# Revealing Importance of Management of Assets in Investment Trust Companies by DEA Analysis

*Telli Şahin* *

College of Economics and Management, Nanjing University of Aeronautics and Astronautics, Nanjing 210016, P. R. China

(Received 20 March 2018; revised 20 April 2018; accepted 30 May 2018)

**Abstract**: In this paper, contribution of sources to the efficiency of Turkish investment trust companies is investigated by eight models which are constructed by different combinations of inputs of DEA analyze structure. Input oriented CRS based data envelopment analysis (DEA) and also Malmquist Productivity Index are applied for the time period of 2009—2016. Inputs of the CRS model are preferred as financial investments, cash and cash equivalents, cost of sales, and total sales while net profit and net sales are outputs of the models. It is reached at the conclusion that only management of investments is providing better results than only focusing on cash or cost management. In addition, effects and contribution of investment management parameter when it is added to the other ones is found more.

**Key words**: asset management; efficiency; Malmquist productivity index; data envelopment analysis

**CLC number**: F833; F837 **Document code**: A **Article ID**: 1005-1120(2018)S-0088-08

## 0 Introduction

Efficiency of investment trust companies are important to investors for evaluating the firms in terms of risks and profits. In this regard, risks and profits are considered as they are linked to managerial and hierarchic structure of firms, managerial skills, making profit ability, their cost management and many other reasons. Any kind of managerial skills of companies reflects on profits and losses. Thus, competitiveness of companies in finance sector are mainly depends on variables related to effective usage of sources like equity, net (and/or total) assets, number of staff; cost related variables like interest expenses, non-interest expenses; and profit related variables like profit, interest income, non-interest income, net sales and so on. However, there are most famous three approaches to measure efficiency of financial companies especially banks. Production approach, intermediation approach[1,2] and profit approach[3]. Selection of inputs and outputs of models to be used in analysis can be specified by these approaches.

In this study, regardless of any approach, an independent way is followed.

In literature, researchers have adopted various variables in a non-parametric analysis called data envelopment analysis (DEA). To measure efficiency Malmquist total factor index (Malmquist TFP) is a very common preference.

Lee and Yang[4] focused on evaluating the operational efficiency of financial holding companies and their subsidiaries which operates in Taiwan by using network data envelopment analysis. They implied that this method has an advantageous of capturing the synergies of cross selling undertaken by subsidiaries. They used various inputs and outputs for different kind of holdings, but the number of employees and operation expenses are inputs and fund size and the number of fund beneficiaries are outputs of CRS based model for investment trust companies. They found that banking and securities companies of financial

* Corresponding author, E-mail address: sahintelli@yahoo.com.

**How to cite this article**: Telli Şahin. Revealing importance of management of assets in investment trust companies by DEA analysis[J]. Trans. Nanjing Univ. Aero. Astro., 2018,35(S):88-95.
http://dx.doi.org/10.16356/j.1005-1120.2018.S.088

holding companies have superior operational efficiency to investment trust companies and insurance companies. They suggest reduceing the use of relevant inputs to improve efficiency for those holdings which includes investment trust companies.

Babalos et al[5] investigated that 31 Greek equity funds' total productivity change by using DEA based Malmquist Index for the period of 2003—2009. Inputs of the input oriented CCR (Charnes, Cooper and Rhodes) linear model are funds' total expense ratio, capital invested, risk (proxied by the standard deviation of returns) and annualized standard deviation of the returns while terminal value is the output. A fund's expense ratio refers to the general overall costs including management fees and other operational and administrative costs incurred by the fund and is typically expressed as a ratio to its average net assets for the year. They draw attention to the importance of domestic policy makers and market regulators. They found a significant negative relationship between fund size and efficiency which might be caused by microstructure of the domestic market.

Saad et al. [6] compared the efficiencies of selected conventional and Islamic unit trust companies (5 in all 27 companies) in Malaysia by the Malmquist Index for the period of 2002—2005. They used expenses ratio and portfolio turnover ratios as inputs and returns as output in the output oriented CRS and VRS models. They found that the efficiency of the mentioned firms is mainly driven by technical efficiency. Besides, some conventional firms are less efficient than their counterparts which are Islamic unit trust firms.

Akhisar and Tezergil[7] studied efficiency 23 insurance companies which operates in Turkey by calculating Malmquist TFP for the period of 2006—2010. He used variables of equity, total assets, the premiums received, net profit and technical profit for output oriented DEA model. They emphasized that the improvements in technology and increasing technical efficiency has big importance in terms of competitive power.

Yang[1] adopted production approach to investigate efficiencies in different branches of a Canadian Bank. They collected the data based on its availability, experts' opinion, traditional performance ratios and literature models. The DEA model of the study composed of 4 inputs (sales FTE, service FTE, support FTE and other FTE) and 9 outputs (all them are related to number of transactions).

Çoban et al. [3] investigated that productivity of ten biggest banks which operates in Turkey by Malmquist TFP based on impacts of Banking Regulation and Supervision Agency (BRSA) for the time period between 1995 and 2000. In this study, they preferred to paid in capital, number of staff and total deposit as inputs while total credits, net current and net profit are outputs of input oriented VRS model. They highlight that not only BRSA, but also global crisis and technological improvements or deteriorations for different time periods effect productivity of banks.

Kutlar et al. [8] investigated technical and allocative efficiency of 23 commercial banks in Turkey by using Malmquist Index for the period of 2003—2012. In this study, net assets, deposits, interest expenses, paid fees and commissions, other operation expenses, salaries and number of personnel are used as inputs of the CCR and BCC models while credits and lendings, operational income, received fees and commissions, interest income and other operational income are outputs. The results of the study indicate that public banks with high amount of deposits tend to have higher efficiency scores than private counterparts.

Yildirim[9] compared efficiencies of 17 Islamic banks from Turkey (four banks) and Malaysia (13 banks) by Malmquist TFP for 2010—2014 period. Using total assets and total equities as inputs while total deposits and net profit are outputs of input oriented CCR model, he found that mostly scale inefficiency causes to technical inefficiency and Islamic banks are not at an optimal level of operations.

Akyüz et al. [10] measured efficiencies of 11 deposit banks in Turkey by Malmquist Total Factor Index for the time period between 2007 and 2011. Deposit, equity capital and interest expenses are used as inputs and net profit and interest income are used as outputs of input oriented CCR model. They found that the increments in efficiency is basically driven by scale efficiency component.

Oncu and Aktas[2] investigated productivity change in banking sector by Malmquist TFP during the restructuring period between 2001—2005 period. Using number of staff, net tangible assets and deposits as inputs while total credits and other income are outputs of input oriented DEA, it is noticed that efficiency improved based on technological improvements during reconstruction. On the other hand, non-interest income has a great importance to make profit, thus non-interest expenses have to be under control to maintain efficiency.

Pehlivanoğlu[11] studied sectoral efficiency and productivity of the largest 500 manufacturing industrial firms in Turkey for the period of 2008—2011. To measure efficiency and productivity of decision making units by Malmquist Total Factor Index, he assigned inputs of an output oriented CRS model as equity, total assets and number of employees while net sales, net profit and exports are outputs.

Kula et al. [12] studied efficiency of 16 firms from cement industry for the time period between 2001 and 2007. Using Malmquist TFP, they assigned seven financial ratios as inputs while three financial ratios are outputs of input oriented CCR model. They found that the increments in efficiency of some firms caused by scale efficiency and some others' by technological improvements.

However, to the best of my knowledge, there are no studies investigating the efficiency of investment trusts in Turkey using the Malmquist Index.

This paper is organized as follows: the data and methodology is provided in the next section. Empirical results are given in Sections 3 and some conclusions are given at the last in the final section.

# 1 Data and Methodology

There are nine investment trust companies listed on the stock market of Turkey (Istanbul Stock Exchange-ISE). This study is limited to eight investment trust companies for the time period of 2009—2016, because one company has missing values for the most of the period (2009, 2010 and from 2014 to 2016). In the whole study companies of the sector are encoded as A, B, C, D, E, F, G and H.

Business and competitive superiority in the sector mainly depends on effective usage of sources (making investments and holding cash and cash equivalents), and reducing kinds of expenses. Thus, it is considered that the efficiency of investment trust companies can be measured by four inputs which are financial investments, cash and cash equivalents, cost of sales and total sales while net profit is output and net sales is an undesirable output of models. This study examines efficiency via eight different input oriented DEA models and investigates efficiency changes via Malmquist Productivity Index (MPI). DEA models are constructed by different combinations of inputs with a coefficient. In other words, in each model different inputs are selected to be reduced in order to see the effect on the output. After implementation of DEA models, the components Technological Efficiency Change (TEC) and Technical Efficiency Change (TC) of MPI Total Factor Productivity Index (TFP), and also the components Scale Efficiency Change (SEC) and Pure Efficiency Change (PEC) of TC are calculated and have been commented.

All mentioned input and output values are taken from balance sheets of each companies. Balance sheets are downloaded from the official website of KAP which is an official disclosure platform of companies for the purpose of announcing their financial statements and important developments. Table 1 presents used contractions for inputs and outputs of models, and also gives information about which inputs the efficiency coefficient of beta used with and which model in.

**Table 1 Abbreviations of inputs and outputs**

| Contractions | Elements of DEA set | Beta |
|---|---|---|
| Inv | Financial investments | Models 1,4,5,7 and 8 |
| Cash | Cash and cash Equivalents | Models 2,4,6,7 and 8 |
| Costs | Costs of sales | Models 3,5,6,7 and 8 |
| T-Sales | Total sales | Model 8 |
| Profit | Net profit | - |
| N-Sales | Net sales | - |

Set of inputs and outputs for all models is defined as follows

$$S=(\text{Inv},\text{Cash},\text{Costs},\text{T\_Sales},\text{Profit},\text{N\_Sales}) \tag{1}$$

where (Inv, Cash, Costs, T_Sales) can produce (Profit, N_Sales)

The objective function of all models which can also be called as static efficiency index (SEI) is stated below

$$\text{SEI}: \min\beta \tag{2}$$

Table 2 represents two sample structure of all models of the study with rest of the model structure which is constraints.

**Table 2 Sample models**

| Model 1 | Model 7 |
|---|---|
| SEI: $\min\beta$ | SEI: $\min\beta$ |
| s. t. $\sum_{i=1}^{l}\lambda\times\text{Inv}_i\leqslant\beta\times\text{Inv}_j$ | s. t. $\sum_{i=1}^{l}\lambda\times\text{Inv}_i\leqslant\beta\times\text{Inv}_j$ |
| $\sum_{i=1}^{l}\lambda\times\text{Cash}_i\leqslant\text{Cash}_j$ | $\sum_{i=1}^{l}\lambda\times\text{Cash}_i\leqslant\beta\times\text{Cash}_j$ |
| $\sum_{i=1}^{l}\lambda\times\text{Costs}_i\leqslant\text{Costs}_j$ | $\sum_{i=1}^{l}\lambda\times\text{Costs}_i\leqslant\beta\times\text{Costs}_j$ |
| $\sum_{i=1}^{l}\lambda\times\text{T\_Sales}_i\leqslant\text{T\_Sales}_j$ | $\sum_{i=1}^{l}\lambda\times\text{T\_Sales}_i\leqslant\text{T\_Sales}_j$ |
| $\sum_{i=1}^{l}\lambda\times\text{Profit}_i\geqslant\text{Profit}_j$ | $\sum_{i=1}^{l}\lambda\times\text{Profit}_i\geqslant\text{Profit}_j$ |
| $\sum_{i=1}^{l}\lambda\times\text{N\_Sales}_i=\text{N\_Sales}_j$ | $\sum_{i=1}^{l}\lambda\times\text{N\_Sales}_i=\text{N\_Sales}_j$ |
| $\lambda\geqslant 0; i=1,2,\cdots,l$ | $\lambda\geqslant 0; i=1,2,\cdots,l$ |

After all eight models are constructed based on the principles mentioned above and SEI values are calculated for each year, SEI values at time $a$ and $b$ ($a<b$) are calculated according to Malmquist productivity index formulations[13] which are given below

$$\text{TC}_j(a,b)=\frac{\text{SEI}_j^b}{\text{SEI}_j^a}=\frac{D_o^{t+1}(x^{t+1},y^{t+1})}{D_o^t(x^t,y^t)} \tag{3}$$

$$\text{TEC}_j(a,b)=\left[\frac{D_o^t(x^{t+1},y^{t+1})}{D_o^{t+1}(x^{t+1},y^{t+1})}\frac{D_o^t(x^t,y^t)}{D_o^{t+1}(x^t,y^t)}\right]^{0.5} \tag{4}$$

$$\text{TFP}_j=\text{TC}_j x\,\text{TEC}_j \tag{5}$$

## 2 Empirical Results

It is useful to start with the general condition of the companies to understand the results. In Table 3 average values of equity, investments and total assets of the companies are given for the period of 2009—2016. According to Table 3, F has total assets greater than whole sector, and A is the smallest scale company.

**Table 3 Some actives and passives of companies**

| Company | Equity | Investments | Total Assets |
|---|---|---|---|
| A | 8 312 791 | 4 841 949 | 9 270 825 |
| B | 41 001 478 | 31 750 924 | 42 143 536 |
| C | 19 684 642 | 15 534 037 | 19 970 053 |
| D | 17 540 257 | 13 530 159 | 17 806 185 |
| E | 32 940 967 | 28 212 196 | 34 290 533 |
| F | 248 554 428 | 233 767 917 | 249 777 956 |
| G | 13 069 276 | 9 928 346 | 13 180 795 |
| H | 15 514 131 | 8 997 189 | 16 108 070 |
| Avg * | 21 151 934 | 16 113 543 | 21 824 285 |

* Average values does not include values of *F*.

Thus the data has negative observations, some adjustments applied and average efficiency scores of the whole sector are calculated with different models for each year of the research period as shown in Table 4. As seen from Table 4 and Fig. 1, best efficiency scores are obtained by Models 8 and 7. Following these models, models which includes criteria of investment are relatively good than others in efficiency scores for the all observations excluding 2011 ones. Since the companies of the whole sector were in loss in 2011, results point out a relationship between importance of investment decisions on efficiency and general crisis on the sector. Models which does not include investment can be called as non-investment block models and it consists of Model 2, Model 3 and Model 6. Based on the investment criteria, results indicate that effective usage of investments might contribute to the efficiency of

**Table 4 Efficiency performance of the sector: Year by year**

| Models | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|
| Model 1 | 0.91 | 0.81 | 0.60 | 0.78 | 0.72 | 0.70 | 0.77 | 0.92 |
| Model 2 | 0.77 | 0.51 | 0.68 | 0.53 | 0.54 | 0.38 | 0.75 | 0.89 |
| Model 3 | 0.59 | 0.58 | 0.72 | 0.71 | 0.66 | 0.33 | 0.55 | 0.75 |
| Model 4 | 0.93 | 0.84 | 0.69 | 0.82 | 0.77 | 0.74 | 0.84 | 0.96 |
| Model 5 | 0.91 | 0.83 | 0.72 | 0.80 | 0.82 | 0.70 | 0.77 | 0.92 |
| Model 6 | 0.78 | 0.59 | 0.75 | 0.71 | 0.68 | 0.43 | 0.75 | 0.89 |
| Model 7 | 0.93 | 0.84 | 0.75 | 0.82 | 0.83 | 0.74 | 0.84 | 0.96 |
| Model 8 | 0.93 | 0.84 | 0.75 | 0.82 | 0.83 | 0.74 | 0.84 | 0.96 |

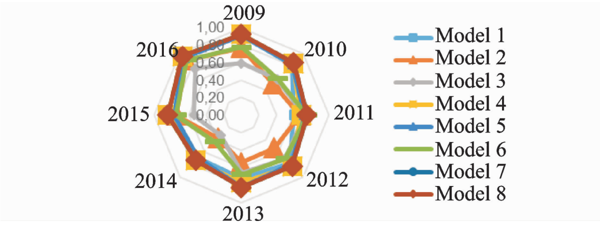


Fig. 1 Efficiency performance of the sector: year by year

the firm more than managing costs or managing cash. It is to say, investment block models have better efficiency scores than non-investment block models. Specifically, the year of 2011 can be defined as the worst year of the period, thus the negative net profits happened with greatest amounts and for all companies of the sector only in this year. The year of quite bad conditions for the sector is a year of non-investment block models showed the importance of cash and cost management. That means, regardless of any reasons behind external conditions, firms should reduce the amounts of investment, if they still have any control on investments; if not they must focus on cash and cost management more than usual in such years, thus most of the external reasons cannot have been predicted before and cannot help to have better investment projects or environment. As a result, Table 4 says that effective usage of investment is the most important factor among others, effective management of cash and costs is also important, and if all these factors are chosen to be considered together, then company will have better efficiency level.

Efficiency scores of companies is given with different models as average of whole research period in Table 5.

**Table 5 Efficiency performance of the firms: Firm by firm**

| Models | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| Model 1 | 0.82 | 0.92 | 0.64 | 0.55 | 0.76 | 0.82 | 0.87 | 0.85 |
| Model 2 | 0.57 | 0.90 | 0.42 | 0.29 | 0.61 | 0.90 | 0.81 | 0.54 |
| Model 3 | 0.33 | 0.95 | 0.44 | 0.21 | 0.78 | 0.86 | 0.66 | 0.65 |
| Model 4 | 0.82 | 0.96 | 0.71 | 0.64 | 0.80 | 0.90 | 0.89 | 0.86 |
| Model 5 | 0.84 | 0.96 | 0.65 | 0.56 | 0.85 | 0.89 | 0.87 | 0.87 |
| Model 6 | 0.60 | 0.95 | 0.48 | 0.34 | 0.80 | 0.92 | 0.81 | 0.68 |
| Model 7 | 0.84 | 0.96 | 0.71 | 0.64 | 0.87 | 0.92 | 0.89 | 0.88 |
| Model 8 | 0.84 | 0.96 | 0.71 | 0.64 | 0.87 | 0.92 | 0.89 | 0.88 |

In Table 5 and Fig. 2, superiority of investment block models draw attention. Best efficient firm of the sector is found as B in all cases with the scores of between 0.90 and 0.96. Apart from B, F and G are the other best efficient firms in the sector. D and relatively C can be considered as the most inefficient firms of the sector at the end of the period. On the other hand, some firms seem like not to take the importance of costs into account enough, while they are focusing more on investments. C and D have an average equity and assets while A is the smallest, G is the second smallest scale company and F is the largest one among the sector companies. According to these results, scale of a company seems not have any effect on efficiency of the company, but flexibility, risk management, effective usage of sources or any other managerial skills can contribute to the efficiency of companies.

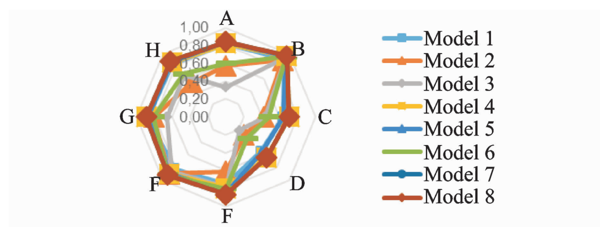


Fig. 2 Efficiency performance of the firms: firm by firm

After all CRS values of the firms were calculated, average values regarding to components of Malmquist productivity index (MPI) are also computed as it is shown in Table 6. First of all, according to Table 6, results with non-investment block models seems beyond the region of reliable results. The reason behind the excessively big numbers is the huge efficiency difference year by year in the mentioned models. Basically, these models can be evaluated according to the weights or importance of the MPI components and progress of the components period by period. Among those models, which components have the most contribution to TFP or TC is not clear, because of mixed results. Secondly, for the period of 2010—2011, TFP found below the score of 1 through all models except Model 3. When the situation of the sector is taken into account, this result says that efficiency of the whole sector decreased as expected. TC as a component of MPI reflects volume in the sector, and TC scores are found greater than 1 with the investment block models. Specifically, TEC has a greater role than TC with the investment block models for the period of 2010—2011.

**Table 6 Components of MPI year by year**

| Models | Period | TFP | TEC | TC | SEC | PEC |
|---|---|---|---|---|---|---|
| Model 1 | 2009—2010 | 0.39 | 0.43 | 0.91 | 0.98 | 0.93 |
| | 2010—2011 | 0.86 | 1.12 | 0.67 | 1.01 | 0.66 |
| | 2011—2012 | 2.43 | 1.16 | 2.13 | 1.02 | 2.07 |
| | 2012—2013 | 1.11 | 1.70 | 1.10 | 0.87 | 1.21 |
| | 2013—2014 | 0.76 | 0.84 | 1.66 | 1.54 | 1.18 |
| | 2014—2015 | 1.21 | 1.80 | 1.23 | 1.20 | 1.04 |
| | 2015—2016 | 2.61 | 2.02 | 1.41 | 1.31 | 1.08 |
| Model 2 | 2009—2010 | 1.34 | 2.27 | 0.85 | 0.89 | 0.98 |
| | 2010—2011 | 0.80 | 0.36 | 2.94 | 2.55 | 1.24 |
| | 2011—2012 | 8.34 | 30.35 | 0.62 | 0.64 | 1.58 |
| | 2012—2013 | 0.24 | 0.24 | 4.24 | 3.42 | 1.59 |
| | 2013—2014 | 30.19 | 31.89 | 0.56 | 0.70 | 1.03 |
| | 2014—2015 | 0.44 | 0.18 | 55.86 | 54.85 | 1.93 |
| | 2015—2016 | 1.53 | 1.24 | 1.66 | 1.37 | 1.19 |
| Model 3 | 2009—2010 | 0.78 | 0.88 | 1.55 | 2.33 | 1.04 |
| | 2010—2011 | 1.39 | 0.55 | 7.80 | 7.38 | 1.40 |
| | 2011—2012 | 2.35 | 2.29 | 1.03 | 1.16 | 0.92 |
| | 2012—2013 | 0.85 | 1.07 | 1.06 | 0.74 | 1.99 |
| | 2013—2014 | 1.13 | 5.70 | 0.45 | 0.46 | 1.01 |
| | 2014—2015 | 1.48 | 2.39 | 4.28 | 4.14 | 1.02 |
| | 2015—2016 | 3.04 | 1.19 | 5.89 | 4.94 | 1.05 |
| Model 4 | 2009—2010 | 0.65 | 0.70 | 0.91 | 0.98 | 0.94 |
| | 2010—2011 | 0.96 | 1.13 | 0.77 | 1.05 | 0.75 |
| | 2011—2012 | 4.62 | 3.47 | 1.65 | 0.95 | 1.85 |
| | 2012—2013 | 0.44 | 0.45 | 1.02 | 0.93 | 1.08 |
| | 2013—2014 | 5.15 | 3.38 | 1.04 | 0.94 | 1.13 |
| | 2014—2015 | 0.52 | 0.41 | 1.25 | 1.25 | 1.00 |
| | 2015—2016 | 1.39 | 1.13 | 1.22 | 1.12 | 1.09 |
| Model 5 | 2009—2010 | 0.40 | 0.44 | 0.92 | 0.98 | 0.94 |
| | 2010—2011 | 0.91 | 1.00 | 0.81 | 0.91 | 0.87 |
| | 2011—2012 | 2.30 | 1.62 | 1.39 | 1.16 | 1.15 |
| | 2012—2013 | 0.96 | 0.90 | 1.16 | 0.93 | 1.22 |
| | 2013—2014 | 0.90 | 1.15 | 0.88 | 0.86 | 1.03 |
| | 2014—2015 | 1.15 | 1.77 | 1.23 | 1.22 | 1.00 |
| | 2015—2016 | 2.30 | 1.72 | 1.41 | 1.34 | 1.03 |
| Model 6 | 2009—2010 | 0.79 | 1.58 | 0.90 | 1.20 | 0.94 |
| | 2010—2011 | 0.91 | 0.46 | 2.98 | 2.39 | 1.36 |
| | 2011—2012 | 5.02 | 5.57 | 0.90 | 0.90 | 1.05 |
| | 2012—2013 | 0.55 | 0.65 | 1.08 | 0.85 | 1.62 |
| | 2013—2014 | 5.50 | 6.16 | 0.58 | 0.59 | 1.01 |
| | 2014—2015 | 0.51 | 0.28 | 4.20 | 4.05 | 1.02 |
| | 2015—2016 | 1.46 | 1.14 | 1.66 | 1.47 | 1.05 |
| Model 7 | 2009—2010 | 0.66 | 0.70 | 0.92 | 0.97 | 0.95 |
| | 2010—2011 | 0.87 | 0.97 | 0.85 | 0.99 | 0.85 |
| | 2011—2012 | 4.35 | 3.79 | 1.27 | 1.03 | 1.20 |
| | 2012—2013 | 0.43 | 0.40 | 1.08 | 0.93 | 1.15 |
| | 2013—2014 | 4.72 | 3.80 | 0.91 | 0.90 | 1.02 |
| | 2014—2015 | 0.54 | 0.43 | 1.25 | 1.23 | 1.00 |
| | 2015—2016 | 1.68 | 1.41 | 1.22 | 1.15 | 1.04 |
| Model 8 | 2009—2010 | 0.76 | 0.82 | 0.92 | 0.97 | 0.95 |
| | 2010—2011 | 0.70 | 0.78 | 0.85 | 0.99 | 0.85 |
| | 2011—2012 | 5.30 | 4.52 | 1.27 | 1.03 | 1.20 |
| | 2012—2013 | 0.43 | 0.40 | 1.08 | 0.93 | 1.15 |
| | 2013—2014 | 5.68 | 4.64 | 0.91 | 0.90 | 1.03 |
| | 2014—2015 | 0.67 | 0.54 | 1.25 | 1.23 | 1.00 |
| | 2015—2016 | 1.84 | 1.59 | 1.22 | 1.15 | 1.04 |

Averages of computed values of MPI components is shown in Table 7 firm by firm.

**Table 7 Components of MPI firm by firm**

| Firms | Models | TFP | TEC | TC | SEC | PEC |
|---|---|---|---|---|---|---|
| A | Model 1 | 1.17 | 1.06 | 1.06 | 1.02 | 1.09 |
| | Model 2 | 2.26 | 8.58 | 2.76 | 2.79 | 1.05 |
| | Model 3 | 1.62 | 2.24 | 8.08 | 8.09 | 1.01 |
| | Model 4 | 1.14 | 1.03 | 1.05 | 1.02 | 1.04 |
| | Model 5 | 1.10 | 1.03 | 1.02 | 1.02 | 1.01 |
| | Model 6 | 1.18 | 1.31 | 2.78 | 2.79 | 1.01 |
| | Model 7 | 1.02 | 0.96 | 1.02 | 1.01 | 1.01 |
| | Model 8 | 1.28 | 1.18 | 1.02 | 1.01 | 1.01 |
| B | Model 1 | 1.18 | 1.23 | 1.09 | 1.00 | 1.09 |
| | Model 2 | 3.33 | 3.06 | 1.08 | 1.01 | 1.04 |
| | Model 3 | 1.11 | 1.05 | 1.01 | 1.00 | 1.01 |
| | Model 4 | 0.91 | 0.91 | 1.01 | 1.00 | 1.01 |
| | Model 5 | 1.04 | 1.04 | 1.01 | 1.00 | 1.01 |
| | Model 6 | 1.07 | 1.02 | 1.01 | 1.00 | 1.01 |
| | Model 7 | 1.00 | 0.99 | 1.01 | 1.00 | 1.01 |
| | Model 8 | 1.44 | 1.40 | 1.01 | 1.00 | 1.01 |
| C | Model 1 | 1.65 | 1.03 | 1.49 | 1.09 | 1.36 |
| | Model 2 | 2.24 | 14.55 | 35.43 | 34.93 | 1.37 |
| | Model 3 | 1.60 | 2.57 | 3.95 | 3.65 | 1.64 |
| | Model 4 | 1.22 | 0.90 | 1.22 | 1.07 | 1.16 |
| | Model 5 | 1.44 | 1.10 | 1.31 | 1.14 | 1.10 |
| | Model 6 | 1.59 | 3.07 | 2.71 | 2.21 | 1.40 |
| | Model 7 | 1.36 | 1.02 | 1.22 | 1.08 | 1.08 |
| | Model 8 | 1.69 | 1.17 | 1.22 | 1.08 | 1.08 |
| D | Model 1 | 1.57 | 0.88 | 1.39 | 1.11 | 1.27 |
| | Model 2 | 1.52 | 15.72 | 28.67 | 28.07 | 1.56 |
| | Model 3 | 2.69 | 1.65 | 4.10 | 5.11 | 1.66 |
| | Model 4 | 0.98 | 0.87 | 1.14 | 1.07 | 1.11 |
| | Model 5 | 1.45 | 0.97 | 1.27 | 1.14 | 1.08 |
| | Model 6 | 1.59 | 2.23 | 2.54 | 2.58 | 1.59 |
| | Model 7 | 1.13 | 0.98 | 1.14 | 1.06 | 1.08 |
| | Model 8 | 1.31 | 1.10 | 1.14 | 1.06 | 1.08 |
| E | Model 1 | 1.18 | 0.93 | 1.40 | 1.01 | 1.42 |
| | Model 2 | 3.15 | 11.00 | 4.00 | 3.76 | 1.83 |
| | Model 3 | 1.08 | 1.27 | 1.28 | 1.16 | 1.03 |
| | Model 4 | 1.45 | 0.88 | 1.38 | 1.02 | 1.54 |
| | Model 5 | 1.06 | 1.05 | 1.06 | 1.02 | 1.02 |
| | Model 6 | 1.03 | 1.27 | 1.13 | 1.09 | 1.03 |
| | Model 7 | 0.98 | 1.01 | 1.03 | 1.02 | 1.02 |
| | Model 8 | 1.41 | 1.47 | 1.03 | 1.02 | 1.02 |
| F | Model 1 | 1.92 | 3.35 | 1.84 | 1.84 | 1.00 |
| | Model 2 | 34.78 | 21.01 | 1.08 | 1.08 | 1.00 |
| | Model 3 | 1.84 | 3.29 | 1.42 | 1.42 | 1.00 |
| | Model 4 | 7.96 | 5.75 | 1.08 | 1.08 | 1.00 |
| | Model 5 | 2.02 | 2.66 | 1.12 | 1.12 | 1.00 |
| | Model 6 | 8.52 | 7.03 | 1.04 | 1.04 | 1.00 |
| | Model 7 | 7.67 | 6.32 | 1.04 | 1.04 | 1.00 |
| | Model 8 | 8.48 | 7.00 | 1.04 | 1.04 | 1.00 |
| G | Model 1 | 1.14 | 0.95 | 1.12 | 1.01 | 1.11 |
| | Model 2 | 1.04 | 0.81 | 1.37 | 1.03 | 1.27 |
| | Model 3 | 1.68 | 2.35 | 3.91 | 2.50 | 1.24 |
| | Model 4 | 1.10 | 0.93 | 1.10 | 1.01 | 1.09 |
| | Model 5 | 1.20 | 1.01 | 1.12 | 1.02 | 1.07 |
| | Model 6 | 0.99 | 0.86 | 1.37 | 1.10 | 1.11 |
| | Model 7 | 1.10 | 0.94 | 1.10 | 1.02 | 1.05 |
| | Model 8 | 0.95 | 0.86 | 1.10 | 1.02 | 1.05 |
| H | Model 1 | 0.89 | 0.95 | 1.00 | 1.00 | 1.00 |
| | Model 2 | 0.69 | 1.30 | 1.87 | 0.98 | 1.79 |
| | Model 3 | 0.95 | 1.66 | 1.45 | 1.23 | 1.07 |
| | Model 4 | 0.92 | 0.93 | 1.02 | 1.00 | 1.02 |
| | Model 5 | 0.89 | 0.96 | 0.99 | 0.99 | 0.99 |
| | Model 6 | 0.87 | 1.32 | 1.48 | 1.27 | 1.07 |
| | Model 7 | 0.87 | 0.91 | 1.00 | 1.00 | 1.00 |
| | Model 8 | 1.02 | 1.01 | 1.00 | 1.00 | 1.00 |

According to Table 7, models have mostly increased TFP values, and company A, C and F have increased TFP values with all models. Specifically, F as the biggest company of the sector has PEC values equals to score of 1, and all other values more than score of 1. Also, TEC is the greater contributor of TFP, while SEC one is of TC. This means that company F uses its scale efficiently and draws attention with efficiency progress. TEC and TC components of MPI do not have dominant contribution behavior for other companies. But mostly, PEC component of TC has greater contribution than SEC for investment block models while SEC has greater contribution for non-investment block models. This tendency might point out to that investment management reduce the effects of disadvantageous sides of the company scale or/and cash or cost management is much easier to focus on regarding to the scale.

## 3 Conclusions

In this study importance of managing assets in Turkish investment trust companies is investigated by eight input oriented DEA model and MPI for the period of 2009—2016. Firstly, it is found that results of Model 1 are closer to the efficiency border than Model 2 and Model 3 ones which means sector is much more efficient in investment management than cash management or cost management. Results regarding to Model 2 and Model 3 tend to be far from the efficiency line according to CRS DEA analysis. It is to say, sector in average is inefficient to manage cash and cash equivalents and costs of sales. Secondly, investment block models which are Model 1, Model 4, Model 5, Model 7 and Model 8 have greater scores than Model 2, Model 3 and Model 6, and closer to the efficiency line. As it is described before, investment block models consider the effects of investment management on efficiency. That means, companies of the sector focused on investment management more than cash and cost management. On the other hand, models constructed based on considering effects of investments might be healthier models than others. In other words, in case of ignoring effects of cash and cash equivalents and costs of sales, effects of investments will have a better performance to measure the efficiency of the firms as it is seen in comparison of Model 1 and Model 4. That is to say, additional explanatory factors other than investments make a small contribution to measure efficiency of the firms. As another important finding of the paper, including the factor of investment to the models reduce the importance of firm scale. Therefore regardless of a scale, firms can compensate disadvantageous sides of scales while they are focusing on managing investments. This results might also point out to that cash and cash equivalents and costs management will be easier to get it close to efficiency line for big scale companies.

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Mr. **Telli Sahin** received the B. S. degree in Statistics in 2011 and M. S. degree in Financing in 2016 from Anadolu University, Eskişehir, Turkey. Currently, he is a Ph. D. candidate majoring Management Science and Engineering at Nanjing University of Aeronautics and Astronautics, Nanjing, China. His Ph. D. research is focused on efficiency and fractality of financial markets.

(Production Editor: Zhang Bei)