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# SOCIAL SECURITY ISSUES: II PILLAR PENSION FUNDS'PERFORMANCE IN LITHUANIA

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**Abstract.** Since demographic problems have appeared, the pension system's transformation has become an extremely relevant issue in terms of dealing with country's social security problems. Development of medicine and a better quality of life have caused population aging which is particularly noticed in the developed countries. The problem of an aging population has encouraged scientists and practitioners to actively discuss the issue of social security. Particularly, the importance of a changing pension system has become a concern in regards of ensuring the public welfare. Therefore, the article analyses the sustainability of Lithuania II pillar pension funds using multi-criteria methods. The carried out research has enabled the evaluation and comparison of II pillar pension funds and their performance. The use of multi-criteria methods combining a few funds' actions defining indicators into a whole have helped to evaluate the pension funds. In addition, it has helped to identify the funds' operational sustainability and to choose the best fund, emphasizing the most important aspects for each member and shaping the weights of multi-criteria methods' evaluation. It is important to emphasize that the aspect of reward indicator is significant in the asset accumulation in pension funds because the goal of these funds is to accumulate the biggest amount of asset for the future pension in a long period and not just to protect the money from its depreciation. Finally, it is worth mentioning that this type of a research provides a new perspective on the pension funds' evaluation in the context of other criteria.

**Keywords:** pension fund, multi-criteria decision making, multi-criteria analysis.

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## 1. Introduction

Social security issues are affected by many factors, among which as sustainable development of economy (Oganisjana et al. 2015; Pather 2015; Travkina, Tvaronavičienė 2015; Tvaronavičienė 2014; Dobele et al. 2015; Olaniyi, Reidolf 2015), and demographic situation play very important role (Starineca; Voronchuk 2015).

Influenced by demographic changes that started a few decades ago, countries around the world began performing an old-age pension system reforms. Some of the countries have made relatively small but significant and consistent changes; meanwhile others extremely rearranged the whole old-age pension system where Lithuania was not an exception. The structural changes of pension system made by The World Bank are still being actively discussed among the scientists who are trying to find some means of an evaluation.

Contrary to the rest of the countries, Lithuania is not obliged to participate in the operations of II pillar pension

funds; however, once having entered the funds, a voluntary leaving would not be approved. This factor influences and presupposes a demand for the further analysis and evaluation. Systemization of the literature has shown that the indicators evaluating performance of pension funds are interpreted each individually (Jasienė, Kočiūnaitė 2007; Bartkus 2007; Gudaitis 2010; Lieksnis 2010; Bohl et al. 2011; Jurevičienė, Samoškaitė 2012; Huang, Mahieu 2012; etc.) without combining them into a whole which could help the members to make the right decision. Therefore, the use of multi-criteria assessment methods is becoming more and more significant (Pendaraki, Zopounidis 2003; Pendaraki et al. 2005; Alptekin 2009; Ching-Hui et al. 2010; Babalos et al. 2011; Stankevičienė, Bernatavičienė 2012; Stankevičienė, Gavrilova 2012; Jurevičienė, Bapkauskaitė 2014). In Lithuania, these methods have been applied for the investment funds' assessment, solving problems of the construction sector and other complicated phenomena that are defined by using indicators which each emphasize different aspects of assessment. However, this kind of analysis has not been carried out for Lithuanian II pillar pension funds.

The aim of the article is to suggest a technique which would enable a complex evaluation of fund's operation and would help to perform quantitative evaluation of Lithuanian II pillar pension funds' performance.

Therefore, the research is not only significant because it allowed evaluating and comparing II pillar pension funds. In addition, a combination of multi-criteria methods has been employed in a scientific context which is quite unusual because it is still only being analysed on the level of theoretical approach. Results of the research enabled current members of the pension system to make decisions while choosing a pension fund for assess accumulation; furthermore, pension management companies obtained a possibility to determine their funds' situation in the context of other funds.

## 2. The Issue of Pension Funds' Assessment

The issue of population aging began to pose a problem in industrial countries at the end of the XX century. It was caused by demographic changes such as increased life expectancy and declining birth rates. R. Lazutka (2008) observes that because of the latter reasons, various countries in the world started implementing parametric and structural reforms of old-age pension systems. The author claims that most of the European Union countries have already performed parametric reforms: they extended the retirement age, made changes in pension indexation mechanism etc. E. L. Croitoru (2012) stresses that some of the European Union countries, such as Hungary, Latvia, Lithuania and others, made cardinal changes in their old-age pension system structures, taking into consideration a multi-system conception promoted by The World Bank and yet widely discussed in scientific contexts (Averting the Old Age Crisis 1994). Some scientists criticized such reform proposals claiming that they were not based and mythical; on the other hand, quite a few post-communistic countries in Latin America have chosen to carry out such reforms based on The World Bank proposals (Orszag, Stiglitz 1999; Kotlikoff 1999). Lithuania was not an exception, however, changes made by the government have caused a lot of discussions that are still present nowadays (Gylys 2002; Lazutka 2008; Bitinas 2011; Gudaitis 2009a, 2009b; Medaiskis, Gudaitis 2013; Bitinas, Maccioni 2014; etc.). Lithuania performed an old-age pension system reform which resulted in three pension system pillars in 2004: I pillar was based on the current payments' principal, i.e. PAYG (pay-as-you-go); II pillar was partially mandatory cumulative pension funds; III pillar meant voluntary cumulative pension funds (Gudaitis 2009b). Since the global financial crisis has started, the reward in cumulative pension funds has significantly decreased. In addition, the government reduced Sodra's pensions and applied additional pension-size reductions to the working pensioners (Bitinas 2011). As a result of all the changes, Lithuania has performed another old-age pension system reform in 2013. Contrary to the system of 2004, a maximum accumulation was introduced in 2014, i.e. in addition to the payment transferred to a particular pension fund account by Sodra, a member is able to add his own assess, in this manner receiving an encouragement made by the government (The Republic of Lithuania… 2012). Although the maximum accumulation became obligatory for all the new signatories in pension funds, in 2013 specified period, the members of these funds had an opportunity to choose whether to start a maximum accumulation, return to Sodra's system, or to stay at the old cumulative mean (Bitinas, Maccioni 2014). Ultimately, at the end of 2013, 96.8 % of all the insured remained in II pillar pension funds without a possibility to terminate the contract voluntary (Statistical… 2013). This promotes an evaluation of the results of pension funds and encourages the creation of ability for the members to choose the best cumulative fund.

Lithuanian scientific literature is limited to the sparse assessment analysis of II pillar pension funds (Jasienė, Kočiūnaitė 2007; Bartkus 2007; Gudaitis 2009a, 2010; Jurevičienė, Samoškaitė 2012; etc.). The articles evaluate data provided by the supervisory authority, Lithuanian Bank: data consist of the unit value changes, standard deviation that reflects the risk, or charges. In addition, Sharpe Ratio, Alpha, and Beta indicators are analysed.

Authors who have analysed investment funds also applied Treynor-Mazuy regression model and new multi-criteria methods SAW (Simple Additive Weighting) (Gavrilova 2011; Stankevičienė, Gavrilova 2012; Stankevičienė, Bernatavičienė 2012; Jurevičienė, Bapkauskaitė 2014). Scientific articles of a theoretical nature are also worth mentioning since they provide a significant amount of applied methods that help to evaluate investment and pension funds (Dzikevičius 2004; Jokšienė, Žvirblis 2011; Žvirblis, Rimkevičiūtė 2010, 2012; Kuodzevičiūtė 2012). Even though the articles discuss quite a few indicators that are already in use, the authors mentioned above discover new possibilities. For instance, A. Žvirblis and V. Rimkevičiūtė describe the assessment of macro factors' influence on investment funds, using various multi-criteria methods. In addition, they suggest applying the regression model in order to predict the prospects of investment fund's capital's volume (2012). R. Kuodzevičiūtė mentions absolute (unconditional), conditional beta and conditional beta-alpha assessment models that are widely used among foreign authors in order to evaluate investment and pension funds (Sawicki, Ong 2000; Ferson, Khang 2002; Cuthberston 2008; etc.).

The methods of the research, used to evaluate pension (investment) funds are provided in Table 1. Even though not all the indicators (e.g. the size of fund's assets, the number of units) used to assess the investment funds are suitable and might be used to compare the pension funds, there are still valuable unemployed methods that would help the members of pension funds to make the right decisions.

**Table 1.** Methods used in Lithuania in Order to Evaluate II Pillar Pension and Investment Funds

| Methods Applied in Lithuania to Evaluate Investment and II-Pillar Pension Funds | Evaluation of II Pillar Pension Funds' Carried Out by | Investment Fund's Evaluation Carried Out by |
|---|---|---|
| **Net Investment Return** | Gudaitis 2009a; Gudaitis 2010. | Gavrilova 2011; Stankevičienė, Gavrilova 2012; Stankevičienė, Bernatavičienė 2012; Jurevičienė, Bapkauskaitė 2014. |
| **Standard Deviation** | Gudaitis 2009a, 2010; Bartkus 2007. | Gavrilova 2011; Stankevičienė, Gavrilova 2012; Stankevičienė, Bernatavičienė 2012; Jurevičienė, Bapkauskaitė 2014. |
| **Charge Rate** | Gudaitis 2010. | Stankevičienė, Gavrilova 2012;Jurevičienė, Bapkauskaitė 2014. |
| **Change of an Investment Unit Value** | Gudaitis 2010; Bartkus 2007. | Stankevičienė, Gavrilova 2012; Stankevičienė, Bernatavičienė 2012; Jurevičienė, Bapkauskaitė 2014. |
| **Alpha Ratio** | Gudaitis 2010. | Stankevičienė, Gavrilova 2012; Stankevičienė, Bernatavičienė 2012; Jurevičienė, Bapkauskaitė 2014. |
| **Beta Ratio** | Gudaitis 2010. | Stankevičienė, Gavrilova 2012; Stankevičienė, Bernatavičienė 2012; Jurevičienė, Bapkauskaitė 2014. |
| **Sharpe Ratio** | Jurevičienė, Samoškaitė 2012; Jasienė, Kočiūnaitė 2007. | Gavrilova 2011; Stankevičienė, Gavrilova 2012; Stankevičienė, Bernatavičienė 2012; Jurevičienė, Bapkauskaitė 2014. |
| **Coefficient of Variation** | Bartkus 2007. | Stankevičienė, Bernatavičienė 2012. |
| **Correlation Coefficient** | Gudaitis 2010. | Stankevičienė, Gavrilova 2012; Jurevičienė, Bapkauskaitė 2014. |
| **Treynor – Mazuy Model** | - | **(Gamma ratio)** Stankevičienė, Gavrilova 2012; **(Alpha, beta and gamma ratios)** Gavrilova 2011. |
| **Treynoro – Black Indicator** | - | Stankevičienė, Bernatavičienė 2012; Jurevičienė, Bapkauskaitė 2014. |
| **The Number of Fund's Investment Units** | - | Stankevičienė, Gavrilova 2012; Stankevičienė, Bernatavičienė 2012; Jurevičienė, Bapkauskaitė 2014. |
| **Fund's Assets** | - | Stankevičienė, Gavrilova 2012; Stankevičienė, Bernatavičienė 2012; Jurevičienė, Bapkauskaitė 2014. |
| **SAW (*Simple Additive Weighting*) Multi-Criteria Assessment Method** | - | Stankevičienė, Gavrilova 2012; Stankevičienė, Bernatavičienė 2012; Jurevičienė, Bapkauskaitė 2014. |

*Source*: composed by the authors

To conclude the researches provided by Lithuanian scientists, there are a few observations worth discussing. D. Jurevičienė and Š. Samoškaitė suggest evaluating pension funds using Sharpe ratio in the period of three and a half years, however, they also claim that the funds have been already active for seven years (2012). It is important to notice that pension funds aim at a long-term reward, thus the researches should be also aimed at long periods. Nevertheless, according to R. Lazutka, a short-term evaluation should not be neglected either: waiting for a long period of time the results might appear disappointing and such a system would not help to ensure higher pensions (2008). However, taking into consideration the ideas provided in the article written by D. Jurevičienė and Š. Samoškaitė, the research could have been performed at the very beginning of the funds' performance, i.e. in the period of seven years (2012). It is worth mentioning that the chosen period of time coincided with the year of crisis when many funds generated negative return and a risk-free interest rate had a considerable risk premium. In his dissertation T. Gudaitis employs alpha and beta ratios to calculate the period of 2008 which resulted in alpha ratios being negative in 18 funds out of 28, in other words, the performance of 18 funds' managers was supposedly inefficient. Therefore, the evaluation of a short-term might distort the results, thus it is recommended to analyse pension funds covering a possibly maximum period of time.

**Table 2.** Analysis of Indicators Evaluating the Results of II Pillar Pension Funds

| Indicator | Analysis of the Indicator |
|---|---|
| **Change of the Unit Value** | The indicator measures changes in pension fund's member's assets after they have been transferred into a pension fund account. Lithuanian Bank emphasizes that these indicators focus on deduction of property and not on the payment tax. M. Jasienė and D. Kočiūnaitė agree that change of the unit value enables a proper evaluation of company's investment yield; however, it does not show net rates of return received by the member (2007). T. Gudaitis contributes to the ideas mentioned above and proves them in his dissertation in a practical nature (2010). It is worth mentioning that in the pension system reform performed in 2013, management companies applied taxes that were significantly reduced, furthermore, in a few years period, the payment fee will be entirely eliminated (Republic of Lithuania… 2012). Without a payment fee, the unit value change will become an even more significant indicator used to measure pension fund's return. |
| **Average Standard Deviation** | T. Gudaitis emphasizes that an average standard deviation is "one of the best indicators to measure the risk" (2009a). He shows distribution of the average, i.e. how much the fund unit value is fluctuating in the period of the analysis (Noulas *et al.* 2005). Nevertheless, according to X. Huang and R. L. Mahieu, standard deviation is not an accurate indicator to evaluate fund's risk (2012). M. Eling agrees and emphasizes that the standard deviation involves both positive and negative return directions, thus does not fully reflect an authentic definition of the risk (2008). However, Lithuanian II pillar pension fund's risk shows that Lithuanian Bank does calculate this indicator. |
| **Sharpe Ratio** | The ratio combines the reward and the risk (standard deviation). J. Estrada claims that this indicator is the most popular in terms of evaluating fund's reward that takes into consideration the risk; however, all the criticism related to the standard deviation is attributed to the Sharpe ratio (2006). Meanwhile, M. Eling states that despite the new alternative indicators, Sharpe coefficient remains one of the most appropriate measurements to evaluate reward and the risk (2008). |
| **Beta Ratio** | According to A. G. Noulas and other scientists, this ratio measures an investment systematic risk (2005). To be more specific, Beta ratio shows the change in fund's reward when the market return is changing (market return reflects the changes of benchmark index) (Gudaitis 2010). |
| **Treynor's Ratio** | This ratio evaluates fund's reward that is related with the risk. According to M. T. Bohl and other scientists, contrary to the Sharpe ratio, this indicator evaluates systematic and not the general portfolio risk, this means, that the indicator deals with beta coefficient instead of standard deviation (2011). A. Dzikevičius emphasizes that the value of the indicator would only be correct in case of a fully diversified investment portfolio, which is, unfortunately, still quite abstract in a practical nature (2004). To conclude, although the indicator is criticized, it is quite widely used in terms of funds' evaluation. |
| **Jensen's Alpha Ratio** | J. Stankevičienė and A. Bernatavičienė define this indicator as an added value created by the actions of funds' managers; it does not consider market development and the risk taken by the funds (2012). A. Dzikevičius criticizes that this indicator is based on averages and dispersions that do not reflect actual results (2004). Despite the criticism, this indicator is widely used and employed by many scientists in the evaluation of both investment and pension funds. |

*Source*: composed by the authors

Investment and pension funds (see Table 2) are quite often evaluated using already mentioned Sharpe, Jensen's alpha, Beta, and Treynor's indicators in foreign scientific literature (Redman *et al.* 2000; Artikis, 2003; Noulas *et al.* 2005; Aamir Shah, Hijazi 2005; Jagric *et al.* 2007; Bohl *et al.* 2011; HemaDivya 2012). However, quite a few researches also involve other methods, such as Sortino ratio, Fama index or Sterling ratio (Hribernik, Vek 2011; Kolbadi, Ahmadinia 2011; Prajapati, Patel 2012; Parlak 2014). Regression models are applied and used to

calculate the weights of coefficient, for instance, CAMP (Capital Asset Pricing Model), Treynor-Mazuy, Fama-French and other models (Lieksnis 2010; Bohl *et al.* 2011; Adami *et al.* 2014). Although there are more various mathematical and statistical methods used in foreign scientific literature (Otten, Bams 2004; Cuthberston *et al*. 2008; Aldaa *et al.* 2013; etc.), most of the authors consider fund's reward, standard deviation, Sharpe ratio, Jensen's alpha ratio, Beta and Treynor's ratio as the most influential indicators to evaluate investment funds.

## 3. The Issue of Multi-criteria Assessment Methods

Quite lot indicators that are used to evaluate II pillar pension funds presuppose a demand to combine them and evaluate the funds in a complex nature. According to J. Stankevičienė and A. Bernatavičienė, this resulted in now widely used multi-criteria assessment methods (MCA) becoming quite popular over the last decade (2012). R. Ginevičius and V. Podvezko agree and claim that its popularity is influenced by the versatility of these particular methods since the application of multi-criteria assessment methods enable a quantitative evaluation of any complicated phenomena expressed by many indicators (2008b).

Multi-criteria assessment methods receive more and more consideration in scientific literature (Opricovic, Tzeng 2002; Pendaraki et al. 2003; Ginevičius, Podvezko 2008a, 2008b; Simanavičienė 2011; Jokšienė, Žvirblis 2011; Žvirblis, Rimkevičiūtė 2012; Prascevic, Prascevic 2013; Sarkar 2013). Although II pillar pension funds have not been evaluated using these methods before, they are being used more and more in other fields of science (see Table 3).

The use of these methods helps to explore more than just social phenomena; it is used to evaluate the construction sector and its technological processes, the quality of products etc. Thus the methods are widely employed and appropriate in order to evaluate complicated complex phenomena. It is important to mention that multi-criteria methods enable determination of analysed alternative priority queue; furthermore, it is advanced because of the ability to combine both maximizing and minimizing indicators denominated in various dimensions into one summative indicator. In other words, the growth of such indicators in some cases result in a better phenomenon situation, and in others, the opposite. This type of combination is possible when all the indicators are transformed into zero-dimensional; this means that they are being compared among each other (Ginevičius, Podvezko 2008b).

**Table 3.** Multi-criteria Assessment Methods and Their Uses

| Author | Multi-criteria Assessment Method | Object of Evaluation |
|---|---|---|
| Bogdanovic, Miletic (2014) | **PROMETHEE** (Preference Ranking Organization Method for Enrichment Evaluation)<br>**AHP** (Analytic Hierarchy Process) | Personnel assessment and selection |
| Tvaronavičienė *et al.* (2008) | **SAW** (Simple Additive Weighting)<br>**AHP** | Comparison of development in the Baltic countries |
| Podvezko, Podviezko (2009) | **PROMETHEE I** | Assessment of economic situation in the Baltic countries and Poland |
| Podvezko *et al.* (2010) | **TOPSIS** (Technique for Order Preference by Similarity to Ideal Solution)<br>**SAW**<br>**VS** (Sum of Ranks)<br>**AHP** | Quality of construction contracts |
| Ginevičus, Podvezko (2009) | **TOPSIS**<br>**SAW**<br>**COPRAS** (Complex Proportional Assessment)<br>**COPRAS-M**<br>**VS** | Economic and social development in Lithuanian districts |
| Malinauskas, Kalibatas (2005) | **COPRAS** | Selection of rational construction processes |
| Tamošiūnienė *et al.* (2006) | **SAW**<br>**GA** (Geometric average) | Assessment of investment projects |

| | | |
|---|---|---|
| Zavadskas *et al.* (2009) | **COPRAS** | Assessment of housing maintenance contractors |
| Pabedinskaitė, Vitkauskas (2009) | **SAW** | Assessment of a product quality |
| Baranauskienė (2012) | **SAW** | Assessment of a social welfare |
| Drejeris (2014) | **COPRAS** | Assessment of agricultural buildings' functioning consistency |
| Ginevičius, Krivka (2009) | **VS**<br>**SAW**<br>**COPRAS**<br>**TOPSIS**<br>**VIKOR** (serb. *VIKOR Vls eKriterijumska Optimizacija I Kompromisno Resenje*) | Assessment of competitive environment in the oligopolistic market |
| Stankevičienė, Bernatavičienė (2012) | **SAW** | Investment funds' assessment |
| Andruškevičius (2010) | **COPRAS** | Contractors' assessment |

*Source*: composed by the authors

Table 3 shows that there are quite a few various methods applied in the analysis of different phenomena. According to the level of complexity, the methods are divided into two groups: simpler or less complicated (SAW, GA, and VS) and those that have a more complicated internal logic (VIKOR, COPRAS, TOPSIS, and PROMETHEE) (Ginevičius, Podvezko 2008a; Podvezko 2008; Ginevičius et al. 2013). Every single method has its advantages and disadvantages, thus it is essential to decide which method should be used when dealing with a particular problem: their use and peculiarities are quite widely discussed in scientific literature. To begin with the least complicated method of VS, it is worth mentioning its difference from the rest of the indicators: in order to calculate the summative indicator, it does not use ratio weight. Furthermore, VS does not depend on the mean of data normalization or transformation since it only helps to determine the priority queue of each indicator that is involved (Ginevičius, Podvezko 2008a). Interestingly, V. Podvezko claims that alternatives set by VS method are not considerably different from the results of other methods that are based on complex mathematical calculations. Nevertheless, later R. Ginevičius and V. Podvezko in their article mention that, notwithstanding, this method provides quite accurate results (2008, 2008a). The authors compare various methods and exclude that VS is similar to GA: both of the methods do not depend on the included ratio weight. However, there are some GA's disadvantages that should be mentioned, for instance, GA as well as SAW method only includes maximizing indicators (Podvezko 2008). V. Podvezko claims that it is fairly easy to change minimizing indicators into the maximizing ones, thus eliminating disadvantage mentioned previously applying both GA and SAW methods (2011). Considering SAW method, it is important to notice that this is one of the oldest and the most widely used methods. Nevertheless, V. Podvezko adds that using SAW method does not always provide accurate results because of the contradiction among used indicators (2011). As an alternative, COPRAS method that includes both minimizing and maximizing indicators is mentioned. After having carried out VIKOR and TOPSIS comparison, S. Opricovic and G. H. Tzeng observe that although both methods are based on similar principle (best proximity point), their normalization process is different. This determines that VIKOR method does not depend on the indicators' units of measurement, meanwhile TOPSIS, contrary to VIKOR, might be influenced by these units of measurement (2002).

There are quite a few comparisons of various methods performed in the scientific literature in order to ascertain the coincidence of the results. J. Antuchevičienė et al. (2011) used Spearman's correlation coefficient to compare TOPSIS, COPRAS and VIKOR methods' results. The authors concluded that the arrangement of alternative summative ratios coincides the most when it is calculated by using TOPSIS and COPRAS methods; meanwhile the coincidence probability of other methods was significantly lower. R. Ginevičius and V. Podvezko compared the results' coincidence of SAW, VS, GA, TOPSIS and VIKOR methods by using correlation coefficient (2008a). They claim that even though there is a strong connection between methods, VS and SAW methods are the least related because VS method does not include ratio weight (2008a). R. Ginevičius and A. Krivka has performed the research and concluded that the results calculated by using four methods (SAW, VS, COPRAS, TOPSIS) coincided; VIKOR was the only method that showed different results (2009). In addition,

T. Y. Chen compares SAW and TOPSIS methods and concludes that the alternatives rated by these methods are fairly similar, furthermore, the author emphasizes that SAW method is easier applied and perceived than TOPSIS (2012). Meanwhile R. Kareivaitė explores sustainable development and declares that among SAW, COPRAS and TOPSIS methods, the latter is the best and the most appropriate method since it is more objective than the others (2012).

Scientific literature analyses methods' sensitivity to the initial data change. S. Opricovic and G. H. Tzeng have performed comparative analysis of VIKOR and TOPSIS methods and claim that VIKOR tends to be less sensitive to the initial data instability than TOPSIS (2002). R. Simanavičienė and L. Ustinovičius conclude that TOPSIS is also more sensitive than SAW and COPRAS methods (2011). Meantime, sensitivity to the initial data change between SAW and COPRAS is similar. However, V. Podvezko has performed analysis of SAW and COPRAS and has observed that when the maximizing indicators are included, the results calculated by using these methods coincide. Meanwhile, if the analysis includes minimizing indicators, SAW method becomes more stable than COPRAS (2011).

In conclusion, although there have been quite a few method researches and comparative analysis performed, according to R. Simanavičienė, it is still not determined which methods are the best for solving different tasks (2011). As a result, R. Ginevičius and V. Podvezko in their article claim that "in order to reduce the influence of individual multi-criteria assessment means on the calculation results it is adequate to evaluate the phenomenon using various methods and then finding their average" (2008a). The authors emphasize that in such case, disadvantages of one multi-criteria assessment method are exchanged by the advantages of another method. It is important to mention that in order to use and combine various methods, they must be synchronized. The authors mentioned above have carried out the research and concluded that by using correlation analysis and evaluating the relation between different methods, it is possible to determine whether the methods could be used as a package in order to achieve an accurate assessment of alternatives.

The choice of indicators used in a summative ratio is also quite significant. According to V. Podvezko, in order to achieve an adequate assessment, it is important to include all the essential magnitudes to the list of indicators (2008). For instance, A. Andriuškevičius (2010) performs contractors' assessment by including 26 indicators, V. Podvezko et al. (2012) analyse the quality of construction contracts by using 9 indicators, meanwhile, J. Stankevičienė and A. Bernatavičienė (2010) perform the research about investment funds and only use 8 indicators. No doubt, involvement of different factors has quite a significant influence on the phenomenon assessment. This reveals that the accuracy of the methods' results depends a lot on the perspectives of the researcher, as well as his choice of the indicators used in the assessment.

As V. Podvezko claims, establishment of ratios' weight is as important as the choice of the indicators (2008). An interesting research has been carried out by M. Tvaronavičienė and others: they compared development in Baltic countries every time giving the greater importance to a different group of indicators this way determining how countries' development has been influenced by economic or social factors (2008). This type of evaluation expands multi-criteria assessment's use spectrum: it enables a comparison that is not limited to determining complex alternatives of a phenomenon, in addition, the evaluation allows to rate complex alternatives emphasizing different analyzed characteristics.

Some of the authors in scientific literature employ an expert evaluation in order to determine ratios' weight (Stankevičienė, Bernatavičienė 2012; Stankevičienė, Gavrilova 2012; Ginevičius et al. 2013; etc.). Various methods are also used for this type of assessment, for instance, direct weighing method, AHP (Podvezko 2006; Simanavičienė 2011). It is worth mentioning that expert evaluation quite often leads to contradictory results: this happens when various groups of experts have different position or opinion about the analysed issue. Therefore, determination of ratios' weight is quite a subjective aspect in the use of MCA.

In conclusion, the versatility, wide application and increasing popularity of these methods presuppose a demand in their use in order to evaluate Lithuanian II pillar pension funds: the methods enable a complex assess-

ment thus helping a member to choose the best old-age pension fund.

## 4. Methodology

Taking into account the fact that the most important indicators in pension funds' evaluation are reward and risk, the research has been carried out by using average annual return rate and standard deviation. It is important to mention that Beta, which shows systematic risk, is also ascribed as a risk indicator, thus must be included. In addition, Jensen's alpha ratio is also included: it shows the added value created by active managers; operations, and allows determining which funds acquire higher reward because of those actions. Finally, Sharpe and Treynor's ratios mentioned above, combine both reward and risk, thus they are not used in funds' evaluation when MCA is used. Therefore, four methods have been chosen: average annual return, standard deviation, Beta coefficient, and Jensen's alpha ratio.

In order to avoid inaccuracies in expert evaluation, four alternatives have been used in the research: all the indicators are granted an equal amount of weights (i.e. 25%); a greater weight is given to the reward (in some cases reward indicators are granted 75%, and risk indicators – 25%. In other cases, respectively, 90% and 10%) or risk indicators (risk indicators are granted 75%, and reward – 25%. In other cases, respectively, 90% and 10%), and then the conclusion about the use eligibility in pension funds' evaluation is made. In the first case, these proportions are chosen to assign one indicator's weight (i.e. 25%) to risk (reward) ratios, and the three remaining indicators' weights are distributed to the ratios reflecting reward. The next case is aimed at minimally taking into account the risk (reward) (i.e. 10%) and evaluating the funds focusing on one aspect, then comparing the results with funds' average annual return (and standard deviation).

The research deals with simpler methods, such as, SAW, VS, GA, and more complicated methods, for instance, TOPSIS, VIKOR and COPRAS. The calculations of multi-criteria assessment method indicators are carried out by using the techniques of R. Ginevičius and V. Podvezko (2008a, 2008b, 2008c, 2009) and V. Podvezko (2008).

**SAW** *(Simple Additive Weighing)* method is used the most widely: it combines the indicators and weights of the same direction (i.e. maximizing or minimizing). The research involves Beta ratio and standard deviation that are minimizing indicators, meanwhile, unit value change and Jensen's alpha ratio are maximizing indicators, and therefore, the minimizing indicators are changed into maximizing ones using this formula:

$$\frac{\min_j r_{ij}}{r_{ij}}, \qquad [1]$$

$min_j\, r_{ij}$ *– minimum value of i-th indicator to j-th fund;* $r_{ij}$ *– value of i-th indicator to j-th fund.*

Calculated indicators are normalized:

$$\widetilde{r_{ij}} = \frac{r_{ij}}{\sum_{i=1}^{m} r_{ij}}, \qquad [2]$$

SAW method's summative indicator is obtained by carrying out the normalization of indicators. Then the following formula is used in order to calculate SAW summative indicator:

$$S_j = \sum_{i=1}^{m} w_i\, \widetilde{r_{ij}}, \qquad [3]$$

$w_i$ *– weight of a corresponding indicator.*

Each fund obtains a serial number according to the calculated indicator: fund with the highest ratio is ascribed a first place. Hereby, funds are rated in descending order.

**VS** *(sum of ranks)* method is carried out by using the simplest manner: each fund is ascribed with the serial number according to each indicator; in addition, the summative indicator is calculated by using the following formula:

$$V_j = \sum_{i=1}^{m} m_{ij}, \quad [4]$$

$m_{ij}$ – *place of i-th indicator to j-th fund.*

In this case, the lowest amount is ascribed the first place and all the funds are rated in ascending order.

**GA** *(geometric average)* method is calculated by applying the simplest geometric average formula:

$$\prod j = \sqrt[m]{\prod_{i=1}^{m} \widetilde{r_{ij}}} \quad [5]$$

In this case, equally as in VS method application, ratios' weights are not included. Serial number is ascribed after calculating funds' summative indicator with the formula [5]: as well as in SAW method, the highest amount is given the first place, and in this manner, all the funds are rated in descending order.

**TOPSIS** *(Technique for Order Preference by Similarity to an Ideal Solution)* method is used to carry out normalization in the following manner:

$$\widetilde{r_{ij}} = \frac{r_{ij}}{\sqrt{\sum_{j=1}^{n} r_{ij}^2}} \quad [6]$$

In order to calculate the summative indicator, this method also uses calculations of the best $V^g$ and the worst $V^b$ solutions:

$$V^g = \{V_1^g, V_2^g, \dots, V_m^g\} = \{(\max_j w_i r_{ij} / i \in I_1), (\min_j w_i \widetilde{r_{ij}} / i \in I_2)\}, \quad [7]$$

$$V^b = \{V_1^b, V_2^b, \dots, V_m^b\} = \{(\min_j w_i r_{ij} / i \in I_1), (\max_j w_i \widetilde{r_{ij}} / i \in I_2)\}, \quad [8]$$

$I_1$ – *index set of maximizing indicators,* $I_2$ – *index set of minimizing indicators.*

After these solutions are found, the distances of indicators to the worst $D^b$ and the best $D^g$ solution in each fund are calculated:

$$D_j^g = \sqrt{\sum_{i=1}^{m} (w_i \widetilde{r_{ij}} - V_i^g)^2}, \quad [9]$$

$$D_j^b = \sqrt{\sum_{i=1}^{m} (w_i \widetilde{r_{ij}} - V_i^b)^2} \quad [10]$$

Finally, the summative indicator is calculated by applying the following formula:

$$C_j^* = \frac{D_j^b}{D_j^g - D_j^b} \quad [11]$$

Equally to SAW method application, summative indicator is rated in descending order: the first place is given to the fund with the highest ratio.

**VIKOR** (serb. *VIKOR Vlse Kriterijumska Optimizacija I Kompromisno Resenje*) is only applied for the maximizing indicators (maximization is carried out in the same manner as SAW method). The application of this method in indicators' normalization is based on formula:

$$\widetilde{r_{ij}} = \frac{\max_j r_{ij} - r_{ij}}{\max_j r_{ij} - \min_j r_{ij}} \quad [12]$$

Then two auxiliary indicators are calculated:

$$S_j = \sum_{i=1}^{m} w_i \widetilde{r_{ij}} \quad [13]$$

$$R_j = \max_i (w_i \widetilde{r_{ij}}) \quad [14]$$

Finally, the summative indicator is found:

$$Q = \frac{v(S_j - S^b)}{(S^g - S^b)} + \frac{(1-v)(R_j - R^b)}{(R^g - R^b)}, \quad [15]$$

$S^b = min_j\, S_j;\ S^g = max_j\, S_j;\ R^b = min_j\, R_j;\ R^g = max_j\, R_j,$ *$v$ – strategic weight (in case of the research – 0,5).*

Funds are rated in ascending order by using the indicator calculated with formula [15]: fund with the lowest amount is given the first place.

**COPRAS** *(Complex Proportional Assessment)* method uses formula [16] to calculate a summative indicator, whereas normalization is carried out by using formula [17]:

$$K_j = S_{+j} + \frac{S_{-min} \sum_{j=1}^{n} S_{-j}}{S_{-j} \sum_{j=1}^{n} \frac{S_{-min}}{S_{-j}}}, \quad [16]$$

$$\widetilde{r_{ij}} = \frac{r_{ij} w_i}{\sum_{j=1}^{n} r_{ij}}, \quad [17]$$

The calculated summative indicators are rated in descending order. It is worth mentioning that without the presence of minimizing indicators, COPRAS method is calculated in the same manner as SAW.

It is important to observe that all the indicators must be compatible in order to combine them and calculate their averages. Compatibility of the methods is examined separately in each fund group by using correlation coefficient: the higher correlation coefficient is discovered, the more compatible methods are.

## 5. Results of the Research

***Assessment of Conservative II Pillar Pension Funds by Using Calculations of MCA.*** Summative indicators of all the conservative funds have been calculated by using five variations (see Table 4 and Table 1A), furthermore, the calculations between SAW and other methods have been carried out by using correlation coefficient. They revealed that the value of coefficient's module was higher than 90% in almost all the cases (except from the cases where the greater weight of 75% was given to risk indicators). Fund correlation coefficient evaluated by using TOPSIS coincided with the results of SAW and reached 75%: this shows a strong correlation which allows combining both of the methods and calculating their common average position (Dancey, Reidy 2007).

It is worth mentioning that given the same weights to reward and risk indicators, the results of almost all the funds have coincided (see Table1A); however, order of the funds rated by MCDM method has been slightly different. Meanwhile, the results of SAW and COPRAS methods were practically identical which was caused by the similarities of calculation methods. Giving bigger weights for the reward (see Table1A), summative indicators calculated by using all the methods have shown that Finasta Conservative Investment fund was leading: the fund generated the highest amount of average annual return, however, it did not take too many risk. Nevertheless, after emphasizing the risk indicators (75%) (see Table 1A), only the summative indicator calculated by using TOPSIS method has shown the Finasta Conservative investment fund leading; meanwhile, other methods have shown that the leading fund was MP Stabilo II, which took the lowest risk. The results confirm that each method has its peculiarities which influence the differences in the results.

It is interesting to notice the gap of indicators themselves. Indicators have been given the same weights (see Table1A) therefore; summative indicators of Finasta Conservative investment and MP Stabilo II funds calculated by using SAW and GA methods have differed only in hundredths. However, when the reward or risk indicators are given greater weights, the gap varies: in one case, the benefit was on the side of Finasta Conservative investment fund, in another case, it was on the side of MP Stabilo II fund. Similarly insignificant indicators' differences have been noticed when the same weights have been given and calculated by using GA method in Danske Conservative and Swedbank Pension 1 funds (rounded values equal to 0.09). After emphasizing reward

(75%), the values of these funds calculated by using SAW method were also almost identical (up to 0.08); meanwhile, after emphasizing risk (75%), COPRAS method has shown that ERGO Conservative Investment and SEB Pension 1 funds were operating in a similar manner. Therefore it might be concluded, that even though positions of the funds after their rating may differ, an insignificant gap in the summative indicator shows that the funds operate quite likewise. Thus, when the funds are evaluated by using multi-criteria assessment method, it is important to pay attention to the gap of the summative indicator in respect to others, as well as to the position of the fund itself.

After having discussed the results of individual methods, some conclusions may be made about the calculations; furthermore, it is possible to compare the results of multi-criteria assessment methods with funds' average annual return, standard deviation and Sharpe coefficient that combines both reward and risk.
Table 4 (and Table 1A) demonstrates that when the funds are evaluated by focusing on average annual return or a multi-criteria assessment method, both of which grant a higher value for return, in all the cases the leading fund is Finasta Conservative Investment fund. Nevertheless, the results of other funds are not unambiguous. MP Stabilo II fund is only given the 7th position when it is rated by emphasizing average annual return, since the average annual return has been only 2.5% in the period of its performance. Meantime, this same fund goes up to the second position when standard deviation is included in the assessment: standard deviation of MP Stabilo II fund is the least in the group of all the conservative funds (only 0.67%). It is worth mentioning that MP Stabilo II fund only operates since 2011, this excludes the results in the context of all the other funds thus making its assessment inadequate.

**Table 4.** List of the Top Conservative II Pillar Pension Funds Based on Calculations Made by Using Multi-criteria Assessment Method, Average Annual Return, Standard Deviation and Sharpe Coefficient

| **Conservative Investment Pension Funds** | Finasta Conservative Investment | Aviva Europension | DnB Pension 1 | ERGO Conservative | Danske Conservative | SEB Pension 1 | MP Stabilo II | Swedbank Pension 1 |
|---|---|---|---|---|---|---|---|---|
| The sequence when the weights are equal | **1** | **4** | **3** | **7** | **6** | **8** | ***2*** | **5** |
| The sequence when return indicators' weight is greater (75%) | **1** | **2-3** | **4** | **7** | **5** | **8** | ***2-3*** | **6** |
| The sequence when return indicators' weight is greater (90%) | **1** | **2** | **4** | **6** | **5** | **8** | ***3*** | **7** |
| The sequence according to annual average return | **1** | **2** | **3** | **4** | **5** | **6** | ***7*** | **8** |
| The sequence when risk indicators' weight is greater (75%) | **2** | **5-6** | **4** | **7** | **5-6** | **8** | ***1*** | **3** |
| The sequence when risk indicators' weight is greater (90%) | **2** | **6** | **4** | **7** | **5** | **8** | ***1*** | **3** |
| The sequence according to average standard deviation | **3** | **6** | **4** | **7** | **5** | **8** | ***1*** | **2** |
| The sequence according to Sharpe ratio | **2** | **3** | **4** | **5** | **6** | **7** | ***1*** | **8** |

*Source*: composed and calculated by the authors

It is interesting mentioning the analysis of DnB Pension 1: taking into account average annual return the fund is in the 3rd position (3.54% average annual return). However, when indicators reflecting risk are included, the fund drops to the 4th position, meanwhile, the fund goes back to the 3rd position when all the indicators are given equal weights. The results of Aviva Europension fund are changing according to the size of the risk weight: the fund falls to the lower positions when the weights of risk reflecting indicators are greater.
The results of Swedbank Pension 1 and ERGO Conservative fund are contradictory: when risk indicators are

increased, Swedbank Pension 1 rises to the higher position, meanwhile ERGO Conservative fund drops to the lower position. This shows that even though the latter fund operates quite a significant amount of average annual return (3.04%), it is also the second one in regards of the highest risk (its standard deviation goes up to 2.27%).

The results are more alike when risk indicators are taken into account; however, particular differences are encountered when the funds are evaluated by using standard deviation. For instance, Swedbank Pension 1 is granted the 1st position, but after having included reward indicators, it falls to the 3rd place. This shows that even though the fund has a low risk, it also generates a lower return than the funds with a similar amount of risk. Finally, the evaluation of multi-criteria assessment method's and Sharpe coefficient's results (given the same weights) has revealed that the only Danske Conservative fund is granted the 6th position, the results are different for the rest of the cases. Sharpe ratio has shown that the lowest operating fund is Swedbank Pension 1; nevertheless, multi-criteria assessment method has revealed that the lowest operating fund is SEB Pension 1. A deeper analysis of the funds' results has revealed that although SEB Pension 1 generates a higher average annual return (up to 2.61%), it has the lowest Jensen's alpha ratio. Meanwhile Sharpe ratio including reward and risk indicators reveals that even though Swedbank takes a lower risk than SEB Pension 1 does, its reward is too low to pay off that risk. The opposite results are seen in cases of Aviva Europension and DnB Pension 1 funds: a higher position is given to Aviva Europension by using Sharpe ratio, nevertheless, DnB Pension 1 is granted the 3rd place by using MCA. Funds' results indicate that Aviva Europension generates a higher return rate (4.46%, DnB Pension 1 – 3.54%), but it also takes significantly higher risk (standard deviation is 2.26, meanwhile DnB Pension 1 – 1.43). This has determined that according to MCA its position is becoming lower despite a fairly better Jensen's alpha ratio. Therefore, it may be concluded that MCA methods are used by taking into consideration the position of the indictor in the context of the rest of the operating funds.

Thus, multi-criteria assessment methods have different results from the Sharpe ratio which is calculated in a traditional manner. MCA methods' results include more indicators, at the same time taking into account the position of each indicator respectfully to others: this enables a comparison of fairly equally operating funds.

***Assessment of Small Equity Share II Pillar Pension Funds Based on MCA Calculations***. Funds in this group have been evaluated using all five MCA methods: the results have shown that not all the correlation coefficients are close to one (see Table 2A). Results calculated by using MCDM method with the same amount of weights, have shown a weak correlation (-0.36), thus these results will not be included to the calculations of the summative indicator. Meanwhile, methods have had a strong or average correlation in the rest of the cases, which has allowed combining their results into a whole.

Giving the same weights to indicators has revealed that almost all the methods used gave the same results: summative indicators of Aviva Europension Plus and DnB Pension 2 funds have turned out to be quite alike. Meanwhile, Swedbank Pension 2 was in the last position in all the cases. As well as among the conservative funds, the best managed small equity share fund is owned by PLLC Finasta Asset Management. As it has been mentioned before, this fund has generated the highest amount of return since its establishment among all the 28 II pillar pension funds.

Emphasis of the return indicators has shown that all the methods give equal positions to the funds (see Table 2A); however, Finasta Growing Yields' fund stands out since summative indicators of its methods have turned out to be fairly higher than the others. Meanwhile, methods show contradictory results when the emphasis is put on risk indicators (75%) (see Table 2A). Results calculated using SAW (as well as COPRAS) and MCDM methods have given the first position to DnB Pension 2 fund, nevertheless, TOPSIS has given the same first position to Finasta Growing Yields fund. Results of all the methods have placed Aviva Europension plus fund to the second position. It is interesting to mention that summative indicators calculated by using TOPSIS (as well as SAW) method differed just a little, the difference was in tenths, apart from Swedbank Pension 2 which was given the last position. Therefore, all the funds of this particular group operated fairly efficiently and effectively despite their arrangement. After having discussed individual results of the methods in this group, it is possible to compare them with average return, standard deviation and Sharpe coefficient (see Table 5). It is interesting mentioning that the results

are identical in almost all the cases, contrary to the conservative funds. Regardless of evaluating the funds by emphasizing their return while increasing the amount of risk, funds' sequence remains unchanged. Meanwhile, putting emphasis on risk indicators, it can be seen that when 25% weight is given to return indicators, Finasta Growing Yields and Swedbank Pension 2 funds exchange their positions. This reveals that even though these two funds operate a high amount of the risk, Finasta Growing Yields fund expresses a fairly higher amount of return: return indicator influences only 25% of all the weight, thus outweighing risk indicators. Sharpe coefficient does not oppose funds' sequence either. Therefore, all the facts mentioned before, support the idea that the indicators included in MCA calculations are not contradictory: this shows that unambiguously Finasta Growing Yields fund is the best when seeking a maximum amount of return.

**Table 5.** The List of Top Small Equity Share II Pillar Pension Funds Based on the Calculations of MCA, Average Annual Return, Standard Deviation and Sharpe Coefficient

| **Small Equity Share Pension Funds (up 30 per cent)** | Finasta Growing Yield | Aviva Europension plus | DnB Pension 2 | Swedbank Pension 2 |
|---|---|---|---|---|
| The sequence when the weights are equal | **1** | **2** | **3** | **4** |
| The sequence when return indicators' weight is greater (75%) | **1** | **2** | **3** | **4** |
| The sequence when return indicators' weight is greater (90%) | **1** | **2** | **3** | **4** |
| The sequence according to annual average return | **1** | **2** | **3** | **4** |
| The sequence when risk indicators' weight is greater (75%) | **3** | **2** | **1** | **4** |
| The sequence when risk indicators' weight is greater (90%) | **4** | **2** | **1** | **3** |
| The sequence according to average standard deviation | **4** | **2** | **1** | **3** |
| The sequence according to Sharpe ratio | **1** | **2** | **3** | **4** |

*Source*: composed and calculated by the authors

***Assessment of II Pillar Pension Funds' Average Share Based on MCA Calculations***. Methods' correlation coefficient modules that are calculated in this group are close to one equally as the ones in the conservative funds (see Table 4A), thus the funds are compatible and combined into a one summative indicator.

Taking into account all the methods, MP Medio II is the best managed fund, however, it should not be overlooked that the fund has been only operating since 2007 therefore having avoided a negative influence of the crisis on the results. For that reason, it is not entirely adequate to exclude MP Medio II as the best one among the rest of the funds in this group because of the differences in their operational periods.

The results are quite contradictory when indicators are given the same amount of weights (see Table 4A). Despite the fact that all the methods' calculations grant the second position to Danske Pension 50, TOPSIS method gives the second place to Finasta Active Investment fund which has the highest amount of average annual return. MCDM method grants only eighth position to this fund because of its advantage in risk indicators; nevertheless, after increasing the weight of return indicators, MCDM method, equally to the rest of the methods, places Finasta Active Investment fund to the second position.

After having emphasized risk indicators, the second position is unambiguously given to Danske Pension 50 fund which has a low standard deviation and a positive Jensen's alpha ratio. Meanwhile, except from Swedbank Pension 4 which has been granted the last position by all he methods, other funds have not been equally placed. For instance, Finasta Active Investment fund's position ranges from the third to the eighth: it has the highest average annual return, however, the fund invests taking more risks than the market and its standard deviation is one of the greatest. Thus, this particular fund is rated differently by every method because of its extreme results.

MCA summative indicators of some of the funds in this group are fairly equal, however, some of the funds are granted a lower position in the total sequence even though evaluating indicator is quite similar. For instance, SEB Pension 2, Swedbank Pension 3, and Aviva Europension Extra have almost equal summative indicators when they are calculated by using GA method. SAW and COPRAS methods have revealed the same results, meanwhile TOPSIS method has shown almost equal indicators for six funds (risk indicators have been given

90%): Finasta Active Investment, DnB Pension, ERGO Balans, SEB Pension 2, Swedbank Pension 3, Aviva Europension Extra (see Table 4A).

It is necessary to analyse the results of modelling after having concluded the sequence of the funds considering different MCA. Contrary to small equity share funds, the results in these funds are also fairly ambiguous. While analysing the sequences of funds that emphasize return, it is interesting to notice Finasta Active Investment fund: it drops to a lower position when its risk weight starts increasing. This shows (see Table 6) that the fund operates quite a significant amount of risk (its standard deviation is 8.71%).

Indicators emphasizing return ratios show that Aviva Europension Extra fund is the most significantly influenced by return indicator. When return weight coefficient is increased, the fund falls to the lower position: this indicates that even though the risk of the fund is lower than the average of the rest of the group, its return is fairly low thus other funds are able to outrun it. It is worth mentioning that Swedbank Pension 4 is given 9th position after having calculated the results by all the methods: this reveals that the fund operates neither high return nor low risk which would normally enable competition with other funds.

**Table 6.** List of Top Average Equity Share II Pillar Pension Funds Based on Calculations Made by Using Multi-criteria Assessment Method, Average Annual Return, Standard Deviation and Sharpe Coefficient

| **Average Equity Share Funds** | Finasta Active Investment | MP Medio II | DnB Pension 3 | Danske Pension 50 | ERGO balans | SEB Pension 2 | Swedbank Pension 3 | Aviva Europension extra | Swedbank Pension 4 |
|---|---|---|---|---|---|---|---|---|---|
| The sequence when the weights are equal | **4** | **1** | **3** | **2** | **5** | **8** | **6** | **7** | **9** |
| The sequence when return indicators' weight is greater (75%) | **2** | **1** | **4** | **3** | **5** | **8** | **6** | **8** | **9** |
| The sequence when return indicators' weight is greater (90%) | **2** | **1** | **4** | **3** | **5** | **7** | **6** | **8** | **9** |
| The sequence according to annual average return | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| The sequence when risk indicators' weight is greater (75%) | **6** | **1** | **3** | **2** | **5** | **8** | **4** | **7** | **9** |
| The sequence when risk indicators' weight is greater (90%) | **8** | **1** | **3** | **2** | **5** | **7** | **4** | **6** | **9** |
| The sequence according to average standard deviation | **8** | **1** | **3** | **2** | **6** | **7** | **4** | **5** | **9** |
| The sequence according to Sharpe ratio | **3** | **1** | **2** | **4** | **5** | **7** | **6** | **8** | **9** |

*Source*: composed and calculated by the authors

Comparison of the main MCA sequence (while given equal weights) with Sharpe ratio shows that contrary to the conservative funds, the last and the first positions are given to the same funds. The first place is granted to Swedbank Pension 4, meanwhile the first one – to MP Medio II; however, the latter should be evaluated with a particular attention to its operating period (the fund was established in 2007). It should be noted that the distribution of 2-4th positions is not arranged equally. According to Sharpe ratio, DnB Pension 3 is given the second position; meanwhile Danske Pension 50 also gets the second position when it is rated by using MCA, however, with Sharpe ratio it falls to the fourth place. It is worth mentioning that DnB Pension 3 has a higher amount of return (up to 5.10%) than Danske Pension 50 (its return goes up to 4.86%), however, the fund operates a higher risk too (respectively standard deviations are 5.03 and 4.84). Nevertheless, Danske Pension 50 has a higher Jensen's alpha ratio (up to 0.54%) which is not evaluated by using Sharpe coefficient. Thus, it might be concluded that even though DnB Pension 3 generates more return in respect to the taken risk unit, Danske Pension 50 generates a higher added value as a result of active managers' actions; in addition, it takes a lower

systematic risk (beta coefficient is lower).

***Assessment of Shares II Pillar Pension Funds by Using Calculated MCA***. As Table 3A show, the modules of correlation coefficients are close to one, therefore, all the summative indicators calculated by using MCA are again combined into a whole.

MP Ekstremo II leads in this group, however, it is worth emphasizing its operational period (since 2007) which causes some complications and does not allow equal comparison with other funds. Generally, there are only two funds in this group that operate since 2004 (Danske Pension 100 and Finasta Rational Risk): this aggravates the comparison of this group's funds. It should be noted that the methods in the analyzed group reveal fairly similar results: the first position is given to MP Ekstremo II, the second – Danske Pension 100, and only the positions of three funds varies.

When equal weights are given, the results of VS differ the most (see Table 3A); nevertheless, its summative ratio value in respect to the last three funds varies over one, which shows that funds evaluated by using this method operate quite similarly.

The comparison of pension funds' modelling results with Sharpe ratio, standard deviation and return has shown that the results are more similar to the ones of small equity share funds: the results largely coincide (see Table 7). Only third and fourth positions are different: according to Sharpe ratio the 3rd place should be given to Swedbank Pension 5, meanwhile, the sequence calculated by MCA grants the 3rd position to Finasta Rational Risk fund. Table 3A reveals that both of the funds generate fairly equal return (5.66 and 5.65), however, Finasta Rational Risk fund operates much higher risk which results in a lower Sharpe ratio. However, Jensen's alpha ratio is much higher, it goes up to 1.1%, meantime, the one of Swedbank Pension 5 is negative (-3.59). It is important to emphasize that people who invest into shares pension funds are young people who aim at receiving a maximum return as well as a maximum return achieved by managers' active operations. Therefore, in this case MCA is more advanced since it emphasizes the ratio of risk and reward as well as it enables taking into account the added value created by the managers' active operations.

**Table 7.** List of Top Shares II Pillar Pension Funds Based on Calculations Made by Using Multi-criteria Assessment Method, Average Annual Return, Standard Deviation and Sharpe Coefficient

| **Shares Pension Funds (up to 100 per cent)** | Danske Pension 100 | MP Extremo II | Finasta Rational Risk | Swedbank Pension 5 | SEB Pension 3 |
|---|---|---|---|---|---|
| The sequence when the weights are equal | **2** | **1** | **3** | **4** | **5** |
| The sequence when return indicators' weight is greater (75%) | **2** | **1** | **3** | **4** | **5** |
| The sequence when return indicators' weight is greater (90%) | **2** | **1** | **3** | **4** | **5** |
| The sequence according to annual average return | **1** | **2** | **3** | **4** | **5** |
| The sequence when risk indicators' weight is greater (75%) | **2** | **1** | **4** | **3** | **5** |
| The sequence when risk indicators' weight is greater (90%) | **2** | **1** | **5** | **3** | **4** |
| The sequence according to average standard deviation | **2** | **1** | **5** | **3** | **4** |
| The sequence according to Sharpe ratio | **2** | **1** | **4** | **3** | **5** |

*Source*: composed and calculated by the authors

To conclude the results of the research, it might be stated that MCA enables the evaluation of the funds by combining more indicators: this allows choosing the best fund by emphasizing the aspects that are the most important for each member. The results have shown that when risk and reward indicators are emphasized, the outcome is contradictory, therefore, according to the authors, more attention should be paid to reward indicators: the aim of the funds is to accumulate maximum amount of assets for the long-term future pension and not only to protect the money from its depreciation. Nevertheless, risk indicators should be distinguished for individuals with a minimum amount of years left until their retirement thus protecting them from the loss of assets in case of a complicated situation in the market.

## Conclusions

Analysis of the scientific literature has shown that the field of multi-criteria method's assessment is constantly expanding and these methods are adequate in II pillar pension funds' evaluation. The assessment of pension funds by using various MCA methods has revealed that the peculiarities of each method influence rating of the funds thus putting them into different positions. Therefore, it is still not determined which MCA methods are more appropriate for individual tasks: as a consequence, combining all the methods solves the problem and enables finding the most accurate sequence for evaluating the funds.

Some of MCA methods take into account value of the indicator and its position in respect to other indicators' value: this allows a more accurate and complex evaluation of each fund respectively to others. Results of the research have contributed to a versatile assessment of the funds' operation and have shown that it is important to evaluate the position of individual indicators as well as a size of a particular indicator and its separation in comparison with others when choosing a fund.

After having carried out funds' assessment by using MCA, it might be concluded that in order to achieve an accurate evaluation of funds' performance, it is necessary to include as many various indicators as possible since different indicators reflect limited information. It is important to note that MCA is a new way of combining risk and reward indicators: the results calculated by using MCA have turned out to be different from the funds' sequence provided by Sharpe ratio. Therefore, MCA allows including more indicators and evaluating average annual return, standard deviation and other indicators that are relevant for funds' assessment.

Since this article is the first in Lithuania's scientific field to evaluate, shape and rate pension funds' performance using MCA, the suggestions for further researches have been made:

- It is recommended to include more evaluating indicators; hereby it would be possible to find the best complex of indicators that would evaluate funds' performance thus helping the members to make a proper decision.
- A wider variety of MCA methods should be used; in addition, the weight of indicators should be changed in order to find the most accurate algorithm while evaluating pension funds' performance thus helping the members to make the most adequate choice.

## Appendix

**Table 1A.** List of the Position Conservative II Pillar Pension Funds Based on the Calculations of MCA

**Indicators with equal weights**

| **Conservative Investment Pension Funds** | | Finasta Conservative Investment | Aviva Europension | DnB Pension 1 | ERGO Conservative | Danske Conservative | SEB Pension 1 | MP Stabilo II | Swedbank Pension 1 | **Correlation coefficient** |
|---|---|---|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,20 | 0,14 | 0,13 | 0,07 | 0,09 | 0,06 | 0,20 | 0,11 | **1,00** |
| | Position | **2** | **3** | **4** | **7** | **6** | **8** | **1** | **5** | |
| **VS** | Value | 8 | 16 | 15 | 25 | 20 | 29 | 12 | 19 | **-0,95** |
| | Position | **1** | **4** | **3** | **7** | **6** | **8** | **2** | **5** | |
| **GA** | Value | 0,19 | 0,12 | 0,13 | 0,06 | 0,09 | 0,03 | 0,19 | 0,09 | **0,99** |
| | Position | **1** | **4** | **3** | **7** | **6** | **8** | **2** | **5** | |
| **TOPSIS** | Value | 1,18 | 0,83 | 0,86 | 0,63 | 0,73 | 0,60 | 0,98 | 0,74 | **0,96** |
| | Position | **1** | **4** | **3** | **7** | **6** | **8** | **2** | **5** | |
| **VIKOR** | Value | 0,00 | 0,70 | 0,35 | 0,95 | 0,65 | 1,00 | 0,16 | 0,85 | **-0,93** |
| | Position | **1** | **5** | **3** | **7** | **4** | **8** | **2** | **6** | |
| **COPRAS** | Value | 0,20 | 0,14 | 0,13 | 0,07 | 0,09 | 0,06 | 0,21 | 0,11 | **1,00** |
| | Position | **2** | **3** | **4** | **7** | **6** | **8** | **1** | **5** | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **AVERAGE OF METHODS' POSITIONS** | | 1,33 | 3,83 | 3,33 | 7,00 | 5,67 | 8,00 | 1,67 | 5,17 | - |
| **COLOCATION** | | **1** | **4** | **3** | **7** | **6** | **8** | **2** | **5** | |

**Indicators reflecting return are given greater weights (75%)**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,23 | 0,17 | 0,14 | 0,07 | 0,08 | 0,06 | 0,17 | 0,08 | **1,00** |
| | Position | **1** | **3** | **4** | **7** | **5** | **8** | **2** | **6** | |
| **TOPSIS** | Value | 0,41 | 0,28 | 0,24 | 0,15 | 0,17 | 0,14 | 0,26 | 0,17 | **0,97** |
| | Position | **1** | **2** | **4** | **7** | **5** | **8** | **3** | **6** | |
| **VIKOR** | Value | 0,00 | 0,22 | 0,41 | 0,88 | 0,82 | 1,00 | 0,55 | 0,96 | **-0,95** |
| | Position | **1** | **2** | **3** | **6** | **5** | **8** | **4** | **7** | |
| **COPRAS** | Value | 0,23 | 0,17 | 0,14 | 0,07 | 0,08 | 0,06 | 0,18 | 0,08 | **1,00** |
| | Position | **1** | **3** | **4** | **7** | **5** | **8** | **2** | **6** | |
| **AVERAGE OF METHODS' POSITIONS** | | 1,00 | 2,75 | 3,50 | 6,75 | 5,25 | 8,00 | 2,75 | 6,00 | - |
| **COLOCATION** | | **1** | **2-3** | **4** | **7** | **5** | **8** | **2-3** | **6** | |

**Indicators reflecting risk are given greater weights (75%)**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,18 | 0,10 | 0,12 | 0,07 | 0,09 | 0,06 | 0,23 | 0,14 | **1,00** |
| | Position | **2** | **5** | **4** | **7** | **6** | **8** | **1** | **3** | |
| **TOPSIS** | Value | -3,13 | -5,39 | -4,01 | -11,27 | -5,15 | -14,25 | -3,27 | -4,63 | **0,75** |
| | Position | **1** | **6** | **3** | **7** | **5** | **8** | **2** | **4** | |
| **VIKOR** | Value | 0,45 | 0,86 | 0,65 | 0,98 | 0,80 | 1,00 | 0,00 | 0,55 | **-0,99** |
| | Position | **2** | **6** | **4** | **7** | **5** | **8** | **1** | **3** | |
| **COPRAS** | Value | 0,18 | 0,11 | 0,12 | 0,06 | 0,09 | 0,06 | 0,24 | 0,13 | **1,00** |
| | Position | **2** | **5** | **4** | **7** | **6** | **8** | **1** | **3** | |
| **AVERAGE OF METHODS' POSITIONS** | | 1,75 | 5,50 | 3,75 | 7,00 | 5,50 | 8,00 | 1,25 | 3,25 | - |
| **COLOCATION** | | **2** | **5-6** | **4** | **7** | **5-6** | **8** | **1** | **3** | |

**Indicators reflecting return are given greater weights (90%)**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,24 | 0,19 | 0,15 | 0,07 | 0,08 | 0,05 | 0,16 | 0,06 | **1,00** |
| | Position | **1** | **2** | **4** | **6** | **5** | **8** | **3** | **7** | |
| **TOPSIS** | Value | 0,33 | 0,21 | 0,15 | 0,06 | 0,06 | 0,05 | 0,16 | 0,05 | **0,99** |
| | Position | **1** | **2** | **4** | **6** | **5** | **8** | **3** | **7** | |
| **VIKOR** | Value | 0,00 | 0,25 | 0,46 | 0,87 | 0,84 | 0,98 | 0,66 | 1,00 | **-0,97** |
| | Position | **1** | **2** | **3** | **6** | **5** | **7** | **4** | **8** | |
| **COPRAS** | Value | 0,24 | 0,19 | 0,15 | 0,07 | 0,08 | 0,05 | 0,16 | 0,06 | **1,00** |
| | Position | **1** | **2** | **4** | **6** | **5** | **8** | **3** | **7** | |
| **AVERAGE OF METHODS' POSITIONS** | | 1,00 | 2,50 | 3,50 | 6,33 | 5,25 | 7,75 | 3,00 | 6,67 | - |
| **COLOCATION** | | **1** | **2** | **4** | **6** | **5** | **8** | **3** | **7** | |

**Indicators reflecting risk are given greater weights (90%)**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,17 | 0,09 | 0,12 | 0,06 | 0,10 | 0,06 | 0,25 | 0,15 | **1,00** |
| | Position | **2** | **6** | **4** | **7** | **5** | **8** | **1** | **3** | |
| **TOPSIS** | Value | -1,31 | -1,54 | -1,37 | -1,71 | -1,43 | -1,69 | -1,30 | -1,36 | **0,82** |
| | Position | **2** | **6** | **4** | **8** | **5** | **7** | **1** | **3** | |
| **VIKOR** | Value | 0,56 | 0,93 | 0,72 | 1,00 | 0,82 | 1,00 | 0,00 | 0,57 | **-0,99** |
| | Position | **2** | **6** | **4** | **7** | **5** | **8** | **1** | **3** | |
| **COPRAS** | Value | 0,16 | 0,09 | 0,12 | 0,06 | 0,10 | 0,06 | 0,26 | 0,15 | **1,00** |
| | Position | **2** | **6** | **4** | **7,5** | **5** | **7,5** | **1** | **3** | |
| **AVERAGE OF METHODS' POSITIONS** | | 1,75 | 5,50 | 3,75 | 7,33 | 5,25 | 7,67 | 1,25 | 3,67 | - |
| **COLOCATION** | | **2** | **6** | **4** | **7** | **5** | **8** | **1** | **3** | |

*Source*: composed and calculated by the authors

**Table 2A.** The List of Position Small Equity Share II Pillar Pension Funds Based on the Calculations of MCA

**Indicators with equal weights**

| **Small Equity Share Pension Funds (up 30 per cent)** | | Finasta Growing Yield | Aviva Europension plus | DnB Pension 2 | Swedbank Pension 2 | **Correlation coefficient** |
|---|---|---|---|---|---|---|
| **SAW** | Value | 0,30 | 0,25 | 0,25 | 0,20 | **1,00** |
| | Position | **1** | **2** | **3** | **4** | |
| **VS** | Value | 10 | 8 | 8 | 14 | **-0,59** |
| | Position | **3** | **1-2** | **1-2** | **4** | |
| **GA** | Value | 0,28 | 0,25 | 0,24 | 0,18 | **0,98** |
| | Position | **1** | **2** | **3** | **4** | |
| **TOPSIS** | Value | 4,26 | 3,61 | 3,42 | 2,91 | **0,99** |
| | Position | **1** | **2** | **3** | **4** | |
| **VIKOR** | Value | 0,67 | 0,17 | 0,18 | 1,00 | **-0,36** |
| | Position | **3** | **1** | **2** | **4** | |
| **COPRAS** | Value | 0,30 | 0,26 | 0,25 | 0,20 | **1,00** |
| | Position | **1** | **2** | **3** | **4** | |
| **AVERAGE OF METHODS' POSITIONS** | | 1,40 | 2,00 | 3,00 | 4,00 | - |
| **COLOCATION** | | **1** | **2** | **3** | **4** | |

**Indicators reflecting return are given greater weights (75%)**

| | | | | | | |
|---|---|---|---|---|---|---|
| **SAW** | Value | 0,35 | 0,25 | 0,23 | 0,17 | **1,00** |
| | Position | **1** | **2** | **3** | **4** | |
| **TOPSIS** | Value | 0,49 | 0,37 | 0,36 | 0,33 | **0,97** |
| | Position | **1** | **2** | **3** | **4** | |
| **VIKOR** | Value | 0,00 | 0,42 | 0,58 | 1,00 | **-0,99** |
| | Position | **1** | **2** | **3** | **4** | |
| **COPRAS** | Value | 0,35 | 0,25 | 0,23 | 0,17 | **1,00** |
| | Position | **1** | **2** | **3** | **4** | |
| **AVERAGE OF METHODS' POSITIONS** | | 1,00 | 2,00 | 3,00 | 4,00 | - |
| **COLOCATION** | | **1** | **2** | **3** | **4** | |

**Indicators reflecting risk are given greater weights (75%)**

| | | | | | | |
|---|---|---|---|---|---|---|
| **SAW** | Value | 0,25 | 0,26 | 0,27 | 0,23 | **1,00** |
| | Position | **3** | **2** | **1** | **4** | |
| **TOPSIS** | Value | -1,74 | -1,75 | -1,76 | -1,81 | **0,86** |
| | Position | **1** | **2** | **3** | **4** | |
| **VIKOR** | Value | 1,00 | 0,51 | 0,00 | 0,79 | **-0,61** |
| | Position | **4** | **2** | **1** | **3** | |
| **COPRAS** | Value | 0,25 | 0,26 | 0,27 | 0,23 | **0,99** |
| | Position | **3** | **2** | **1** | **4** | |
| **AVERAGE OF METHODS' POSITIONS** | | 2,75 | 2,00 | 1,50 | 3,75 | - |
| **COLOCATION** | | **3** | **2** | **1** | **4** | |

**Indicators reflecting return are given greater weights (90%)**

| | | | | | | |
|---|---|---|---|---|---|---|
| **SAW** | Value | 0,38 | 0,25 | 0,22 | 0,15 | **1,00** |
| | Position | **1** | **2** | **3** | **4** | |
| **TOPSIS** | Value | 0,28 | 0,14 | 0,11 | 0,09 | **0,97** |
| | Position | **1** | **2** | **3** | **4** | |
| **VIKOR** | Value | 0,00 | 0,54 | 0,71 | 1,00 | **-1,00** |
| | Position | **1** | **2** | **3** | **4** | |
| **COPRAS** | Value | 0,38 | 0,25 | 0,22 | 0,15 | **1,00** |
| | Position | **1** | **2** | **3** | **4** | |
| **AVERAGE OF METHODS' POSITIONS** | | 1,00 | 2,00 | 3,00 | 4,00 | - |
| **COLOCATION** | | **1** | **2** | **3** | **4** | |

**Indicators reflecting risk are given greater weights (90%)**

| | | | | | | |
|---|---|---|---|---|---|---|
| **SAW** | Value | 0,22 | 0,26 | 0,28 | 0,24 | **1,00** |
| | Position | **4** | **2** | **1** | **3** | |
| **TOPSIS** | Value | -1,18 | -1,17 | -1,17 | -1,18 | **0,91** |
| | Position | **4** | **1** | **2** | **3** | |
| **VIKOR** | Value | 1,00 | 0,53 | 0,00 | 0,71 | **-0,97** |
| | Position | **4** | **2** | **1** | **3** | |
| **COPRAS** | Value | 0,22 | 0,26 | 0,28 | 0,24 | **1,00** |
| | Position | **4** | **2** | **1** | **3** | |
| **AVERAGE OF METHODS' POSITIONS** | | 4,00 | 1,75 | 1,25 | 3,00 | **-** |
| **COLOCATION** | | **4** | **2** | **1** | **3** | |

*Source*: composed and calculated by the authors

**Table 3A.** List of Position Shares (up 100 per cent) II Pillar Pension Funds Based on the Calculations of MCA

**Indicators with equal weights**

| **Shares Pension Funds (up to 100 per cent)** | | Danske Pension 100 | MP Extremo II | Finasta Rational Risk | Swedbank Pension 5 | SEB Pension 3 | **Correlation coefficient** |
|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,22 | 0,29 | 0,16 | 0,18 | 0,14 | **1,00** |
| | Position | **2** | **1** | **4** | **3** | **5** | |
| **VS** | Value | 7 | 5 | 15 | 17 | 16 | **-0,91** |
| | Position | **2** | **1** | **3** | **5** | **4** | |
| **GA** | Value | 0,22 | 0,28 | 0,16 | 0,18 | 0,13 | **1,00** |
| | Position | **2** | **1** | **4** | **3** | **5** | |
| **TOPSIS** | Value | -1,96 | -1,92 | -2,07 | -2,16 | -2,18 | **0,89** |
| | Position | **2** | **1** | **3** | **4** | **5** | |
| **VIKOR** | Value | 0,50 | 0,00 | 0,87 | 0,90 | 1,00 | **-0,99** |
| | Position | **2** | **1** | **3** | **4** | **5** | |
| **COPRAS** | Value | 0,25 | 0,32 | 0,17 | 0,14 | 0,13 | **0,96** |
| | Position | **2** | **1** | **3** | **4** | **5** | |
| **AVERAGE OF METHODS' POSITIONS** | | 2,00 | 1,00 | 3,33 | 3,83 | 4,83 | **-** |
| **COLOCATION** | | **2** | **1** | **3** | **4** | **5** | |

**Indicators reflecting return are given greater weights (75%)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,22 | 0,26 | 0,18 | 0,19 | 0,14 | **1,00** |
| | Position | **2** | **1** | **4** | **3** | **5** | |
| **TOPSIS** | Value | 2,30 | 2,53 | 1,90 | 1,64 | 1,62 | **0,90** |
| | Position | **2** | **1** | **3** | **4** | **5** | |
| **VIKOR** | Value | 0,21 | 0,00 | 0,47 | 0,88 | 1,00 | **-0,90** |
| | Position | **2** | **1** | **3** | **4** | **5** | |
| **COPRAS** | Value | 0,26 | 0,30 | 0,19 | 0,13 | 0,12 | **0,92** |
| | Position | **2** | **1** | **3** | **4** | **5** | |
| **AVERAGE OF METHODS' POSITIONS** | | 2,00 | 1,00 | 3,25 | 3,75 | 5,00 | **-** |
| **COLOCATION** | | **2** | **1** | **3** | **4** | **5** | |

**Indicators reflecting risk are given greater weights (75%)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,22 | 0,32 | 0,14 | 0,17 | 0,14 | **1,00** |
| | Position | **2** | **1** | **4** | **3** | **5** | |
| **TOPSIS** | Value | -1,20 | -1,19 | -1,21 | -1,22 | -1,22 | **0,89** |
| | Position | **2** | **1** | **3** | **4** | **5** | |
| **VIKOR** | Value | 0,57 | 0,00 | 0,97 | 0,93 | 0,97 | **-1,00** |
| | Position | **2** | **1** | **5** | **3** | **4** | |
| **COPRAS** | Value | 0,24 | 0,33 | 0,15 | 0,14 | 0,14 | **0,99** |
| | Position | **2** | **1** | **3** | **4** | **5** | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AVERAGE OF METHODS' POSITIONS** | | 2,00 | 1,00 | 3,75 | 3,50 | 4,75 | - |
| **COLOCATION** | | **2** | **1** | **4** | **3** | **5** | |

**Indicators reflecting return are given greater weights (90%)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,23 | 0,24 | 0,20 | 0,20 | 0,13 | **1,00** |
| | Position | **2** | **1** | **4** | **3** | **5** | |
| **TOPSIS** | Value | 0,37 | 0,41 | 0,32 | 0,27 | 0,27 | **0,82** |
| | Position | **2** | **1** | **3** | **5** | **4** | |
| **VIKOR** | Value | 0,14 | 0,00 | 0,41 | 0,87 | 1,00 | **-0,87** |
| | Position | **2** | **1** | **3** | **4** | **5** | |
| **COPRAS** | Value | 0,26 | 0,29 | 0,21 | 0,13 | 0,11 | **0,86** |
| | Position | **2** | **1** | **3** | **4** | **5** | |
| **AVERAGE OF METHODS' POSITIONS** | | 2,00 | 1,00 | 3,25 | 4,00 | 4,75 | - |
| **COLOCATION** | | **2** | **1** | **3** | **4** | **5** | |

**Indicators reflecting risk are given greater weights (90%)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,22 | 0,34 | 0,13 | 0,16 | 0,14 | **1,00** |
| | Position | **2** | **1** | **5** | **3** | **4** | |
| **TOPSIS** | Value | -1,06 | -1,06 | -1,07 | -1,07 | -1,07 | **0,92** |
| | Position | **2** | **1** | **5** | **4** | **3** | |
| **VIKOR** | Value | 0,59 | 0,00 | 1,00 | 0,92 | 0,95 | **-1,00** |
| | Position | **2** | **1** | **5** | **3** | **4** | |
| **COPRAS** | Value | 0,23 | 0,34 | 0,13 | 0,15 | 0,14 | **1,00** |
| | Position | **2** | **1** | **5** | **3** | **4** | |
| **AVERAGE OF METHODS' POSITIONS** | | 2,00 | 1,00 | 5,00 | 3,25 | 3,75 | - |
| **COLOCATION** | | **2** | **1** | **5** | **3** | **4** | |

*Source*: composed and calculated by the authors

**Table 4A.** List of Position Average Equity Share II Pillar Pension Funds Based on the Calculations of MCA

**Indicators with equal weights**

| **Average Equity Share Funds** | | Finasta Active Investment | MP Medio II | DnB Pension 3 | Danske Pension 50 | ERGO balans | SEB Pension 2 | Swedbank Pension 3 | Aviva Europension extra | Swedbank Pension 4 | **Correlation coefficient** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,12 | 0,17 | 0,12 | 0,13 | 0,11 | 0,10 | 0,10 | 0,10 | 0,05 | **1,00** |
| | Position | **3** | **1** | **4** | **2** | **5** | **8** | **6** | **7** | **9** | |
| **VS** | Value | 19 | 5 | 13 | 11 | 22 | 28 | 23 | 23 | 36 | **-0,96** |
| | Position | **4** | **1** | **3** | **2** | **5** | **8** | **6-7** | **6-7** | **9** | |
| **GA** | Value | 0,11 | 0,17 | 0,12 | 0,13 | 0,11 | 0,10 | 0,10 | 0,10 | 0,05 | **1,00** |
| | Position | **4** | **1** | **3** | **2** | **5** | **8** | **6** | **7** | **9** | |
| **TOPSIS** | Value | -6,17 | -5,28 | -6,58 | -6,44 | -7,28 | -7,96 | -7,54 | -7,95 | -14,55 | **0,87** |
| | Position | **2** | **1** | **4** | **3** | **5** | **8** | **6** | **7** | **9** | |
| **VIKOR** | Value | 0,73 | 0,00 | 0,50 | 0,34 | 0,63 | 0,70 | 0,61 | 0,65 | 1,00 | **-0,94** |
| | Position | **8** | **1** | **3** | **2** | **5** | **7** | **4** | **6** | **9** | |
| **COPRAS** | Value | 0,12 | 0,17 | 0,12 | 0,13 | 0,11 | 0,10 | 0,10 | 0,10 | 0,05 | **1,00** |
| | Position | **3** | **1** | **4** | **2** | **5** | **6** | **8** | **7** | **9** | |
| **AVERAGE OF METHODS' POSITIONS** | | 4,00 | 1,00 | 3,50 | 2,17 | 5,00 | 7,80 | 6,00 | 6,80 | 9,00 | - |
| **COLOCATION** | | **4** | **1** | **3** | **2** | **5** | **8** | **6** | **7** | **9** | |

**Indicators reflecting return are given greater weights (75%)**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,14 | 0,17 | 0,12 | 0,13 | 0,11 | 0,10 | 0,10 | 0,09 | 0,05 | **1,00** |
| | Position | **2** | **1** | **4** | **3** | **5** | **7** | **6** | **8** | **9** | |
| **TOPSIS** | Value | 0,73 | 0,80 | 0,68 | 0,69 | 0,65 | 0,63 | 0,64 | 0,63 | 0,56 | **0,99** |
| | Position | **2** | **1** | **4** | **3** | **5** | **8** | **6** | **7** | **9** | |
| **VIKOR** | Value | 0,20 | 0,00 | 0,32 | 0,33 | 0,44 | 0,54 | 0,50 | 0,62 | 1,00 | **-0,99** |
| | Position | **2** | **1** | **3** | **4** | **5** | **7** | **6** | **8** | **9** | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **COPRAS** | Value | 0,14 | 0,17 | 0,12 | 0,13 | 0,11 | 0,10 | 0,10 | 0,09 | 0,05 | **1,00** |
| | Position | **2** | **1** | **4** | **3** | **5** | **7** | **6** | **8** | **9** | |
| **AVERAGE OF METHODS' POSITIONS** | | 2,00 | 1,00 | 3,75 | 3,25 | 5,00 | 7,25 | 6,00 | 7,75 | 9,00 | - |
| **COLOCATION** | | **2** | **1** | **4** | **3** | **5** | **8** | **6** | **8** | **9** | |

**Indicators reflecting risk are given greater weights (75%)**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,10 | 0,17 | 0,12 | 0,13 | 0,10 | 0,10 | 0,11 | 0,10 | 0,06 | **1,00** |
| | Position | **4** | **1** | **3** | **2** | **6** | **8** | **5** | **7** | **9** | |
| **TOPSIS** | Value | -1,40 | -1,38 | -1,40 | -1,39 | -1,41 | -1,41 | -1,41 | -1,41 | -1,46 | **0,90** |
| | Position | **3** | **1** | **4** | **2** | **5** | **7** | **6** | **8** | **9** | |
| **VIKOR** | Value | 0,84 | 0,00 | 0,54 | 0,38 | 0,67 | 0,74 | 0,64 | 0,67 | 1,00 | **-0,98** |
| | Position | **8** | **1** | **3** | **2** | **5** | **7** | **4** | **6** | **9** | |
| **COPRAS** | Value | 0,10 | 0,17 | 0,12 | 0,13 | 0,11 | 0,10 | 0,11 | 0,10 | 0,06 | **1,00** |
| | Position | **7** | **1** | **3** | **2** | **5** | **8** | **4** | **6** | **9** | |
| **AVERAGE OF METHODS' POSITIONS** | | 5,50 | 1,00 | 3,25 | 2,00 | 5,25 | 7,50 | 4,75 | 6,75 | 9,00 | - |
| **COLOCATION** | | **6** | **1** | **3** | **2** | **5** | **8** | **4** | **7** | **9** | |

**Indicators reflecting return are given greater weights (90%)**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,15 | 0,17 | 0,12 | 0,12 | 0,11 | 0,10 | 0,10 | 0,09 | 0,04 | **1,00** |
| | Position | **2** | **1** | **4** | **3** | **5** | **7** | **6** | **8** | **9** | |
| **TOPSIS** | Value | 0,25 | 0,29 | 0,20 | 0,21 | 0,18 | 0,17 | 0,17 | 0,17 | 0,14 | **0,95** |
| | Position | **2** | **1** | **4** | **3** | **5** | **8** | **6** | **7** | **9** | |
| **VIKOR** | Value | 0,05 | 0,01 | 0,32 | 0,34 | 0,43 | 0,53 | 0,50 | 0,62 | 1,00 | **-1,00** |
| | Position | **2** | **1** | **3** | **4** | **5** | **7** | **6** | **8** | **9** | |
| **COPRAS** | Value | 0,15 | 0,17 | 0,12 | 0,12 | 0,11 | 0,10 | 0,10 | 0,09 | 0,04 | **1,00** |
| | Position | **2** | **1** | **4** | **3** | **5** | **7** | **6** | **8** | **9** | |
| **AVERAGE OF METHODS' POSITIONS** | | 2,00 | 1,00 | 3,75 | 3,25 | 5,00 | 7,25 | 6,00 | 7,75 | 9,00 | - |
| **COLOCATION** | | **2** | **1** | **4** | **3** | **5** | **7** | **6** | **8** | **9** | |

**Indicators reflecting risk are given greater weights (90%)**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SAW** | Value | 0,09 | 0,17 | 0,12 | 0,14 | 0,10 | 0,10 | 0,11 | 0,10 | 0,07 | **1,00** |
| | Position | **8** | **1** | **3** | **2** | **5,5** | **7** | **4** | **5,5** | **9** | |
| **TOPSIS** | Value | -1,11 | -1,10 | -1,11 | -1,10 | -1,11 | -1,11 | -1,11 | -1,11 | -1,13 | **0,87** |
| | Position | **6,5** | **1** | **3** | **2** | **4,5** | **8** | **4,5** | **6,5** | **9** | |
| **VIKOR** | Value | 0,91 | 0,00 | 0,55 | 0,38 | 0,69 | 0,76 | 0,64 | 0,68 | 1,00 | **-0,99** |
| | Position | **8** | **1** | **3** | **2** | **6** | **7** | **4** | **5** | **9** | |
| **COPRAS** | Value | 0,09 | 0,17 | 0,12 | 0,14 | 0,10 | 0,10 | 0,11 | 0,10 | 0,07 | **1,00** |
| | Position | **8** | **1** | **3** | **2** | **5** | **7** | **4** | **6** | **9** | |
| **AVERAGE OF METHODS' POSITIONS** | | 7,63 | 1,00 | 3,00 | 2,00 | 5,17 | 7,25 | 4,13 | 5,83 | 9,00 | - |
| **COLOCATION** | | **8** | **1** | **3** | **2** | **5** | **7** | **4** | **6** | **9** | |

*Source*: composed and calculated by the authors

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