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Abstract

This paper estimates economies of scale and scope for 200 large Australian superannuation (pension) funds in 2009 using a multiple-output cost function. This is the first and currently only year that certain fund-level information provided in the superannuation annual returns to the Australian Prudential Regulation Authority (APRA) has been deemed non-confidential and made publicly available. Costs are separately defined in terms of investment expenses—including investment, custodian and asset management fees—and operating expenses—comprising management, administration, actuarial, director and trustee fees and charges. Four outputs are specified for each cost: namely, cash flow adjusted net assets, the number of investment options, the proportion of total assets in the default strategy and the five-year rate of return for investment costs, and cash flow adjusted net assets, the number of members, net contribution flows and net rollovers for operating costs. The findings indicate that ray economies of scale hold up to at least 300 percent of current mean output in both investment and operating costs, though product-specific economies of scale hold primarily for assets under management and the number of investment options at relatively high levels of output for investment costs and for rollovers at low levels of output for operating costs. In contrast, there is little evidence that global and product-specific economies of scope prevail in the sector, and this is reflected in the proclivity of many superannuation funds to contract out many aspects of their investments and operations.

JEL codes: C21 · D24 · G23

Keywords: Economies of scale · Economies of scope · Cost efficiency · Superannuation · Pension funds

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1. Introduction

Australia's superannuation system [comprising a compulsory employer-funded superannuation (retirement income) system supplemented by a narrowly-focused (age, means and income tested) public pension] continues to grow apace with collective superannuation savings forecast to increase from $1.1 trillion (90% of GDP) today to $6.1 trillion (130% of GDP) by 2035. At the same time, the profile and structure of the superannuation industry has also changed rapidly, with consolidation projected to cause the number of large funds (excluding eligible rollover funds) to fall from 447 today (4,734 in 1996) to 74 in 2035 and the size of the largest fund to increase from $41.5 billion today to $350 billion in 2035 (Cooper Review 2010: 10). However, accompanying these dramatic changes has been disquiet about the limitations of the present system in terms of efficiency (that the system operates in the most cost effective manner and in the best interests of members), structure (that effective competition is promoted leading to downward pressure in system costs) and operations (that returns to members be maximized, including through minimizing costs).

It was on this basis that the Review of the Governance, Efficiency, Structure and Operation of Australia's Superannuation System (Cooper Review) was tasked in May 2009. Reporting back in June 2010, the Cooper Review (2010b) made a large number of recommendations. These include the substantial benefits for members of increased scale in the superannuation industry, the desirability of the Australian Prudential Regulation Authority (APRA) in overseeing and promoting the efficiency of the superannuation system, and the proposed role of SuperStream (a package of measures aimed at reforming back-office operations in terms of the increased use of technology, uniform data standards, tax file identification, and straight-through processing of transactions) and MySuper (a simple product designed for the majority of members) in lowering overall costs.

Clearly, a major focus in these and future developments has been and will be the level of investment and operating (administration) costs, particularly their interaction with the scale (the size of production) and scope (the diversity of production) of superannuation funds. For instance, in terms of investment costs, the Cooper Review (2010: 13) argues that these will necessarily vary according to whether the assets are actively or passively management, the underlying asset allocation, scale, and the extent to which the trustee has decided to invest in alternative and illiquid assets to capture the benefits of diversification returns in disparate assets classes. Putting this aside, superannuation costs in Australia are substantial with the Cooper Review's (2010) estimated costs of investing passively (actively) ranging from 24 (47) basis points (bps) for conservative portfolios to 31 (62) bps for balanced portfolios for funds with an asset size of less than $100 million, down to 2 (20) bps for conservative portfolios and 2 (36) bps for balanced portfolios for funds with assets in excess of $20,000 million. Similarly, operating costs should also vary widely with the scale of superannuation fund operations with the respective MySuper estimates for small ($10,000) and large ($250,000) accounts falling from 262 and 10 bps in funds with less than $100 million in assets and 4,000 members to 74 and 3 bps in funds with more than $20,000 million in assets and 800,000 members. It should be noted that the Cooper Review expressed rather less concern with the scale of self-managed super funds (SMSFs) where it held the view that scale did not appear to be an issue, with one in three SMSFs paying 25 bps or less in MER (management expense ratio) (Fahrer 2010).

Unfortunately, and outside the Cooper Review's (2010a) recent evidence, there is relatively little work on efficiency measurement in superannuation funds, in stark contrast with most other financial services and products [see Berger et al. (1993), Berger and Humphrey (1997) and Worthington (2010) for suitable surveys]. This is an important deficiency because of the ability of investment and operating costs, as reflected in member fees, to erode retirement benefits. For example, Bikker and de Dreu (2006) argue that an increase in annual operating costs of just one percent of pension fund assets implies a cumulative reduction of 27% in eventual benefits, or equivalently, an increase of more than 37% in pension costs [see also Bateman et al. (2001)]. Similarly, the Cooper Review (2010a) details Treasury evidence that the benefit of its proposed MySuper reforms incorporating a roughly 40 percent fee cut would lift the average worker's final superannuation balance by around $40,000 or 7 percent. Moreover, even less attention is paid to the particular role of economies of scale and scope in improving the level of cost efficiency in superannuation funds. For instance, the Cooper Review (2010a: 112) emphasizes scale as a dominant factor in the determination of both investment and operating costs in superannuation funds: "In relation to a superannuation fund, scale advantages can relate to investment fees, in-house investment expertise, private placement capabilities, ability to spread investment risk through diversification, reduced administrative unit costs, and enhanced availability of education, information and service".

Of the literature that does exist concerning economies of scale and scope in superannuation funds, we may identify two separate though related strands. The first, much smaller strand, concerns the few studies investigating the influence of superannuation (pension) fund characteristics on operating costs, primarily focusing on scale and experience in the US (Mitchell and Andrews 1981; Mitchell 1998; Ghilarducci and Terry 1999; Barber et al. 2005), but also Australia (Clare 2001; Bateman 2001; Bateman and Mitchell 2004), Ireland (Mahon 2006) and the UK (Audit Commission 2006) along with some international comparisons (Whitehouse 2000; Dobrogonogov and Murthi 2005; James et al. 2005). Overall, the findings suggest that significant economies of scale may be attained in operating costs and that these costs vary significantly across both systems and funds.

The second, much larger, strand examines the costs of investment (mostly in terms of their ability to generate abnormal returns) incurred by mutual funds [see Dermine and Roller (1992), Malhotra and McLeod (1997), Latzko (1999), Bauer et al. (2006), Malhotra et al. (2007), Bauer et al. (2010)] and sometimes REITs (Bers and Springer 2007). In this regard, Bikker and De Dreu (2006) argue that the costs of investment operations for mutual funds are similar to pension funds (indeed many pension funds invest in mutual funds) and so the mutual fund literature offers useful insights into the investment costs of pension funds. Once again, the evidence is that substantial unused economies of scale relate to costs in the mutual fund industry, and by inference, the overall pension system.

For the most part, just three studies are broadly related to the objective of this paper to estimate economies of scale and scope in Australian superannuation funds. First, Ang and Wuh Lin (2001) also employ cost functions to estimate economies of scale and scope, though in the context of US mutual funds. The main emphasis there is on the parameter estimates for different fund characteristics (including asset allocation and investment strategy) with the findings indicating strong economies of scale in operating expenses but only weak evidence of economies of scope in multiproduct funds. Second, Malhotra et al. (2001) estimate a translog cost function for retail superannuation funds in

Australia in 1999/2000. Putting aside that this analysis is now rather dated, the emphasis lies with estimates of cost elasticities at the mean and not economies of scale at different levels of output. No attention is paid to economies of scope. Finally, Bikker and de Dreu (2006, 2009) formulate models of investment and operating costs for Dutch pension funds, but as with Malhotra et al. (2001) there is no attempt to estimate economies of scope nor discuss scale and scope efficiencies at different levels of observed output. Nevertheless, it is in the spirit of the latter that this study is most framed.

The paper is divided into four main sections. Section 2 briefly discusses the investment and operating costs in superannuation funds and how the theoretical and conceptual sources of economies of scale and scope apply. Section 3 deals with the specification of superannuation fund costs and outputs. Section 4 focuses on the cost function specification used to estimate the economies of scale and scope and Section 5 presents the results. The paper ends with some concluding remarks in the final section.

2. Economies of scale and scope in superannuation funds

In general, we can divide the overall costs required to operate a superannuation fund into two areas: investment costs and operating (or administration) costs. To start with, investment-related costs are those expenses required to make and undertake investment decisions and, according to the Cooper Review (2010a), are quite properly related to the assets under management, principally investment, custodian and asset management fees. As also noted by the Cooper Review (2010a), while the quantum of these costs are expected to increase proportionately to the amount of assets under management, they will necessarily vary with whether the assets are managed actively or passively, the nature of the underlying asset distribution, the extent to which the trustee has decided to in invest in alternative and illiquid assets, and the size of the assets under management.

For instance, while the Cooper Review (2010a) reasonably suggests that the costs (in basis points) of managing a passively managed portfolio will generally be lower than an equivalent actively managed portfolio, the costs for both will decline as assets increase. One reason for this is that smaller funds generally make key strategic decision regarding investment using external advice and then delegate and monitor (outsource) the managers appointed to implement these decisions. The larger the fund, however, the more likely it will have its own internal investment specialists and the broader the role they will play, with the presumption this can be done at lower cost. Another reason is that many investment costs are fixed and so increasing the assets under management can distribute this over increasing levels of output. Costs will also necessarily vary by asset class and this may well reflect the management skills and information required. For example, the Cooper Review (2010a) concludes that the costs of balanced portfolios will exceed conservative portfolios, with the costs of investment also being relatively higher for international investments over domestic investments and property and equity relative to fixed interest and cash.

By comparison, operating costs in superannuation funds largely reflect the transaction-based needs of members across a wide range of services, including the customer interface (call centres, websites, mailrooms, marketing), back-office processing (new members, benefit payments, contribution uploads, compliance, audit and reporting), and record-keeping systems (information technology, member records, transactions, and investment support), comprising expenses on both labour and physical capital. Importantly, some of these services are almost universally handled by external parties (such as custodian services) whereas others are found along a spectrum of in-house and external third-party providers. Equally importantly, while most of these costs are positively related to fund membership, they have the propensity to decline with average account size.

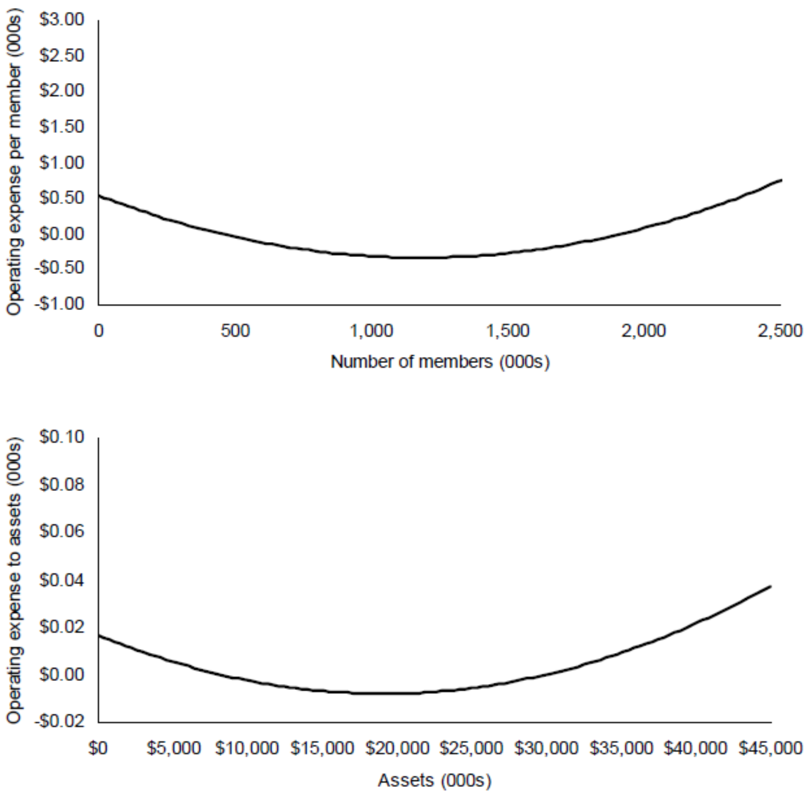
That said, the Cooper Review (2010a) identifies four principal patterns of behaviour with operating costs and these typically vary by the type of fund. First, most corporate funds will typically partner with a third party to deliver the bulk of administrative services, with the major role of the (small) trustee office being to liaise with and manage the service providers. Second, industry funds will generally work with an administrator for day-to-day processing; smaller industry funds will tend to operate their own departments with purchased software or boutique administration services companies. Third, wealth management organizations will generally maintain their own internal administration, including an independent trustee office working closely with the administrative arm. Finally, public sector funds sometimes use a specialist administer that has evolved alongside the fund.

In terms of both theory and the goal of maximising member benefits net of costs, a possible long-run cost objective for a superannuation fund is to be in a position to produce the desired output (or outputs) at the lowest possible cost (or cost minimisation). Based on the above discussion, the principal outputs for most superannuation funds would appear to be assets (for investment costs) and members (for operating costs). Among other things, this means adjusting the scale of production to the most appropriate size. Sometimes dividing the production process into smaller more specialized production units can result in economies, as evidenced by the allocation of some superannuation funds tasks across divisions or departments. On other occasions, enlarging the scale of production can achieve lower unit costs. This can proceed over time through a continuum ranging from the internal provision of services through to full contracting out. Through this process, superannuation funds overcome indivisibilities in factor inputs, avoid the costs of a lack of capacity, and gain access to economies in the fixed costs of production including purchasing, marketing and administration (including human resources and information technology).

The production process for a specific output (say, dollar value of assets or number of members) is then said to exhibit *economies of scale* when average cost (*AC*) (i.e. cost per unit of output) declines over some range (where $AC = TC/Q$). For long-run average cost (*LRAC*) to decline, the marginal cost (*MC*) (i.e. the cost of the last unit produced) must be less than overall average costs (where $MC = \Delta TC/\Delta Q$). If average cost is increasing, then marginal cost must exceed average cost and production exhibits *diseconomies of scale*. It is thought that diseconomies of scale could arise from a number of sources. These include the increase in input prices as industry constraints on factor availability apply, the reduction of incentives and the growth of bureaucracy in large organisations, and the increasing lack of specialised resources in once small markets.

In the superannuation industry, as in most industries, it is thought that average costs are U-shaped in cost–output space, so that the smallest and largest funds have equally high costs relative to medium-sized funds. That is, on either side of the *minimum efficient scale* (MES) of production, costs are rising so output less than or more than the MES is inefficient from a cost perspective. This would appear to match the simple analysis in Figure 1 where a quadratic function is fitted to a scatter plot of observations using the data to be employed in this analysis. As shown, both operating costs per member and operating costs per dollar value of assets display a distinct U-shaped pattern. In practice, there is potentially much variation. One possibility is that economies of scale are negligible and diseconomies dominate at relatively low levels of output. Elsewhere, economies of scale may be extremely important and decline continuously over a wide range until output diseconomies are experienced. This results in cost efficient outputs for output levels equal to and exceeding the MES.

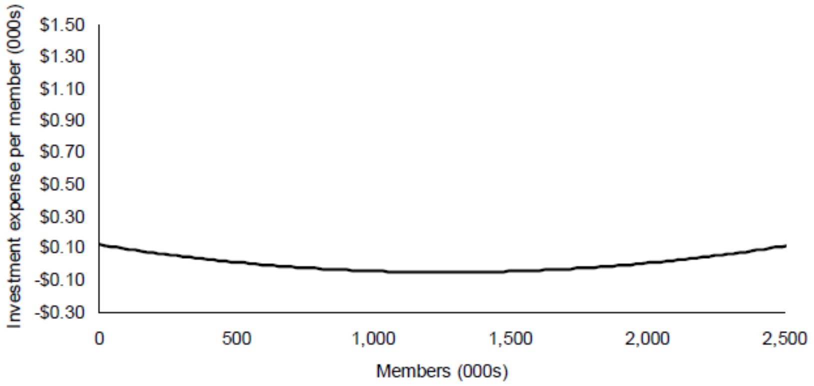
Figure 1 Operating costs per member and dollar value of assets

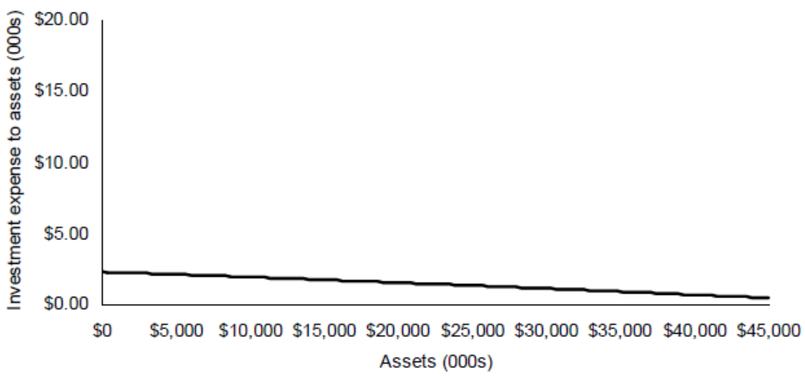


In yet other contexts, the LRAC may be virtually horizontal over a wide range of output: economies of scale are quickly exhausted though diseconomies are not encountered until very large levels of output are produced. These L-shaped cost curves are indicative that small, medium, and large-sized superannuation funds could operate with an approximately equal level of cost efficiency beyond the point of MES where average costs are either flat or only slightly increasing. This would seem to be the case in Figure 2 where investment costs per member are increasing only slightly while investment costs per dollar value of assets appear to be declining over a large range of output.

The presence of economies (diseconomies) of scale rests on the functional relationship between the costs of production and the rate of output per period. In other words, costs = f(output). However, the rate of output is, in turn, a function of the rate of usage of the resource inputs: that is, output = f(inputs). As the production function displays the relationship between input and output flows, once the prices of the inputs (or factor prices) are known, the costs of a specific quantity of output can be calculated. Consequently, the level and behaviour of costs as a fund's rate of output changes (as evidenced by the LRAC) depends on two important factors: (i) the character of the underlying production function and (ii) the prices the firm must pay for its resource inputs. Generally, the first factor determines the shape of the cost function while the second determines the level of costs.

Figure 2 Investment costs per member and dollar value of assets





Consider now a superannuation fund using L units of labour (say, investment management and administrative labour) in combination with K units of capital (both financial and physical) to obtain an output of Q units such that $L + K \rightarrow Q$. Now assume that the amounts of labour and capital are increased by some arbitrary proportion a with the expected proportional increase in output given by b such that $aL + aK \rightarrow bQ$. When the change in output is more than proportional to the change in input ($b > a$), *increasing returns to scale* are found. For example if the inputs of labour and capital increase by 20%, output rises by 30%. Alternatively, when the change is less than proportional to the change in inputs ($b < a$), the firm experiences *decreasing returns to scale*. An example here would be the labour and capital inputs increase by 20% but outputs only rise by 10%. Finally, where the change in output is proportional to the change in inputs ($b = a$) *constant returns to scale* are present. In this case, increasing inputs by 20% would also result in output increasing by 20%.

It is often tempting to use the terms economies (diseconomies) of scale (a cost concept) and increasing (decreasing) returns to scale (a production concept) interchangeably. While strictly incorrect, to yield economies of scale the production function must have some region of increasing returns to scale, and to yield diseconomies of scale it must have a region where there are decreasing returns to scale. In fact, the levels of output where economies (diseconomies) of scale and increasing (decreasing) returns to scale occur will exactly correspond when the firm faces constant input prices as output expands. This is most likely to occur for a relatively small entity in a competitive industry where the input demand by one firm is likely to be small relative to total market demand. In other cases, however, where the firm's demand for inputs is large relative to total industry demand, situations may arise where economies of scale occur at the same time that the firm experiences constant (or even decreasing) returns to scale.

Consider, for example, a superannuation fund with constant returns-to-scale in a decreasing cost industry. If the inputs (L, K) increase by a given proportion (a), output (Q) will expand by the same proportion (b) such that $b = a$ (i.e. constant returns-to-scale). However, if input prices decline as Q rises, it follows that the average costs of producing aQ must be less than the average cost of producing Q, and long-run average costs must fall (i.e. economies of scale). Similar arguments show that production can even exhibit decreasing returns-to-scale and we can still attain economies of scale so long as the impact on average costs by the decline in factor prices sufficiently offsets the increased use of inputs and vice versa.

In the above discussion, a single output (member accounts and assets) is considered. Once multiple product production arises, the presence or absence of complementarity between outputs in production in a firm becomes important. This diversity of products (goods or services) within a single firm (or superannuation fund in this case), known as 'scope', may provide cost advantages in that a single fund producing a given level of output for product may spend less than a combination of several specialised funds. That is, economies of scope arise when it is cheaper in terms of total cost (TC) to produce some level Q of product A in conjunction with some level of product B, rather than each separately, $TC(Q_A, Q_B) < TC(Q_A, 0) + TC(0, Q_B)$. Among firms, this process often manifests itself in the jargon as leveraging core competences, competing on capabilities, mobilizing invisible assets, diversification into related products, and umbrella branding. In the case of production in superannuation funds, the production process typically comprises multiproduct attributes because it produces multiple products (different investment options, member services, and returns) through the sharing and joint utilisation of inputs including investing management and administrative labour, custodian services, information technology, human resources, and so on.

3. Specification of outputs and costs

The data consists of fund-level observations of Australia's 200 largest superannuation funds. This data is obtained from the Australian Prudential Regulation Authority (APRA) as published in the *Superannuation Fund-level Rates of Return* and *Superannuation Fund-level Profiles and Financial Performance* and prepared from the superannuation returns submitted to APRA under the *Financial Sector (Collection of Data) Act 2001*. Unfortunately, only the data for 1999 (issued in March 2010) is currently available (the next scheduled release is in 2011) and even this follows an extended period of consultation that first began in November 2008 when a discussion paper on fund level disclosure of APRA's superannuation statistics collection was released, followed in August 2009 by a determination by APRA on the release of certain non-confidential information.

Stochastic cost functions typically regress costs (here separated into investment and operating costs) on the quantity and price of the factor inputs used in production (typically capital and labour) and the outputs produced. Unfortunately, the limited data released by APRA does not permit full specification of the prices and quantities of the factor inputs. For example, it would be typical in a bank cost function to specify the quantity of labour employed (where the price is the average wage and salary) along with the dollar value of deposits and other borrowings reflecting the input of financial capital (where the price is the average deposit rate) and some measure of physical capital (say, the dollar value of physical assets) (where the price could be the rate of depreciation on physical capital). As this data is not available, it amounts to the assumption that input prices are constant across the superannuation industry and so the quantity of factor inputs employed in production is proportional to the quantity of investment expenses—including investment, custodian and asset management fees—and operating expenses—comprising management, administration, actuarial, director and trustee fees and charges. Fortunately, this is not too unrealistic in that Australian superannuation funds are arguably price-takers operating in highly competitive global factor markets.

Table 1 Selected descriptive statistics

	Cash-flow adjusted assets ($ mil.) (CAS)	Number of investment options (IOP)	Percentage of funds in defined benefit (%) (DEF)	Five-year return (%) (FIV)
Mean	3435.4930	97.1421	51.3484	3.3775
Maximum	43584.5300	2752.0000	100.0000	9.6400
Minimum	176.4190	1.0000	0.0000	-0.4400
Std. Dev.	6145.1620	333.8608	33.7765	1.3430
Skewness	3.6646	5.9853	-0.0158	0.4265
Kurtosis	18.5560	43.4502	1.5539	4.8195
	Cash-flow adjusted assets ($ mil.) (CAS)	Number of members (MEM)	Net contributions ($ mil.) (CNT)	Net rollovers ($ mil.) (RLL)
Mean	3435.4930	153.9352	193.4730	22.1628
Maximum	43584.5300	2642.9670	2911.0470	1744.0210
Minimum	176.4190	0.9520	-639.7790	-514.9150
Std. Dev.	6145.1620	353.2147	497.1930	247.2119
Skewness	3.6646	4.1877	3.2377	3.7179
Kurtosis	18.5560	22.8917	14.9612	22.8568

Four outputs each are specified for the investment and operating functions of superannuation funds. Table 1 includes selected descriptive statistics. For investment costs these are: cash flow adjusted assets (CAS) (in $ millions), the number of investment options (IOP) (n), the percentage of funds in defined benefits (DEF) (%), and the five-year average return (FIV) (%). The justification is that while it is generally accepted that the costs of investment are expected to increase proportionately to the amount of assets under management, they will also necessarily vary with whether the assets are managed actively or passively, the nature of the underlying asset distribution, the extent to which the trustee has decided to in invest in alternative and illiquid assets, and the size of the assets under management. On this basis, as the number of investment options increases, so too will the costs associated with management, while a larger proportion of members in a defined benefit fund will tend to place downward pressure on investment costs associated with a relatively more conservative strategy. Lastly, it is expected that higher investment returns will ultimately only result from increased investment expenses at the fund level, even if only for the fact that management securing higher returns will demand a premium for its services.

Turning to operating costs, the four outputs are cash flow adjusted assets (CAS) (in $ millions), the number of members (MEM) (n), net contributions (CNT) (in $ millions) and net rollovers (RLL) (also in $ millions). The principal argument here is that operating costs are mostly related to transaction-related services within the fund and that these will first and foremost vary with the number of fund members. However, they will also vary with the average account size (as reflected in the interaction with assets under management) and the frequency and magnitude of members' principal transactions with the fund in terms of contributions and rollovers. Given the extremely limited literature in this area it is difficult to build a strong case for either specification on the basis of assumptions used in previous studies. Nonetheless, it is comparable to that employed in Bikker and de Dreu (2006) where investment and operating costs were specified as a common function of investment funds, liabilities of various types, the percentage invested in stocks, and the proportion of pensioner and inactive members. Bikker and de Dreu (2006) also included dummy variables for industry, professional, company and defined contribution funds and a similar attempt was made in this study to identify retail, industry and corporate funds and those offering either an accumulation, hybrid or defined benefit. Regrettably, the variance inflation factors for these dummies greatly exceeded ten, thereby indicating the presence of harmful multicollinearity, and accordingly removed from the final specifications.

4. Model specification

A cost function is employed to estimates the economies of scale and scope in Australian superannuation funds. The basic assumption is that superannuation funds seek to minimise their costs at some chosen level of output. A quadratic cost function is used for this purpose. This has the advantage of a flexible specification applicable to multifactor production. The cost function is also an appropriate form to take account of the linear, quadratic and cross-product terms found with more than a single output. A cost function that allows the economies of scale to vary with the different levels of output is specified as:

$$C = \alpha_0 + \sum_{i=1}^{4} \alpha_i y_i + 1/2 \sum_{i=1}^{4} \beta_i (y_i)^2 + \sum_{\substack{i,j=1 \\ i \neq j}}^{4} \delta_{ij} y_i y_j + \varepsilon_i \quad (1)$$

where α_0 is the fixed cost term, α_i (i = 1, 2, 3, 4) are the slope coefficients of the linear term, β_i (i = 1, 2, 3,4) are the slope coefficients of the quadratic terms, δ_{ij} (i = 1, 2, 3, 4, j = 1, 2, 3, 4 and $i \neq j$), are the slope coefficients of the cross-product terms, C is the of the total operating costs of each superannuation fund (in $000) and y_1 to y_4 represent the four outputs.

The cost function in (1) allows the estimation of the economies of scale and scope. These are defined as ray economies of scale, product-specific economies of scale and product-specific economies of scope. Under ray economies of scale, the composition of each superannuation fund's output is assumed to remain fixed while the aggregate size of output varies. This provides a measure of scale analogous to the single output case where ray economies (diseconomies) of scale exist if the measure is greater (less) than unity. Product specific economies of scale, however, allow one output to vary, while all other outputs are held constant. Product-specific economies (diseconomies) of scale then exist if the measure is greater (less) than unity. Finally, product-specific economies of scope measure whether the cost of producing the outputs jointly is less than the costs of producing them separately. A value greater than or equal to zero thus indicates that cost advantages accrue through the joint production of outputs.

The method for calculating these measures is as follows. First, the average incremental cost, $AIC(y_i)$ for producing output y_i is defined as:

$$AIC(y_i) = \frac{C(y) - C(y_{N-i})}{y_i} \qquad i = 1, 2, 3, 4 \tag{4}$$

where $C(y)$ is the total cost of producing the four outputs and $C(y_{N-1})$ is the total cost of producing zero units of the *i*th output. In the case of a single product, the economies of scale are measured by the average incremental cost divided by the marginal cost. The product-specific economies of scale for y_i, $E(y_i)$ are specified as:

$$E(y_i) = \frac{AIC(y_i)}{MC(y_i)} \tag{5}$$

where $MC(y_i) = \partial C / \partial y_i$ is the marginal cost of producing y_i units of output. Ray economies of scale exist when the quantities of the product are increased proportionately and are presented as:

$$E(RAY) = \frac{C(y)}{\sum_{i=1}^{4} y_i \times MC(y_i)} \tag{6}$$

If $E(y_i)$ or $E(RAY)$ is greater than one (less) than one then economies of scale (diseconomies of scale) exists for output y_i. Second, economies of scope can be divided into global economies of scope (*GES*) and product-specific economies of scope (*PES*) and these are defined as:

$$GES(y_i) = \frac{\sum_{i=1}^{4} C(y_i) - C(y)}{C(y)} \tag{7}$$

The product-specific economies of scope are calculated as:

$$PES(y_i) = \frac{C(y_i) + C(y_{N-i}) - C(y)}{C(y)} \tag{8}$$

5. Empirical results

The estimated coefficients, standard errors and *p*-values of the investment and operating quadratic cost functions are presented in Table 2. It is clear that the model will inevitably have some multicollinearity as the explanatory variables contain a linear combination of outputs together with squared and cross-product terms. Accordingly, it is generally difficult to interpret the estimated slopes of quadratic cost functions. The R^2 for the investment cost function reported on the left-hand side of Table 2 is 0.6470 while that for the operating cost function on the right-hand side is 0.7776. The null hypotheses of no output effects are jointly tested in addition with various tests of no linear, quadratic and output cross-product effects with Chi-squared test statistics. All hypotheses are rejected at the one percent level of significance, thus suggesting that jointly all explanatory variables should be included in estimating the investment and operating cost functions for Australian superannuation funds.

The estimated quadratic cost functions in Table 2 are used to estimate the marginal costs (MC) and average incremental costs (AIC) for each of the four superannuation fund outputs (CAS, IOP, DEF and FIV for investment costs and CAS, MEM, CNT and RLL for operating costs) for levels of mean output running from 50% to 300% (i.e. 100% is the mean output in the sample data) in Table 3. The mean values are $3,435 for CAS, 97.14 for IOP, 51.34% for DEF, 3.37% for FIV, 153.93 for MEM, $193.47 for CNT and $22.16 for RLL.

Table 2 Estimated cost function

Investment costs						Operating costs					
Variable		Coefficient	Std. Error	t-Statistic	Prob.	Variable		Coefficient	Std. Error	t-Statistic	Prob.
C	α_0	7785.6090	4383.4570	1.7761	0.0774	C	α_0	192.6253	1561.3220	0.1234	0.9020
CAS	α_1	-1.4574	0.9082	-1.6048	0.1103	CAS	α_1	5.0082	1.2489	4.0102	0.0001
IOP	α_2	0.5851	8.9677	0.0652	0.9481	MEM	α_2	30.6483	11.6216	2.6372	0.0091
DEF	α_3	-28.7158	122.1786	-0.2350	0.8145	CNT	α_3	15.3724	15.7031	0.9789	0.3290
FIV	α_4	-1725.1990	1508.0080	-1.1440	0.2542	RLL	α_4	-15.3239	22.1377	-0.6922	0.4897
$.5\times CAS^2$	β_1	0.0000	0.0000	-1.3005	0.1951	$.5\times CAS^2$	β_1	0.0007	0.0004	1.5193	0.1305
$.5\times IOP^2$	β_2	-0.0004	0.0156	-0.0242	0.9807	$.5\times MEM^2$	β_2	-0.0194	0.0149	-1.3032	0.1942
$.5\times DEF^2$	β_3	0.6318	1.8871	0.3348	0.7382	$.5\times CNT^2$	β_3	-0.0407	0.0397	-1.0257	0.3065
$.5\times FIV^2$	β_4	380.0642	466.0736	0.8155	0.4159	$.5\times RLL^2$	β_4	-0.1497	0.0790	-1.8938	0.0599
CAS×IOP	δ_{12}	0.0022	0.0015	1.4730	0.1426	CAS×MEM	δ_{12}	-0.0087	0.0048	-1.8195	0.0705
CAS×DEF	δ_{13}	0.0090	0.0067	1.3357	0.1834	CAS×CNT	δ_{13}	-0.0062	0.0039	-1.6185	0.1074
CAS×FIV	δ_{14}	0.8976	0.1105	8.1262	0.0000	CAS×RLL	δ_{14}	0.0046	0.0024	1.9239	0.0560
IOP×DEF	δ_{23}	0.0589	0.1394	0.4226	0.6731	MEM×CNT	δ_{23}	0.1169	0.0465	2.5127	0.0129
IOP×FIV	δ_{24}	-1.9881	6.6670	-0.2982	0.7659	MEM×RLL	δ_{24}	-0.0160	0.0460	-0.3484	0.7280
DEF×FIV	δ_{34}	-9.5886	19.4821	-0.4922	0.6232	CNT×RLL	δ_{34}	0.0743	0.0465	1.5982	0.1118
R-squared		0.6470				R-squared		0.7776			
F-statistic		22.9072			0.0000	F-statistic		43.6986			0.0000

Consider the marginal costs of investment on the left-hand side of Table 3 in the lower panel. As shown, investment costs decline continuously as output (as measured by cash flow adjusted assets) increases from 50% to 300% of the current mean output of Australia's 200 largest superannuation funds. This is also the case for the number of investment options (IOP) suggesting that larger funds with more investment options find it increasingly less costly on a marginal basis. However, the marginal costs increase as the share of defined benefits (DEF) in the fund and the five-year return (FIV) increases, suggesting that better investment performance comes at a price to net benefits. A similar picture emerges with the operating cost function on the right-hand side of Table 3. As shown, the main driver of operating costs at higher levels of output appears to be size of the fund in terms of cash flow adjusted assets (CAS) and the amount of fund rollovers (RLL). At all but the lowest level of mean output, the number of members (MEM) and the levels of contributions (CNT) have only a small impact on operating costs, suggesting that most operating costs are fairly small per member and dollar value of contributions once some minimum fund size is attained.

Table 3 Marginal and average incremental costs

		Investment costs				Operating costs			
	Levels at Means	CAS	IOP	DEF	FIV	CAS	MEM	CNT	RLL
Average incremental costs (AIC)	50%	0.3576	2.5098	0.0000	0.0000	0.3577	26.0977	12.5012	109.1305
	75%	1.2650	3.4721	0.0000	554.9150	0.0365	23.8224	11.0655	96.5980
	100%	2.1725	4.4344	0.0000	1314.9530	0.0000	21.5471	9.6299	84.0655
	125%	3.0800	5.3967	0.0000	2074.9910	0.0000	19.2719	8.1943	71.5330
	150%	3.9875	6.3591	1.8424	2835.0290	0.0000	16.9966	6.7587	59.0006
	175%	4.8950	7.3214	6.9354	3595.0670	0.0000	14.7213	5.3230	46.4681
	200%	5.8025	8.2837	12.0284	4355.1050	0.0000	12.4460	3.8874	33.9356
	225%	6.7100	9.2460	17.1215	5115.1430	0.0000	10.1707	2.4518	21.4031
	250%	7.6175	10.2084	22.2145	5875.1810	0.0000	7.8954	1.0162	8.8707
	300%	9.4325	12.1330	32.4006	7395.2570	0.0000	3.3449	0.0000	0.0000
Marginal costs (MC)	50%	3.6300	3.8493	20.3618	3040.1520	0.0000	4.3413	1.0355	16.4395
	75%	3.5920	3.8401	28.4717	3361.0700	0.0000	0.0000	0.0000	20.3637
	100%	3.5541	3.8310	36.5815	3681.9881	0.0000	0.0000	0.0000	24.2879
	125%	3.5161	3.8218	44.6914	4002.9061	0.4545	0.0000	0.0000	28.2121
	150%	3.4781	3.8127	52.8012	4323.8242	1.0343	0.0000	0.0000	32.1363
	175%	3.4402	3.8035	60.9111	4644.7422	1.6140	0.0000	0.0000	36.0605
	200%	3.4022	3.7944	69.0209	4965.6602	2.1937	0.0000	0.0000	39.9847
	225%	3.3643	3.7852	77.1307	5286.5783	2.7735	0.0000	0.0000	43.9089
	250%	3.3263	3.7761	85.2406	5607.4963	3.3532	0.0000	0.0000	47.8331
	300%	3.2504	3.7577	101.4603	6249.3324	4.5127	0.0000	0.0000	55.6814

The product-specific (E) and ray (RAY) economies of scale for investment and operating costs are presented in the upper panel of Table 4. As defined earlier, the point estimates represent the degrees of ray economies (diseconomies) of scale: if the point estimate is greater than unity, then ray economies of scale exist across the output set. As shown, ray economies (the proportional augmentation of output holding composition constant) exist from 50% to 300% of the mean output over the sample period for both investment and operating expenses. This suggests that the sector as a whole is currently experiencing economies of scale and there is a clear incentive to expand the production of all outputs to exploit existing potential scale economies. However, while the ray economies for investment costs are continuously increasing at an increasing rate those for operating costs are increasing at a decreasing rate. Ultimately, at some level above 300% of the current mean output, diseconomies of scale will impact upon operating costs in Australia's superannuation funds.

The upper panel in Table 4 also includes the product-specific economies of scale. These are the scale economies that exist were an output increased in isolation. As shown, for investment costs there are product-specific economies of scale from 150% to 300% of current mean output for CAS, from 100% to 300% for IOP and from 250% to 300% for FIV. This complements evidence from the previous table that the main drivers of scale economies in superannuation funds are increasing the level of assets under management and the number of investment options. Turning to operating costs, the product-specific economies of scale only operate for relatively narrow bands at fairly low levels of output. This suggests that scale economies in operating costs can only be realised when increasing all transaction-related activities in proportion within the same fund.

Unlike many other industries, production in Australian superannuation funds does not typically involve full joint production of the various investment and operating outputs given the tendency for funds to choose various combinations of contracted out and in-house provision of both investments and operations. This would appear justified in the lower panel of Table 4 where there are global economies of scope (GES) only for operating costs at fairly high levels of mean output (150% to 300%). There would appear to be no economies of scope possible in investment overall, and only some product-specific economies of scope for the IOP, DEF and FIV at extremely low levels of output. Overall, this would suggest there is little incentive for superannuation funds to undertake all of their various investment and operating activities in-house once the fund has reached just 50% to 75% of the current level of mean output. Beyond this point, there are certainly strong economies of scale in both investments and operations, and thus an incentive for the fund to grow larger through increasing assets under management and the number of members through growth or fund consolidation, but little evidence of economies of scope. Hence, it is highly cost-effective for large superannuation funds to contract-out many of their investment and operating activities.

Table 4 Economies of scale and scope

	Levels at Means	Investment costs					Operating costs				
		E(CAS)	E(IOP)	E(DEF)	E(FIV)	E(RAY)	E(CAS)	E(MEM)	E(CNT)	E(RLL)	E(RAY)
Scale economies	50%	0.0985	0.6520	0.0000	0.0000	3.2737	0.0000	6.0115	12.0729	6.6383	2.7133
	75%	0.3522	0.9042	0.0000	0.1651	2.6778	0.0000	0.0000	0.0000	4.7436	2.5680
	100%	0.6113	1.1575	0.0000	0.3571	2.9277	2.2737	0.0000	0.0000	3.4612	2.4396
	125%	0.8760	1.4121	0.0000	0.5184	3.5160	0.0000	0.0000	0.0000	2.5355	2.3179
	150%	1.1465	1.6679	0.0349	0.6557	4.2735	0.0000	0.0000	0.0000	1.8359	2.1996
	175%	1.4229	1.9249	0.1139	0.7740	5.1277	0.0000	0.0000	0.0000	1.2886	2.0832
	200%	1.7055	2.1832	0.1743	0.8770	6.0423	0.0000	0.0000	0.0000	0.8487	1.9680
	225%	1.9945	2.4427	0.2220	0.9676	6.9972	0.0000	0.0000	0.0000	0.4874	1.8537
	250%	2.2901	2.7034	0.2606	1.0477	7.9802	0.0000	0.0000	0.0000	0.1855	1.7399
	300%	2.9020	3.2288	0.3193	1.1834	10.0027	0.0000	0.0000	0.0353	0.0000	1.5134
	Levels at Means	PSE(CAS)	PSE(IOP)	PSE(DEF)	PSE(FIV)	GES	PSE(CAS)	PSE(MEM)	PSE(CNT)	PSE(RLL)	GES
Scope economies	50%	0.9165	1.5316	1.5398	1.1471	4.1178	0.4440	0.0941	0.0542	0.0542	0.6231
	75%	0.1013	1.2293	1.2442	0.5241	2.8130	0.6708	0.1162	0.0530	0.0530	0.7194
	100%	0.0000	0.8249	0.8431	0.0000	1.4080	0.9253	0.1470	0.0583	0.0583	0.8423
	125%	0.0000	0.5339	0.5528	0.0000	0.4911	1.2076	0.1835	0.0669	0.0669	0.9847
	150%	0.0000	0.3529	0.3715	0.0000	0.0000	1.5203	0.2253	0.0778	0.0778	1.1458
	175%	0.0000	0.2410	0.2591	0.0000	0.0000	1.8677	0.2725	0.0908	0.0908	1.3267
	200%	0.0000	0.1695	0.1870	0.0000	0.0000	2.2555	0.3258	0.1060	0.1060	1.5299
	225%	0.0000	0.1218	0.1389	0.0000	0.0000	2.6907	0.3859	0.1233	0.1233	1.7589
	250%	0.0000	0.0888	0.1055	0.0000	0.0000	3.1825	0.4541	0.1433	0.1433	2.0184
	300%	0.0000	0.0478	0.0638	0.0000	0.0000	4.3856	0.6215	0.1928	0.1928	2.6547

6. Concluding remarks

This study examined economies of scale and scope in Australian superannuation fund in 1999. Costs were defined separately in terms of investment expenses—including investment, custodian and asset management fees—and operating expenses—comprising management, administration, actuarial, director and trustee fees and charges. Four distinct outputs were also specified for each type of cost: namely, cash flow adjusted net assets, the number of investment options, the proportion of total assets in the default strategy and the five-year rate of return for investment costs, and cash flow adjusted net assets, the number of members, net contribution flows and net rollovers for operating expenses. Product-specific and ray economies of scale and product-specific and global economies of scope are calculated using estimates from a quadratic cost function. The main findings are as follows.

First, there is evidence of ray economies of scale (assuming the composition of outputs remains unchanged) up to at least 300% of current mean output in both investments and operations. After this point, there is some evidence that diseconomies of scale in operations may arise and so there is little incentive for universities to expand output far beyond that level. However, the economies of scale in investment costs increase at an increasing rate up to 300% of the current level of output and this suggests that diseconomies in investment costs (if they do exist) will only apply at much higher levels of output than currently found in the Australian superannuation fund industry. Second, in contrast the evidence for economies for scope is very weak, with global economies of scope only found in operations and then only slowly at very high levels of output. This suggests that only the largest funds will benefit in cost terms from full in-house production of administrative services and that for the typical superannuation fund there are substantial cost savings in contracting-out many administrative tasks and nearly all investment activities (or at least, no cost savings in in-house production).

Of course, this analysis has a number of limitations and these provide useful avenues for future research. The main limitation is data availability in that only a single cross-section of the fund-level returns provided to APRA is currently available. Certainly, the estimated parameters of any cost function will be more robust if it is possible to employ panel data, but this will not be possible until 2011 for the 2010 data. Another limitation is that APRA has only released certain fund level information. Once again, a larger set of candidate explanatory variables would enable a more comprehensive analysis to be made.

References

Ang, J.S. and Wuh Lin, J. (2001), A fundamental approach to estimating economies of scale and scope of financial products: The case of mutual funds, *Review of Quantitative Finance and Accounting*, 16, 205-222.

Audit Commission (2006) Efficiency challenge: Cost of administering local government pension funds in London, Local Government National Report, available at: http://www.audit-commission.gov.uk/.

Barber, B., Odean, T., & Zheng, L. (2005). Out of sight, out of mind: the effects of expenses on mutual fund flows. *Journal of Business*, 78(6), 2095–2119.

Bateman, H. (2001) Disclosure of superannuation fees and charges, Centre for Pensions and Superannuation, Discussion Paper No. 03/04, available at: http://www.superannuation.asn.au.

Bateman, H. Kingston, G., and Piggot, J. (2001) *Forced Saving: Mandated Private Retirement incomes*, Cambridge University Press, Cambridge.

Bateman, H. and Mitchell, O.S. 2004, New evidence on pension plan design and administrative expenses: the Australian experience, *Journal of Pension Economics and Finance* 3, 63-76.

Bauer, R. Frehen, R. Lum, H. and Otten, R. (2006) Economies of scale, lack of skill or misalignment of interest: A study on pension and mutual fund performance, Rotman International Centre for Pension Management (ICPM) Working Papers, available at: http://www.rotman.utoronto.ca/icpm/.

Bauer, Rob, Cremers, Martijn and Frehen, Rik G. P., (2010) *Pension Fund Performance and Costs: Small is Beautiful* (April 30, 2010). Available at SSRN: http://ssrn.com/abstract=965388.

Berger A.N. and Humphrey D.B., 1997, 'Efficiency of financial institutions: International survey and directions for future research', *European Journal of Operational Research*, 98, 175–212.

Berger A.N., Hunter W.C. and Timme S.G., 1993, 'The efficiency of financial institutions: A review and preview of research past, present and future', *Journal of Banking and Finance*, 17, 221–249.

Bers, M. and T. Springer, 1997, Economies of scale for real estate investment trusts, *Journal of Real Estate Research*, 14, 275-290.

Bikker, J. & De Dreu, J. (2009). Operating Costs of Pension Funds: the Impact of Scale, Governance and Plan Design. *Journal of Pensions, Economics and Finance*, 863-89.

Bikker, J. and de Dreu, J. (2006) Pension fund efficiency: The impact of scale, governance and plan design, DNB Working Paper, No. 109. Available at: http://ideas.repec.org/p/dnb/dnbwpp/109.html.

Chance, D. M., & Ferris, S. P. (1991). Mutual fund distribution fees: an empirical analysis of the impact of deregulation. *Journal of Financial Services Research*, 5, 25–42

Clare, R. (2001) *Are administration and investment costs in the Australian superannuation industry too high?* Association of Superannuation Funds of Australia, available at: http://www.superannuation.asn.au.

Collins, S., Ph. Mack, 1997, The optimal amount of assets under management in the mutual fund industry, *Financial Analyst Journal* 53(3), 67-73.

Dermine, J. and L. Roller, "Economies of Scale and Scope in French Mutual Funds." *Journal of Financial Intermediation* 283–293, (1992).

Dobronogov, A., M. Murthi, 2005, Administrative fees and costs of mandatory private pensions in transition economies, *Journal of Pension Economics and Finance* 4, 31-55.

Fahrer, M. (2010) Taking super to the next level, *inFinance*, 124(3), 10-14.

Fortin, Rich and Stuart Michelson, 1998, Mutual fund trading costs, *Journal of Investing*, 7, 66-70.

Ghilarducci, T. and Terry, K. (1999) Scale economies in union pension plan administration: 1981-1993, Ind*ustrial Relations* 38(1), pp. 11-17.

Indro, D.C., C.X. Jiang, M.Y. Hu, W.Y. Lee, 1999, Mutual fund performance: Does fund size matter?, *Financial Analysts Journal* 55, 74-87.

James, Estelle, Smalhout, James H. and Vittas, Dimitri, (2005) *Administrative Costs and the Organization of Individual Retirement Account Systems: A Comparative Perspective* (February 2001). World Bank Policy Research Working Paper No. 2554. Available at SSRN: http://ssrn.com/abstract=632621.

Latzko, D., 1999, Economies of scale in mutual fund administration. *Journal of Financial Research*, 22, 3, 331-339.

Mahon, A. (2006) *Irish occupational pensions: An overview and analysis of scale economies*. Presentation to the Irish Association of Pension Funds, available at http://repository.wit.ie/426/.

Malhotra, D., & McLeod, R. (1997). An empirical analysis of mutual funds expenses. *Journal of Financial Research*, 20, 175−190.

Malhotra, D.K. K., Marisetty, Vijaya B. and Ariff, Mohammed, *Economics of Scale in the Retail Superannuation Funds in Australia* (August 2001). EFMA 2002 London Meetings. Available at SSRN: http://ssrn.com/abstract=314395.

Malhotra, D.K. Martin, R. and Russel, P. (2007) Determinants of cost efficiencies in the mutual fund industry, *Review of Financial Economics*, 16, 323-324.

McLeod, R., & Malhotra, D. (1994). A re-examination of the effect of 12b-1plans on mutual fund expense ratios. *Journal of Financial Research*, 17, 237−244.

Mitchell, O.S. and Andrews, E.S. (1981) Scale economies in private multi-employer pension systems, *Industrial and Labor Relations Review*, 34(4), pp. 522-530.

Mitchell, O.S., 1998, Administrative Costs of Public and Private Pension Plans. In: M. Feldstein, ed., *Privatizing Social Security*, NBER. Chicago: University of Chicago Press, 403-456.

Review of the Governance, Efficiency, Structure and Operation of Australia's Superannuation System (Cooper Review) (2010a), *Super System Review, Final Report — Part One: Overview and Recommendations*, Commonwealth of Australia, Canberrra, available at: http://www.supersystemreview.gov.au.

Review of the Governance, Efficiency, Structure and Operation of Australia's Superannuation System (Cooper Review) (2010b), *Super System Review, Final Report — Part Two: Recommendation Packages*, Commonwealth of Australia, Canberrra, available at: http://www.supersystemreview.gov.au.

Twinney, M. eds., *Positioning Pensions for the 21st Century*. Pension Research Council. Philadelphia, PA: Univ. of Pennsylvania Press, 187-208. Reprinted in: Z. Bodie, E P. Davis, eds., 2000, *Foundations of Pension Finance*, London: Edward Elgar.

Whitehouse, E., 2000, Administrative Charges for Funded Pensions: An International Comparison and Assessment, Pension Reform Primer Series, *Social Protection Discussion Paper* No. 16, The World Bank, Washington.

Worthington, A.C. (2010) Frontier efficiency measurement in deposit-taking financial mutuals: A review of techniques, applications, and future research directions, *Annals of Public and Cooperative Economics*, 81(1), 2010, pp. 39-75.