth recalling that the indices included in the model must describe different segments of the stock market, therefore the WIG index was not included. The results of the parameter estimation are presented in Table 5.

In the Bello-Janjigian model, the convexity of the characteristic line relates to one of the indices considered. The authors assumed that this is an index of large companies WIG20. It is dictated by the fact that managers with large capital seek liquid assets, and this condition is met by the assets included in this index. The other benchmarks are related to the linear expressions of the model, which suggests their relatively smaller impact on changes in participation units compared to the index of large companies.

**Table 5**  
*Results of Estimation of Structural Parameters in the Bello-Janjigian Model*

Fund	3-factor model					4-factor model					
	$\hat{\alpha}_{1A}^{BJ}$	$\hat{\beta}_{1A}^{BJ}$	$\hat{\delta}_{1A}^{BJ}$	$\hat{a}_{1A}^{BJ}$	$\hat{g}_{1bond,A}^{BJ}$	$\hat{\alpha}_{2A}^{BJ}$	$\hat{\beta}_{2A}^{BJ}$	$\hat{\delta}_{2A}^{BJ}$	$\hat{a}_{2A}^{BJ}$	$\hat{e}_{2A}^{BJ}$	$\hat{g}_{2bond,A}^{BJ}$
Gen	0.0000	<b>0.2820</b>	0.0766	<b>0.2035</b>	<b>0.3943</b>	0.0002	<b>0.2835</b>	0.0336	<b>0.1505</b>	<b>0.0569</b>	<b>0.3954</b>
Inv	<b>0.0042</b>	<b>0.2079</b>	-0.5341	<b>0.3034</b>	0.3121	<b>0.0046</b>	<b>0.2110</b>	-0.6173	<b>0.2007</b>	<b>0.1103</b>	0.3142
NN	-0.0001	<b>0.3305</b>	-0.1568	<b>0.1737</b>	<b>0.4832</b>	0.0001	<b>0.3318</b>	-0.1930	<b>0.1290</b>	<b>0.0480</b>	<b>0.4842</b>
Novo	<b>-0.0028</b>	<b>0.4058</b>	-0.1274	<b>0.1941</b>	-0.0488	-0.0025	<b>0.4080</b>	-0.1894	<b>0.1176</b>	0.0822	-0.0472
Pekao	<b>-0.0035</b>	<b>0.4024</b>	0.0114	<b>0.2917</b>	<b>0.2618</b>	<b>-0.0031</b>	<b>0.4055</b>	-0.0734	<b>0.1869</b>	<b>0.1125</b>	<b>0.2639</b>
PKO	0.0004	<b>0.2804</b>	-0.5901	<b>0.1749</b>	<b>0.2561</b>	0.0006	<b>0.2826</b>	-0.6512	<b>0.0996</b>	<b>0.0809</b>	<b>0.2576</b>
Rock	<b>-0.0022</b>	<b>0.2724</b>	0.0795	<b>0.2127</b>	<b>0.3355</b>	<b>-0.0018</b>	<b>0.2757</b>	-0.0111	<b>0.1007</b>	<b>0.1202</b>	<b>0.3378</b>
Sant	0.0014	<b>0.3347</b>	-0.7182	<b>0.2512</b>	0.2228	0.0017	<b>0.3372</b>	-0.7866	<b>0.1667</b>	<b>0.0907</b>	0.2245
Skarb	-0.0016	<b>0.2908</b>	0.0429	<b>0.2105</b>	<b>0.3304</b>	-0.0014	<b>0.2927</b>	-0.0084	<b>0.1472</b>	0.0680	<b>0.3317</b>

As in previous models, the coefficients of determination assume acceptable values, namely they are in the range of 76.1% to 95.9%, when market factors are WIG20 and mWIG40 and in the range of 76.7% to 96.1%, when market factors are WIG20, mWIG40 and sWIG80.

In both variants, all coefficients describing the correlation with WIG20 and mWIG40 were statistically significant, however their values were relatively small. In particular, in the 3-factor variant, the average value of coefficients  $\hat{\beta}_{1A}^{BJ}$  was equal to 0.312 and coefficients  $\hat{\alpha}_{1A}^{BJ}$  equal to 0.224. In the 4-factor model, on the other hand, the corresponding values are 0.314 and 0.144. It can be assumed that the largest and medium-sized companies had a relatively small impact on the rate of return on the fund's investment portfolio. Coefficients associated with the WIG20 index take lower values than they did in the Treynor-Mazuy model, which seems understandable. Because the inclusion of smaller company indices indicates portfolio diversification between different market segments. If we consider the third sWIG80 index, as in the 4-factor model, it turns out that the average value of the estimator of the structural coefficient associated with this market factor is 0.689. In addition, in the case of two funds the coefficient  $\hat{e}_{2A}^{BJ}$  was not statistically significant. This distribution of values indicates that the vast majority of managers prefer companies from the WIG20 index, only "enriching" the portfolio with medium-sized companies with slightly lower liquidity. On the other hand, the share of small enterprises is negligible, which can be partly explained by the volume of transactions, usually of a million value.

The share of debt securities in fund portfolios is interesting. In three cases out of nine, the estimators were irrelevant regardless of whether we were dealing with a four or five factor variant. The average value was 0.229 in the first case and 0.230 in the second. Similar average values of the ratios can be partly explained by the negligible impact of the sWIG80 index on the rate of return on funds in the 4-factor model. It is also worth noting that in the 3-factor variant, the coefficients associated with the mWIG40 stock index and the TBSP bond index have similar values. This shows that managers of investments in medium-value companies treat on an equal footing with investments in bonds. However, in the 4-factor variant, the ratio for bonds is definitely higher than for the mWIG40 index. This may indicate that managers may possibly diversify the portfolio between medium and small companies, but they do not do so at the "cost" of bonds.

The ability to selectively select assets for a portfolio does not differ from the results obtained in previous models. Most alpha coefficients are not statistically significant, in the 3-factor model four are significant, and in the 4-factor only three. Only the Inv fund has a positive coefficient in both models, the others are negative. Therefore, one can formulate the thesis that only the fund manager attaches importance to the selection of companies not correlated with the market situation, taking into account fundamental and macroeconomic factors.

## 7. Conclusion

The results obtained should be summarized in two variants, one covers the years 2003-2006 and the other 2007-2019. The main reason is that in the second subperiod in the fund portfolios debt instruments are included and in the first one they are not. It should be recalled that the reason for this is that the only publicly available TBSP bond market index has been published by the Warsaw Stock Exchange only since 2007. Unfortunately, it only concerns government bonds, although municipal and corporate instruments are listed. One explanation for the limitation to treasury instruments in the TBSP definition is that their liquidity is greater than the bonds of other issuers. Although on the Polish market the liquidity of all debt instruments is rather small. In all models and for both subperiods the coefficients of determination had an acceptable value, their list is presented in Table 6.

Consequently, it can be stated that the explanatory variables in all models significantly affected the percentage changes in participation units. However, not all in the same "strong" way. The factors associated with the basic stock market indices definitely had the greatest impact. In all models and in all subperiods, these coefficients had significant positive values, with the exception of the Henriksson-Merton model and the beta ratio of the NN fund in 2003-2006 at the WIG20 index and the Bello-Janjigian model in which two coefficients related to the small business market (index sWIG80) were zero. However, it should be noted that all non-zero coefficients took on relatively small values, which should not be interpreted positively in good times (2003-2006). For example, in the Henriksson-Merton model, the average value of the beta in these years was 0.478 when the market index was WIG and 0.387 when WIG20 (the value lowers the insignificant beta for the NN fund, which is replaced by zero when calculating the average). In these years, the market situation was favorable to



**Table 6**  
*Statement of Determination Coefficients*

Models	Range of determination coefficients (%)			
	2003-2006		2007-2019	
Henriksson-Merton	76-93		67-91	
Weigel	76-94		67-92	
Treydor-Mazuy	WIG	WIG20	WIG	WIG20
	86-93	81-93	75-93	67-91
Bello-Janjigian			WIG20, mWIG40, TBSP	WIG20, mWIG40, sWIG80, TBSP
			76-96	77-96

follow the stock market. Therefore, it seems that managers should make greater use of it. Greater correlations of percentage changes in the value of the fund portfolio with the stock market were to be expected. Including bonds in the portfolios does not change much in the Weigel model (2007-2019 only) the average beta coefficients for WIG and WIG20 were 0.596 and 0.568, respectively. However, it must be remembered that this was a period of changing market conditions. Nonetheless, the average values of the coefficients measuring correlations with the bond market are very small and take values equal to 0.296 and 0.186 in the model with WIG and WIG20, respectively. Therefore, it can be concluded that the use of bonds in fund portfolios had little impact on the achieved rate of return.

In the case of the Treynor-Mazuy model, the situation is actually repeated, the average values of the coefficients taking into account the impact of the WIG and WIG20 indices are similar to the values from previous models. The situation is slightly different for the Bello-Janjigian model (only 2007-2019). In the 3-factor model, the average values of the structural coefficient estimators at WIG20 and mWIG80 are 0.312 and 0.224, respectively, and in the 4-factor model 0.314 and 0.144, respectively. However, the average of this ratio, when taking into account the small business index (sWIG80) is 0.069. Consequently, it can be seen that managers definitely prefer the assets included in the WIG20 index. What probably should be considered understandable, due to the scale of orders placed, then liquidity is an important factor. On the other hand, one should not underestimate the importance of companies from the mWIG40 index, an appropriate selection could significantly improve the funds' results. However, avoiding companies with sWIG80 seems reasonable.

So far, there have been talks about the impact of share

indices on the results achieved. However, when dealing with sustainable funds, investment in bonds that are a substantial part of the investment portfolio should be taken into account. For the reasons already mentioned several times in the models, only the years 2007-2019 could be included. In the Weigel model, the coefficients describing the impact of the bond market on the return on participation units are quite often statistically insignificant (four or five out of nine coefficients), and their average values are equal to 0.296 and 0.186 when the stock market is described by WIG and WIG20, respectively. Similar values were obtained in the Bello-Janjigiana model, in both variants three coefficients were not statistically significant, and the average value was 0.229 (3-factor model) and 0.230 (4-factor model). Consequently, it can be concluded that the inclusion of more share indices in this model has no significant effect on the portion of the portfolio containing bonds. In addition, the quantitative compliance of the coefficient values with those obtained in the Weigel model seems to confirm this conclusion.

The issue of market-timing is not optimistic, the ability to sense the market through changes in portfolio compositions and the ability to choose the moment of the transaction should be assessed negatively. In the case of the Treynor-Mazuy model in 2003-2006, all coefficients  $\hat{\gamma}_A^{HM}$  were equal to zero for both indices, and in the second subperiod only four were statistically significant, but negative. Consequently, managers were unable to achieve results with a rate of return exceeding the risk-free rate. In the case of the Weigel model, the situation is analogous, but this time market-timing consists in taking into account the rate of return on bonds in investments.

In the Treynor-Mazuy model, market-timing is characterized by the factor  $\delta_A^{TM}$ , which is a measure of the

convexity of the trend line in the model. The obtained results are fully analogous to those obtained in the Henriksson-Merton model. The latest Bello-Janjigiana model fully confirms the previous conclusions, which can be formulated briefly: managers under the considered models do not show the ability to choose the right moment to conclude transactions. Even if the measure of these skills is statistically significant, it has a negative value, which negatively affects the rate of return they achieve. It should be noted that the application is consistent with many studies conducted on funds operating in other countries, as mentioned several times in the literature review.

The last issue is the ability of managers to properly select financial instruments to the portfolio irrespective of market conditions, both on the stock and bond market. This is called selectivity. It can be said that, in principle, all models indicate a lack of ability to selectively select assets. Alpha coefficients (free words in models) are in most cases statistically insignificant. If they are different from zero, they take very small values, and sometimes also negative. As a consequence, managers attach negligible importance to this aspect of building investment portfolios.

In the final summary it can be stated that in the case of sustainable funds operating on the Polish market in the years 2003-2019 managers have attached the greatest importance to following the stock market. And this is when the market of most listed shares (WIG index) as well as the markets of fundamental companies (WIG20) and medium-sized companies (mWIG40) are taken into account. Smaller companies included in the sWIG80 index are less important. The managers devoted much less attention to the bond market, but this can be justified by the low liquidity of this market and the fact that the bonds account for 30% to 40% of the portfolio composition. However, what is most important from the point of view of investment strategies, i.e., market-timing and selectivity, in this case the managers of any fund have not demonstrated the appropriate skill. As a result, the thesis can be formulated that investment strategies of sustainable fund portfolio managers are passive strategies. Unfortunately, incentives offering participation units to buy them, and consisting in praising professional asset management are not confirmed by the results of the research.

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