International Variations in Pension Accounting: A Simulation Analysis

Paul J M Klumpes
Liyan Tang
Tanaka Business School
Imperial College London
South Kensington SW72AZ
United Kingdom

ABSTRACT

This paper explores economic theory underlying pension accounting using simulation analysis. Pension assets and liabilities could be discounted using either a traditional discounted cash flow or cost-based matching accounting approach, or using a fair value approach. A simulation analysis is used to examine the effect of alternative discount rate assumptions on the strength of associations between an economic or expected cash flow and two alternative traditional accounting measures of the sponsoring firm's net pension liability and expense. The findings suggest that the reliability and relevance of pension information would be improved by enhancing the consistency of pension discount rate assumptions between US, UK and international GAAP.

1. Introduction

The FASB recently announced an Exposure Draft on the first phase of the revision to current accounting rules and has stated its intention to rewrite the pension accounting rules completely. Part of the impetus behind the FASB's stated intention is to rewrite the pension accounting rules completely. Formerly, only the minimum liability was required to be recognized in the financial statements, while the income reflected a series of accrual-based adjustments that were subject to considerable managerial discretion. The FASB recently promulgated Statement of Financial Accounting Standards No. 158, *Employers' Accounting for Defined Benefit Pension and Other Postretirement Benefit Plans* (FAS 158) to amend FAS 87 and FAS 106 with respect to financial disclosures of pensions and other postretirement. An unprecedented change towards ameliorating relevance of financial reporting is mirrored in the provision of reporting the funded status of a benefit plan sponsored by an employer. FAS 158 defines the funded status of a pension plan in terms of the fair value of pension assets as compared with the projected benefit obligation, and as such advances usage f future information in accounting for pensions. This paper discusses the economic underpinnings of pension accounting rules and considers the impact of alternative treatments for representing the economics of pension accounting in financial statements.

Actuarial valuations based on discounting principles are used in defined benefit pension plans to assess the extent to which pension benefits are covered by existing assets and to estimate future contributions to the scheme (Carne and Warne, 1987). Discounted cash flow analysis involves making choices for its two data sources: forecasts of future cash receipts and payments, and an appropriate interest rate (Lovejoy et al., 1989). A variety of pension liability measures are associated

with pension plans, which can differ for accounting, taxation and financing purposes. Interest rates can be based on either current market (or 'fair') value or use (from use and expected future benefits) value (Baxter, 1993). Thus, pension cost amounts reported by different plan sponsors as required under current pension accounting rules will not articulate with each other because the adopted discount rates are based on different underlying actuarial cost methods.[1]

Moreover, accounting standard setting bodies disagree as to how pension assets and liabilities should be discounted. In November 2001, the Accounting Standards Board of the U.K. ('ASB') issued Financial Reporting Standard No. 17, 'Retirement Benefits' (hereinafter FRS 17), that proposes substituting market value based rates to discount pension liabilities for an actuarial or value in use rate. FRS 17 was justified on the grounds of the need to improve the harmonization of international pension accounting standards. It requires the use of fair value methodology for discounting both pension liabilities and assets.[2] These methods apply a stochastic discount rate to a 'best estimate' of future cash flows. By contrast, the Financial Accounting Standards Board introduced the expected cash flow approach to accommodate the use of present value techniques when the timing of cash flows is uncertain. The FASB claimed that the expected cash flow approach is superior to 'best estimate' approach in discounting pension assets and liabilities (FASB, 1999). However subsequently the FASB adopted principles broadly similar to FRS 17 when it issued SFAS 158 in 2006.

These inconsistent measurement schemes demonstrate the differential trade-offs made, at least implicitly, by the ASB and the FASB between reliability and relevance. This trade-off involves exercising prudence in recognising pension benefit obligations for accumulated service to date, as codified in FAS87, to mitigate the

uncertainty inherent in a long-term actuarial view where expected total service is concerned. Further, the use of cost-based methods is used to allocate pension costs to relevant income periods under the accrual-based accounting convention. Bodie (1990) suggests instead that a longer-term actuarial view is needed to reflect the 'economics' of pension plans.

However whether economics and fair value are consistent is another issue. Logue and Rader (1998) argue that, for practical pension plan management purposes, the various net pension liabilities as required to be calculated under accounting standards are not appropriate measures of the 'true' economic benefits that employers have guaranteed. Winkelvoss (1993, p. p.228) defines an economic liability as representing what management believes is a rational allocation of benefits over the working career of an active employee. In its simplest form, the net or unfunded economic pension plan obligation at any date ('UEBO') is conceptually equal to the actuarial best estimate of a market-consistent present value of amounts expected to be paid to employees, less the actuarial (long-term) discounted value of pension assets. This 'fair value' measure of the unfunded pension obligation is logically most consistent with the FASB's reporting objective cited above, but was not incorporated into SFAS 87. Since it incorporates use of probabilities, it also represents the 'true' pension liability which the pension plan sponsor needs in defining an appropriate funding target as defined by FRS 17.

None of these pension liability measures adopted by existing accounting standards fully incorporates these expected factors (i.e., future salary and expected total service) that determine the possible cash flows underlying the EBO. By contrast, the unfunded pension liabilities calculated under UK and US accounting standards are that pensions are based on one of two polemic deterministic assumptions. Under FRS

17, pension contracts are assumed to be determined by 'spot contracts', the value of which is determined by market forces. This liability is deducted from pension assets using mark-to-market 'fair valuation' procedures. Alternatively SFAS 87 assumed that pensions are deferred wages and that firms enter into 'implicit' lifetime wage contracts with their employees (Pesando and Clarke, 1983). These measures have since been formalized by accounting standards into the unfunded Accumulated Benefit Obligation ('UABO') and unfunded Projected Benefit Obligation ('UPBO'), respectively (Scott, 1992).

Selling and Stickney (1986) demonstrate that the economic measure cannot be deducted from the reported unfunded prior service obligation without knowledge of the various actuarial methods and assumptions underlying the reported amounts. This paper extends this analysis by discriminating between competing (market or use value) rates used to discount pension assets and liabilities and examines their implications for explaining longitudinal effects of differential rate assumptions on pension liabilities and expense. We develop a simulation model to examine the time series correlations between alternative traditional accounting-based and fair value-based measures of pension liabilities. We extend prior analysis by incorporating measures used in both international (IAS 19) and UK (FRS 17) reporting rules, by assuming that the concept of fair value consistent pension liabilities as defined in FRS 17 as being consistent with the concept of economic benefit obligation (Winkelvoss, 1993); and evaluating the implications of these alternative measures for reported pension expense. Enhancing the alignment of accounting pension liabilities with a broader economic model improves the reliability of reported pension expenses. Following Selling and Stickney (1986), computer simulation models are used to generate the pension data and to study their sensitivity to various actuarial

assumptions and funding methods used in practice, in order to quantify salient characteristics of pension environments and to study the effects of each of the variables affecting firms' pension exposure. [3]

We apply the computer simulation methodology approach to examine the relative and incremental reliability of alternative GAAP treatments of pension liability and expense. Recently accounting rule-makers have debated whether the valuation of corporate sponsoring companies' pension exposures should continue to be valued on a cost based, long-term deferred labor compensation basis (i.e. cash-flow relationship of assets to liabilities based on long-term funding assumptions). Others argue that valuations should be more consistent with the principles of financial economics, i.e. based on 'fair' valuation principles as for other types of corporate financial instruments. Our simulation results suggest that the reliability of SFAS 87 pension liability and expense are lower and less reliable than under fair value reporting rules.

The rest of this paper is set out as follows. Section 2 provides the institutional background to the study and the main simulation analyses are presented and discussed in section 3. Section 4 discusses the criticisms of existing GAAP and presents sensitivity analysis. Section 5 provides a summary and conclusion.

2. Institutional Background

Pension accounting rules in the US (SFAS 87) and the UK (FRS 17) imply that differing theoretical perspectives can be taken about the nature of pension obligations. Understanding the differences in the nature and scope of pension commitments that are implied by each of these perspectives provides a conceptual basis to assess the contributions and implications of extant pensions-related research and to critically evaluate the ongoing promulgation of pension-related accounting standards.[4] Table 1

summarizes the conceptual differences between each of various standards analyzed in this paper, and their accounting implications.

INSERT TABLE 1 ABOUT HERE

2.2 Criticisms of SFAS 87 and FRS 17 Discounting Assumptions

FRS 17 implies that the net worth of the pension fund should be fully consolidated into the employer sponsor's own net financial position. Therefore, the pension fund's net surplus or deficit, defined as the fair market value of plan assets minus the ABO, should be recognized on the employer sponsor's balance sheet. Since pension liabilities are just another form of fixed monetary debt, they can be discounted using the corporate bond rate. Note that this is virtually identical to the current treatment in SFAS 87, except that only in the case of a net deficit are the under-funded liabilities recognized.

By contrast, SFAS 87 implies that the pension fund is a separate legal entity from the employer sponsor. Therefore, the net surplus or deficit, defined as the fair market value of plan assets minus the PBO, would not be shown on the employer's balance sheet unless there was a deficit (i.e. PBO > fair market value of plan assets). Note that the valuation of the deficit which is recognized under SFAS 87 instead requires recognition of the ABO (with the PBO being footnoted). By contrast, the SFAS 87 approach implies that pension liabilities should be segregated, and that an appropriate discount rate should be used for fixed monetary liabilities and for salary-related liabilities.

SFAS 87 thus represents a compromise between the corporate finance (FRS 17) and a deferred wages perspective. The most significant inconsistency between

SFAS 87 and FRS 17 concerns what measure should be reported in the financial statements. By allowing both footnote disclosure of the PBO and balance sheet recognition of the ABO in SFAS 87, the FASB does not fully support either a deferred wages or FRS 17-based corporate finance perspective. Further, by requiring full recognition of the ABO (instead of the EBO), SFAS 87 appears to contradict its going concern assumption [Para 149], since the ABO neither encompasses the pension liability pledged to pension plan members due to salary growth, nor expectations for further advancement in salary due to their prospective service.

Another area of inconsistency between SFAS 87 and subsequent standards is the unfunded ABO, which is implied by the corporate finance perspective. By contrast, the alternative measure (the unfunded accrued pension expense), results from the failure to fund accrued periodic pension expense and incorporates nonvested benefits and salary progression for normal service, but not unamortized past and prior service costs. However, it concludes that the ABO, which is measured without considering future compensation levels, should be the basis on which to decide whether a minimum liability needs to be recognized [Para. 152].[5]

A third area of inconsistency concerns the treatment of pension assets and liabilities between SFAS 87 and subsequent standards. FRS 17 generally prohibits the offsetting of a long-term liability with a long-term asset. By contrast, SFAS 87 promulgates a notion of 'offsetting', whereby recognized values of assets contributed to a [pension] plan and the net pension cost of past periods are shown net in the employer's statement of financial position.

This is also inconsistent with the FRS 17 perspective, which suggests that property rights over pension assets and liabilities lie fully with the pension plan.

In some respects SFAS 87 adopts certain elements of a longer-term economic perspective by relying upon a number of actuarial assumptions that underlie its various measures of pension obligations [Para. 39]. It also recognizes that employers undertake pension obligations with the expectation of future economic benefits [Para. 145].

Furthermore, an insurance perspective implies that pension liabilities should be discounted from an appropriate portfolio of assets derived by asset/liability models [Oxley et al., 1993]. This stands in contrast to the procedure required in both SFAS 87, FRS 17 and IAS 19 in using a fixed interest corporate bond yield to discount all liabilities. Nevertheless, the economic balance sheet implied by the insurance perspective is of particular significance to pension accounting research, because it is defined in terms of probability, not legality, since presumably economic measurements (rather than legal measurements) will be useful for investment decisions.

3. Simulation Analysis [6]

This section examines the implications of competing measures of pension liabilities for explaining the effects of differential rate assumptions on the magnitude of calculated unfunded pension liabilities defined in section 3. The pension liability modeling is based on differing standard actuarial concepts of measuring the unfunded pension obligation, as outlined in Selling and Stickney (1986) and Winkelvoss (1993).

3.1. Research Method

Simulation analysis is used to generate time series of each of the two accounting measures and the economic measure of employer sponsors' pension liabilities. Each datum point in the time series reflects the present value of future cash payments to plan participants (i.e., pension obligation), net of the present value of pension fund assets at that time. A different time series is generated for each of the three measures of the unfunded pension obligation. The sensitivity of these time series to various actuarial assumptions is examined by varying several parameters (discussed in the following section) of the simulation.

In summary, time series of three measures of the unfunded pension obligation are generated and examined in this study (Selling and Stickney, 1986):

$$^{U}\left(EBO\right)_{t}^{*} = \left(EBO\right)_{t}^{*} - \left(Assets\right)_{t} \tag{8}$$

$$^{U}\left(PBO\right)_{t}^{*} = \left(PBO\right)_{t}^{*} - \left(Assets\right)_{t} \tag{9}$$

$$^{U}\left(ABO\right)_{t}^{*} = \left(ABO\right)_{t} - \left(Assets\right)_{t} \tag{10}$$

where the superscript '*U*' denotes the unfunded pension obligation.

Selling and Stickney (1986) claim that the first measure reflects the unfunded liability associated with future economic benefits. These include benefits accrued to date plus benefits expected to accrue over the remainder of the employee's career. The second measure considers future salary, but does not fully reflect future service. The third measure is based on current salary and accumulated service to date. The actuarial cost method used for funding affects the amount of assets in the pension fund and is studied as an independent variable in the simulation.

3.2. Mechanics of the Deterministic Simulation

The deterministic simulation involves two steps. The first determines the number of employees hired at the beginning of each year (based on a random draw from an exponential distribution) and creates a record in the employee file for each employee hired. The employee record contains the following fields as defined in Selling and Stickney (1986, 279):

1. *Entry Age*. It is assumed that employees enter sometime between the ages of 20 and 50 in 10-year increments.
2. *Current age*. The age of the employee at the beginning of the year.
3. *Status*. There are three statuses: young, middle-aged or retirement age.
4. *Current Salary*: At the beginning of each year.
5. *Accrued Benefits*. At the end of the year.
6. *Age at termination*. If terminated.

The second step updates each existing employee record each year to reflect current age and any stochastic change in status that occurred during the period. This latter step involves determining the probability of each change and then simulating the actual outcome.

3.3. Independent Variables

To gain additional insight into the determinants of the pooled correlations between accounting and fair value-based pension liabilities, following Selling and Stickney (1986), three parameters were treated as independent variables.

1. *Funding Method*. Either an accrued benefit cost method or a projected benefit cost method (FRS 17 or SFAS 87); or an EBO (generational accounting).
2. *Interest (Discount) rate*. The interest, or discount, rate may be viewed as comprising a real rate and an amount for anticipated inflation. The anticipated rate

of inflation varied from 1% to 20%. The interest used therefore was either the real corporate bond rate (market value), as required by SFAS 87 and IAS 19, or the weighted average of the expected rate of return on each of the major asset categories held under the plan, including equities, bonds and real estate investments, as required by FRS 17.

3. *Plan Duration*. The plan initiation date was 30 years.
4. *Growth State of the Firm*. It is assumed that benefits are either fixed or grow at 3% above inflation for each year, representing productivity gains that are consistent with a growth firm.

Except for the growth stage of the pension plan, each independent variable was held constant. The choice of respective values for these independent variables was intended to reflect reality. Thus a total of 2 x 4 x 2 x 2 = 32 simulation runs were made, each for 30 years. The runs provided time series of the unfunded pension obligations under the three methods described earlier. Thus, 32 x 3 = 96 series of unfunded pension obligations were obtained.

3.4. Simulation Results

Table 2 presents the descriptive statistics and shows the sample Pearson correlation coefficients for the unfunded pension liabilities. The correlations shown are between the three measures of the pension liability, the FVBO, PBO and ABO. Any of the three measures of the unfunded pension liability could be used as the basis for comparisons. The FVBO is used as the basis of comparison, because it incorporates more of the variables affecting the likely pension obligation (future service, future salary) than the other two accounting measures as envisaged by the FASB (1999).

INSERT TABLE 2 ABOUT HERE

The correlations shown in each column are based on aggregated, or pooled, data from all the simulations run in which the variable in the column heading is held constant (except for the first column). They reflect the data generated for all factorial combinations of growth rates, interest rates and plan initiation dates. The most obvious result in Table 2 is that the UFVBO is always more highly correlated with the UPBO than with the UABO. The generally higher correlation for UPBO is not surprising given that it is a calculated percentage of the EBO. These results are also generally consistent with those obtained by Selling and Stickney (1986) and thus provide a specification check on the main simulation results.

Table 3 reports the mean and standard deviation values of the net periodic pension cost, pooled across the presented consistently with Winkelvoss (1993, 193), but calculated under ABCM, PBCM or fair value scenarios. The reported pension costs are very sensitive to alternative assumptions and are in general much higher and more volatile under fair value assumptions. The FRS 17 net periodic pension cost is not significantly higher than either the SFAS 87 or IAS 19 equivalent calculation under all scenarios; although as expected the volatility is higher.

INSERT TABLE 3 ABOUT HERE
---

4. Critique of SFAS 87 and Sensitivity Analysis

In this section we analyse the impact of overcoming certain technical deficiencies in the promulgation of extent pension accounting rules. We then consider the sensitivity of our simulated pension liabilities and expenses to alternative, fair value based assumptions regarding mortality, inflation and investment risk.

4.1. Critique of SFAS 87

Winkelvoss [1993, 201] levels several criticisms at various aspects of SFAS 87 requirements which he claims are not consistent with an insurance perspective. These include: the use of the settlement or 'wind up' rate for discounting liabilities; the use of benefit rather than salary service proration for the PBO; and the failure to prorate the projected benefit uniformly from entry age to each future decrement age. We briefly outline each of these criticisms below and then consider their implications for alternative measures of the pension liability and pension expense. Winkelvoss (1999, 202) also criticizes the amortisation periods, disclosures and terminology but are not considered here as they are relatively cosmetic.

The existing legalistic basis of pension accounting rules is inconsistent with the generic issues raised by a longer-term economic view of pension contracts. Winkelvoss (1993, 199) argues that the service proration methodology used for the service cost and PBO should be changed to a proration based on salary. This is more consistent with the economic model which implies that pensions are a form of deferred wages.

Winkelvoss (1993, 200) argues that the projected benefit should be uniformly prorated from entry age to each future decrement age. This is in contrast to the existing procedure of allocating benefits according to the plan's benefit formula, which can vary across plans and thereby produce anomalous results. He also claims

that the discount rate used for the interest cost should not be based on a so-called settlement rate that includes insurance company risk, expense and profit charges. He instead proposes that the discount rate be based on market conditions, i.e. the spot rate on investment-grade long-term corporate bonds as of measurement date, and taking account of the asset allocation policy of the plan.

Winkelvoss (1993, 202) also argues that the effect of discount rate changes, and other actuarial assumption changes, should be shown separate from the effects of experience differing from the underlying assumptions. This is reflected in FRS 17 and partially in IAS 19. He also argues that the 10 percent corridor around the larger of PBO or market-related assets can produce some strange results. Winkelvoss (1993, 203) instead proposes that the corridor be based on service cost. However since FRS 17 does not allow for any corridor but instead requires immediate write-off of gains and losses to the Statement of Recognized Gains and Losses.

4.2. Sensitivity to Alternative Assumptions

Pension liabilities are not known values but based on actuarial estimates. Alternative assumptions concerning rates of plan termination, mortality, disability, salary and interest that may have a material impact on reported pension liabilities and expense. It should be noted that no pension accounting rules make any assumptions or requires disclosures about these rates except the interest cost. In this section we briefly consider their sensitivity to adopting realistic assumptions regarding these parameters that are more consistent with a 'fair value' basis, and to alternative funding and investment policies.

Winkelvoss (1993, 205-209) models the effects on pension liability and pension cost of alternative deviations in mortality, mortality and termination rates from those assumed. Since pension costs are usually directly proportional to the level of benefits, salary rates, disability rates and mortality rates, there is little long-term impact on changes in these assumptions on either the reported liability or expense. By contrast with the liability assumptions, interest rate changes can have a very significant impact on reported pension liability and expense.

Table 4 reports the effect of adopting the proposed changes above on the pension expense computed in table 3. In this case only the PBCM funding approach has been modeled. While the magnitude of the net periodic pension cost increases for US GAAP, it decreases for both IAS 19 and FRS 17. Moreover the standard deviations of the net periodic cost components significantly reduce. Consequently it could be argued that the proposed suggestions, if incorporated, would both increase the value relevance and the reliability of reported pension expense figures. [8]

INSERT TABLE 4 ABOUT HERE

---

5. Summary and Conclusion

This paper evaluates the economic impact on firms' reported pension exposure arising from the conflict between reliability and relevance issues affecting current deliberations on pension accounting rules. We investigate the statistical relationship between alternative accounting-based measures of a pension plan's net pension liability as defined in SFAS 87 and IAS 19, and a fair value based expected cash flow measure defined in FRS 17, using alternative assumptions about the appropriate rate used to discount pension liabilities.

The study highlights major problem in producing a single set of internationally harmonized set of financial reporting standards affecting defined benefit-based pension liabilities. The most serious problem is the lack of consensus about how best to meaningfully describe the financial position today in respect of a pension obligation created in the past that will involve payments in the future. In response to both economic and legal pressures in recent years, accounting standard setting bodies in both countries have developed GAAP which incorporate various methods for dealing with this issue, in order to serve both stewardship and valuation purposes.

The lack of any consistent method asset and liability measurement principles in existing GAAP also leads to conceptual difficulties which may limit their reliability and comparability to investors. However this in turn raises significant unresolved issues in determining the 'fair value' of pension liabilities. Since fair value liabilities change constantly because of changes in the discount rate and other assumption changes, traditional concepts of loss recognition, income smoothing and accounting practices that vary across pension plan sponsors are no longer applicable.

The existence of major, unresolved accounting issues between existing matching-based US GAAP on the one hand, and the ASB's asset-liability approach on

the other, highlights the continuing difficulties underlying pension accounting. By contrast, the alternative fair value 'best estimate' method as proposed by the ASB is an evolving system, which focuses on assets and liabilities being measured consistently. Assets and liabilities should be additionally recognized on the balance sheet. The simulation analysis was motivated by the assumption that both employer sponsors require information about the 'true' economic liability and/or its value in the future for funding purposes. We also examine the sensitivity of the choice of discount rates to changes in parameters that reflect cross-sectional differences in pension characteristics.

The results of the pension simulation show that the net difference between pension assets and liabilities when calculated with fair-value rates are more highly correlated with the economic measure than when calculated with value-in-use rates. Both measures are found to be more highly correlated with economic unfunded pension liabilities when they are discounted using market instead of value-in-use rates. The value at use rates are also highly sensitive to differences in funding method, real versus nominal interest rates and plan initiation dates.

The strength of association also differs substantially depending upon which funding method is used to calculate pension liabilities, the use of real versus nominal interest rates, and pension plan initiation dates. These results generally support the FASB's decision to change the rate used to discount pension assets and liabilities from that currently allowed under SFAS 87. However we conclude that the change interacts with the choice of pension liability measure, and thus will have a considerably more complex effect on US corporate pension plans' actuarial surpluses and deficits than the FASB appears to assume.

A further limitation of our analysis is that UK GAAP is less deterministic than is modeled above since it encourages pension plan sponsors to adopt 'best estimate assumptions' in determining pension liabilities. In further analysis, we adjust the baseline model as presented here to account for likely further individual-plan sponsor 'best estimate assumption' differences in mortality rates, termination rates, salary rates, interest rates, inflation rates, as well as alternative funding and asset allocation policies. We also use stochastic methodology to consider the implications of fluctuations in asset returns on funding policy.

The validity of these findings and their implications are limited to those applicable to any standard actuarial simulation analysis. For example, it is assumed that only the net deficiency of pension liabilities over pension assets is value-relevant to both employer sponsors and financial statement users. The correlations between various accounting measures of the gross pension liability and the economic measure of the gross pension liability are very close to unity for all accounting methods investigated.

Notwithstanding these limitations, the simulation analysis also raises a number of interesting and unresolved questions which require further empirical research. Further research is needed to isolate the potential impact of the proposed change in discount rate assumption on the pension cost-related costs of sponsoring pension plans that significantly differ in terms of both plan (defined benefit versus defined contribution) and pension plan financial characteristics. Since health care benefits (SFAS 106) involve similar considerations, simulation-based research can be conducted on the sensitivity of firms' exposure to alternative assumptions. Further research on these and other issues is necessary before it can be determined whether

alternative measures of pension liability examined in this paper are likely to be perceived as relatively more useful by financial statement users.

Footnotes

1. Financial Accounting Standards Board, Statement of Financial Accounting 87 'Employers' Accounting for Pensions' or SFAS 87 and Accounting Standards Board, Financial Reporting Standard FRS 17, 'Accounting for Pension Costs' or 'FRS 17').
2. By contrast, relying on reported pension information in corporate annual reports permits study only of the particular set of actuarial assumptions selected by each pension plan. Alternative bases for measuring pension obligations raise more fundamental questions about the validity of differing underlying theoretical perspectives about the nature of the pension liabilities.
3. Selling and Stickney (1986) argue that empirical research cannot easily control for differences in actuarial methods used (e.g. accumulated benefits v. projected benefits) to measure reported pension obligations and expenses. A similar issue applies where the fair value approach is compared to cost-based approaches that are analyzed here.
4. Both SFAS 87 and FRS 17 additionally suffer from a number of technical limitations. These are discussed in Winkelvoss (1993).
5. This issue is addressed in Winkelvoss (1993).
6. The section assumes that the reader is familiar with the various time series pension measurements which are subject to the simulation analysis. Selling and Stickney (1986) and Winkelvoss (1993) discuss important concepts relating to the measurement of pension assets, liabilities and funding methods in more detail.

References

Accounting Standards Board. 1993. *Aspects of Accounting for Pension Costs*, ASB: London.

----------. 2001. FRS 17: Retirement Benefits, ASB: London.

Baxter, W. 1993. Discount. *Accountancy* (September): 105-106.

Carne, S. and G. Warne 1987. *The Work of a Pension Scheme Actuary.* Auditing Practices Committee, Institute of Chartered Accountants in England and Wales: London (cited in Lovejoy et al., 1989).

Black, F. 1980. The tax consequences of long-run pension policy. *Financial Analysts Journal* (July-August): 21-28.

Bodie, Z. 1990a. Pensions as retirement income insurance. *Journal of Economic Perspectives* 28(January): 28-49.

Bulow, J. 1982. What are corporate pension liabilities? Q*uarterly Journal of Economics* 97: 435-52.

Financial Accounting Standards Board (1985), SFAS 87: Pension Costs.

-----(1999). Cash Flows in Financial Statements.

Fogarty, T.J. and J. Grant. 1995. Impact of the actuarial profession on financial reporting. *Accounting Horizons.* (September) 9(3): 23-33.

Ippolito, R. 1985. The labor contract and true pension liabilities. *American Economic Review*. (December): 1031-1043.

----------, 1986, Pensions, Economics and Public Policy, Dow-Jones Irwin, Homewood.

Lovejoy, C., K. Peasnell, P.Taylor and Y. Talukdar. 1989. *Discounting in corporate financial reporting*. Institute of Chartered Accountants in England and Wales: London.

Pesando, J.E. and C.K. Clarke. 1983. Economic models of the labor market and pension accounting: an exploratory analysis. *The Accounting Review*. 53(4): 733-747.

Scott, T.W. 1992. Costing the gold watch. CA Magazine (September): 39-44.

Selling, T.I and C.P. Stickney. 1986. Accounting measures of unfunded pension liabilities and the expected present value of future pension cash flows. *Journal of Accounting and Public Policy*, 5, 267-285.

Sharpe, W. 1976. Corporate pension funding policy. *Journal of Financial Economics* 3(2):183-193.

Tang, L. and P. Klumpes. 2007. Valuing Contingent Claim Liabilities for Chinese SOEs, Mimeo.

Tepper, I. 1981. Taxation and corporate pension funding policy. *Journal of Financial Economics* 6(June): 3-51.

Treynor, J.L., P.J. Regan and W.W. Priest. 1976. *The Financial Reality of Pension Funding Under ERISA*, Dow-Jones Irwin.

Winkelvoss, H. 1993. *Pension Mathematics with Numerical Illustrations*. (2nd Edition). Richard D. Irwin, Homewood IL.

TABLE 1
Major Differences Among Theoretical Frameworks on Pension Liabilities and Employer Sponsor's Balance Sheet Recognition of Pension Assets and Liabilities

Framework	*Theoretical Basis*	*Definition of Pension Benefit*	*Definition of Discount Rate*	*Recognition of Liability*	*Measurement of Liability*	*Recognition of Deficit / Surplus*
SFAS 87	Combination of labor economics and corporate finance theoretical perspectives	Pension benefits are a form of deferred compensation based on a life compensation contract assumption	Prime corporate rate	Employees willing to forgo current wages in return for vested and non-vested benefits	PBO; projected labor contracts ABO; accrued labor contracts	ABO – FMV if ABO > FMV and footnote PBO
IAS 19	Corporate finance theoretical perspective; integrated with pension plan view	Pension benefits are a form of corporate bond debt based on a spot contract assumption	Fixed interest corporate bond yield	Only pension benefits which 'legally' accrue during period in which service performed	ABO; accrued labor contracts	ABO – FMV if ABO > FMV; FMV – ABO otherwise
FRS 17, SFAS 158	Economic or insurance theoretical perspective	Pension benefits are a complex implicit contingent claim based on an insurance contract assumption	Long-term corporate bond rate for pensions, index-linked rate for salary-related liabilities	Present value of future benefits actuarially calculated over pension plan's lifetime	FVBO; implicit lifetime labor contracts	FVBO – FMV if FVBO > FMV; FMV – FVBO otherwise
Generational Accounting	Generational accounting perspective	Multi-life time , set of intergenerational contracts	Risk free rate or rate that hedges applicable pension liability duration	Present value of future expected cash flows	EBO	EBO (future generations) and EBO (existing generations)

TABLE 2
Descriptive Statistics – Unfunded Pension Liability under Alternative Valuations

This table reports descriptive statistics for the pooled version of the three pension liabilities examined in this study: the Unfunded Fair Value Benefit Obligation (UFVBO), the Unfunded Accrued Benefit Obligation (ABO) and the Unfunded Projected Benefit Obligation (UPBO). Each is calculated under differing US (cost-based projected cash flow), UK (best estimate) and IFRS assumptions.

	UFVBO	***UPBO***	***UABO***
SFAS87:			
Mean	$568,210	$293,427	$221,140
Standard Deviation	$2,786,332	$1,065,689	$467,960
Correlation to UEBO	/	0.9924	0.9908
IAS 19:			
Mean	$523,916	$278,095	$219,088
Standard Deviation	$2,411,000	$931,897	$443,618
Correlation to UEBO	/	0.9933	0.9907
FRS 17:			
Mean	$523,817	$277,995	$218,942
Standard Deviation	$2,418,548	$934,625	$444,042
Correlation to UEBO	/	0.9933	0.9907
Generational Accounting:			
Mean			
Standard Deviation			

TABLE 3
Components of Pension Expense – Baseline Case

This table reports the correlations between the pension expense reported under baseline assumptions, for each level of asset funding (ABCM, PBCM or fair value). The net periodic pension cost (8) is equal to the service cost (1) plus the interest cost (2), less the actual return on assets (5) plus any amortization and/or deferrals (7).

Unit: $

			Service cost	Interest cost	Expected Return	Asset Loss (Gain)	Actual Return (3-4)	Actuarial Loss/(Gain)	Loss/(Gain) Amortisation	Net Periodic Pension Cost
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: ABCM	SFAS 87	Mean	39,790	35,467	478	- 3,191	3,669	NA	0	71,587
		Std Dev.	592,552	84,524	113,135	35,719	118,106	NA	0	507,507
	IAS 19	Mean	42,010	25,846	2,850	937	1,913	NA	3,050	68,993
		Std Dev.	557,067	61,454	27,760	7,799	32,471	NA	43,308	531,120
	FRS 17	Mean	42,010	25,846	2,860	904	1,956*	3,859	NA	64,995
		Std Dev.	557,067	61,454	27,859	7,827	32,586	34,803	NA	565,976
Panel B: PBCM	SFAS 87	Mean	12,987	36,362	-8,199	-11,185	2,986	NA	385	46,747
		Std Dev.	1,759,301	88,851	343,583	108,020	358,118	NA	5,674	1,430,593
	IAS 19	Mean	28,787	31,779	1,954	1,792	162	NA	10,698	71,103
		Std Dev.	1,654,420	130,645	80,451	20,574	97,116	NA	131,946	1,561,735
	FRS 17	Mean	28,787	31,779	1,961	1,798	163*	3,805	NA	58,605
		Std Dev.	1,654,420	130,645	80,737	20,647	97,461	29,348	NA	1,659,724
Panel C: Fair Value	SFAS 87	Mean	-16,859	58,313	-26,027	-29,200	3,173	NA	282	292,302
		Std Dev	4,678,366	176,589	918,701	286,760	954,461	NA	2,742	4,623,476
	IAS 19	Mean.	28,637	58,185	1,806	4,181	-2,375	NA	21,698	110,567
		Std Dev	4,393,577	340,283	212,999	54,853	258,274	NA	257,975	4,565,323
	FRS 17	Mean	28,637	58,185	1,812	4,196	-2,384*	-581	NA	85,010
		Std Dev.	4,393,577	340,283	213,757	55,048	259,194	8,710	NA	4,405,520

Note: * The actual return under UK GAAP is not included in the calculation of net periodic pension cost as defined above but is instead written off against the Statement of Realized Gains or losses.

TABLE 4

Components of Pension Expense – Incorporating Suggested Technical Enhancements

This table reports the correlations between the pensions expenses reported under suggested assumptions, for PBCM asset funding level. The net periodic pension cost (8) is equal to the service cost (1) plus the interest cost (2), less the actual return on assets (5) plus any amortization and/or deferrals (7).

Unit: $

			Service cost	Interest cost	Expected Return	Asset Loss (Gain)	Actual Return (3-4)	Actuarial Loss/(Gain)	Loss/(Gain) Amortisation	Net Periodic Pension Cost
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PBCM	SFAS 87	Mean	26,374	24,879	-288	-3,032	2,744	-3,032	51	48,561
		Std Dev.	537,837	64,817	102,756	32,535	358,118	32,535	922	454,601
	IAS 19	Mean	28,679	118,491	1,943	680	1,263	680	2,832	48,609
		Std Dev.	506,297	50,784	25,191	6,917	97,116	6,917	39,232	485,022
	FRS 17	Mean	28,679	24,879	1,950	683	163*	683	NA	45,220
		Std Dev.	506,297	64,817	25,281	6,941	97,461	6,941	NA	512,141

Note: * The actual return under UK GAAP is not included in the calculation of net periodic pension cost as defined above but is instead written off against the Statement of Realized Gains or losses.