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Operational efficiency assessment of pension fund management companies

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Abstract

The aim of the research is to assess operational efficiency of pension fund management companies by using dedicated efficiency assessment methodology and analyse implications brought by the efficiency assessment. The efficiency assessment methodology employed is Data Envelopment Analysis (DEA). The pension fund management companies subject to operational efficiency assessment are the ones operating in Baltic countries Estonia, Latvia and Lithuania. The general research period is 2009-2013. The operational efficiency within the given research is defined as ability of a pension fund management company to generate profit before interest and taxes (i.e. output variable of the efficiency model) by using commission and administration expenses (i.e. input variables of the efficiency model). Because pension fund management business might be dependent on economies of scale and scope, a cluster analysis is performed on the basis of assets under management and a share of non-pension fund management revenue of fund management companies in order to improve comparability of efficiency findings. Methods used in the empirical part of the research to process above mentioned data are mathematical programming, mainly DEA as well as main trend analysis, cluster analysis, development indicators, relative and absolute indicators and other methods.
The research outcome is specific implications for top management of pension fund companies derived from operational efficiency ranks as well as business volume and scope indicators of pension fund management companies operating in the chosen Baltic countries during the time period 2009-2013.

Keywords: business economics, input-output models, cluster analysis
JEL: M21, C67, C38

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Introduction

Continuous efficiency or performance improvement posed challenges to measurement practices as they are expected to respond to more sophisticated demand for business reporting. However, a performance measurement problem also triggered a fair amount of scientific discussion. Typically, accounting, market, economic value added or balance scorecard based measurements are used for performance assessment purposes. Accounting and market based performance indicators are prevailing in diversification research. One of its benefits is that accounting performance measurements can be also used when non-listed firms are included. One part of performance management studies addresses parametric and non-parametric approaches. Studies that compare parametric and non-parametric techniques were performed by a number of authors like Ferrier and Lovell (1990: 229–245), Sheldon (1994: 115–133), Resti (1997: 221–250), Bauer et al. (1998: 85–114), Casu and Girardone (2002: 3–23), Weill (2004: 133–152) and Beccalli et al. (2006: 218–235.).
One of the earliest studies that compare alternative frontier techniques was done by Ferrier and Lovell (1990: 229–245). Researchers analysed the cost structure of 575 US banks for the year 1984 using Stochastic Frontier Analysis

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(SFA*)* and Data Envelopment Analysis (DEA) methodologies. Higher efficiency scores were found when DEA was used compared to SFA. The researchers came to a conclusion that DEA is sufficiently flexible to envelop the data more closely than a functional cost frontier. Even though it was also discovered that efficiency scores did not reveal significant correlation, thus indicating, that other non-controlled factors might have influenced results obtained by the two measures. This conclusion is also applicable to the current research, which is discussed in the analysis part.

Sheldon (1994: 115–133) analysed the cost efficiency of Swiss banks with SFA and DEA in the period from 1987 to 1991. While results from DEA indicate that the average degree of cost efficiency is about 56%, SFA provided an estimate of only 3.9% mean efficiency. This substantial deviation from usually obtained magnitudes of around 80% for US and European studies casts some doubt to a specification of the cost function (Amel et al. 2004: 2493–2519). Likewise, the researcher reports insignificant rank-order correlation of 0.01, indicating that no relationship exists between the two groups of efficiency scores. These results confirming that two alternative methods implemented to solve the same cost minimization problem might not necessarily correlate are remarkable.

Resti (1997: 221–250) provides different evidence. The researcher assesses cost efficiency of 270 Italian banks over the period 1988-1992. Parametric and non-parametric efficiency scores were compared and no substantial difference between econometric and linear programming results was found. In contrast to Ferrier and Lovell (1990: 229–245) as well as Sheldon (1994: 115–133), the researcher reports higher efficiency scores between 81% and 92% for SFA as opposed to DEA scores between 60% and 78%. Rank correlation between SFA and DEA is statistically significant at the 1% level and ranges from 0.44 to 0.58. The rank ordering of firm specific inefficiency is strongly correlated over time, although it is more persistent with DEA than with SFA.

Bauer et al.'s (1998: 85–114) study is among the most significant, provided the application of four approaches SFA, DEA, Thick Frontier Analysis and Distribution Free Analysis (DFA) on a data set of 683 banks operating in the United States of America over the period 1977-1988. Researchers proposed six consistency conditions to analyse the robustness of frontier efficiency measures. Researchers performed a comparison of efficiency distributions, rank order correlation of the efficiency distributions, correspondence of best-practice and worst--practice banks across techniques, the stability of measured efficiency over time, the consistency of efficiency with market competitive conditions and the consistency with standard non--frontier performance measures. A measure of single year efficiency and a measure of all year efficiency based on one set of banks was calculated for by using each approach over the entire time period. Mean efficiency of parametric techniques averages 83% while mean efficiency for the nonparametric approaches is only around 30%. Nonparametric and parametric techniques give only very weak consistency ranking with each other: rank-order correlation is 0.1. All the methods are stable over time although DEA generally shows slightly better stability than the parametric methods. On the other hand, the parametric efficiency scores are generally consistent with the standard performance measures, while DEA efficiency scores are much less so. Bauer et al. (1998: 85–114) concluded that there is no single correct approach to specify an efficient frontier. Instead, both measures seem to react to varying degrees to particularities of the data. Thus, reporting methodological cross--checks are important to ensure that policy makers are aware of the different information contained in efficiency measures derived with alternative methods.

In their later study, Casu and Girardone (2002: 3–23) examined cost characteristics, profit efficiency and productivity change of Italian financial conglomerates during the 1990s using SFA, DFA and DEA. Efficiency measures from stochastic and deterministic frontiers are reasonably similar in magnitude and also show similar variation in efficiency levels. Notwithstanding these similarities in range and variance of efficiency scores, the trend in the DEA cost efficiency is increasing between 1996 and 1998 and shows a rather sharp decrease in 1999. In turn, SFA estimates exhibit steady improvement in cost efficiency. DFA efficiency estimates show consistency with the DEA scores rather than with the SFA while exhibiting a decreasing trend of efficiency.

Weill (2004: 133–152) examined robustness of SFA, DFA and DEA approaches. The researcher measured the cost efficiency of 688 banks from France, Italy, Germany, Spain, and Switzerland over the period starting from 1992 to 1998. The researcher compared mean efficiencies, correlation coefficients derived by using different methodologies and correlation with standard performance measures. Findings of the research were that efficiency scores did not differ

substantially across methodologies in use and were positively correlated between SFA and DFA. However, one of the research findings was evidence that there was no positive relationship between any parametric approach and DEA. All approaches were found to provide efficiency scores, which correlated with standard performance measures.

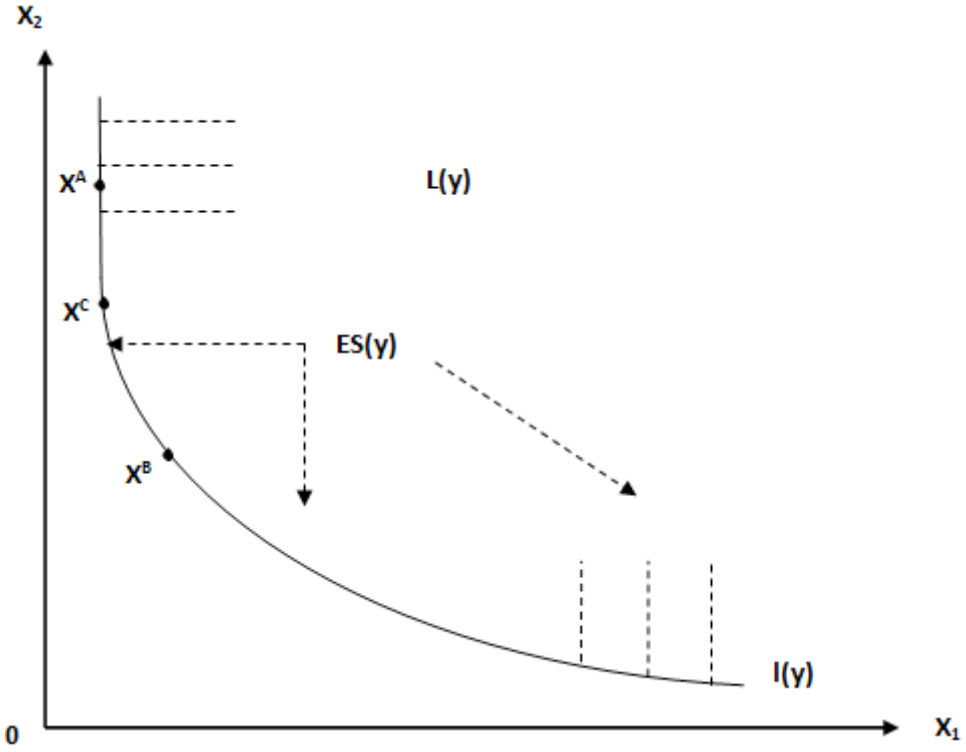
Beccalli et al. (2006: 218–235) assessed cost efficiency of listed European banks in 1999 and 2000. The researchers investigated any possible relationship between efficiency measures and market performance of financial institutions by employing SFA and DEA. The findings were that that percentage changes in stock prices reflected percentage changes in cost efficiency, particularly those derived from DEA methodology. Additionally, SFA efficiency scores were somewhat higher than DEA scores while the latter were more dispersed compared to SFA. Studies aimed to discover differences among the above mentioned methods continuously show that efficiency measures differ not only in terms of mean industry efficiency. Efficiency rankings, their stability over time and the consistency with traditionally employed performance measures contain important additional information for policy making purposes. Eventually, except for Bauer et al. (1998: 85–114), none of these cross-checking attempts succeeded in quantifying differences for a banking system as a whole but rather focused on distinct time intervals and particular groups of banks in the system as such. Summing up the previous research on performance measurement of financial companies by using parametric and non-parametric approaches, findings can be considered to be both different in nature and raising concerns over sustainability of efficiency rankings. The first poses consistency challenges because, as findings show, SFA and DEA efficiency measurements might result in one approach indicating higher efficiency values than another, measurements might also provide efficiency values, which do correlate, but are not clearly higher for one approach than for another. Besides, measurements might produce efficiency values that do not correlate. Sustainability of performance management findings also might pose a problem because a vast research was focused on distinct and fairly short time intervals and particular groups of financial companies.

Despite the fact, that previous research on efficiency of financial companies using both parametric and non-parametric approaches can be considered to be both extensive and deep enough, certain gaps can be identified. For instance, the previous research was mainly focused on mainstream developments of efficiency concepts in Europe, including Nordic countries. A focus of efficiency research has clearly shifted to such fast-growing Asian countries like China, South Korea, Taiwan and Malaysia. Meanwhile, efficiency spill-over effects, which could have been witnessed in smaller emerging markets like Baltic countries during past ten to fifteen years, have not been studied enough. However, such a research on spill-over effects on smaller markets might comprise scientific value and serve as guidance for more efficient exploitation of such spill-over effects in future. The author believes that the above stated identifies the current research gap and has set an ambition to fill it in with his research on efficiency of pension fund management companies in Baltics. Sustainability of performance measurements will be analysed at the cluster level.

Theoretical framework

The estimation of efficiency can be categorized according to assumptions and techniques used to construct an efficient frontier. On one hand, parametric methods like SFA estimate the frontier with statistical methods. On the other hand, nonparametric methods like DEA rely on linear programming to calculate piecewise linear segments of the efficient frontier. Parametric methods impose an explicit functional form for both the frontier and deviations from it, which is defined as inefficiency. Nonparametric methods, in contrast, do neither impose any assumptions about functional form of the frontier nor any distributional assumptions about inefficiency. This entirely deterministic construction of the frontier explains the difference between an inefficient observed unit and an efficient reference unit on the frontier solely by inefficiency. Thus, in the context of a production function, the output of a firm is a function of inputs subject to a production technology and inefficiency arising from employment of that technology. Farrell (1957: 253–281) laid the foundation to measure efficiency and productivity studies at the micro level. The fundamental assumption proposed by the researcher was to depart from perfect input-output allocation and to allow inefficient operations. Inefficiency was defined as the distance of a firm from a frontier production function, which was accepted as the benchmark. If a firm's actual production point lies on the frontier, it is considered to be perfectly efficient. If it is out of the frontier, then it is inefficient while the ratio of the actual to

Figure 1: Input requirements for datasets



Source: Ercok (2012).

potential production defining the level of efficiency of the individual firm is called Decision Making Unit (DMU). Efficiency frontier is presented graphically on the Figure 1 below.

Firms X^A, X^B and X^C are considered to lie on the efficiency frontier, which is defined as the production function *I*(y) derived from input isoquant function, consisting of input bundles to produce *y* (Ercok 2012: 1-23):

$$l(y) = \{x: x \in L(y), \lambda x \notin L(y) \; if \; \lambda < 1 \}$$

Further, the full set of input vectors, *L*(*y*), which can produce an output vector *y,* is defined as:

$$L(y) = \{x: (y, x) \; is \; producible\}$$

The efficient input subset *ES*(y), consisting of bundles of minimum possible inputs needed to produce *y*, is defined as:

$$ES(y) = \{x: x \in L(y), x' \notin L(y), x' < x \}$$

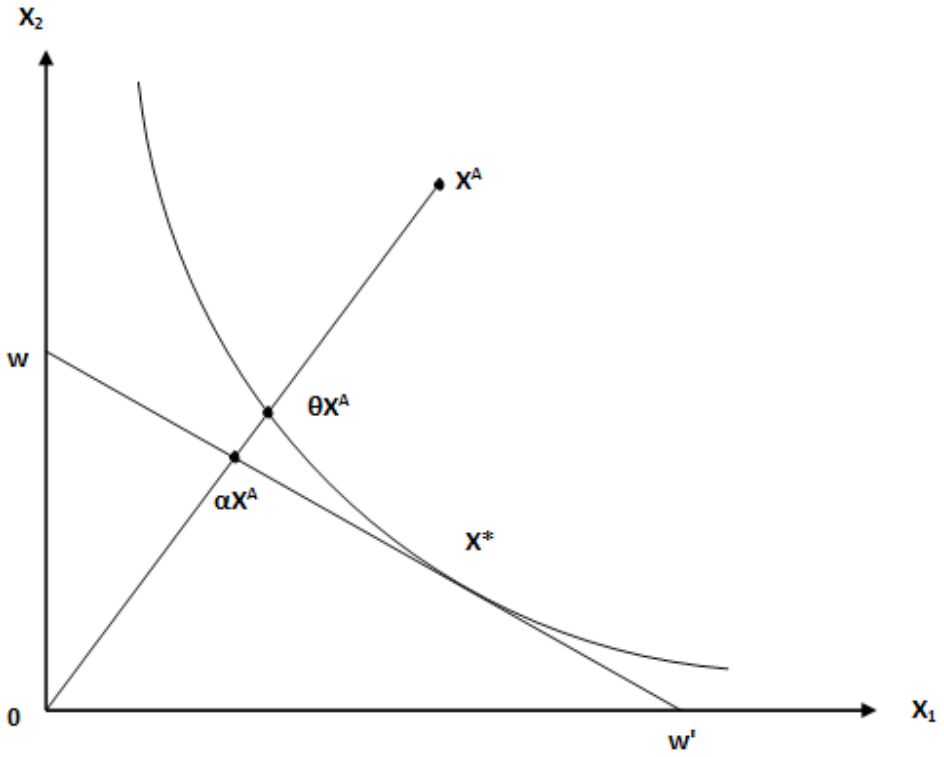
Eventually interrelation between these three subsets can be represented as:

$$ES(y) \subseteq l(y) \subseteq L(y)$$

Koopmans (1951) is considered to pioneer the earliest formal definition of technical efficiency, which says that a producer is technically efficient if, and only if, it is impossible to produce more of any output without producing less of some other output or using more of some input. Afterwards, Debreu (1951: 273–292) and Farrell (1957: 253–281) developed a different definition of technical efficiency (TE) by ruling out slack units, which says that TE is equal to one minus the maximum equiproportionate (radial) reduction in all inputs that is feasible with given technology and output (Fried et al: 2008).

Debreu-Farrell model assumes that the first and foremost requirement of being technically efficient is to be situated exactly on the isoquant curve *I(y)*. Koopmans (1951) stipulates that there is absence of coordinatewise improvements, which means a simultaneous membership in both efficient subsets (Fried et al. 2008). For example, while the point X^A on Figure 1 is technically efficient according to the Debreu-Farrell definition, Koopmans (1951) spots this point, which is outside the efficient subset, as inefficient due to slack usage of X_2. As a consequence, it is convenient to state that Debreu-Farrell technical efficiency is necessary, but not sufficient for technical efficiency. Farrell (1957: 253–281) proposed that efficiency consists of two components- TE and allocative efficiency (AE). TE reflects the ability of a DMU to minimize input use to produce a given amount of output. AE reflects the ability of a DMU to use inputs in optimal proportions, given their respective

Figure 2: Technical and allocative efficiency



Source: Ercok (2012).

prices and the production technology. Together, these two measures represent a total efficiency measure (Coelli et al. 1997).

While performing an efficiency analysis, two components have been put forward by Farrell (1957: 253–281) as fundamentals of efficiency comprising TE and AE. As plotted in Figure 2, producer utilises two inputs X_1 and X_2 in order to produce a specific output. At the input bundle of X^A, this producer has the capability to decrease the amount of inputs all the points in "level set" back to isoquant curve until reaching to the point θX^A. The input choices at can be radially contradicted with the "absence of coordinate wise improvements" up to the point ϑX^A. Assuming both Koopmans and Debreu-Farrell definitions, technical efficiency of this firm at the point is calculated as:

$$TE = \frac{\theta XA}{XA}$$

Where X^A denotes the observed input levels and θX^A represents the combination of technically efficient amounts of inputs. To have an economically efficient production set, TE is not sufficient. The input combination should be selected appropriately on the basis of their prices. The best-practicing mixture of inputs concerning the prices is the intersection point of isoquant and isocost curves where technically feasible production units are produced at the lowest cost. According to the *Figure 2*, allocative efficiency at is:

$$AE = \frac{\alpha XA}{\theta XA}$$

where θX^A represents the combination of technically efficient amounts of inputs, αX^A refers to the mixture of inputs that has the lowest cost given this output and technology. In order to convert production efficiency to cost efficiency, an assumption that a producer faces input prices and aims to minimise costs has to be made. Cost efficiency (*CE*) can be calculated as the ratio of minimum cost to actual cost. In relation to the points shown in Figure *2*, cost efficiency at is:

$$CE = \frac{\alpha XA}{XA}$$

As it is plotted on the Figure *2*, cost-efficiency has two components which are allocative and technical efficiency. Whereas corresponds to the technical side of it, is indicating the allocative component. The product of them gives the value of cost efficiency.

$$CE = \frac{\theta XA}{XA} \times \frac{\alpha XA}{\theta XA} = \frac{\alpha XA}{XA}$$

To measure efficiency of firms, two separate methods- DEA and SFA have been developed by researchers under the rubric of mathematical programming approach and the econometric approach. Mathematical programming approach which is also known as DEA was originated by Charnes et al. (1978: 429–444). In DEA, multiple outputs and inputs are reduced into a single output-input form in which efficiency measure is yielded after necessary calculations are completed with linear programming. Ercok (2012: 1-23) suggests the following mathematical explanation of DEA algorithms. First, it is assumed that each DMU uses m inputs for the production of n outputs at a given technology level. X_{ij} denotes the amount of input *i* (*i=1,2,……,m*) produced by j^{th} DMU (*j=1,2,….,k*), whereas Y_{sj} represents the quantity of output *s* (*s=1,2,……,n*) produced by j^{th} DMU (*j=1,2,….,k*). The variables u_r (*r=1,2,….,n*) and w_i (*i=1,2,…….,m*) are weights of each output and input respectively derived from values of these outputs and inputs. The technical efficiency of DMU_0 can be written as:

$$Max \frac{\sum_{r=1}^{n} urYro}{\sum_{i=1}^{m} wiXij}$$

subject to:

$$\frac{\sum_{r=1}^{n} urYrj}{\sum_{i=1}^{m} wixi} \leq 1$$

for *j=1,2,…k*
u_r and $w_i \geq 0$ *(r=1,2,…n)* and (*i=1,2,…m*)
AE of a DMU can be gauged alongside the TE scores by the means of cost minimisation or revenue or profit maximisation if price information about input set is available. Finally, CE (sometimes referred to economic efficiency) of the firm is calculated as the minimum cost to observed cost:

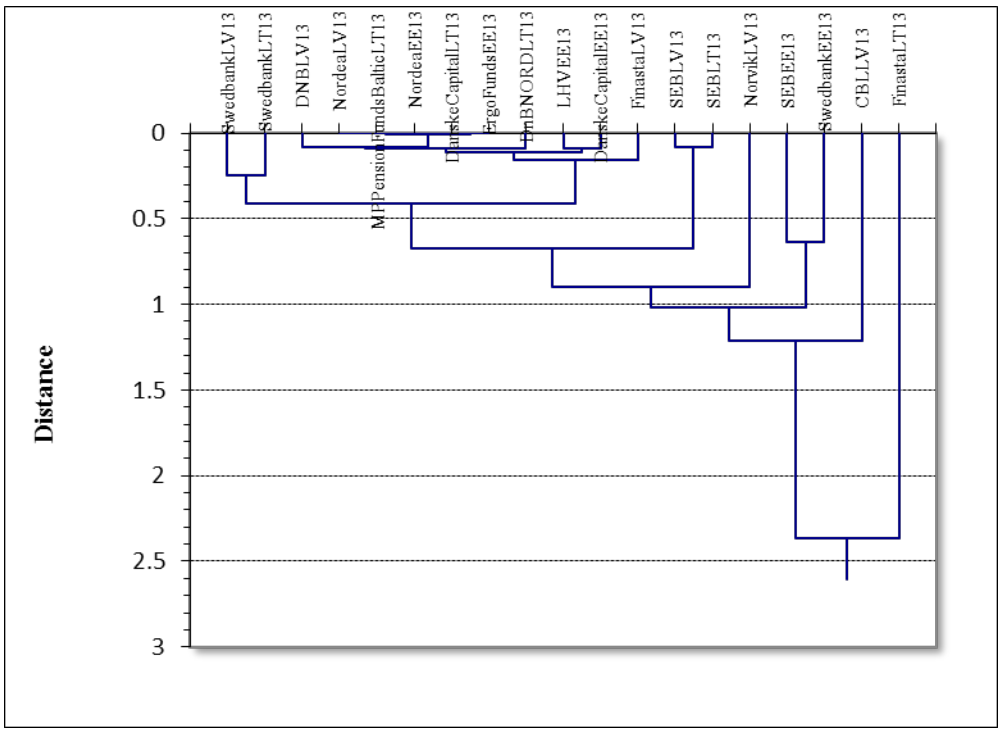
$$CE = \frac{\sum_{i=1}^{m} piXio'}{\sum_{i=1}^{m} piXij}$$

where p_i represents price data about input set and X_{io}' is the cost minimising input quantities derived by linear programming.

Analysis and discussion of results

The pivotal role in the Baltic pension fund marketplace belongs to players with the Nordic origin while local companies with mixed shareholding structures provide some diversification to the market. This is a natural outcome of general banking market shares of the Baltic market, which is mainly driven by such Nordic financial groups like Swedbank, SEB, Nordea, DNB and to some extent Danske Bank. Since Baltic countries in the given research are defined as Estonia, Latvia and Lithuania, certain local market players are also present in each of these countries. Following twenty pension fund management companies are included in the research (last two capital letters stands for Estonia in case of EE, Latvia in case of LV and Lithuania in case of LT)- Swedbank LV, SEB LV, CBL LV, DNB LV, Norvik LV, Finasta LV, Nordea LV, Hipo Fondi LV, Swedbank EE, LHV EE, Danske Capital EE, Ergo EE, SEB EE, Nordea EE, Swedbank LT, SEB LT, Danske Capital LT, MP Pension Funds Baltic LT, DNB LT and Finasta LT.
In order to provide a concise and comprehensive overview of market players of the Baltic market, a cluster analysis with single linkage was done for twenty companies operating in the market for years starting from 2010 and till 2013. Lee (2015: 1164–1175) explains, that within the single linkage cluster analysis the closest pairs are linked together and form clusters. The pension fund management companies are grouped into clusters in accordance with volume of their assets under management and share of non-pension fund management income. These cluster analysis criteria are chosen to segregate companies, which have pension fund management business as their core activity and which are not big, from companies, which are big market players or have other investment management activities. Data on assets under management as well as pension fund management and non-pension fund management income for the cluster analysis were taken from the annual reports of companies for the time period from 2010 till 2013. Afterwards, an operational efficiency analysis is performed to investigate whether small to medium pension fund management companies are less efficient than big pension fund management companies and other management companies, which are getting a bigger share of income from non-pension fund management. The cluster analysis with the same assumptions shows various clusters of fund management companies as at the end of 2013 (see Figure 3).
Even though in years from 2010 till 2013 the fund management industry came through major developments, the market structure can be considered to be very similar in principle. It is quite obvious that the core cluster of the so called small to medium companies became even more homogenous comprising ten companies (e.g., DNB LV, LHV EE, Danske Capital EE, DNB LT, Finasta LV, Nordea LV, Nordea EE, MP Funds LT, Ergo Funds EE, Danske Capital LT)

Figure 3: Cluster analysis of the pension fund management companies as at 2013



Source: author's own elaboration.

while more companies can be treated as outliers (e.g., Norvik LV, CBL LV, Swedbank EE, SEB EE, Finasta LT). The outcome of the cluster analysis will be used to support the discussions of the results of the efficiency analysis. As starting data for 2010 show, a relatively homogenous group of eleven market players could have been identified- DNB LV, DNB LT, LHV EE, Norvik LV, Finasta LV, Danske Capital EE, Nordea LV, Ergo Funds EE, MP Funds LT, Danske Capital LT and Nordea EE. Their assets under management vary from 8 million euros to 143 million euro and a share of non-pension income varies from 0% till 36%. Then on the left-hand side there are big market players Swedbank LV and Swedbank LT with assets under management ranging from 426 million euros to 497 million euros and having less than 3% share of non-pension fund management income. Then there are CBL LV, Hipo Fondi LV and Finasta LT with their assets ranging from 104 million euro to 435 million euros and share of non-pension fund management income varying from 25% to 55%. The final group is SEB LV, Swedbank EE and SEB LT, which has an asset volume range from 608 million euros till 953 million euros and share of non-pension fund income varies from 20% to 34%. Eventually, SEB EE is an outlier because of too big reported assets of funds and a big proportion of non-pension fund management income.

The operational efficiency of the pension fund management companies is performed by using the input orientated CRS model of DEA, which is further extended by assessing AE and CE. CE is used as a final measure for the efficiency. The author also attempted to use SFA as an alternative methodology to DEA. However, in two years out of five the SFA approach did not succeed because data were not valid to establish a reliable frontier function. The author also refers to the introduction of the paper, where several researchers, for example Ferrier and Lovell (1990: 229–245), concluded that DEA is sufficiently flexible to envelop the data more closely than a functional cost frontier. For the purpose of the efficiency assessment, commission fees as well as administrative fees were used as input variables while profit before tax was used an output variable. The net profit was not chosen as an output variable because of specifics of the Estonian legislation, which allows to reinvest corporate profit and no corporate income tax is paid in this case. This option has been often used also by the pension fund management companies domiciled in Estonia, what would make these figures non-comparable to profit after tax earned by pension fund management companies domiciled in Latvia and Lithuania.

Pension fund management companies are providing services locally in each country and such

Table 1: Efficiency estimates and ranks of pension fund management companies

		2013		2012		2011		2010		2009	
	Company	CE	Rank	CE	Rank	CE	Rank	CE	Rank	CE	Rank
1	Swedbank LV	0.29	11	0.11	11	0.24	8	0.16	10	0.16	10
2	SEB LV	0.61	4	0.25	4	0.84	2	0.66	3	0.48	6
3	CBL LV	0.13	13	0.00	18.5	0.17	11	0.18	8	0.05	13
4	DNB LV	1.00	1.5	0.33	2	0.53	5	0.75	2	0.84	3
5	Norvik LV	0.11	16	0.00	18.5	0.10	14	0.04	13	0.17	9
6	Finasta LV	0.11	17	0.10	12	0.00	18	0.11	11	1.00	1
7	Nordea LV	1.00	1.5	0.21	8	0.17	9	0.00	17.5	0.00	17
8	Hipo Fondi LV	0.13	14	1.00	1	0.15	12	0.31	6	0.11	11
9	Swedbank EE	0.15	12	0.08	13	0.14	13	0.18	9	0.00	17
10	LHV EE	0.32	10	0.01	16	0.00	18	0.00	17.5	0.00	17
11	DanskeCapital EE	0.48	8	0.23	5	0.50	6	0.52	5	0.71	4
12	Ergo EE	0.54	5	0.22	6	0.28	7	0.00	17.5	0.00	17
13	SEB EE	0.49	7	0.21	9	0.59	4	0.64	4	0.63	5
14	Nordea EE	0.43	9	0.12	10	0.00	18	0.00	17.5	0.00	17
15	Swedbank LT	0.09	18	0.03	15	0.05	15	0.02	14	0.19	8
16	SEB LT	0.62	3	0.25	3	0.65	3	0.27	7	0.21	7
17	DanskeCapital LT	0.13	15	0.06	14	0.17	10	0.08	12	0.07	12
18	MP Pension Funds Baltic LT	0.00	20	0.00	18.5	0.00	18	0.00	17.5	0.00	17
19	DnB NORD LT	0.51	6	0.22	7	1.00	1	1.00	1	0.93	2
20	Finasta LT	0.04	19	0.00	18.5	0.00	18	0.00	17.5	0.00	17

Source: author's own elaboration.

services are subject to national regulations and licensing. The author believes that pre-tax profit is a fairly comparable measure for pension fund management companies operating in Estonia, Latvia and Lithuania assuming that in case of cross-border outsourcing effective transfer pricing regulations are followed. The summary table with companies subject to research and their efficiency scores and rankings is presented in Table 1.

The efficiency ranks presented can provide valuable insights into performance of pension fund management companies at a country level. Therefore, the author has grouped companies into the top quartile (25% of companies with the highest efficiency rankings) and bottom quartile of companies (25% or more of companies with the lowest efficiency rankings). Findings are presented in the Table 2.

One can notice an obvious trend for pension fund management companies domiciled in Latvia to dominate in the top quartile in 2013 and 2012 while in 2011, 2010 and 2009 Latvian companies were just merely represented in the group. However, in any single year of the given research, also Lithuanian and Estonian companies are represented in the top quartile. The bottom quartile, on the opposite, used to be dominated by the Estonian pension fund management companies in 2010 and 2009 while recently in 2013 and 2012 Lithuanian companies are overrepresented in the group. The noteworthy observation is that no Estonian pension fund management company was represented in the bottom quartile in 2013 while only one was presented in the top quartile. Thus one can conclude that Estonian pension fund management companies demonstrated broadly average performance in 2013. Provided the implications discussed above, there might be somewhat more favourable conditions in running pension fund management business in one country compared to other. However, there is clear evidence that a company from any of three considered countries has chances to win a place in the top efficiency quartile.

In order to facilitate further result discussion of the efficiency analysis, efficiency ranks are

Table 2: Top and bottom efficiency quartiles of pension fund management companies

	2013	2012	2011	2010	2009
Top quartile	Nordea LV, DNB LV, SEB LT, SEB LV, Ergo EE	Hipo Fondi LV, DNB LV, SEB LT, SEB LV, Danske Capital EE	DNB Nord LT, SEB LV, SEB LT, SEB EE, DNB LV	DNB Nord LT, DNB LV, SEB LV, SEB EE, Danske Capital EE	Finasta LV, DNB Nord LT, DNB LV, Danske Capital EE, SEB EE
Bottom quartile	Norvik LV, Finasta LV, Swedbank LT, Finasta LT, MP Pension Funds Baltic LT	LHV EE, CBL LV, Norvik LV, Finasta LT, MP Pension Fund Baltic LT	Finasta LV, LHV EE, Nordea EE, MP Pension Funds Baltic LT, Finasta LT	Nordea LV, LHV EE, Ergo EE, SEB EE, MP Pension Funds Baltic LT, Finasta LT	Nordea LV, Swedbank EE, LHV EE, Nordea EE, Ergo EE, MP Pension Funds Baltic LT, Finasta LT

Source: author's own elaboration.

inserted in the summary table of the cluster analysis (see Table 3). The table presents main clusters of pension fund management companies in the context of volume of their operations expressed as assets under management, share of non-pension fund income as well as efficiency ranks of companies included in the given cluster. The first cluster represents small to medium pension fund companies with none to little exposure to non-pension fund management income. In terms of a number of companies, this is the most representative cluster, which comprises nearly a half of all market players. The cluster clearly benefitted from the tailwind of increasing volume of pension fund assets defined as assets under management range, which increased from 8 to 143 million euro in 2010 up to 43 to 374 million euro in 2013. None of other clusters experienced such a rapid growth of assets under management. Also the share of non-pension fund management income decreased steadily for the cluster 0 to 36% in 2010 down to 0 to 11% in 2013. Meanwhile the cluster has continuously had top efficiency performers belonging to the top quartile (top 25%) while in 2010 and 2013 the cluster hosted three out of five top performers including two best ones. In 2011 and 2012 the 1st cluster hosted two best performers out of five, which is also considered a strong result. However, it should be reminded that the cluster hosts nearly half of all companies subject to research. Logically, if 2-3 companies of the top efficiency quartile of five companies come from the given cluster of small to medium pension fund management companies, which have zero to little exposure to non-pension fund management income, it brings an implication of no real returns to scale in the industry. The cluster also includes companies with the worst performance indicators, as naturally it should because it is the biggest cluster. The second cluster is formed by two related pension fund companies operating in different countries. The companies are similar in terms of assets under management and almost non-existent income from non-pension fund management activities. Efficiency indicators are average except the 1st rank in 2011. The third cluster of companies poses a scientific interest because it ceased to exist as a cluster in 2013. One common thing of these medium in size companies belonging to the cluster is their major exposure to non-pension fund management business. In terms of efficiency ranking there are quite mixed findings. The fourth cluster of companies is very similar to the second cluster. However, its main distinction is stable non-pension fund business related stream of income. Efficiency rankings are most often on the top, however not the best ones. The final group of companies are so-called outliers. These companies have a big portion on non-pension fund management related income (27-55%). Efficiency indicators of outliers are mainly poor except 2010, when only one company was an outlier. Therefore, one can argue that having a major exposure to non-pension fund management business does not increase chances of a company to improve its operational efficiency.

To sum up the discussion of results, there might be somewhat more favourable conditions in running pension fund management business in one country compared to other. However, there is clear evidence that a company from any of three considered countries has chances to win a place in the top efficiency quartile. The cluster analysis combined with the DEA shows that in Estonia, Latvia and Lithuania small to medium pension fund management companies with little exposure to non-pension fund management revenues from 2010 till 2013 have been most often leading the efficiency frontier defined as

Table 3: Efficiency estimates and ranks of pension fund management companies

Cluster	Item	2013	2012	2011	2010
1	Companies	DNB LV, LHV EE, Danske Capital EE, DNB LT, Finasta LV, Nordea LV, Nordea EE, MP Funds LT, Ergo Funds EE, Danske Capital LT	DNB LV, LHV EE, Danske Capital EE, DNB LT, Finasta LV, Nordea LV, Nordea EE, MP Funds LT, Ergo Funds EE, Danske Capital LT	DNB LV, LHV EE, Norvik LV, Danske Capital EE, DNB LT, Finasta LV, Nordea LV, Nordea EE, MP Funds LT, Ergo Funds EE, Danske Capital LT	DNB LV, DNB LT, LHV EE, Norvik LV, Finasta LV, Danske Capital EE, Nordea LV, Ergo Funds EE, MP Funds LT, Danske Capital LT, Nordea EE
	AuM range, millions euro	43-374	39-252	31-219	8-143
	Non-pension share range	0-11%	0-14%	0-23%	0-36%
	Efficiency ranks	1.5, 1.5, 5, 6, 8, 9, 10, 15, 17, 20	2, 5, 6, 7, 8, 10, 12, 14, 16, 18.5	4, 5, 6, 7, 10, 11, 12, 14, 18, 18, 18	1, 2, 5, 11, 12, 13, 17.5, 17.5, 17.5, 17.5, 17.5
2	Companies	Swedbank LV, Swedbank LT	Swedbank LV, Swedbank LT	Swedbank LV, Swedbank LT	Swedbank LV, Swedbank LT
	AuM range, millions euro	548-737	524-628	445-512	426-497
	Non-pension share range	0%	1-2%	0-2%	0-3%
	Efficiency ranks	11, 18	11, 15	1, 15	10, 14
3	Companies	-	Hipo Fondi LV, Finasta LT	CBL LV, Hipo Fondi LV, Finasta LT	CBL LV, Hipo Fondi LV, Finasta LT
	AuM range, millions euro	-	114-166	92-368	104-435
	Non-pension share range	-	50-55%	51-55%	25-55%
	Efficiency ranks	-	1, 18.5	3, 8, 18	6, 8, 17.5
4	Companies	SEB LV, SEB LT	SEB LV, SEB LT	SEB LV, SEB LT	SEB LV, Swedbank EE, SEB LT
	AuM range, millions euro	770-780	524-754	616-633	608-953
	Non-pension share range	14-18%	15-16%	17-24%	20-34%
	Efficiency ranks	3, 4	3, 4	2, 18	3, 7, 9
Outliers	Companies	Norvik LV, CBL LV, Swedbank EE, SEB EE, Finasta LT	Norvik LV, CBL LV, Swedbank EE, SEB EE	Swedbank EE, SEB EE	SEB EE
	AuM range, millions euro	124-1,284	155-1,473	846-1,300	1,980
	Non-pension share range	27-55%	29-43%	34-47%	47%
	Efficiency ranks	16, 13, 12, 7, 19	9, 13, 18.5, 18.5	9, 13	4

Source: author's own elaboration.

ability of a company to generate profit before tax out of its commission and administration expenses. However, if adjusted for the cluster size and a number of top quartile performers, there is no evidence for any probabilistic advantage of the cluster to host top efficiency performers. It clearly shows that there are also no real returns to scale in the industry because the cluster is capable of competing effectively with other clusters, which include companies with bigger business volumes and diversified business revenues. Big pension fund management companies with moderate exposure to non-pension fund management revenues proved often to be on the top of the efficiency frontier, but not leading it. Companies with major exposure to non-pension fund management revenues were much often on the bottom part of the efficiency rankings and quiet rarely on the top. Medium in terms of size and major in terms of exposure to non-pension fund management revenue companies ceased to exist as a cluster in 2013 and joint the so-called outliers group. With only one exception, companies from the outlier group have never been on the top of the efficiency frontier. Findings of the efficiency analysis from the angle of different clusters can be considered to be sustainable for the research period except for companies, belonging to the cluster, which ceased to exist in 2013. These findings bring two major implications for top management of pension fund companies. First, there is no evidence that increasing volume of assets under management improves pre-tax profitability. Second, an attempt to diversify pension fund management business with non-pension fund management revenues does not improve pre-tax profitability either. Thus, the two findings combined show that top management of pension fund companies in Estonia, Latvia and Lithuania can ensure competitive pre-tax profitability by pursuing an organic growth and non-diversification strategy.

Conclusion

Performance or efficiency improvement posed challenges to measurement practices as they are expected to respond to more sophisticated demand for business reporting. Typically, studies suggest both parametric and non-parametric performance measurement techniques.

The operational efficiency of twenty Baltic pension fund management companies was performed by using the input orientated CRS model of DEA, which is further extended by assessing AE and CE. CE is used as a final measure for the efficiency. The author also attempted to use SFA as an alternative methodology to DEA. However, in two years out of five the SFA approach did not succeed because data were not valid to establish a reliable frontier function. For the purpose of the efficiency assessment, commission fees as well as administrative fees were used as input variables while profit before tax was used an output variable. Even though in years from 2010 till 2013 the fund management industry came through major developments, the market structure can be considered to be very similar in principle. There might be somewhat more favourable conditions in running pension fund management business in one country compared to other. However, there is clear evidence that a company from any of three considered countries has chances to win a place in the top efficiency quartile. It is quite obvious that the core cluster of the so called small to medium companies became even more homogenous comprising ten companies. The cluster analysis combined with the DEA has shown, that in Estonia, Latvia and Lithuania small to medium pension fund management companies with little exposure to non-pension fund management revenues from 2010 till 2013 have been most often leading the efficiency frontier. However, if adjusted for the cluster size and a number of top quartile performers, there is no evidence for any probabilistic advantage of the cluster to host top efficiency performers. It clearly shows that there are also no real returns to scale in the industry because the cluster is capable of competing effectively with other clusters, which include companies with bigger business volumes and diversified business revenues. Big pension fund management companies with moderate exposure to non-pension fund management revenues proved often to be on the top of the efficiency frontier, but not leading it. Companies with major exposure to non-pension fund management revenues were much often on the bottom part of the efficiency rankings and quiet rarely on the top. Medium in terms of size and major in terms of exposure to non-pension fund management revenue companies ceased to exist as a cluster in 2013 and joint the so-called outliers group. With the only exception, companies from the outlier group have never been on the top of the efficiency frontier. Findings of the efficiency analysis from the angle of different clusters can be considered to be sustainable for the research period except for companies, belonging to the cluster, which ceased to exist in 2013. These findings bring two major implications for top management of pension fund companies. First, there is no evidence that

increasing volume of assets under management improves pre-tax profitability. Second, an attempt to diversify pension fund management business with non-pension fund management revenues does not improve pre-tax profitability either. Thus should be possible to ensure competitive pre-tax profitability by pursuing an organic growth and non-diversification strategy.

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Ocena operacyjnej efektywności zarządzania towarzystwami emerytalnymi

Abstrakt

Celem badań jest ocena efektywności operacyjnej firm zarządzających funduszami emerytalnymi za pomocą dedykowanej metodologii oceny wydajności i analiza skutków wynikająca z oceny efektywności. Do oceny efektywności wykorzystano metodę Data Envelopment Analysis (DEA). Towarzystwa emerytalne, które poddano ocenie efektywności operacyjnej, działają w krajach bałtyckich, takich jak Estonia, Łotwa i Litwa. Badanie obejmuje lata 2009–2013. Efektywność operacyjna, w ramach danego badania, jest definiowana jako zdolność spółki zarządzającej funduszem emerytalnym do generowania zysku przed spłatą odsetek i opodatkowaniem (tj. zmiennej wyjściowej modelu efektywności) za pomocą prowizji i kosztów administracji (tj. zmiennych wejściowych modelu efektywności). Ponieważ przedsiębiorstwo zarządzania funduszami emerytalnymi może być uzależnione od korzyści skali i zakresu działalności, analiza klastrowa odbywa się na podstawie zarządzanych aktywów i udziału nieemerytalnych przychodów w zarządzanych aktywach firm zarządzających funduszami w celu poprawy porównywalności wyników. Metody zastosowane w empirycznej części badań do analizy powyższych danych są metodami

matematycznymi (głównie DEA), a także analiza trendu, analiza skupień, wskaźniki rozwoju, względne i bezwzględne wskaźniki oraz inne metody.
Wynik badania wskazuje na konkretne implikacje dla kadry zarządzającej towarzystwami emerytalnymi działającymi w wybranych krajach bałtyckich w latach 2009–2013.

Słowa kluczowe: ekonomia, modele wejścia-wyjścia, analiza skupień
JEL: M21, C67, C38