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Economies of Scale

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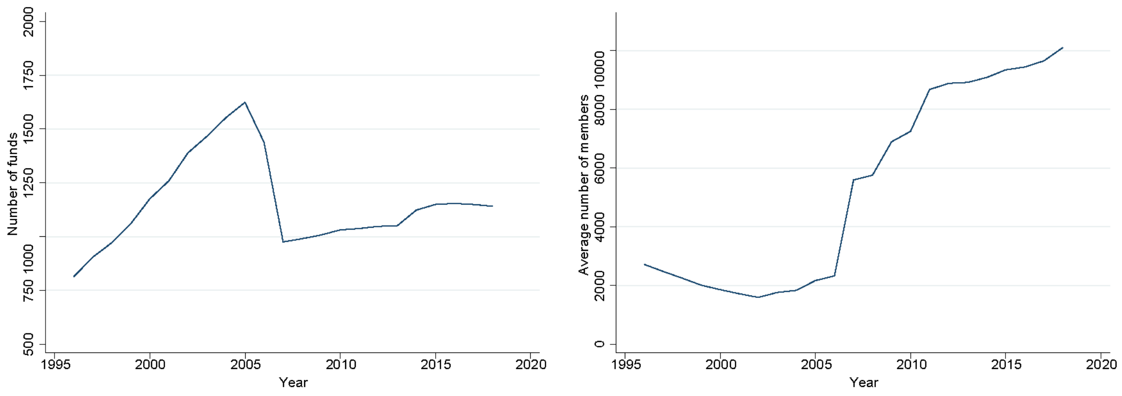
Introduction

In South Africa pension funds and life insurance constitute the largest category of individuals' private wealth comprising 36% of total private assets, which is higher than in many advanced economies (Orthofer, Du Plessis, and Reid 2019). Given the importance of retirement funds inhouseholds' wealth, it is important to ensure that the system is well functioning and low cost. While there may not be agreement on the characteristics of an optimal retirement funds system, it is generally accepted that cost efficiency is important. Administrative costs affect the net rate of return on retirement fund contributions and directly impact the ability of retirees to attain adequate income.

We study economies of scale in the South African retirement fund industry, building on earlier work by Touna Mama, Pillay, and Fedderke (2011) who found that there were between 25%-30% of unused scale economies in the retirement fund industry, with an optimal fund size of about 220,000 members. This finding was based on data from 1996-2006 and since then the number of funds has decreased, and the average fund size has increased significantly as shown in Figure 1.

Figure 1: Number of funds and average fund size over time, 1996-2018

(a) Number of funds (b) Average fund size



Notes: Sample includes all normal active funds with non-negative member numbers and administrative expenses. Underwritten funds are excluded.

These changes in the industry warrant an updated investigation into economies of scale in retirement funds. We make use of an updated dataset that contains data on retirement funds through 2018 to study the effects of these industry changes on administrative expenses and economies of scale.

We begin by describing the data and presenting summary statistics in Section 2. In Section 3 we examine economies of scale by first exploring whether economies of scale in retirement fund administration exist in Section 3.2. In Section 3.3 we consider a related question–whether the cost-size relationship is concave, i.e. whether there is an optimal fund size with economies of scale for smaller funds and dis- economies of scale for larger ones. We examine whether economies of scale vary with fund age and fund characteristics in Sections 3.4 and 3.5, respectively. In Sec- tion 3.6 we break down economies of scale across the seventeen administrative cost categories, and present a robustness check in Section 3.7. Based on the results in Section 3, we offer some recommendations on fund adjustments and consolidation in Section 4. Section 5 provides some estimates for the administrative costs of the NSSF based on the results in this report. Finally, Section 6 concludes.

Contents

Data and Summary Statistics

We use administrative data provided by the National Treasury that covers all retirement funds falling under its regulatory responsibility over the period 1996-2018. The data contains detailed information on administrative expenses, membership, assets, fund type, fund class, fund status, benefit structure, member contributions and benefits paid.

There are some limitations to the data. We are unable to split umbrella funds into Type A (open and thus more complex) and Type B (employer linked and thus less complex) and so have to group them together. This conceals the differences between the types of umbrella funds. We are unable to identify 'back-to-back' funds, where a pension and provident fund have the same members but all costs are reported under the provident fund. This will overstate the costs of some provident funds and understate the costs of some pension funds. Since individuals can belong to more than fund, there is some double counting of members that we are unable to identify.

We restrict the sample to include only those funds with a normal active status that report non-negative member numbers and administrative expenses. Underwrit- ten funds are only reported in the dataset from 2005 onwards so, where appropriate, we present results both including and excluding these funds. Underwritten funds are typically smaller, and hence potentially more inefficient, and excluding them could create selection bias in the results.

Figure 2 shows average administrative expenses by fund size, measured by the number of total members, over the full sample period 1996-2018. It is evident from this figure that smaller funds have much greater variation in average expenses than larger funds, and that the largest funds all have very similar average expenses. There are also many more smaller funds than larger funds in the South African retirement fund industry.

Figure 2: Average administrative expenses by fund size, 1996-2018

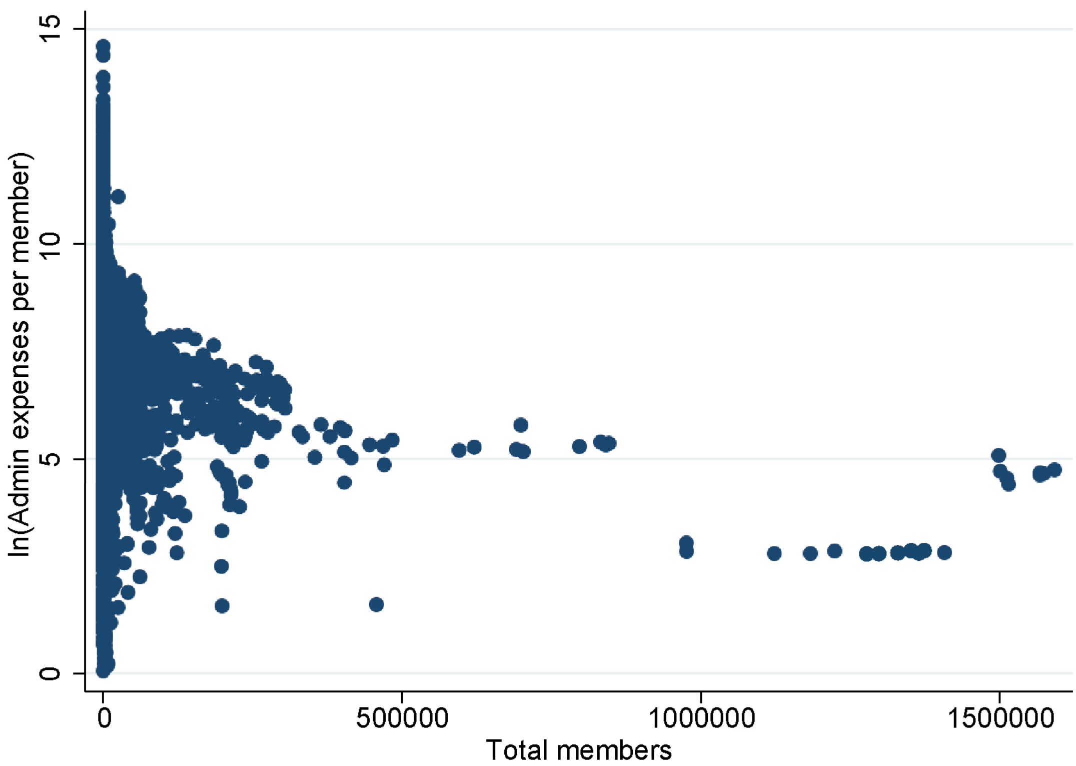


Table 1 shows administrative expenses by fund size for 2006 in Panel A, and 2018 for Panel B. The last available year of data used by Touna Mama, Pillay, and Fedderke (2011) was 2006 so comparing Panel A and Panel B gives a sense of how the industry has changed since then. It is evident that the industry is much larger with retirement fund membership more than tripling from 3.5 million members in 2006 to 13 members in 2018 (column (4) of Table 1. Despite this large growth in membership, the number of funds has declined from 1,918 in 2006 to 1,262 in 2018 (column (5) of Table 1) suggesting that there has been consolidation within the industry. The smallest fund sizes, i.e. those with less than 1,000 members, experienced decreases in the total number of members whereas the largest funds experienced a growth in membership indicating that the trend in the industry has been toward larger funds and away from smaller ones. Alongside these shifts, there has also been an increase in the average number of assets per member for all fund sizes with the exception of mid-sized funds (column (3) of Table 1).

Table 1: Administrative expenses by fund size, 2006 and 2018

	Administrative expenses per member (1)	Administrative expenses/total assets (%) (2)	Total assets per member (R1,000) (3)	Total number of members (1,000) (4)	Number of pension funds (5)
Panel A: 2006					
0-100	7,056	2.70	916	25	762
100-1,000	2,314	1.01	465	294	793
1,000-10,000	1,243	0.68	483	871	312
10,000-100,000	705	0.64	357	1,173	46
100,000+	140	2.24	7	1,181	5
Avg/Total	3,979	1.62	643	3,545	1,918
Panel B: 2018					
0-100	13,880	3.44	2,168	8	235
100-1,000	2,599	1.08	556	204	465
1,000-10,000	1,424	0.86	366	1,419	419
10,000-100,000	1,176	1.35	245	3,413	120
100,000+	645	1.11	103	7,866	23
Avg/Total	4,139	1.48	756	12,911	1,262

Notes: Sample includes all normal active funds with non-negative member numbers and administrative expenses. All Rand values expressed in constant 2016 Rands.

In both Panel A and Panel B of Table 1, column (1) indicates that average administrative expenses are falling as the fund size increases, although average administrative costs have also increased from 2006 to 2018 for all fund sizes. The pattern is less clear when looking at administrative expenses as a percentage of total assets in column (2) of Table 1. In 2006, administrative expenses as a percentage of total assets are generally falling as fund size increases except for the largest funds where this value increases again. In 2018, there does not appear to be a discernible relationship between fund size and administrative expenses as a percentage of total assets, but the largest value is still found for the smallest funds. Comparing 2006 and 2018, it is evident that administrative expense as a percentage of total assets has increased for all fund sizes except for the largest funds where this value has actually fallen.

Table 2 investigates average administrative expenses, number of funds, and average membership by fund type, class and benefit structure for 2006 in columns (1), (2) and (3), and 2018 in columns (4), (5) and (6). Panel A indicates that the majority of funds are ordinary funds in both 2006 and 2018, but the total number of ordinary funds is declining over the period while the number of preservation and umbrella funds is increasing (columns (2) and (5)). The average fund size is increas- ing from 2006 to 2018 across all fund types and umbrella funds are now noticeably much larger. Real administrative costs per member have increased from 2006 to 2018 for ordinary and umbrella funds, but fallen for preservation funds.

Table 2: Administrative expenses by fund type, class and benefit structure, 2006 and 2018

	2006			2018		
	Administrative expenses per member (1)	Number of pension funds (2)	Average number of members (3)	Administrative expenses per member (4)	Number of pension funds (5)	Average number of members (6)
Panel A: Type of pension fund						
Ordinary	4,057	1,772	1,673	4,986	752	4,427
Preservation	6,885	26	1,158	4,027	122	9,301
Umbrella	2,201	120	4,583	2,531	388	21,770
Panel B: Class of fund						
Pension	4,465	923	1,934	5,628	605	7,826
Provident	3,538	976	1,769	2,670	611	10,207
Retirement Annuity	3,111	19	1,767	4,055	46	42,166
Panel C: Benefit structure						
Defined benefit	9,269	262	2,449	14,347	143	17,189
Defined contribution	3,113	1,617	1,710	2,842	1,092	9,394
Hybrid	4,380	39	3,539	2,509	27	7,190

Notes: Sample includes all normal active funds with non-negative member numbers and administrative expenses. All Rand values expressed in constant 2016 Rands.

Panel B of Table 2 breaks down the results by the class of fund. We see that the average fund size is much higher for all fund classes in 2018 than in 2006, although the number of pension and provident funds is declining. Average administrative expenses has decreased for provident funds over the period, but increased for pension and retirement annuity funds. The same pattern of increasing average fund size and decreasing number of funds is seen across different benefit structures in Panel C. However, average administrative expenses have fallen for defined contribution and hybrid plans but increased for defined benefit plans.

The analysis in this section shows that there have been significant changes in the retirement fund industry over the period 2006 to 2018. There has been a general decrease in the number of funds, an increase in the average fund size, and an increase in average administrative expenses per member. The analysis by fund type reveals that these general trends conceal some important differences across fund class and benefit structure. In particular, average administrative costs per member have actually decreased for preservation, provident, defined contribution and hybrid funds from 2006 to 2018. This suggests that there is likely to be a change in the economies of scale results originally found over 1996-2006 by Touna Mama, Pillay, and Fedderke (2011).

In the next section, we undertake regression analysis to more closely examine these changes.

Estimation of economies of scale

3.1 Methodology

We estimate the effect of fund size on administrative costs using a translog function and controlling for other potential determinants of administrative expenses:

$$\ln(Cost_{it}) = \beta_0 + \beta_1 \ln(Members_{it}) + \gamma X_{it} + \delta_t + E_{it} \quad (1)$$

where $Cost_{it}$ is fund i's administrative expenses in year t and $Members_{it}$ is the total number of fund members. X_{it} contains a set of additional fund characteristics that may affect administrative costs - fund subtype dummies (preservation or umbrella, with ordinary as the reference category), fund class dummies (provident or retirement annuity, with pension as the reference category), benefit structure dummies (defined benefit or hybrid, with defined contribution as the reference category), assets per member, percentage deferred members, percentage pensioners, percentage beneficiaries and percentage unclaimed benefits. When underwritten funds are included in the sample, an indicator for underwritten is also included in X_{it}. The δ_t are a full set of year dummies to flexibly control for time trends. The specification in equation (1) is identical to that in Touna Mama, Pillay, and Fedderke (2011).

We use the log of administrative costs and number of members to reduce the impact of heteroskedasticity and to enable the measurement of scale economies. The coefficient β_1 measures the cost elasticity and reflects economies of scale (indicated by $\beta_1 < 1$) or diseconomies of scale (indicated by $\beta_1 > 1$).1 A null hypothesis of $\beta_1 = 1$ is equivalent to the hypothesis that administrative expenses rise proportionally with fund size, i.e. there are neither economies nor diseconomies of scale. Thus, in all results we present the t-statistic from a hypothesis test that $\beta_1 = 1$.

Standard errors are clustered at the pension fund level throughout.

3.2 Estimates of economies of scale

Table 3 gives the results of estimating equation (1) for the sample excluding underwritten funds in columns (1)-(3), and including underwritten funds in columns (4)-(6). Column (1) of Table 3 replicates the main estimate in Touna Mama, Pil- lay, and Fedderke (2011) and our estimate of 0.705 is very close to their estimate of 0.697, and the small difference could be due to slight changes in the data. In column (2) we estimate economies of scale over the more recent period 2007-2018, and it is evident that the cost elasticity has increased somewhat in the latter period relative to the earlier period - the scale coefficient β_1 increases from 0.705 over 1996-2006 (Table 3 column (1)) to 0.731 over 2007-2018 (Table 3 column (2)). Over all years, the estimate of the cost elasticity is 0.715 (Table 3 column (3)).

Columns (4)-(6) of Table 3 include underwritten funds, which were excluded in Touna Mama, Pillay, and Fedderke (2011) because they are only reported in the dataset from 2005 onwards. Including underwritten funds does not change the estimates of the cost elasticity much, and the estimates are slightly larger in two of the three cases.

In all the estimates, the scale coefficient β_1 of the number of members is significantly different from the constant returns-to-scale value of 1. There are strong and significant economies of scale in the South African retirement fund industry - total administrative costs increase by only 72% when membership doubles (Table 3 column (6)). This is equivalent to 28% potential economies of scale.

The estimated scale coefficient is similar to that estimated for the Netherlands (64% by Bikker and De Dreu (2009), and 69% by Bikker, Steenbeek, and Torracchi (2012)) and Australia (74% by Bikker, Steenbeek, and Torracchi (2012)). The South African retirement fund industry thus has similar economies of scale to the Dutch and Australian industries. On the other hand, the estimated scale coefficient is much smaller than Bikker, Steenbeek, and Torracchi (2012) estimate for the United States (0.79) and Canada (0.95, and not statistically significantly different from 1). South African retirement funds are not as efficient as those in the US and Canada. In particular, Canadian retirement funds are operating on an efficient scale.

Looking at fund characteristics, we see that underwritten funds have lower administrative costs than private funds. Preservation funds have significantly higher administrative costs than ordinary funds. Over 1996-2006, umbrella funds had significantly lower administrative costs than ordinary funds but this difference is no longer there over 2007-2018 and when looking over the entire sample period. Since more than one employer can participate in an umbrella fund, we might expect umbrella funds to have lower administrative costs but this does not appear to be true in all sample periods. There does not appear to be a significant difference in administrative costs between pension and provident funds. Some of the coefficient estimates for retirement annuity funds are statistically significant, indicating that retirement annuity funds may have higher administrative costs than pension funds. This may be because retirement annuity funds collect contributions by directly debiting members' bank accounts and this is likely to be more expensive than the payroll deductions used by pension and provident funds. Both defined benefit and hybrid funds have significantly higher administrative costs than defined contribution funds.

The results in Table 3 suggest that the cost elasticity over the period 2007-2018 is higher than over the earlier period 1996-2006. In order to examine this further, Figure 3 illustrates the scale coefficients when equation (1) is estimated separately for each year. We exclude underwritten funds in these estimations since they are only reported in the data from 2005 onwards, but the results including underwritten funds are very similar.

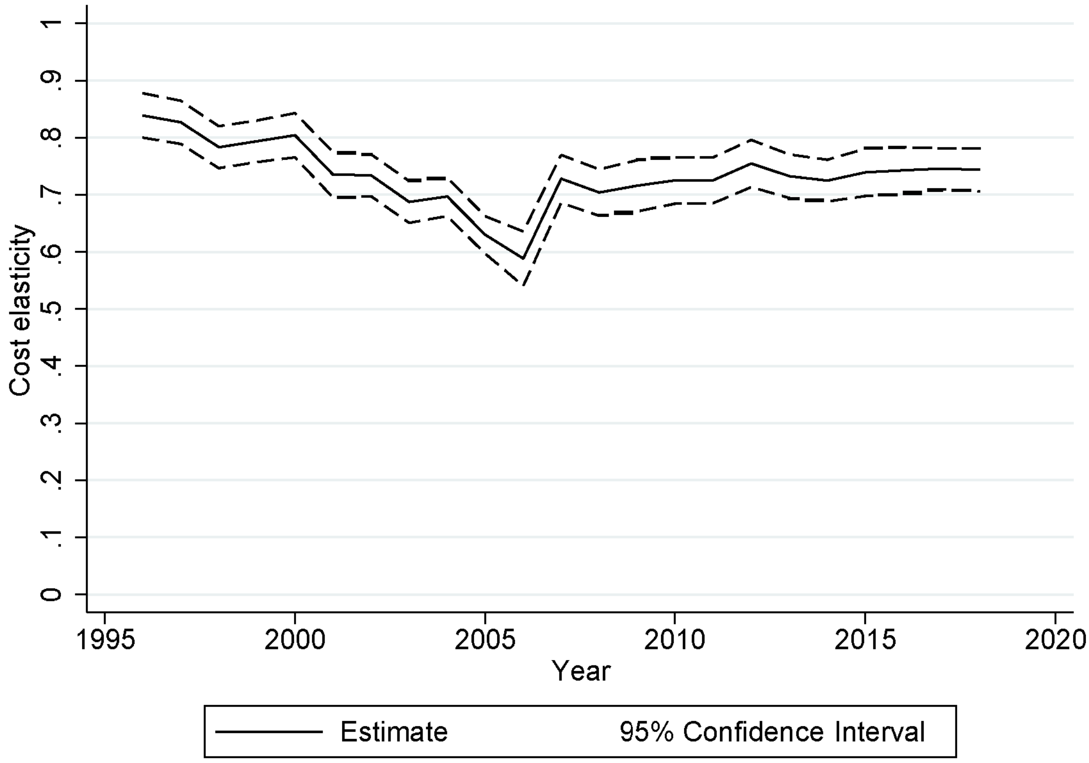
Table 3: Estimates of economies of scale using linear specification

	Excluding underwritten funds			All funds		
	1996-2006	2007-2018	All years	1996-2006	2007-2018	All years
	(1)	(2)	(3)	(4)	(5)	(6)
Total members (log)	0.705***	0.731***	0.715***	0.701***	0.736***	0.719***
	(0.014)	(0.015)	(0.013)	(0.013)	(0.014)	(0.012)
Underwritten				-0.699***	-0.328***	-0.487***
				(0.053)	(0.077)	(0.057)
Preservation	0.898***	0.574***	0.632***	0.844***	0.511***	0.578***
	(0.175)	(0.140)	(0.129)	(0.168)	(0.130)	(0.120)
Umbrella	-0.183**	0.018	-0.018	-0.170**	0.044	0.010
	(0.074)	(0.066)	(0.054)	(0.072)	(0.063)	(0.052)
Provident	-0.062	0.062	-0.002	-0.063	0.037	-0.017
	(0.047)	(0.065)	(0.047)	(0.042)	(0.061)	(0.043)
Retirement annuity	0.335	0.391*	0.365*	0.278	0.314	0.304
	(0.235)	(0.222)	(0.203)	(0.231)	(0.208)	(0.192)
Defined benefit	0.255***	0.334***	0.303***	0.282***	0.329***	0.329***
	(0.062)	(0.127)	(0.068)	(0.060)	(0.109)	(0.063)
Hybrid	0.443***	0.350***	0.403***	0.466***	0.347***	0.421***
	(0.105)	(0.102)	(0.082)	(0.106)	(0.100)	(0.082)
Total assets per member (R10,000s)	0.001**	0.001***	0.001***	0.001**	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Deferred members, percentage	-0.001	-0.006**	-0.004**	-0.011***	-0.006***	-0.010***
	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)
Pensioners, percentage	0.006***	0.003*	0.005***	0.006***	0.003*	0.005***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Beneficiaries, percentage	0.011***	0.007*	0.009***	0.009***	0.006*	0.008***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)
Unclaimed benefits, percentage	-0.002	-0.012***	-0.012***	-0.004	-0.013***	-0.013***
	(0.003)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)
Constant	8.943***	8.959***	8.851***	8.979***	8.947***	8.843***
	(0.084)	(0.103)	(0.080)	(0.079)	(0.099)	(0.077)
t-statistic: $\beta_1 = 1$	-21.468***	-17.740***	-22.556***	-23.913***	-18.896***	-24.147***
Number of observations	13,652	12,853	26,505	15,408	14,515	29,923
R-squared	0.626	0.646	0.642	0.689	0.669	0.688

Notes: Sample includes all normal active funds with non-negative member numbers and administrative expenses. Columns (1)-(3) exclude underwritten funds while columns (4)-(6) includes them. All estimates include a full set of year dummies in addition to the variables shown in the table. Clustered standard errors are in parentheses. *** significant at the 1% level, ** at the 5% level, * at the 10% level.

Looking at Figure 3, we can see that the cost elasticity was indeed falling over the period 1996 to 2006 and then increases slightly over the years 2007 to 2018. In 2018, the estimated cost elasticity is 0.74 which is equivalent to 26% potential economies of scale. In all years, the scale coefficient is statistically significantly different from the constant returns-to-scale value of 1.

Figure 3: Estimates of cost elasticity by year, 1996-2018



Notes: Sample includes all normal active funds with non-negative member numbers and administrative expenses. Underwritten funds are excluded.

[1]Note that economies of scale are equal to 1 minus the cost elasticity.

3.3 What is the optimal fund size?

In order to determine the optimal fund size, we estimate a specification that allows economies of scale to vary with fund size by introducing a squared membership term:

ln(Costit) = β0 + β1ln(Membersit) + β2[ln(Membersit)]2 + γXit + δt + Eit (2)

In this specification, the cost elasticity now depends on the fund size and is given by β1 + 2β2ln(Members). This specification is useful to determine if larger funds have larger cost elasticities and to ascertain the optimal fund size.

Table 4 gives the results of estimating equation (2) for the full sample including underwritten funds in columns (1)-(3), and for the sample of 23 year funds only in columns (4)-(6). The 23 year funds in particular might be more useful for determining the optimal fund size since they represent the sample of funds who have survived entry and competition and therefore might better reflect efficiency in the industry.

Table 4: Estimates of economies of scale using quadratic specification

	All funds			23 year funds		
	1996-2006	2007-2018	All years	1996-2006	2007-2018	All years
	(1)	(2)	(3)	(4)	(5)	(6)
Total members (log)	0.521***	0.615***	0.562***	0.887***	0.319*	0.492***
	(0.047)	(0.061)	(0.045)	(0.218)	(0.186)	(0.189)
Total members (log), squared	0.016***	0.009*	0.013***	-0.005	0.027**	0.018
	(0.004)	(0.005)	(0.004)	(0.015)	(0.012)	(0.012)
Underwritten	-0.749***	-0.351***	-0.528***			
	(0.055)	(0.076)	(0.057)			
Preservation	0.805***	0.494***	0.545***	0.228*	1.541***	0.854***
	(0.169)	(0.132)	(0.121)	(0.116)	(0.115)	(0.108)
Umbrella	-0.181**	0.028	-0.021	-0.098	0.108	0.040
	(0.072)	(0.064)	(0.053)	(0.190)	(0.083)	(0.086)
Provident	-0.069*	0.037	-0.022	-0.158	0.086	-0.036
	(0.042)	(0.060)	(0.043)	(0.122)	(0.112)	(0.109)
Retirement annuity	0.287	0.275	0.251	-0.140	0.015	-0.052
	(0.234)	(0.209)	(0.194)	(0.429)	(0.596)	(0.522)
Defined benefit	0.283***	0.315***	0.318***	0.145	0.099	0.074
	(0.059)	(0.108)	(0.061)	(0.099)	(0.110)	(0.083)
Hybrid	0.457***	0.344***	0.414***	0.341*	0.211	0.215
	(0.103)	(0.098)	(0.079)	(0.173)	(0.163)	(0.141)
Total assets per member (R10,000s)	0.001**	0.001***	0.001***	0.010***	0.002***	0.004***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Deferred members, percentage	-0.012***	-0.007***	-0.012***	-0.006**	-0.002	-0.003
	(0.001)	(0.002)	(0.001)	(0.003)	(0.005)	(0.004)
Pensioners, percentage	0.006***	0.003*	0.005***	-0.003	0.005***	0.005**
	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)
Beneficiaries, percentage	0.008***	0.006*	0.008***	0.010*	0.011***	0.014***
	(0.003)	(0.003)	(0.002)	(0.005)	(0.003)	(0.003)
Unclaimed benefits, percentage	-0.006*	-0.013***	-0.013***	-0.012**	-0.008***	-0.007***
	(0.003)	(0.001)	(0.001)	(0.006)	(0.002)	(0.002)
Constant	9.434***	9.337***	9.289***	7.929***	10.406***	9.569***
	(0.145)	(0.208)	(0.147)	(0.776)	(0.714)	(0.694)
Number of observations	15,408	14,515	29,923	2,134	2,328	4,462
R-squared	0.691	0.670	0.689	0.747	0.785	0.745

Notes: Sample includes all normal active funds with non-negative member numbers and administrative expenses. Underwritten funds are included in the sample of all funds in columns (1)-(3). Columns (4)-(6) contain only the 23 year funds and there are no underwritten funds among this sample. All estimates include a full set of year dummies in addition to the variables shown in the table. Clustered standard errors are in parentheses. *** significant at the 1% level, ** at the 5% level, * at the 10% level.

Looking at all funds in columns (1)-(3) of Table 4, the statistical significance of the quadratic terms indicates that the cost elasticity is not constant and economies of scale decrease as fund size increases. Although the quadratic term is statistically significant, the actual effect is not very large. For example, the cost elasticity at the average fund size of 5,000 members is 0.78 and the cost elasticity at 47,000 members (roughly a one standard deviation increase from the average) is 0.84. Thus, the actual effect of larger fund size on the cost elasticity is relatively small.

A similar result is observed when looking at only the 23 year funds in columns (4)-(6). Here, the quadratic term is insignificant except for over they years 2007- 2018. For the 23 year funds, there is no effect of fund size on cost elasticity over the years 1996-2006 and over the full sample period.

We can use the estimates in Table 4 to determine the optimal fund size. When the cost elasticity is equal to 1, there is constant returns to scale and the fund has reached its optimal size. Based on the estimates for the full sample (column (3) of Table 4), the optimal fund size is just under 21 million members. However, 21 million far exceeds the sample maximum fund size of 1.6 million members, as well as the sample total number of members of 13 million in 2018. Thus, this estimate is of limited usefulness and we instead look at the 23 year funds to determine the optimal fund size. Based on the estimates for the 23 year funds over the period 2007-2018, the optimal fund size is 300,000 members. This is larger than the optimal fund size of 220,000 members estimated by Touna Mama, Pillay, and Fedderke (2011) for the 11 year funds over 1996-2006.

Overall, we interpret the evidence in this section as indicative that economies of scale do not meaningfully vary with fund size.3 The exception is for 23 year funds over 2007-2018 where the quadratic term is significant and indicates an optimal fund size of 300,000.

[2]Touna Mama, Pillay, and Fedderke (2011) cover the years 1996-2006 and so use a sample of 11 year funds that represents those funds that appear in every year in their dataset.
[3]The quadratic term is also not statistically significant in the fixed effects estimates (results not shown).

3.4 Do economies of scale vary with fund age?

In order to test whether older funds have a larger cost elasticity, we estimate the following specification:

$$\ln(Cost_{it}) = \beta_0 + \beta_1 \ln(Members_{it}) + \beta_2[\ln(Members_{it}) \times FundAge_{it}] + \beta_3 FundAge_{it} + \gamma X_{it} + \delta_t + E_{it} \quad (3)$$

where FundAgeit represents the age of fund i in year t and is calculated as the number of years the fund appears in the dataset. This specification allows us to test whether the cost elasticity depends on the age of the fund by examining β2. Table 5 gives the results of estimating equation (3) on the sample excluding underwritten funds in Panel A and for all funds (including underwritten funds) in Panel B.

Table 5: Economies of scale and fund age

	Total members (log) (1)		Total members (log) X Fund age (2)		Fund age (3)		N (4)
Panel A: Excl underwritten funds							
1996-2006	0.765***	(0.018)	-0.013***	(0.003)	0.103***	(0.016)	13,652
2007-2018	0.744***	(0.027)	-0.002	(0.002)	0.041***	(0.014)	12,853
All years	0.731***	(0.014)	-0.003**	(0.001)	0.047***	(0.010)	26,505
Panel B: All funds							
1996-2006	0.736***	(0.015)	-0.009***	(0.002)	0.083***	(0.016)	15,408
2007-2018	0.747***	(0.024)	-0.002	(0.002)	0.038***	(0.013)	14,515
All years	0.734***	(0.012)	-0.003**	(0.001)	0.047***	(0.010)	29,923
Panel C: 23 year funds							
1996-2006	0.818***	(0.031)					2,134
2007-2018	0.704***	(0.032)					2,328
All years	0.749***	(0.029)					4,462

Notes: Sample includes all normal active funds with non-negative member numbers and administrative expenses. Underwritten funds are excluded in Panel A and included in Panel B. There are no underwritten funds among the 23 year funds in Panel C. All estimates include controls for fund subtype, fund class, benefit structure, assets per member, percentage deferred members, percentage pensioners, percentage beneficiaries, percentage unclaimed benefits, and a full set of year dummies. Clustered standard errors are in parentheses. *** significant at the 1% level, ** at the 5% level, * at the 10% level.

Looking at column (3) of Table 5, it is clear that older funds actually have higher administrative costs than younger funds and this is true in all sample periods and whether or not underwritten funds are included. For the full sample, a 1 year increase in fund age will increase administrative costs by 4.7% (column (3) of Panel B, All years).

The coefficient on the interaction term [ln(Membersit) FundAgeit] is given in column (2). This coefficient is negative and statistically significant over the period 1996-2006, in both Panels A and B, indicating that older funds have lower cost elasticities than younger funds. This is equivalent to decreasing economies of scale as funds get older. However, over the later period 2007-2018, this effect is no longer statistically significant and is much smaller in magnitude. This suggests that the relationship between fund age and cost elasticity has weakened over time. Looking over all years, the interaction term is statistically significant but the magnitude of the effect is not large - a 23 year old fund will have a cost elasticity that is 0.066 percentage points lower than a 1 year old fund.

Panel C of Table 5 examines the relationship between fund age and economies of scale from a different perspective by estimating equation (1) on the sample of funds that appear in the dataset in every year - the "23 year funds". These funds are likely quite different from the other funds since they have survived the entire sample period and represent the oldest funds in the dataset. For example, there are no underwritten funds among the 23 year funds. Over 1996-2006, these 23 year funds have a cost elasticity of 0.818 which is much higher than the 0.701 estimated for all funds over the same period in Table 3. Thus, over this period the 23 year funds are more efficient than other funds and this result matches the finding for 11 year funds in Touna Mama, Pillay, and Fedderke (2011).[4] However, this advantage of the 23 year funds is no longer present over 2007-2018 when these funds have a lower cost elasticity (0.704) than that estimated for all funds (0.736). Over the full sample period, the 23 year funds are slightly more efficient than other funds with a cost elasticity of 0.749 that is higher than the 0.719 estimated for all funds.

Overall, these results suggest that over the earlier years 1996-2006, older funds had significantly lower cost elasticities than younger funds and the 23 year funds were much more efficient compared to all funds. However, in the later years 2007- 2018 these relationships change and fund age no longer affects the cost elasticity over this period and 23 year funds are actually slightly less efficient than all funds.

[4]Touna Mama, Pillay, and Fedderke (2011) cover the years 1996-2006 and so use a sample of 11 year funds that represents those funds that appear in every year in their dataset.

3.5 Do economies of scale vary with fund characteristics?

The results in Table 3 indicate that there are some differences in administrative costs across the fund characteristics. To test whether economies of scale vary by fund characteristic, we estimate the following specification:

$$\ln(Cost_{it}) = \beta_0 + \beta_{1j}[\ln(Members_{it}) \times Char_j] + \gamma_j[X_{it} \times Char_j] + [\delta_t \times Char_j] + E_{it} \quad (4)$$

where each variable in equation (1) is interacted with a set of indicators for fund characteristics. The three fund characteristics examined are fund subtype, fund class and benefit structure and Charj takes on values that reflect the different categories under each characteristic. So for example, when examining fund subtype Charj is a set of dummies that indicate whether a fund is ordinary, preservation or umbrella. This specification allows us to compare economies of scale across different fund subtypes, classes and benefit structures.

Table 6 gives the results from estimating equation (6) on the sample of all funds over the full sample period. Panel A compares the cost elasticity across fund subtype, Panel B across fund class, and Panel C across benefit structure. The estimated cost elasticity is given in column (1).

Table 6: Economies of scale and fund characteristics

	β_1 (1)	t-stat: $\beta_1 = 1$ (2)	N (3)
Panel A: Fund subtype			
Ordinary	0.695***	-23.148***	23,485
	(0.013)		
Preservation	0.990***	-0.305	1,099
	(0.034)		
Umbrella	0.764***	-11.822***	5,339
	(0.020)		
Panel B: Fund class			
Pension	0.683***	-18.550***	15,027
	(0.017)		
Provident	0.754***	-19.437***	14,305
	(0.013)		
RA	0.910***	-0.973	591
	(0.092)		
Panel C: Benefitstructure			
DB	0.681***	-13.843***	4,295
	(0.023)		
DC	0.722***	-22.724***	24,877
	(0.012)		
Hybrid	0.808***	-6.043***	751
	(0.032)		

Notes: Column (1) gives the estimate of the cost elasticity, β_1, column (2) gives the t-statistic from a test that $\beta_1 = 1$, and column (3) gives the number of observations. Sample includes all normal active funds with non-negative member numbers and administrative expenses. Underwritten funds are included in all estimates. All estimates include controls for fund subtype, fund class, benefit structure, assets per member, percentage deferred members, percentage pensioners, percentage beneficiaries, percentage unclaimed benefits, and a full set of year dummies. Clustered standard errors are in parentheses. *** significant at the 1% level, ** at the 5% level, * at the 10% level.

Panel A of Table 6 reveals that preservation funds are the most efficient funds, followed by umbrella funds with ordinary funds being the least efficient. There are 30% potential economies of scale for ordinary funds and 24% potential economies of scale for preservation funds. The estimated scale coefficient is not significantly different from 1 for preservation funds (Table 6 Panel A column (2)) indicating that preservation funds are operating at an efficient scale.

Comparing fund classes in Panel B, we see that there are 32% potential economies of scale for pension funds and 25% potential economies of scale for provident funds. However, retirement annuities are operating on an efficient scale since the estimated scale coefficient is not significantly different from 1 (Table 6 Panel B column (2)).

Finally, Panel C indicates that hybrid funds are the most efficient, followed by defined contribution funds, and defined benefit funds are the least efficient. There are 19% potential economies of scale for hybrid funds, 28% for defined contribution funds, and 32% for defined benefit funds. None of the benefit structures are operating at an efficient scale.

This section has revealed that there are differences in efficiency across fund subtype, fund class and benefit structure. In particular, preservation funds and retirement annuities are operating at an efficient scale although these represent the smallest categories of funds in terms of numbers.

3.6 Do economies of scale vary across administrative cost categories?

The results in Table 3 indicated that there are strong and significant economies of scale in the South African retirement fund industry - total administrative costs increase by only 72% when membership doubles, which is equivalent to 28% potential economies of scale. In this section, we examine economies of scale separately for each category of administrative costs by estimating equation (1) separately for each administrative cost category.

Table 7 shows the estimated scale coefficient $\beta 1$ for each of the 17 categories of administrative costs estimated over the sample of all funds over all years. The number of observations (column (3)) differs for each category because we discard negative values for each category of administrative costs.

Table 7: Economies of scale by category of administrative cost

	β_1 (1)	t-stat: $\beta_1 = 1$ (2)	N (3)
Actuarial fees	0.510***	-11.879***	29,875
	(0.041)		
Admin fees	0.753***	-6.361***	29,874
	(0.039)		
Audit fees	0.518***	-14.794***	29,780
	(0.033)		
Consultancy fees	0.660***	-8.240***	29,876
	(0.041)		
Depreciation at cost	0.201***	-25.311***	29,918
	(0.032)		
Depreciation at valuation	0.016***	-238.502***	29,923
	(0.004)		
Fidelity cover	0.210***	-24.587***	29,843
	(0.032)		
Levies	0.126***	-24.865***	29,842
	(0.035)		
Other	0.776***	-8.832***	29,711
	(0.025)		
Office expenses	0.309***	-23.901***	29,891
	(0.029)		
Operating lease payments	0.046***	-83.853***	29,920
	(0.011)		
Penalties	0.005***	-369.018***	29,913
	(0.003)		
Principal officer	0.407***	-18.071***	29,918
	(0.033)		
Staff expenses	0.309***	-16.271***	29,919
	(0.042)		
Secretarial fees	0.050***	-73.291***	29,914
	(0.013)		
Trustee fees	0.679***	-10.634***	29,912
	(0.030)		
Amount allocated to UB	0.141***	-54.427***	29,917
	(0.016)		

Notes: Column (1) gives the estimate of the cost elasticity, β_1, column (2) gives the t-statistic from a test that $\beta_1 = 1$, and column (3) gives the number of observations. Sample includes all normal active funds with non-negative member numbers and administrative expenses. Underwritten funds are included in all estimates. All estimates include controls for fund subtype, fund class, benefit structure, assets per member, percentage deferred members, percentage pensioners, percentage beneficiaries, percentage unclaimed benefits, and a full set of year dummies. Clustered standard errors are in parentheses. *** significant at the 1% level, ** at the 5% level, * at the 10% level.

The results in Table 7 indicate that all of the estimated cost elasticities are significantly different from 1 for the administrative cost categories (column (2)). This indicates that there are significant potential economies of scale available across all administrative cost categories. However, the extent of unused economies of scale differs across the administrative cost categories. For example, there are 25% potential economies of scale for admin fees but almost 100% potential economies of scale for penalties.

Ranking the administrative cost categories from most to least efficient we have:

1. Other (22% potential economies of scale)
2. Admin fees (25%)
3. Trustee fees (32%)
4. Consultancy fees (34%)
5. Audit fees (48%)
6. Actuarial fees (49%)
7. Principal officer (59%)
8. Staff expenses (69%)
9. Office expenses (69%)
10. Fidelity cover (79%)
11. Depreciation at cost (80%)
12. Amount allocated to UB (86%)
13. Levies (87%)
14. Secretarial fees (95%)
15. Operating lease payments (95%)
16. Depreciation at valuation (98%)
17. Penalties (99%)

This list provides an indication of the more and less efficient administrative cost categories, and shows where the largest unused scale economies lie. This might be helpful in determining which specific costs to focus on in order to try to increase efficiency.

3.7 Robustness check: fixed effects specification

One concern with the OLS specification in (1) is that there may be unobserved fund characteristics that affect both fund size and administrative costs, such as organisational structure or operational efficiencies, which would result in bias in the OLS estimation. In order to address these concerns, we estimate the following regression that includes pension fund fixed effects with the αi:

$$\ln(Costit) = \beta 0 + \beta 1 \ln(Membersit) + \gamma Xit + \delta t + \alpha i + Eit \qquad (5)$$

where all the other variables are defined as in equation (1), except that the fund fixed effects also absorb fund characteristics that do not vary over time and which appear in the OLS specification - fund subtype dummies (ordinary, preservation or umbrella), fund class dummies (pension, provident or retirement annuity), and benefit structure dummies (defined contribution, defined benefit or hybrid).

The advantage of the fixed effects estimation is that it addresses concerns about omitted variable bias that may be present in the OLS estimation. Further, the fixed effects specification exploits the variation within funds and allows us to estimate the average effect of fund size changes on costs within funds. However, one concern is that the fixed effects specification wipes out the effect of fund size and thereby causes a downward bias in the estimates of economies of scale (Bikker, Steenbeek, and Torracchi 2012).

Table 8 gives the results of estimating the fund fixed effects specification in equation (5) on the sample excluding underwritten funds in columns (1)-(3), and including underwritten funds in columns (4)-(6). The estimated scale coefficients in Table 8 are all smaller than those estimated using OLS in Table 3, which could be due to the downward bias caused by the fund fixed effects mopping up the effect of fund size.

Table 8: Estimates of economies of scale using fund fixed effects specification

	Excluding underwritten funds			All funds		
	1996-2006	2007-2018	All years	1996-2006	2007-2018	All years
	(1)	(2)	(3)	(4)	(5)	(6)
Total members (log)	0.592***	0.680***	0.645***	0.587***	0.707***	0.657***
	(0.037)	(0.031)	(0.022)	(0.036)	(0.029)	(0.021)
Total assets per member (R10,000s)	0.000***	0.001***	0.000***	0.000***	0.001***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Deferred members, percentage	-0.004***	-0.009**	-0.007***	-0.004**	-0.008**	-0.006***
	(0.002)	(0.004)	(0.002)	(0.002)	(0.003)	(0.002)
Pensioners, percentage	-0.005***	0.004*	-0.002	-0.005***	0.003	-0.002
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Beneficiaries, percentage	0.003	-0.002	-0.000	0.003	-0.001	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Unclaimed benefits, percentage	-0.006**	-0.010***	-0.010***	-0.006**	-0.011***	-0.011***
	(0.003)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)
Constant	9.673***	9.392***	9.378***	9.565***	9.189***	9.223***
	(0.214)	(0.209)	(0.144)	(0.204)	(0.194)	(0.134)
t-statistic: $\beta_1 = 1$	-11.143***	-10.352***	-16.120***	-11.396***	-10.050***	-16.365***
Number of observations	13,652	12,853	26,505	15,408	14,515	29,923
R-squared	0.273	0.354	0.321	0.264	0.358	0.319

Notes: Sample includes all normal active funds with non-negative member numbers and administrative expenses. Columns (1)-(3) exclude underwritten funds while columns (4)-(6) includes them. All estimates include fund fixed effects and a full set of year dummies in addition to the variables shown in the table. Clustered standard errors are in parentheses. *** significant at the 1% level, ** at the 5% level, * at the 10% level.

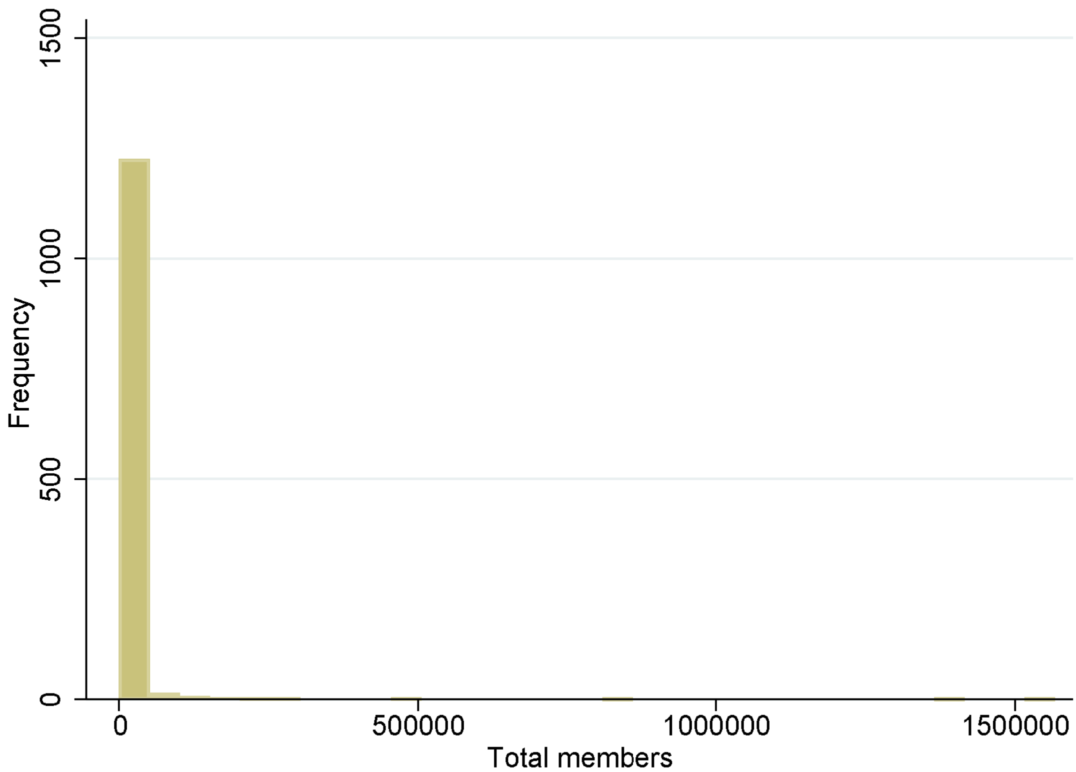
However, the broad conclusions of the main results are confirmed by the fund fixed effects estimation. The scale coefficient is greater over the later period 2007- 2018 than over the earlier period 1996-2006, suggesting that funds have become more efficient over time. In all periods and samples, the scale coefficient is statistically significantly different from 1 indicating that retirement funds are not operating at an efficient scale.

Recommendations on fund adjustments and consolidation

The results in Section 3.2 indicate that the South African retirement fund industry is not operating at an efficient scale since the estimated scale coefficients are significantly different from 1. There is thus scope to improve efficiency in the industry. Looking at the trend over time, we noted that the scale coefficient has been increasing slightly over the years 2007-2018 indicating that there has been movement toward greater efficiency. Nevertheless, in 2018 the estimated cost elasticity is 0.74 which is equivalent to 26% potential economies of scale. Increasing the operational scale of retirement funds can lower average administrative costs and thereby benefit fund members.

While the results in Section 3.3 generally indicate that economies of scale do not vary with fund size, there is an exception when looking at the 23 year funds over the period 2007-2018. The results show that over this period the optimal fund size is 300,000 members. Figure 4 shows the histogram of fund size in 2018, with a vertical line to indicate the estimated optimal fund size of 300,000 members. It is evident that most funds lie below this optimal size and 0.4% of funds are actually above the optimal fund size. This suggests that some funds might be operating at diseconomies of scale while most funds have potential economies of scale available.

Figure 4: Distribution of fund size, 2018



Notes: The vertical line indicates the optimal fund size of 300,000 estimated using 23 year funds over the period 2007-2018.

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The differential analyses by fund characteristics and administrative cost categories can provide some guidance on where the greatest potential economies of scale lie. The analysis by fund characteristics in Section 3.5 reveals that preservation fund and retirement annuities are operating at an efficient scale, although there are relatively few funds of these types. On the other hand, ordinary funds and pension funds have the lowest estimated cost elasticities and thus the greatest potential economies of scale. There is no benefit structure that is operating at an efficient scale although defined benefit funds have the greatest potential economies of scale. Section 3.6 shows that there is also great variation in economies of scale across the administrative cost categories with the five least efficient categories being penalties, depreciation at valuation, operating lease payments, secretarial fees, and levies.

Thus, these results indicate that there are potential efficiency gains from increasing the operational scale of retirement funds. Further, the results suggest possible areas of focus in order to improve efficiency in the retirement fund industry. In particular, ordinary, umbrella, pension and provident funds are not operating at an efficient scale. Within total administrative costs, there are certain categories that are less efficient than others and thus have greater potential economies of scale.

These recommendations focus entirely on economies of scale and efficiency, but there might be other important considerations too. For example, smaller funds may offer greater levels of service and complexity that their members value.

Estimates of NSSF costs

The National Social Security Fund (NSSF) has been proposed to fill the gap in South Africa's social insurance system. The NSSF will complement social assistance programmes, social insurance funds and private arrangements and provide pensions to workers who reach retirement, disability benefits to those who are physically unable to work and survivor benefits to their dependants should they not live until retirement. Contributions to the pension and risk benefit components of the NSSF will be pooled, sharing risk across all contributors.

The retirement system is designed to have three tiers. Tier 1 are low income workers earning below R13,000 a year whose retirement needs will be largely met by the social grant system. Tier 2 is the NSSF and the core of the mandatory system with workers contributing to the fund and receiving retirement income. Tier 3 is voluntary retirement savings made in addition to NSSF contributions to raise the income replacement rate for higher income workers.

Here, we provide an estimate of the administrative costs of the NSSF (tier 2 of the proposed retirement system). These estimates should be treated with some caution because of the number of assumptions required and because the structure of the NSSF is not finalised. We construct this estimate using the model specified in equation (1) and using the available information on the structure of the NSSF. The values used for each variable in the model, and the sources for the values, are discussed below.

Number of members

In a model where workers enroll in the NSSF as soon as they begin formal employment and remain members for life even if their contributions are not continuous, Pick and Simkins (2012) estimate that NSSF membership will eventually reach 80% of the adult population. The latest population estimates indicate that the adult population (i.e. those 25 years and older) is 32,973,449 (StatsSA 2020). Thus, we use 0.8 32, 973, 449 = 26, 378, 759 as the total number of NSSF members. Using 80% of the current population value implicitly assumes that we are estimating the costs for the NSSF as if it were a fully functional fund today.

This total number of members will be split between active members, pensioners, beneficiaries, deferred members and unclaimed benefits members. Only workers earning above R13,000 per year will be required to contribute to the NSSF (Pick and Simkins 2012), and so we use QLFS 2017 Q4 data to estimate the number of contributors based on this income threshold. The data indicate that the estimated number of people whose annual income is more than R13,000 per year (in 2011 Rand) is 11,490,811 and we use this as our estimate of the number of the active members.[5] We are unable to determine how the remaining 56% of total members will be split between pensioners, beneficiaries, deferred members and unclaimed benefits members and so we allocate the remaining members between these categories in proportion to the sample averages for ordinary defined benefit pensions in our administrative dataset on private retirement funds. The sample averages in the administrative dataset provide an indication of the current membership structure for a typical retirement fund with a similar structure to that proposed for the NSSF, with the caveat that there is double counting of members in the dataset since an individual may belong to more than one type of fund although this is less likely to be a problem since we take the average only among a subset of funds.

[5]This estimate of 11.5 million is equivalent to 35% of the adult population, which is similar to the eventual contribution base estimated by Pick and Simkins (2012).

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Fund subtype

We consider the NSSF to be an ordinary fund. It is not a preservation fund that receives lump sum benefits from a pension or provident fund when a worker changes employer, nor is it an umbrella fund that serves many company funds under one structure. It is a large ordinary fund designed to provide pensions to all workers.

Fund class

The NSSF is a pension fund. It is not a provident fund that allows workers to take a lump sum cash withdrawal at retirement, nor is it a retirement annuity since both employers and employees will contribute.

Benefit structure

The NSSF is currently envisioned as a defined benefit fund, although its design is intended to yield an income in retirement similar to the average expected outcome of defined contribution funds (IDTT 2012). Thus, we treat the NSSF as a defined benefit plan.

Total assets per member

The NSSF should have at least a 25% minimum reserve requirement: accumulated funds (NSSF assets) should over the long term never fall below 25% of the present value of accrued future benefits (NSSF liabilities) (IDTT 2012). Department of Social Development (2010) estimate that the total assets required for the NSSF is R533,195,786,000 in 2006 Rands.[6] In order to be comparable to the other estimates used in our analysis, we inflate this estimate to 2016 Rands and scale it by our higher number of members to arrive at an estimated total assets per member of R121,073.54. We note that this figure is lower than the sample average for other funds with a similar structure to the NSSF in our dataset, so this assumed asset level might be too low.

We estimate the model specified in equation (1) on the sample excluding underwritten funds for the full sample period, 1996-2018. We also estimate the model on the sub-sample of 23 year funds as these represent the most stable funds and so might be particularly relevant for estimating the costs of the NSSF. We use the linear specification of equation (1) given the limited significance of the quadratic term in the models estimated in Section 3.3. Using the coefficient estimates from these models and the assumptions discussed above we can estimate the total ad- ministrative costs for the NSSF as

$$\text{Cost} = \exp\left(\frac{\sigma2}{2}\right)\exp(\log(\text{Cost})) \qquad (6)$$

where σ2 is the estimator of the variance of E, and log(Cost) is the predicted value for the log of administrative costs. The adjustment factor exp(2) is required to produce a consistent prediction.

[6]We combine their estimates for Tiers 2A and 2B under Scenario 2 since that most closely matches the current NSSF proposed structure.

Table 9 gives the estimates of the NSSF administrative costs under these assumptions. Column (1) presents the coefficient estimates for equation (1) using all normal active funds with non-negative member numbers and administrative expenses and excluding underwritten funds. Column (2) presents the coefficient estimates when the sample is further restricted to only the 23 year funds. Columns (2) and (4) provide the values used for each variable as discussed above. The percentages for deferred members, pensioners, beneficiaries and unclaimed benefits differ across columns (2) and (4) since these are based on sample averages (see discussion above) while the values for the other variables are unchanged.

Table 9: Estimates of NSSF administrative costs

	All funds		23 year funds	
	Coeff est	Value	Coeff est	Value
	(1)	(2)	(3)	(4)
Total members (log)	0.715	17.088	0.749	17.088
Preservation	0.632	0.000	0.865	0.000
Umbrella	-0.018	0.000	0.060	0.000
Provident	-0.002	0.000	-0.065	0.000
Retirement annuity	0.365	0.000	-0.071	0.000
Defined benefit	0.303	1.000	0.076	1.000
Hybrid	0.403	0.000	0.260	0.000
Total assets per member (R10,000s)	0.001	12.107	0.004	12.107
Deferred members, percentage	-0.004	1.621	-0.003	2.006
Pensioners, percentage	0.005	42.205	0.004	38.564
Beneficiaries, percentage	0.009	4.623	0.014	4.647
Unclaimed benefits, percentage	-0.012	7.552	-0.007	10.783
NSSF Cost estimate	5.7×10^9		5.2×10^9	
NSSF Cost estimate 95% CI	$[4.2 \times 10^9, 7.2 \times 10^9]$		$[1.9 \times 10^9, 8.4 \times 10^9]$	

Notes: The estimates in column (1) are from the sample of all normal active funds with non-negative member numbers and administrative expenses, excluding underwritten funds. The estimates in column (3) further restrict the sample to only the 23 year funds. Columns (2) and (4) give the values for the variables used to produce the estimate of costs.

The estimate for the administrative costs of the NSSF based on the model using all funds is R5.7 billion, and using only the 23 year funds is R5.2 billion (in 2016 Rands). These estimates should be interpreted with caution since they are based on a number of assumptions. Further, the estimates are derived from a model estimated on a sample of private retirement funds and it is possible that the NSSF may have a cost function than that estimated here since it will likely be a different fund to the typical retirement fund in our dataset. In this way, the prediction of the NSSF cost estimate is “out of sample”. In addition, the cost functions estimated here do not explain all the variation in administrative costs with an R2 of 64% for the model using all funds and 78% for the model using 23 year funds. Thus, there could be some variables that are not in our dataset but are important predictors of administrative costs.

The 95% confidence intervals around the NSSF cost estimates are fairly wide– from R4.2-R7.2 billion and R1.9-R8.4 billion. Department of Social Development (2010) produces an estimate for administrative costs of R6.7 billion,[7] which falls within our 95% confidence intervals and so our estimates are comparable.

[7]The figure used from Department of Social Development (2010) combines their estimates for administrative costs for Tiers 2A and 2B under Scenario 2 (excluding asset management costs) and is inflated to 2016 Rands to be comparable to our estimate.

Conclusion

The initial examination of the data shows that there have been significant changes in the retirement fund industry over the period 2006 to 2018. There has been a general decrease in the number of funds, an increase in the average fund size, and an increase in average administrative expenses per member. The analysis by fund type reveals that these general trends conceal some important differences across fund class and benefit structure. In particular, average administrative costs per member have actually decreased for preservation, provident, defined contribution and hybrid funds from 2006 to 2018. This suggests that there is likely to be a change in the economies of scale results originally found over 1996-2006 by Touna Mama, Pillay, and Fedderke (2011).

Indeed, we find that the cost elasticity has increased somewhat from 0.705 over 1996-2006 to 0.731 over 2007-2018. The cost elasticity was falling over the period 1996 to 2006 and then increases slightly over the years 2007 to 2018. In 2018, the estimated cost elasticity is 0.74 which is equivalent to 26% potential economies of scale.

Overall, the evidence indicates that economies of scale do not meaningfully vary with fund size, with the exception of 23 year funds over 2007-2018 where the quadratic term is significant and indicates an optimal fund size of 300,000. This is larger than the optimal fund size of 220,000 members estimated by Touna Mama, Pillay, and Fedderke (2011) for the 11 year funds over 1996-2006. In 2018, most funds have fewer than 300,000 members and 0.4% of funds are actually above this optimal fund size. This suggests that some funds might be operating at disec- onomies of scale while most funds have potential economies of scale available.

We examined whether economies of scale vary with fund age, characteristics and across the administrative cost categories. The results suggest that over the earlier years 1996-2006, older funds had significantly lower cost elasticities than younger funds and the 23 year funds were much more efficient compared to all funds. However, in the later years 2007-2018 these relationships change and fund age no longer affects the cost elasticity over this period and 23 year funds are actually slightly less efficient than all funds. There are differences in efficiency across fund subtype, fund class and benefit structure. In particular, preservation funds and retirement annuities are operating at an efficient scale although these represent the smallest categories of funds in terms of numbers. There are significant potential economies of scale available across all administrative cost categories. However, the extent of unused economies of scale differs across the administrative cost categories. For example, there are 25% potential economies of scale for admin fees but almost 100% potential economies of scale for penalties.

Using our estimated cost function and assumptions about the structure of the NSSF we estimate a 95% confidence interval for the NSSF administrative costs of R1.9 to R8.4 billion (in 2016 Rands). These estimates should be interpreted with caution since they are based on a number of assumptions. Further, the estimates are derived from a model estimated on a sample of private retirement funds and it is possible that the NSSF may have a cost function than that estimated here since it will likely be a different fund to the typical retirement fund in our dataset. In this way, the prediction of the NSSF cost estimate is "out of sample". In addition, the cost functions estimated here do not explain all the variation in administrative costs with an R2 of 78%. Thus, there could be some variables that are not in our dataset but are important predictors of administrative costs.

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