Investigating the Efficiency of Indonesian Employee Pension Funds

Pascalis Seran[1]
Usil Sis Sucahyo[2]
Apriani Dorkas Rambu Atahau [3]
Supramono Supramono[4]

Abstract
This study aims to examine the performance of Indonesian employee pension funds based on technical and scale efficiencies. Our sample is 40 Indonesian pension funds in the 2011-2017 period, resulting in 280 firm-year observations. Data Envelopment Analysis (DEA) is used to measure pension funds' efficiency levels. The results show Indonesian employee pension funds generally cannot operate efficiently. However, based on their size, large pension funds exhibit better technical efficiency levels than small pension funds. Conversely, small pension funds perform better in scale efficiency. Other findings document that, from the ownership perspective, state-owned enterprise (SOE) pension funds exhibit better technical efficiency levels than non-SOE ones. This study also proposes the managers of Indonesian employee pension need to improve their pension fund performance by reducing operational and investment costs and engaging in greater investment diversification.

Keywords. pension funds, technical efficiency, scale efficiency, data envelopment analysis

JEL Classifications: C61; G23,

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Introduction

Ashok & Spataro, 2016). A well-functioning and efficient pension system positively affects economic growth and development (Davis & Hu, 2004; Islam & Osman, 2011; Raisa, 2012). In a microeconomic context, pension funds allocate income or equalize consumption (Barr & Diamond, 2006) and offer old-age savings for

[1] Department of Management, Faculty of Economics and Business, Universitas Kristen Satya Wacana, Salatiga Indonesia, seranpascalsvd@gmail.com
[2] Assistant Professor in Accounting, Faculty of Economics and Business, Universitas Kristen Satya Wacana, Salatiga, Indonesia , usil.sucahyo@uksw.edu
[3] Professor in Finance, Faculty of Economics and Business, Universitas Kristen Satya Wacana, Salatiga, Indonesia, apriani.rambu@uksw.edu
[4] Professor in Finance, Faculty of Economics and Business, Universitas Kristen Satya Wacana, Salatiga, Indonesia, supramono@staff.uksw.edu

individuals (Kadarisman & Wahyuni, 2010).

Several developing countries have tried to improve the efficiency of pension fund management by reforming their pension systems. For example, Indonesia issued Act No. 11 concerning Pension Fund in 1992. The pension system reform continued until the post-2008 global financial crisis years. The reforms include structuring the pension system based on the three-pillar model (Rachmatarwata, 2017; Sudjono, 2017). The first pillar consists of a compulsory pension scheme that includes a PAYG (pay-as-you-go) scheme for civil servants and police/soldiers and a mandatory defined contribution program for the general public. This pillar is administered by three different state-owned enterprises (SOEs). The second pillar is a regulated voluntary pension scheme consisting of employee pension funds (EPF) and financial institution pension funds (FIPF). EPFs may provide a defined benefit (DB) and/or defined contribution (DC) pension program, while FIPFs can only provide the DC program. The third pillar covers all personal savings, insurance, and other personal investments (Rachmatarwata, 2017). According to Act No.11/1992, pension funds only refer to EPFs and FIPFs. Meanwhile, the mandatory pension schemes in the first pillar are considered pension programs administered by several different SOEs.

Although the Indonesian pension system has been reformed for more than two decades, the efficiency of Indonesian pension funds remains relatively understudied. For example, an Asian Development Bank-sponsored study focuses on the reform direction of the Indonesian Social Security System and does not analyze the efficiency of Indonesian pension funds (Guerard, 2012). The research gap arguably indicates the existing literature's limited attention to pension fund efficiency in developing countries that this study seeks to fill. Conceptually, pension fund efficiency can be measured into two indicators: technical and scale efficiencies. Technical efficiency refers to pension funds' ability to increase their wealth optimally to fulfill their obligations. Meanwhile, scale efficiency represents pension funds' ability to operate optimally. Both efficiency indicators can be measured using data envelopment analysis (DEA), a non-parametric technique that identifies firm efficiency by comparing the firms with other similar firms and determining firm efficiency (Coelli et al., 2005).

This study aims to examine the performance of Indonesian employee pension funds based on technical and scale efficiencies. The contribution of this study is twofold. First, we extend the knowledge about pension fund management efficiency in developing countries, especially Indonesia. Previous research largely focuses on developed countries with more advanced pension systems (Arefjevs & Sloka, 2016; Bui, Sarath, & Ahmed, 2016). Second, this study advises pension fund management to take strategic steps in improving their pension funds' performance..

Literature Review

Efficiency is the most important indicator to determine pension fund performance (Fried, Lovell, & Schmidt, 2008). Various methods measure pension fund performance, including financial ratios such as return on investment and return on assets (Badreldin, 2009), risk-adjusted return models such as Treynor ratio, Sharpe ratio, or Jensen's alpha (Oran, Avci, Ashour, & Tan, 2017; Witkowska & Kompa, 2017), and the frontier models such as stochastic frontier analysis (SFA) and DEA (Coelli, 1995; Coelli et al., 2005; Daraio & Simar, 2007). DEA is a linear programming technique developed by Charnes, Cooper, and Rhodes (1978).

This study measures Indonesian pension funds' technical and scale efficiencies using DEA. This technique offers advantages absent in other methods (e.g., Treynor ratio, Sharpe ratio) because it can work with more than one variable with different units without standardization (Avkiran, 2006). In addition, it is often used in empirical studies to measure and evaluate financial institutions' efficiency (Berger & Humphrey, 1997; Emrouznejad & Yang, 2018).

Many prior studies have employed DEA in their analysis. For example, Gokoz and Çandarli (2011) compare the efficiency of Turkish pension funds and mutual funds using beta coefficients, standard deviation, expenditure ratios, and turnover as inputs and excess returns as the single output. The results show that pension funds had greater efficiency than mutual funds. Meanwhile, Kurtaran, Karakaya, and Dağli (2013) compare the technical efficiency of domestic and foreign-managed pension funds in 2004-2011 and observe that foreign-managed pension funds are more efficient than domestic firms.

Further, Sathye (2011) evaluate the technical efficiency of Australian retail superannuation funds in 2005-2009, using the value of member contributions and operating costs as inputs and the values of annual net assets and pension benefits paid as outputs. The study documents that retail superannuation funds exhibit low efficiency, and efficiency correlates with pension fund size. Bui et al. (2016) also use the DEA method to evaluate the efficiency of 183 pension funds with a longer observation period (2005-2012). They use average net worth, the average number of members, and pre-tax yield as input variables, and investment costs, operating costs, director costs, administration, and management costs as output variables. The results show that Australian pension funds exhibit low efficiency levels.

Galagedera and Watson (2015) use the two-stage DEA method to determine factors influencing the efficiency of Australian superannuation funds in 2012. The output variables are one-year return, five-year return, and average benefits, while the input variables include the ratio of operating costs, the ratio of investment costs, and the 2008-2012 standard deviation of annual returns. The results reveal that the size of membership and the portion of the assets at risk are negatively correlated with efficiency, and the value of assets owned is positively related to performance.

Research Methodology

The research population comprises Indonesian EPFs belonging to the Indonesian Pension Fund Association (ADPI) and the Indonesian Christian Pension Fund Cooperation Agency (BKS-DAPEN-KI). We manually collect the 2011-2017 financial statements of 97 EPFs from ADPI, BKS-Dapen-KI, and EPFS that are willing to provide their financial statements to us. After leaving out EPFs with incomplete data, this study eventually obtains the financial statements of 40 EPFs, resulting in 280 firm-year observations.

We then divide the EPF sample into two subsamples (large and small EPFs) based on their size. EPFs with a net worth of at least (below) IDR 600 billion are classified as large (small) EPFs. Additionally, this research also classifies EPFs based on their ownership status: SOEs (those sponsored by SOEs) and non-SOEs (those sponsored by private firms/ other non-SOE organizations).

DEA recognizes two variable categories: input and output variables, with the classification and selection processes largely depend on researchers' subjective judgments (Morita & Avkiran, 2009). This study involves three input variables: operating costs (X1), investment costs (X2), beginning-of-year net asset value (X3), and two output variables: end-of-year net asset value (Y2), and ROI (Y2)

Operational costs include employee salaries, maintenance of fixed assets, and other administrative costs. Higher operating costs will erode end-of-year net asset value. Hence, the ratio of operating costs to end-of-year net asset value arguably indicates efficiency. Investment costs refer to costs incurred due to investing activities that further affect ROI. Thus, investment costs scaled by ROI can be used to indicate EPF efficiency. (Bui et al., 2016).

Net asset value at the beginning of the period is net assets at the end of the prior period, and ROI is the total investment return (i.e., total income plus the difference on investment values) divided by the average values of the total investments. The Indonesia Financial Service Authority [OJK] Regulation No. 5 of 2017 requires that the calculation of pension fund's total income must consider the unrealized returns, i.e., the differences in investment values.

The basic DEA consists of two models, the constant return to scale (CRS/CCR) (Charnes et al., 1978) and the variable return to scale (VRS/BCC) models (Banker, Charnes & Cooper, 1984). Referring to Coelli et al. (2005, p. 163), we use the following envelopment form of the input-oriented CRS/CCR model :

$$\text{Min}_{\theta,\lambda}\ \theta, \text{subject to: } -y_i + Y\lambda \geq 0, \theta x_i - X\lambda \geq 0, \lambda \geq 0 \quad (1)$$

where θ is a scalar between 1 and 0, representing the technical efficiency, Λ is a constant representing the weight, xi, and yi are the inputs and outputs for the i-th DMU, and X and Y are the input and output of all DMUs. The optimal value θ obtained is the efficiency score for a particular firm (firm i) that meets θ ≤ 1. Value 1 is the optimal obtainable value that indicates that the point is right on the frontier line so that the DMU is considered technically efficient, according to Farrell's definition (1957). All values of θ below one are considered inefficient. The CCR model assumes all DMUs operate at their optimal scales (constant return to scale). However, not all DMUs can operate at their optimal scales due to various factors such as limited resources or imperfect competition. Hence, the CCR's technical efficiency may still be confounded by scale efficiency (Coelli, 1996). Therefore, Banker et al. (1984) develop the BCC (VRS) model to estimate technical efficiency without being confounded by DMU's size effect.

This study applies the input-oriented VRS model to the data to obtain the efficiency scores. The formula below illustrates the envelope form of the input-oriented VRS (BCC) model according to Coelli et al. (2005, p. 172):

$$\text{Min}_{\theta,\lambda}\ \theta, \text{subject to:} -y_i + Y\lambda \geq 0, \theta\, x_i - X\lambda \geq 0, N1'\lambda = 1,\ \lambda \geq 0, \quad (2)$$

The difference between the CCR and BCC models lies in the presence of N1'λ = 1 as a convexity constraint in the BCC model, where N1 is a vector Nx1 of unity, N represents DMUs. The presence of the convexity constraint N1'λ = 1 in the BCC model ensures that a DMU should only be compared with its peers of the same size. Thus the resulting technical efficiency score is a "pure" technical efficiency (i.e., free from the effect of the size differences between DMUs). Scale efficiency can be calculated based on technical efficiency generated by the CCR and BCC models with the following formula:

$$SE = \frac{CRSTE}{VRSTE} \quad (3)$$

CRSTE (constant return to scale technical efficiency) is the technical efficiency score of a DMU from the CCR model. VRSTE (variable return to scale technical efficiency) is the pure technical efficiency score produced by the BCC model. SE (scale efficiency) is the scale efficiency score. If SE = 1, then the DMU is efficient in scale (it has operated at its optimal scale). Furthermore, the NIRS (non-increasing return to scale) model determines the nature of scale inefficient DMUs. The following is equation for the NIRS DEA model is :

$$\text{Min}_{\theta,\lambda}\ \theta, \text{subject to: } -y_i + Y\lambda \geq 0, \theta\, x_i - X\lambda \geq 0, N1'\lambda \leq 1, \lambda \geq 0 \quad (4)$$

The restriction N1'λ ≤ 1 ensures that the i-th DMU will only be benchmarked on smaller DMUs, not vice versa. The nature of the scale inefficiency of a particular DMU can be determined by examining whether the technical efficiency score of NIRSTE (non-increasing return to scale technical efficiency) equals VRSTE. If NIRSTE equals VRSTE, the DMU operates in the increasing return to scale (IRS) area. If it is not, then the DMU operates in the decreasing return to scale (DRS) area. All efficiency scores for each DMU (i.e., EPF) in the sample are obtained using DEAP 2.1 software.

Result and Discussion

Table 1 shows vast differences in average net assets, operating costs, investment costs, and ROI between large and small and SOE-owned and non-SOE-owned EPFs. Specifically, the average net assets of large (small) EPFs is IDR. 4.96 trillion (only IDR 114 billion). The average operational costs for large and small EPFs are IDR 24.1 billion and IDR 1.46 billion, respectively. Further, large EPFs' average investment costs are IDR 19.1 billion, and small EPFs are only IDR 244 million. The standard deviations of large EPFs' operational costs and investment costs are high, indicating large variations. Lastly, large EPFs have high investment costs (IDR. 19.1 billion) and a high ROI (10.82%).

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Large (20 funds)				
Net Asset (IDRm)	4,960,000	4,510,000	707,000	19,400,000
Op. costs (IDRm)	24,100	25,300	752	121,000
Invest. costs (IDRm)	19,100	26,600	682	159,000
ROI (%)	10.82	6.93	-4.82	41.03
Small (20 funds)				
Net Asset (IDRm)	114,000	96,400	4,340	523,000
Op. costs (IDRm)	1,460	1,650	49,7	17,400
Invest. costs (IDRm)	244	354	1	1,790
ROI (%)	8.80	4.25	-6.99	25.22
SOE (19 funds)				
Net Asset (IDRm)	4,100,000	4,830,000	4,340	19,400,000
Op. costs (IDRm)	22,100	25,700	49,7	121,000
Invest. costs (IDRm)	15,100	27,100	1	159,000
ROI (%)	11.39	6.03	-4.82	41.03
Non-SOE (21 funds)				
Net Asset (IDRm)	660,000	1,360,000	11,100	8,380,000
Op. costs (IDRm)	2,230	3,150	263	17,700
Invest. costs (IDRm)	2,960	6,210	11	34,400
ROI (%)	8.19	4.93	-6.99	27.32

Source: secondary data, processed

Table 1 indicates that SOE-owned EPFs have higher average net assets than non-SOE-owned EPFs (IDR 4.1 trillion and IDR. 660 billion, respectively). Similarly, SOE-owned EPFs' average operational and investment costs are much higher than those of non-SOE-owned EPFs. Lastly, the standard deviations of SOE-owned EPFs' operational and investment costs are also greater than those of non-SOE-owned EPFs.

The Efficiency Level of All Indonesian EPFs

We run the technical and scale efficiency score tests to measure the efficiency of Indonesian EPFs. We initially run the analysis for the entire sample and then for each subsample based on size and ownership status. Table 2 displays that for the 2011-2017 period, the technical efficiency (TE) scores range between 76.6% and 93.8%, with the mean score of 89.6% (below one), implying that Indonesian EPFs are still not technically efficient. Similarly, Indonesian EPFs' average scale efficiency (SE) score is below one (94.8%). Consequently, Indonesian EPFs need to reduce their operational and investment costs by 10.4% and operational scale by 5.2% to achieve full efficiency.

Table 2. Mean efficiency and number (%) of efficient EPFs for the 2011-2017 period

Year	2011	2012	2013	2014	2015	2016	2017	2111-2017
Efficiency Scores								
TE	0.898	0.766	0.934	0.892	0.912	0.938	0.929	0.896
SE	0.964	0.853	0.958	0.949	0.947	0.982	0.980	0.948
Number (%) of efficient EPFs								
TE	13 (33)	14 (35)	15 (38)	16 (40)	15 (38)	15 (38)	15 (38)	15 (38)
SE	8 (20)	4 (10)	5 (13)	8 (20)	7 (18)	8 (20)	10 (25)	7 (18)
NIRS Results:								
DRS	22 (55)	30 (75)	24 (60)	22 (55)	23 (58)	26 (65)	23 (58)	24 (60)
IRS	10 (25)	6 (15)	11 (28)	10 (25)	10 (25)	6 (15)	7 (18)	9 (22)

Note: TE = technical efficiency; SE = scale efficiency; NIRS = non-increasing return to scale; DRS = decreasing return to scale; IRS = increasing return to scale

Table 2 also illustrates that only 38% of Indonesian EPFs have achieved technical efficiency for each year. The figure is much lower for scale efficiency (18%). The conditions imply that Indonesian EPFs cannot control their operational and investment costs to achieve expected returns and operate at the economic scales. Our non-increasing return to scale (NIRS) analysis shows that, on average, only 60% of pension funds operate in the decreasing return scale (DRS) area, and only 22% of pension funds operate in the increasing return scale (IRS) area during the period. Hence, more pension funds do not exhibit scale efficiency because they operate more than their optimal scales, while fewer pension funds operate below their optimal scales. These findings are in line with Mangkoesoebroto (2017) who indicates Indonesian pension funds' inefficiency and performance stagnation. In a similar vein, Asher and Bali (2015) also document that Indonesian EPFs incur the highest administrative and compliance costs among EPFs in ASEAN countries.

Subsample analysis based on size

This section investigates further whether large and small EPFs exhibit different efficiency behaviors. Table 3 shows that large EPFs have a higher average technical efficiency (92.0%) than small EPFs (86.3%). The K-S test results indicate a significant difference in technical efficiency between these two pension fund subsamples ($p=0.005 < 0.05$). Meanwhile, large EPFs exhibit a lower average scale efficiency (0.928) than small EPFs (96.7%), and the difference is statistically significant ($p=0.000 < 0.05$). The results indicate that large EPFs tend to have higher (lower) technical (scale) efficiency than small EPFs.

Table 3. Mean efficiency and number (%) of large and small EPFs in 2011-2017

Year	2011	2012	2013	2014	2015	2016	2017	2011-2017
A: Mean TE								
Large (20)	0.914	0.812	0.962	0.931	0.940	0.933	0.935	0.920
Small (20)	0.883	0.719	0.905	0.853	0.884	0.944	0.922	0.873
Number (%) of efficient funds								
Large	9 (45)	10 (50)	11 (55)	10 (10)	9 (45)	8 (40)	9 (45)	9.4 (47)
Small	4 (20)	4 (20)	4 (20)	6 (30)	6 (30)	7 (35)	6 (30)	5.3 (26)
B: Mean SE								
Large	0.967	0.781	0.933	0.949	0.914	0.978	0.978	0.928
Small	0.961	0.926	0.983	0.950	0.981	0.986	0.982	0.967
Number (%) of efficient funds:								
Large	9 (45)	3(15)	2 (10)	6 (30)	4 (20)	5 (25)	5 (25)	4.8 (24)
Small	3 (15)	5 (25)	4 (20)	4 (20)	7 (35)	4 (20)	5 (25)	4.6 (23)
C: NIRS)*								
DRS: Large	11 (55)	16 (80)	18 (90)	14 (70)	16 (80)	15 (75)	15 (75)	15 (75)
Small	9 (45)	11 (55)	6 (30)	6 (30)	6 (30)	10 (50)	8 (40)	8 (40)
IRS: Large	0	1(5)	0	0	0	0	0	0.14 (0)
Small	8 (40)	4 (20)	9 (45)	9 (45)	7 (35)	6 (30)	7 (35)	7.14 (36)
D: K-S test	TE	SE						
Difference	0.2071	0.3071						
Sig.	0.005	0.000						

Note: *) = Refers only to scale-inefficient funds

From the scale efficiency perspective, the non-increasing return to scale analysis results reveal that, on average, 75% of large EPFs operate in the decreasing return scale area, and none of them (0%) operates in the increasing return scale area during the period. For small EPFs, only 40% of them operate in the decreasing return scale area, and 36% of them operate in the increasing return scale area. Thus, more large pension funds are not efficient in scale because they operate more than their optimal scales, while fewer pension funds operate below their optimal scales. Conversely, only a few small pension funds are technically inefficient due to operating beyond their optimal scales.

Large EPFs significantly exhibit higher technical efficiency scores than small EPFs, suggesting that asset size is positively correlated with technical efficiency (Galagedera & Watson, 2015; Sathye, 2011). Large EPFs are usually sponsored by large firms. They have greater asset values and sufficient skilled professionals and have integrated information technology into their operating activities. Consequently, they understandably exhibit better technical efficiency. Bikker and Dreu (2007) observe that large pension funds tend to have low fixed operational costs. Large pension funds may generate higher gross returns because they can hire more professional managers. However, small EPFs that are usually sponsored by small private firms, often lack skilled experts, and run their business conventionally can have higher scale efficiency scores than large EPFs. These findings are not consistent with many prior studies highlighting that large pension funds enjoy the economy of scale advantage (Alserda et al., 2018).

Subsample analysis based on ownership

Table 4 shows the efficiency scores based on EPFs' ownership status: SOEs versus non-SOEs. SOE-owned EPFs have higher average technical efficiency (93.2%) than non-SOE-owned EPFs (86.3%). Hence, SOE-owned EPFs only need to reduce their operational and investment costs by 6.8% to achieve full technical efficiency, while non-SOE-owned EPFs have to reduce these costs by 13.7%. The K-S test results suggest a significant difference in technical efficiency between these two pension fund subsamples (p=0.012 < 0.05). Conversely, non-SOE-owned EPFs exhibit higher scale efficiency (97.2%) than SOE-owned EPFs (92.0%) and the difference is statistically significant (p= 0.000 < 0.05). the results imply that SOE-owned and non-SOE-owned EPFs exhibit different efficiency behaviors.

Table 4. Mean Efficiency and number (%) of efficient SOE-owned and non-SOE-owned EPFs, 2011-2017

Year	2011	2012	2013	2014	2015	2016	2017	2011-2017
A: Mean TE								
BUMN	0.958	0.881	0.969	0.913	0.951	0.926	0.925	0.932
Non-BUMN	0.844	0.661	0.902	0.873	0.876	0.950	0.932	0.863
Number (%) of efficient funds								
BUMN	10 (53)	11 (58)	10 (53)	8 (42)	9 (47)	6 (32)	7 (37)	8.7 (46)
Non-BUMN	3 (14)	3 (14)	5 (24)	8 (38)	6 (29)	9 (43)	8 (38)	6 (29)
B: Mean SE								
BUMN	0.955	0.764	0.926	0.945	0.901	0.976	0.975	0.920
Non-BUMN	0.972	0.934	0.986	0.954	0.989	0.987	0.984	0.972
Number (%) of efficient funds								
BUMN	6 (32)	3 (16)	2 (11)	3 (16)	4 (21)	2 (11)	4 (21)	3.4 (18)
Non-BUMN	6 (29)	5 (24)	4 (19)	7 (33)	7 (33)	7 (33)	6 (29)	6 (29)
*C: NIRS Results**)								
DRS: BUMN	13 (68)	15 (79)	16 (84)	13 (68)	14 (74)	16 (84)	14 (74)	14.4(76)
Non-BUMN	7 (33)	10 (48)	6 (29)	6 (29)	6 (29)	8 (38)	8 (38)	7.3 (35)
IRS: BUMN	0	0	0	1 (5)	0	0	0	0.14 (1)
Non-BUMN	8 (38)	5 (24)	9 (43)	8 (38)	7 (33)	6 (29)	7 (33)	7.1 (34)
D: K-S test	TE	SE						
Difference	0.1919	0.347						
Significance	0.012	0.000						

Note: *) Refer only to scale-inefficient funds

Next, the non-increasing return to scale analysis documents that, on average, 76% of SOE-owned EPFs operate in the decreasing return scale area, and none of them (0%) operate in the increasing return scale area. At the same time, 35% of non-SOE-owned EPFs operate in the decreasing return scale area, quite similar to those that operate in the increasing return scale area (34%). Thus, more SOE-owned pension funds are not efficient in scale because they operate beyond their optimal scales than those that operate below optimal scales. Meanwhile, very few non-SOE-owned EPFs are not efficient due to operating beyond their optimal scales. In sum, although SOE-owned EPFs are much larger and more technologically advanced, hire more professional managers, and generate higher returns, they do not necessarily operate in their optimal scales.

Conclusions

This study investigates Indonesian employee pension funds' technical and scale efficiencies. We analyze our sample of 40 EPFs operating in 2011-2017 using the

DEA technique. The results show that Indonesian pension funds generally exhibit low technical and scale efficiency levels. Based on their output levels, the Indonesian pension fund industry needs to reduce its operating and investment costs by 10.4% to reach the optimal technical efficiency level. Further, these EPFs need to reduce their average operating scale by 5.2%. Based on pension fund size, large employee pension funds tend to have higher technical efficiency levels than their small counterparts. Conversely, small pension funds perform better in scale efficiency. Next, based on ownership type, SOE-owned pension funds tend to have better technical efficiency, but not for scale efficiency, than non-SOE-owned pension funds.

This study shows empirical evidence that offers several academic contributions. First, this study broadens our knowledge about EPF's technical and scale efficiency, especially in the Indonesian context. Second, we document that EPFs exhibit different technical and scale efficiency levels based on their size and ownership type. Further, this study offers practical implications. First, because Indonesian employee pension funds generally exhibit low technical and scale efficiencies, pension fund managers need to put more effort into improving pension fund performance by reducing operational and investment costs and diversifying their investments more. Second, small or non-SOE-owned EPFs need to improve their technical efficiency level by referring to larger EPFs' practices and even merging with other pension funds. Third, EPFs' board of trusts and managers need to upgrade their pension fund management skills and competence. Fourth, the regulating body needs to relax or implement different investment regulations for large and small pension funds.

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