ESTIMATING THE COST OF CAPITAL: IMPLICATIONS OF RISK MANAGEMENT ON PENSION FUNDS

Paul Klumpes[1]
Pengguo Wang

Imperial College London
South Kensington SW72AZ
United Kingdom

ABSTRACT

We estimate the cost of capital for a sample of US S&P firms under various scenarios where change in pension Generally Accepted Accounting Principles (GAAP) can occur. We adjust the weighted cost of capital to allow for currently off balance sheet extended pension arrangements to be viewed as either insurance or own risk capital based structured finance instruments. We find that the estimated cost of capital is sensitive to: (a) alternative pension GAAP; (b) whether a firm's pension exposure is classified primarily as a debt or equity instrument; and (c) the scope and nature of the pension plans being consolidated with the firm. We also find that the consolidating or merging both the value and risk of sponsored DC pension plans increases the strength of association with firm risk.

Keywords: pension plans, cost of capital

JEL Classification: J23, M41

[1] We acknowledge financial support from IAAER-KPMG and many helpful comments received from Mary Barth, Kathrine Schipper, Donna Street and participants from AAA and EAA 2008 annual meetings.

ESTIMATING THE COST OF CAPITAL: IMPLICATIONS OF RISK MANAGEMENT ON PENSION FUNDS

1. Introduction

Accounting standards in the US, and internationally allow considerable discretion over the form and content in which pension risk is reflected in firms' cost of capital. Jin et al. (2006) (hereinafter, JMB) show that cost of capital is overestimated if one ignores the value and risk of defined benefits ('DB') pensions and empirically find a significant positive relationship between firm risk and pension plan risk. In this paper, we follow the JMB research design, and examine the cross-sectional relationship between firm risk and the pension risk based on publicly available data source under existing US GAAP and new proposals to evolve existing pension accounting on an 'as if' basis.[2] We refer to new proposals as those proposed by the European Financial Reporting Advisory Group (hereinafter 'EFRAG' (2008)).[3] We extend the analysis and investigate the effect of consolidating defined contribution ('DC') schemes, which have a significant investment in company own stock.[4]

Many firms in US encourage their employees to participate in pension arrangements either in the form of DB and/or DC plans. Currently, DC Plans are not consolidated by sponsoring firms but are effectively treated as 'off balance sheet' special purpose entities (SPEs) or variable interest entities (VIEs).[5] When viewed from a structured finance perspective, these types of scheme can alternatively be viewed as providing retirement risk insurance (Bodie, 1990).[6] While JMB identify the value and risk errors of not consolidating the DB plans, our analysis develops this insight further by integrating other non-DB forms of employee pension arrangements (e.g. 401K plans,

[2] JMB's estimates of pension assets and liabilities are based on the global equity research report published by UBS Warburg in 2002. By contrast, our estimates of these parameters are taken directly from Compustat and Money Market Directory.
[3] EFRAG proposes narrowing the definition of pension liability to exclude future salary increases, but discounting it at a risk free rate. It also proposes charging any unexpected variation in actuarial experience to income instead of to shareholder's equity.
[4] Reference made to DC plans also includes reference to '401K' plans; which are specifically defined within the Employee Retirement Income Security Act 1974 to encourage employees to invest in company stock.
[5] In January 2003 the Financial Accounting Standards Board (FASB) issued FASB Interpretation No. 46, 'Consolidation of Variable Interest Entities', an Interpretation of ARB No. 51 (FASB, 2003), which is the new guidance related to the consolidation of SPEs. in US GAAP. Bockus et al. (2004) discuss the issues surrounding the consolidation of SPEs of various forms, in the light of the Enron scandal.
[6] Bodie (1990) suggests that pensions are really a form of retirement income insurance, and views them instead as having participating annuities. He lists a number of distinguishing features, including the existence of a discretionary reserve.

defined contribution plans, stock option plans, savings plans, hereinafter 'DC' plans for simplicity) with the firm, as either segregated insurance contracts or as fully consolidated sources of retirement income risk capital.[7] These alternative treatments have important debt-equity mix implications since these exposures can either be fully merged with the firm as an insurance subsidiary, or consolidated into the firm as an equity investment.

In this paper, we estimate the cost of capital by incorporating two previously ignored elements of pension risk and value. First, the increasing prevalence and materiality of financial guarantees related to firms' pension exposure can impact pension values, thereby affecting the mix and magnitude of debt and equity components of cost of capital estimation procedures. Second, the scope of entity which is subject to pension risk, depending upon whether pension plan is merged, consolidated or is treated as an off-balance sheet special purpose entity.

We exploit these insights to estimate the cost of capital for a sample of S&P 500 firms, where pension exposures are both material and are relatively transparent.[8] Our sample period covers 2001-2006, when a relatively high proportion of pension plan assets were invested in equities, and consequently pension assets are more risky, thereby shall be reflected in the cost of capital.[9]

Besides integrating the extended pension arrangements into the firm, we also extend JMB's research on this topic in a number of ways. First, we re-estimate the cost of capital, by using more detailed pension asset allocation decomposition than that reported in JMB, using data drawn from annually published industry sources. We also innovate by decomposing the pension liability beta to reflect the underlying demographics of the maturity profile of the scheme liabilities. Taking the long duration of pension liabilities into account, we argue that fund managers may incorporate their estimate of pension liability risk into some component risk in pension assets. Specifically, it is possible that the pension liability risk mirrors that of the debt component of the pension asset allocation. We also use the 30-year Treasury

[7] An insurance contract is one under which one party (the insurer) accepts significant insurance risk from another party by agreeing to compensate the policyholder if a specified uncertain future event (the insured event) adversely affects the policyholder (IFRS 4, Appendix A).
[8] We do this in order to overcome the size effect identified in Fama-French. We also eliminate financial firms from the sample.
[9] Throughout the paper we are consistent with JMB in focusing only the pre-tax cost of capital, or all-equity cost of capital.

bond rate as a useful benchmark as JMB to check the robustness of the test. Second, we examine the effect of industry-specific factors that may affect these cross-sectional relationships. Third, our analysis allows for new proposals in pension accounting (EFRAG, 2008), which replace existing US GAAP by requiring firms to (i) substitute the accrued benefit obligation for the projected benefit obligation (PBO); (ii) replace the high quality long bond rate with a risk free rate; (iii) immediately write off any changes in pension earnings to firm earnings; (iv) consolidate their pension arrangements.[10]

We find the estimated cost of capital is sensitive to these adjustments. While CAPM based estimates confirm JMB's finding that the cost of capital is overestimated for US firms if pension value and pension risk are ignored, these differences are less severe in our sample period. Consolidating the extended pension fund into the firm significantly and materially alters the debt and equity composition of the firm and has both valuation and risk implications for the cost of capital. In contrast to JMB, we find that the relationship between firm risk and pension risk is not statistically significant under existing US GAAP, but it is much stronger and significant where the extended pension arrangements are fully consolidated into the firm as structured finance investments.

The remainder of this paper is as follows. Section 2 outlines the institutional background to the study. Section 3 describes the sample and data. Section 4 provides the empirical tests. Section 5 reports robustness tests. Section 6 concludes.

2. Institutional Background and Relation between Pension Risk and Firm Risk

This section provides the institutional background and reviews the relevant theoretical framework for the foregoing cost of capital estimation and risk analysis.

2.1. Institutional Background

[10] The European Financial Reporting Advisory Group (2008) is an advisory body to the International Accounting Standards Board. Currently the Financial Accounting Standards Board is considering merging with the International Accounting Standards Board, effective 2009, thereby harmonising US GAAP with International GAAP.

Current US GAAP treats the company and its sponsored defined benefits pension plan as separate entities, but the firm is required to recognize an underfunded obligation. Under latest proposals SFAS 157, the sponsoring firm is required to show the market value of pension assets and the projected benefit obligation on the balance sheet. This implicitly assumes that the pension liability for the sponsoring company has identical risk to firm financial liabilities, while pension assets are added to conventional operating assets. However the risk underlying these assets and liabilities can be very different. For example, the sponsored DB plan can invest in the sponsoring company's own equity.

There are significant variations in international GAAP as to both the scope and nature of pension obligations. Therefore, the estimation of pension liability depends on different accounting standards and assumptions. For example, if the accounting regime is assumed to be SFAS 87, only the minimum funding obligation is required to be recognized.

Under the existing legal framework, the combined DB and DC Plan scheme is instead assumed to be a separate legal entity and is not consolidated into the sponsoring firm (Bodie, 1990). However, many DC Plans involve a significant element of sponsoring company involvement and involve a significant investment in company stock. In fact, under an insurance perspective, a DC pension fund can be viewed as an insurance contract. Under this approach, the DC Plan participants are effectively deferred participating annuitants. That is, pension liability is deferred payments for employee's compensation or employees' retirement income insurance. There is scope for such contracts to be either merged with the sponsoring company (as a separate legal entity) or 'consolidated' such that any company stock owned by the DC Plan is 'eliminated' from the equity of the combined firm. Each of these treatments can have differential debt and equity implications. Differentiating the consequences for cost of capital of a 'merger' and 'consolidation' of the sponsored DC Plan then becomes important.

However, prior studies examining the cost of equity capital do not appear to have taken account of the vagaries imposed by arcane accounting rules. In this section we tease out subtle differences in accounting treatment and their implications for cost of capital estimation.

JMB consolidate the value of the pension assets and liabilities and consider US GAAP being a satisfactory basis for consolidating pension plans while admitting that they make no attempt to disentangle arcane aspects of pension accounting. It seems that pension assets and liabilities are consolidated into the corporate entity, but in fact it is only the minimum funding amount is required to be disclosed in the statement of equity. Because the current approach used by US GAAP is involving non-articulation of the balance sheet and the earnings statement, this approach appears to be rather opaque and arbitrary. In this paper we consider four different GAAP treatments of pension risk and value.

(i) 'Enhanced' Pension Asset Risk with US GAAP. Under current US GAAP, SFAS 87, the minimum pension obligation was only required for under-funded schemes, and the assets were allowed. Any variation in the minimum funding beyond 10% could be accrued and amortized over time. While various accruals and amortizations are still permitted to smooth the earnings impact of pension accruals, consistent with SFAS 87, the new SFAS 157 imposes market consistent valuation of pension assets and liabilities. Thus the periodic changes in value of pension assets and liabilities recognized in the balance sheet are not reflected in the statement of earnings, since the latter still rely on accruals and amortizations to smooth periodic changes. Thus there is an unrecorded 'dirty surplus' reflecting these discrepancies in the Statement of Stockholders' Equity. JMB use the Form 5500 pension asset categorization to identify pension asset risk and acknowledge that they are only able to use the average risk level for each broader asset class. We consider the allocation of pension assets at a more detailed level than reported under the Form 5500 data. We use the self-reported detailed pension asset allocation data provided for both DB and DC Plans as reported in Money Market Directory for each year of our study.

(ii) Proposed GAAP (without consolidation). The EFRAG (2008) proposes that assets and liabilities are separately determined. The liability block is determined by the growth of the obligations defined in terms of accrued benefit obligations (ABO). This is then discounted at the risk free cost of capital.[11]

[11] Proposed GAAP also recommends writing off any unexpected gains or losses immediately to Profit and Loss Account instead of to Stockholders' equity. However, by contrast the book value of equity is lower due to the immediate recognition of unrealized gains and losses relating to the immediate recognition, in the Statement of Shareholders' Equity of variations actuarial

(iii) Proposed GAAP 2: Merger of firm with 'combined' DB and DC Plans as separate merged entities: The above approaches treat the pension fund as if it were just another form of corporate debt. The DC Plan is ignored and, under US GAAP, is effectively left off-balance sheet as an SPE or VIE, even though most of these schemes heavily invest in the sponsoring company's own stock. However the EFRAG (2008) envisages that the DC Plan as well as the DB plan should be fully 'consolidated' into the firm's balance sheet. While the value of the DB and DC Plan investment in company stock is deducted, it is not eliminated from the risk of the combined entity. In fact JMB argue that the risk levels of pension liabilities and firm debt are similar for firms with normal leverage ratios.[12][13]

(iv) Proposed GAAP 3: 'Consolidated entity' approach. Instead of treating the VIE as a capital instrument, in this case we assume that it is fully consolidated into the corporation as an equity investment. This implies that modifications must be made to the standard measurement of corporate liabilities where the pension liability instead depends on further assumptions that need to reflect their own expectation. For example it is usually assumed that the entity's own credit standing should be incorporated in the value of the liability under fair value accounting. However if insurance contracts are taken over by a third party, then that party's credit standing would apply to the insurance contracts. If the credit standing is not applicable (as in the case above), then risk capital (i.e. the minimum required to attain risk free obligations for regulatory purposes) must also be incorporated into the pension liability measurement. This assumption is also used in the EFRAG's (2008) proposals.[14]

If it is assumed that pensions are a form of either insurance asset or structured financing vehicle (cases (*iii*) and (*iv*)), there are important implications for how a

experience in asset/liability from what was assumed. This will also have the effect of increasing the pension deficit and making it more volatile.

[12] JMB conduct 'filtered tests' where they eliminate company stock ownership from the pension risk of the firm, on the assumption that investment in company stock is more like equity beta. However they only apply this test to DB plans.

[13] Pension plans specialize in transferring longevity, inflation and mortality risk from the employee participants to the employer sponsor (Bodie, 1990). Although employment benefits and share ownership are explicitly excluded from the scope of the insurance standard. There is no conceptual or logical reason why they should be, since inherently they appear to otherwise meet all of the requirements to be defined as an insurance contract. An increasing number of companies are either freezing their DB schemes or transferring them to DC schemes, and/or are outsourcing the management of the DB scheme to insurance companies. This raises the conceptual question of whether 'insurance contract fair value' principles should also apply to pension funds.

[14] The general approach to the measurement of pension (insurance) contracts is that International Financial Reporting Standard (IFRS 4, para. 15) requires that an insurer should carry out a liability adequacy test to ensure that the carrying value is adequate in the light of estimated future cash flows. Any deficiency is required to be recognized in profit and loss. Ironically such treatments are also proposed for DB schemes by the EFRAG (2008).

pension liability is represented in the corporate sponsor's balance sheet. For example, it is likely that an entity-specific approach to valuation of insurance liabilities is more appropriate than a fair valuation, especially since most insurance liabilities are not traded.[15] An entity specific value represents the value to the enterprise that holds it and may reflect factors that are not available (or not relevant) to other market participants. The entity-specific value of a liability is the present value of the costs that the enterprise will incur in settling the liability in an orderly fashion over the life of the liability (Hairs et al. (2001)).[16] In the case of DC Plan related insurance liabilities, which are consolidated as a form of 'unit linked insurance contract' into the corporate sponsors' accounts, pensions are a form of participating annuities.[17]

We argue that, JMB's posited inter-relationship of pension value and risk with firm risk is sensitive to alternative treatments under various domestic, international and proposed pension accounting treatments. Moreover differences in GAAP have implications for the nature and magnitude of pension liabilities, reveal charges against equity not recognized by current US GAAP. Finally, proposals for consolidating a broader set of pensions into the firm as either debt or equity, as a form of retirement income insurance have important implications both for the valuation and risk of the pension-related liabilities and assets, depending upon the mix of DB and DC schemes which comprise the long-term retirement income insurance that employee participants can expect to receive.

2.2 The estimation of operating asset risk

In this section, we refine the JMB analysis of the relationship of pension value and risk to firm risk, by incorporating various nuances of pension accounting as discussed above. We specifically focus on cases (*iii*) and (i*v*) and their implications for redefining the relationship between corporate capital structure and that of the sponsored DB and DC Plans.

---

[15] Froot and Stein (1998) and Froot (2004) consider the implications of unhedged capital on cost of capital estimation but do not explicitly model the impact of the cost of capital procedure.

[16] Exley and Smith (2008) develop a replicating portfolio approach to estimate pension liability risk., they argue that cash flows should be discounted using the return on a replicating asset portfolio whose cash flows most closely replicate the liability cash flows.

[17] A number of other currently unresolved issues in insurance contract accounting also give rise to uncertainty over an insurance basis for pensions. The first is the treatment of credit risk. The second is whether contingent guarantees (such as government insurance of corporate pension obligations) should be incorporated into the analysis.

Define NOA as the value of net operating assets, NFL as the net financial liabilities, PA_{DB} as the value of pension asset for a DB plan, PA_{DC} as the value of pension asset for a DC Plan, PL_{DB} as the value of pension liability for the DB plan, PL_{DC} as the value of pension liability for the DC Plan, E_{CE} as the value of common equity (outsider shareholders), E_{EE} as the value of employee equity (employee shareholders), OPT as pension plan related options, including PBGC and insurance credit default options.[18]

Similar to JMB, we consider cases without taxes. The economic balance sheet can be written as:

$$NOA + PA_{DB} + PA_{DC} + OPT = NFL + PL_{DB} + PL_{DC} + E_{CE} + E_{EE} \qquad (1a)$$

Denote $NPL_{DB} = PL_{DB} - PA_{DB} = - NPA_{DB}$,

$NPL_{DC} = PL_{DC} - PA_{DC} = - NPA_{DC}$, and

$E = E_{CE} + E_{EE.}$.

The systematic risk or beta of operating assets, β_{OA}, when both the pension value and pension risk are correctly taken into account, is

$$\begin{aligned}\beta_{NOA} = &\frac{E}{NOA}\beta_E + \frac{NFL}{NOA}\beta_{NFL} - (\frac{PA_{DB}}{NOA}\beta_{PA_{DB}} - \frac{PL_{DB}}{NOA}\beta_{PL_{DB}}) \\ &-(\frac{PA_{DC}}{NOA}\beta_{PA_{DC}} - \frac{PL_{DC}}{NOA}\beta_{PL_{DC}}) - \frac{OPT}{NOA}\beta_{OPT}\end{aligned} \qquad (1b)$$

Error case 1: The calculation of operating asset risk ignores both DB and DC pension plans, including their values and risks. The estimated operating asset beta becomes

$$\hat{\beta}_{NOA} = \frac{E}{\widehat{NOA}}\beta_E + \frac{NFL}{\widehat{NOA}}\beta_{NFL} - \frac{OPT}{\widehat{NOA}}\beta_{OPT} \qquad (2)$$

The resulting estimation specification error, define as $\hat{\varepsilon}_{NOA} = \hat{\beta}_{NOA} - \beta_{NOA}$, is

$$\hat{\varepsilon}_{OA} = \frac{PA_{DB}}{\widehat{NOA}}(\beta_{PA_{DB}} - \beta_{PL_{DB}}) + \frac{PA_{DC}}{\widehat{NOA}}(\beta_{PA_{DC}} - \beta_{PL_{DC}}) - \frac{NPA_{DB}}{\widehat{NOA}}(\beta_{NOA} - \beta_{PL_{DB}}) - \frac{NPA_{DC}}{\widehat{NOA}}(\beta_{NOA} - \beta_{PL_{DC}}) \qquad (3)$$

[18]Note that in case (iii), there is no need to distinguish E_{CE} from E_{EE} , E is 'correct' equity number to take into account when we discuss the effect of pension plan on the systematic risk of operating assets. In addition, OPT = 0 and the systematic risk $\beta_{OPT} = 0$ since credit risk is not a relevant concept in case (iii).

Where $\widehat{NOA} = NOA + NPA_{DB} + NPA_{DC}$.

Proof. See Appendix.

Without considering the DC Plan, this expression of difference between "true" and estimated systematic risks of operating assets is the same as that in JMB. For both DB and DC Plans, it is usually true that: $\beta_{PA} \geq \beta_{PL}$ and $\beta_{NOA} \geq \beta_{PL}$. Therefore, if both DB and DC pension surpluses are not large, then $\hat{\varepsilon}_{NOA} > 0$ or $\beta_{NOA} < \hat{\beta}_{NOA}$, i.e., the specification error on the estimation of the operating asset beta generally leads to an upward bias. If both DB and DC pension funds are in balance, NPA=0, or if $NPA_{DB} = 0$, and $NPA_{DC} < PA_{DB}\frac{(\beta_{PA_{DB}} - \beta_{PL_{DB}})}{(\beta_{NOA} - \beta_{PL_{DC}})} + PA_{DC}\frac{(\beta_{PA_{DC}} - \beta_{PL_{DC}})}{(\beta_{NOA} - \beta_{PL_{DC}})}$, or if $NPA_{DC}=0$, and $NPA_{DB} < PA_{DB}\frac{(\beta_{PA_{DB}} - \beta_{PL_{DB}})}{(\beta_{NOA} - \beta_{PL_{DB}})} + PA_{DC}\frac{(\beta_{PA_{DC}} - \beta_{PL_{DC}})}{(\beta_{NOA} - \beta_{PL_{DB}})}$, then $\hat{\beta}_{NOA} > \beta_{NOA}$ holds.

Error case 2: The calculation of operating asset risk includes both pension values, but inappropriately assumes the associated risks for both pension plans. If, for example, both DB and DC pension asset and pension liability risks are assumed to be the same and equal to the risk of the debt of the firm, $\hat{\hat{\beta}}_{PA} = \hat{\hat{\beta}}_{PL} = \beta_{NFL}$, then the estimated operating asset beta becomes

$$\hat{\hat{\beta}}_{NOA} = \frac{E}{NOA}\beta_E + \frac{NFL - NPA_{DB} - NPA_{DC}}{NOA}\beta_{NFL} - \frac{OPT}{NOA}\beta_{OPT} \qquad (4)$$

The specification error in the estimated beta is given by

$$\hat{\hat{\varepsilon}}_{OA} = \frac{PL_{DB}}{NOA}(\beta_{NFL} - \beta_{PL_{DB}}) + \frac{PA_{DB}}{NOA}(\beta_{PA_{DB}} - \beta_{NFL}) + \frac{PL_{DC}}{NOA}(\beta_{NFL} - \beta_{PL_{DC}}) + \frac{PA_{DC}}{NOA}(\beta_{PA_{DC}} - \beta_{NFL}) \qquad (5)$$

Proof: See Appendix.

As JMB point out that usually the risk level of pension liabilities and firm debt are similar with normal leverage ratios, i.e., $\beta_{PL} \approx \beta_{NFL}$, but the portion of pension assets that are invested in equities has significantly higher beta risk than the firm debt, i.e.,

$\beta_{PA} > \beta_{NFL}$. Therefore, it generally holds that $\hat{\hat{\beta}}_{OA} > \beta_{OA}$. Again operating asset beta is biased upward when both pension fund risks are assumed to be the same as firm's liability risk.

3. Sample and Data

The sample is based on the S&P 500 firms that (1) are in continuous existence in the index for the study period 1 January 2001 to 31 December 2006; (2) have all available stock price in CRSP and financial information on Compustat; and (3) have complete DB and DC Plan asset allocation information reported in the relevant Money Market Directory publication. We also exclude financial firms. This resulted in a final sample of 163 firms.

3.1. Sample and Data collection procedures

Data for this study is collected from a variety of sources. Stock price and returns data was captured from the merged CRSP Compustat file. Compustat was also used to capture the main DB pension variables; ABO, PBO and market value of pension assets. The Money Market Directory was the source of data for detailed asset allocation. The Ratings Direct service of Standard & Poor's provided the credit rating history

3.2. Data Description

Table 1 reports the descriptive statistics for the sample firms. Panel A reports selected company balance sheet information separately by type of GAAP used. A procedure was used to back out the effect on shareholders' equity of unexpected gains and losses arising from both asset and liability experience. The descriptive statistics show that the book value of equity is sensitive to the form of pension accounting regime used. The US GAAP generally overstates the liability relative to proposed GAAP.

INSERT TABLE 1 ABOUT HERE

The insurance values of pension liabilities and assets is much higher than under existing GAAP due to the recognition of the DC Plan within the consolidated entity,

although the consolidation under the equity approach is mitigated by the elimination of investment in company sponsoring stock. The pension assets and liabilities also incorporate estimates of future cash flows, risk capital and credit insurance margins which insurance firms would expect to incur. This in turn increases the amount of equity in the combined firm.

Table 1, Panel B reports relevant data on the composition of the pension plans sponsored by these companies. It shows the impact of the pensions as a percentage of firm value. The amount of DB, DC plan and stock ownership plan as a proportion of total corporate market capitalization is shown. The total percentage of DB and DC plan investments in the corporate sponsor's own stock is also shown. It averages nearly 5% in 2001, but this reduces to 3% in 2006. The decrease is due to the declining economic significance of plans relative to stock options over this period.

As we can see that, relative to stock holders' equity, both DB and DC Plan pension funds are on average very significant. This information is not available from JMB as neither the sample selection procedure nor the composition of the data sets is described.

Table 2 shows the assumed beta of each asset category identified by the Money Market Directory (MMD). The MMD lists at a detailed level, the asset composition of pension schemes on a 'functional' basis. For example, MMD decomposes investments across various debt instruments, from government bonds, corporate bonds, high-yield bonds, convertible bonds, indexed linked bonds and international bonds. Similarly pension equities are decomposed into various risk classes, including small, medium or large stock, and/or growth versus value stocks, as well as international, indexed and emerging market equities.

INSERT TABLE 2 ABOUT HERE

The asset allocation for the relevant DB plan and DC Plan are shown separately in the table. Note that DC plans, on average, have invested 35% of sponsoring company's stocks relative to 2% invested in DB plans. This has important implication for risk transformation and changes in capital structure for sponsoring companies.

JMB suggest that the cost of capital should be 'corrected' to allow for both the value and risk of pension plans. However they do not consider DC Plans, which have a significant investment in company stocks. Since DC Plans own a significant proportion of company own stock, they can alternatively be 'consolidated' into the firms by eliminating these common investments. They can alternatively be 'merged' with the firm and retain a separate set of asset and liabilities to the firm. These overlays complicate the relationship of pension risk to firm risk as represented by JMB.

Table 3 shows the beta estimates and CAPM –based cost of capital estimates, relating to each of the four accounting treatments outlined above, as generated in four different scenarios: (*i*) US GAAP, based on detailed MMD asset allocation classification of pension assets (DB plan only); (ii) proposed GAAP (without consolidating the DC/DC Plan); (*iii*) 'merger' of the DC/DC Plan with the firm as a separate, grossed up set of insurance contracts; and (i*v*) full 'equity consolidation' of the DC/DC Plan, as a structured finance vehicle, into the firm.

INSERT TABLE 3 ABOUT HERE

Table 3, Panel A shows that the beta estimates for firm operating asset beta decrease from cases (i) to (iv) as more risk is taken on by the pension risk. The cases (i) and (ii) do not show any DC plan risk as it remains off balance sheet. For case (iii), the DC and DB plans are combined as a 'merged entity' and hence the pension asset betas and pension liability betas are the same. In case (iv), the pension asset and pension liabilities are separated for the DC and DB plans and are de-leveraged to reflect the elimination of company stock ownership in pension risk.

Panel B confirms the results of JMB that correcting for valuation and risk in the pension fund results in lower cost of capital estimates. The cost of capital is lower when the insurance contracting approach is used instead of either US GAAP or the unconsolidated EFRAG proposals. The lower cost of capital is due to the lower risk premium arising from the higher proportion of equity to debt for these GAAP. Enhancing the risk management allocation or consolidating the DC Plan into the

entity slightly increases the cost of capital estimates. Consolidating the DC Plan as equity investments reduces the cost of capital estimates even further, especially the insurance contracting case. By contrast, using a fair value approach actually increases the cost of capital estimates both for equity and debt relative to all other cases.

Table 4, gives yearly (Panel A) and industry segment (Panel B) breakdowns of the overall average cost of capital estimates reported in Table 3. The results show significant variation across the years, with the lowest cost of capital on average in 2004 and the highest cost of capital in 2001.

The industry breakdown (Panel B of Table 4) shows that significant inter-industry variation in cost of capital estimates. The lowest sector is utilities, while the highest if retail. These results are consistent with the finding that incorporating risk and value of pension risk in utilities has little impact on their already structured balance sheets, whereas it has a more significant impact on more leveraged retail firms.

INSERT TABLE 4 ABOUT HERE
---

4. Baseline Empirical Tests

In this section we examine the relationship between firm risk and pension risk. We restrict the discussion of our main results to non-distressed firms since firms in financial distress are likely to behave differently from non-distressed firms due to PBGC. In the next section we conduct robustness checks to extend the analysis to explicitly incorporate new insights on risk management, consolidated treatments, industry,effect and financially distressed firms.

Following the procedure in JMB, we use three measures to identify financially distressed firms: book to market, return on investment, and leverage. These capture measures of overall risk, operating risk and financial risk, respectively.[19] Then, in each year of the sample, all firms are ranked by each measure of financial distress, and the deciles of firms with the most severe measure as distressed and the rest are

[19] Cochrane (1999) reviews the empirical asset pricing literature and provides an intuitive discussion of the nondiversifiable risks proxied by the size and financial distress risk factors.

treated as non-distressed. Regressions are run on firms that are not in distress in the previous year. The following panel data regression is fitted, where equation (8) is the adjusted specification for case (iv), i.e. where the DC Plan is merged with the firm, but as a separate financial services entity.

In terms of the 'extended proposed' GAAP cases (iii) and (iv), where the presently off-balance sheet DC plans and the DB plans are 'fully consolidated'; i.e. either merged with the firm as an additional or consolidated as an equity investment, we need to adjust JMB's model as follows. Note that

$$NOA + PA_{DB} + PA_{DC} - (PL_{DB} + PL_{DC}) + OPT = NFL + E,$$

or

$$NOA + PA_{DB} + (PA_{DC} - E_{EE}) - (PL_{DB} + PL_{DC}) + OPT = NFL + E_{CE},$$

and both DB and DC net pension plan risks are separately 'consolidated' into the firms' accounts consistent with case (iv). Denote

$$\beta_{E+NFL} \equiv \frac{E}{E+NFL}\beta_E + \frac{NFL}{E+NFL}\beta_{NFL}.$$

$$\beta_{E_{CE}+NFL} \equiv \frac{E_{CE}}{E_{CE}+NFL}\beta_{E_{CE}} + \frac{NFL}{E_{CE}+NFL}\beta_{NFL}$$

Therefore, β_{E+NFL} can be rewritten as

$$\beta_{E+NFL} = \beta_{DB1} + \beta_{DC} + \frac{NOA}{E+NFL}\beta_{NOA} + \frac{OPT}{E+NFL}\beta_{OPT} \qquad (6a)$$

where $\beta_{DB1} = (\frac{PA_{DB}}{E+NFL}\beta_{PA_{DB}} - \frac{PL_{DB}}{E+NFL}\beta_{PL_{DB}})$

$$\beta_{DC} = (\frac{PA_{DC}}{E+NFL}\beta_{PA_{DC}} - \frac{PL_{DC}}{E+NFL}\beta_{PL_{DC}})$$

Similarly, $\beta_{E_{CE}+NFL}$ can be rewritten as

$$\beta_{E_{CE}+NFL} = \beta_{DB2} + \beta_{DCE} + \frac{NOA}{E_{CE}+NFL}\beta_{NOA} + \frac{OPT}{E_{CE}+NFL}\beta_{OPT} \qquad (6b)$$

where $\beta_{DB2} = (\frac{PA_{DB}}{E_{CE}+NFL}\beta_{PA_{DB}} - \frac{PL_{DB}}{E_{CE}+NFL}\beta_{PL_{DB}})$

$$\beta_{DCE} = \left(\frac{PA_{DCE}}{E_{CE} + NFL}\beta_{PA_{DCE}} - \frac{PL_{DC}}{E_{CE} + NFL}\beta_{PL_{DC}}\right)$$

$PA_{DCE} = PA_{DC} - E_{EE}$, and $\beta_{PA_{DCE}}$ is the systematic risk of PA_{DCE}.

We can use the relationships in equations (6a) and (6b) to test whether the beta risk of pension is incorporated in the risk of the firm's capital structure as below:

$$\beta_{E+NFL} = a + b\beta_{pension1} + \varepsilon \qquad (7a)$$

$$\beta_{E_{CE}+NFL} = a + b\beta_{pension2} + \varepsilon \qquad (7b)$$

where $\beta_{pension1} = \beta_{DB1} + \beta_{DC}$, and $\beta_{pension2} = \beta_{DB2} + \beta_{DCE}$. For case (iv), we can also test

$$\beta_{E_{CE}+NFL} = a + b\beta_{DB} + c\beta_{DCE} + \varepsilon \qquad (8)$$

In these regressions, b and c represent the sensitivity of firm risk to firm pension risks, and intercept a represents the part of the expected firm risk that cannot be captured by the pension risks. We will use a number of instrumental variables to pick up the effect of the intercept. We expect b and c to be positive.

4.1. Simple Tests

Table 5 reports various estimates of pension risk that are appropriate to the various cases outlined in Section 2. These show that pension risk is generally lower under proposed GAAP than under US GAAP.

INSERT TABLE 5 ABOUT HERE

Following the procedure outlined in JMB, we run Fama-McBeth (1973) methodology to compute robust standard errors for the coefficient estimates, by first running cross-sectional regressions for each year separately, while controlling for fixed effects at the industry levels using the two-digit Standard Industrial Classification (SIC) code, and report the time-series averages of the coefficient estimates and use the time series standard errors of the average slopes to draw inferences, The regression coefficients

for each of the three measures of risk and their t-statistics are initially reported for the 'simplistic' cases (i) and (ii) in Table 6.

INSERT TABLE 6 ABOUT HERE

Contrary to the results reported in JMB, we find large variation in the pension asset betas. The standard deviations increase as we move from the simplistic US GAAP case (i) towards the proposed GAAP case (ii). However, the pension risk turns negative for proposed GAAP case (ii) indicating extreme volatility in the measurement.

4.2. Tests by incorporating various control variables for operating asset risk

We now follow JMB by running multiple regressions which incorporate various control variables as proxies for differences in the no pension operating asset risks across the firms.

The list of control variables and the procedures used to describe them are also initially based on those described in Jin et al. (2006, 15) and are set out in Table 7.

INSERT TABLE 7 ABOUT HERE

The results of the regression with control variables are listed in Table 8.

INSERT TABLE 8 ABOUT HERE

Table 8, Panel A shows that neither US GAAP nor modified US GAAP (cases (i) and (ii), respectively) demonstrate any relationship between firm risk and pension risk. Panel C results suggest, for proposed GAAP, especially where the DB and DC pension arrangements are segregated as insurance contracts (case (iii)), there is a significant and positive association between pension risk and firm risk. However we also have reservations in estimating standard pension risk to firm risk comparisons in

the latter cases, since the consolidation or merger of the pension plans with the sponsoring firm also change the nature of firm risk. We examine this issue below.

4.3. Incorporating the effects of Risk Management in the Cost of Capital

The second adjustment needed to Jin et al. (2006, 17) empirical tests is that the risk management items above were not actually incorporated in their estimate of firm risk, which they define as 'naïve' weighted average cost of capital. However, this is strictly not an appropriate basis to compare firm risk with pension risk in the 'consolidated' cases (iii) and (iv). The weighted average cost of capital for a firm that merges an insurance subsidiary will differ from the enterprise WACC of the firm that instead uses the risk capital reserve strategy and that the enterprise WACC is not the correct hurdle rate for the operating assets. Instead, a firm can adjust its WACC to find the cost of capital for the operating assets in these cases (O'Brien, 2006). We use the basic value additivity identity for the enterprise WACC, effect of revising firm risk estimates based on incorporating risk management assets, which can either be held as insurance contracts, case (iii), or as structured finance vehicles that provide risk capital case (iv).

Table 9 reports, for the two affected consolidation cases (iii) and (iv) only, the effects of incorporating risk management assets on the firm risk and the overall enterprise WACC estimates. We find that the firm risk and enterprise WACC are overestimated if the risk management assets are not taken into account.

INSERT TABLE 9 ABOUT HERE

Table 10 repeats the results of multiple regression tests for non-distressed firms as in Table 8, but only for cases (iii) and (iv) where these adjustments are implemented. Note that in case (iv) we have separate measures for pension risk for both the DC Plan and the DB plan as per the model set up above. We find that the overall R squareds are comparable, but that the relation of pension risk and firm risk is much stronger for the merged entity, as consistent with a substance-based notion of control as envisaged by EFRAG (2008).

INSERT TABLE 10 ABOUT HERE
---

5. Robustness Checks

In this section, we report various robustness checks on the regressions results that were reported in Section 4. We follow the procedures described in JMB for financial distressed firms and filtered tests. We also conduct industry-based tests.

5.1. Financially distressed firms

Following Jin et al. (2006, 17) we first re-run the regression analysis specified in Table 8 (for baseline GAAP cases) and in Table 10 (for the consolidated cases with 'corrected' firm risk estimates) with the distressed firms sub sample.[20] JMB posit that distressed firms are likely to have a distinctly different pattern than non-distressed firms. Table 11 reports the results.

INSERT TABLE 11 ABOUT HERE

Table 11 also shows the results for US GAAP (with enhanced asset allocation and proposed GAAP (EFRAG proposal, without consolidation of the DC Plan) which should be compared with the results reported for the more complicated cases for the non-distressed firms in Table 8.

The overall results for US GAAP are consistent with those reported by JMB, and shows that the relation between pension risk and firm risk is insignificant for those firms. However the results for the other cases are more equivocal. The EFRAG Proposal case results, where financial leverage is a proxy for financial distress, are statistically significant and negative. This negative association between leverage and pension risk supports the contention that the option to put DB pensions to the PBGC is potentially valuable for financially distressed firms.

[20] In our initial results we report pooled OLS regressions for the years 2002-2006 only.

5.2. Industry effects

The initial cost of capital estimates reported in Table 4b (Panel B) indicate significant cross-sectional variation in cost of capital estimates across major industry classifications. We now undertake more sophisticated tests to determine whether these variations also affect the strength of cross-sectional relationship between firm risk and pension risk in the 'consolidated cases'. In particular we note that prior empirical evidence suggests that the relationship between these variables is less likely to hold in highly unionised industries (Laurence and Kurme, 1990). Due to limitations in our sample we restrict our tests by comparing highly unionised manufacturing versus less unionised non-manufacturing industries. Table 12 report the results by industry with panel A (manufacturing firms) and panel B (non-manufacturing firms).

INSERT TABLE 12 ABOUT HERE

The results appear to imply that the relationship between firm risk and pension risk is stronger in non-manufacturing industries, and especially for the equity (consolidated) case (iv). These results support the notion that the structural relationship between firm risk and pension risk is more likely to hold in non-unionized, non-manufacturing industries.

6. Conclusion

In this study, we reconsider whether JMB's results concerning the relation of pension risk to firm risk are sensitive to variations in pension asset and liability values and risk under existing and proposed GAAP, and then consider the impact of increasing the scope of the pension arrangement by fully consolidating both the DB and DC Plan into the firm's balance sheet. We respecify the issue of ignoring pension value and risk relationships by considering the impact of merger or consolidation of DC plans. These subtle changes as result of apparently minor variations in GAAP and in accounting entity can have a significant impact on the magnitude, relative weighting and risk implications of equity and liability. Our findings suggest that altering the mix

and magnitude of value and risk components of pension assets and liabilities can affect the cost of capital and pension risk.

The primary conclusions of the paper are the following:
(1) It is important to control for the possible effects of alternative GAAP when incorporating pension values and estimating betas for pension assets and liabilities under the standard CAPM method.
(2) Cost of capital estimates should incorporate sufficient detail in pension asset allocation to enable reliable inferences to be drawn concerning the predicted relationship between pension risk and firm risk.
(3) The relation of pension risk to firm risk is consistent with that predicted by theory when the DB and DC Plan is either merged or consolidated into the firm results in a separation of the rights and expectations of outside shareholders to those implied to 'closed' employee participants of the DC Plan. This also raises the need for separate pension risk estimates for the DC Plan than for the sponsored DB plan.
(4) Differential treatment of DC Plans as an equity consolidation, or as a merged 'financial services' entity, can alter the mix of debt and equity used to estimate the cost of capital, and affect the strength of relationship of firm risk to pension risk.
(5) Eliminating the percentage of DB and DC Plan investments in sponsoring company stock further strengthens the relationship of pension risk to firm risk, and helps clarify and delineate the cost of capital effect on both outside shareholders and 'employee' shareholders.

The results of this study lends tentative support to extending the scope of consolidating firms pension arrangements as either a set of insurance contracts or as an integrated form of structured finance vehicle. We find that the relationship between pension risk and firm risk is most unequivocal for these cases, whereas implementing cost of capital on the basis of existing GAAP obfuscates this relationship. The cost of capital estimates are sensitive to alternative equity-debt combinations that arise from EFRAG's proposed pension consolidation accounting GAAP treatments.

These proposals would, if adopted have significant implications both for investors and policy makers. First, the mental accounting and passivity of pension plan participants in 401(k) accounts that has been previously documented (Choi et al., 2007) implies

that these plans should be consolidated along with the more standard defined benefit plans into employers stock.[21] Second, there are significant debt-equity implications for analyzing firms' cost of capital, since most 401(k) plans invest heavily in company own stock, depending on whether they are consolidated as SPEs or merged as insurance contracts. Further research is needed to apply this type of analysis to other settings to examine the cost of capital implications before these proposals are implemented.

[21] Benartzi (2001) and Huberman and Sengmueller (2004) argue that the the influence of employer sponsors' stock influence the asset allocation decisions of 401K employee asset allocation decisions.

REFERENCES

Barber, B.M. and J. D. Lyon, 1997. 'Firm Size, Book-to Market and Security Returns: A Holdout Sample of Financial Firms', *Journal of Finance* 52(2): 875-883.

Benartzi, S. (2001). Excessive Extrapolation and the Allocation of 401(k) Accounts to Company Stock, *Journal of Finance*, 56(5): 1747-1764.

Bodie, Z. 1990. Pensions as Retirement income insurance. *Journal of Economic Literature*, 30: 1-30.

Bockus, K.A., W. Dana Northcut and M.E. Zmijewski. 2004. Accounting and disclosure issues in structured finance, in C.L. Culp and W.A. Niskanen eds., *Corporate Aftershock: the public policy lessons from the collapse of Enron and Other Major Corporations.* Wiley.

Brealey, R.A. and S.C. Myers, 2007. *Principles of Corporate Finance*, 7th Edition, Boston: McGraw-Hill/Irwin.

Choi, J.J., B.C. Madrian, and D. Laibson. The Flypaper effect in individual pension asset allocation. NBER Working paper 13656.

Cochrane, J.H. 1999. 'New Fact in Finance', Economic Perspectives 23(3): 36-58.

European Financial Reporting Advisory Group, 2008. *The Financial Reporting of Pensions*. EFRAG: Brussels.

Exley, W. and C. Smith. 2007. Cost of capital for financial firms, *British Actuarial Journal,* Vol. 12, London: Institute of Actuaries.

Froot, K.A. 2004. 'Risk Management, Capital Budgeting and Capital Structure Policy for Insurers and Reinsurers', Harvard Working Paper, Boston MA.

Froot, K.A. and J.C. Stein. 1998. 'Risk Management, Capital Budgeting and Capital Structure Policy for Financial Institutions: An Integrated Approach', *Journal of Financial Economics* 47: 55-82.

Graham, J.R. and C.R. Harvey, 2001. 'The Theory and Practice of Corporate Finance: Evidence from the Field', *Journal of Financial Economics* 60: 187-243.

Hairs,, C.J., D.J. Belsham, N.M. Bryson, C. M. George, D.J.P. Hare, D. A. Smith and S. Thompson. (2001). Fair valuation of liabilities. *British Actuarial Journal*.

Huberman, G. and P. Sengmueller (2004). Performance and Employer Stock in 401(k) Plans, *Review of Finance* 8(3): 403-443.

International Accounting Standards Board. (2004). IFRS 4 Insurance Contracts.

----. 2004. Basis for Conclusions IFRS 4.

Jin, Z. Bodie and R.C. Merton. 2006. Do firms incorporate pension risk into their cost of capital? *Journal of Financial Economics* 1-26 Ibbotson Associates. 2006. *Stocks, Bonds, Bills and Inflation: Valuation Edition* (2002 Yearbook) Chicago.

Laurence, P and D. Curme. 1990. The structure of compensation and incidence of bankruptcy. *Journal of Labor Economics.*

Merton, R.C. and A. F. Perold. 1993. Management of risk capital in financial firms. In S. L. Hayes ed., *Financial Services: Perspectives and Challenges*. HBS Press.

O'Brien, T.J. 2006. Incorporating Risk Management into the Cost of Capital. *Journal of Applied Corporate Finance* (18(4): 2-7.

TABLE 1

Descriptive Statistics
Selected Company Balance sheet information
(Standard deviations statistics in brackets)

Pension asset, pension liability and market cap information are obtained from Compustat. Figures are in millions of dollars. Sample is 163 S&P 500 firms. Data is pooled from 2001-2006. The EFRAG Proposal (2008) is identical to the FRS 17 case but an ABO is substituted for the PBO and is discounted using risk-free (Treasury rate) instead of reported discount rate. The Pension data is obtained from the accounts. The insurance case is based on the discounted distributed earnings emerging from the future cash flows of the DB pension fund. The DC/DC Plan assets are consolidated as a merged entity with those of the DB plan and the corporate sponsor for the 'debt' case; investment in company stock are eliminated from the consolidation of the DC Plan/DC plan assets with the firm in the 'equity insurance' case.

Panel A: Pension and capital structure variables

Case	*Pension asset*	*Pension liability*	*Pension surplus (shortfall)*	*Book value of equity*	*Book value of debt*	*Operating asset (E+D-PA-PL)*
(i) US GAAP	4099 (8614)	4097 (8474)	2	6177 (12890)	4169 (10797)	10344
(ii) EFRAG Proposal 1	4099 (8614)	1010 (2114)	3089	2885 (10936)	4169 (10797)	3965
(iii) Insurance (debt) Proposal 2	7823 (16713)	7889 (16315)	(65)	7015 (12426)	4169 (10797)	11249
(iv) Insurance FV (debt) Proposal 3	7687 (16618)	7888 (16315)	(201)	7015 (12426)	4169 (10797)	11385

Panel B: Pension as a percentage of firm (market capital) value

Year	DB plan	DC/K plan	SOE plan	TL invested in company stock
2001	12.1	11.1	0.4	4.9
2002	9.0	8.6	0.4	4.5
2003	9.3	9.1	0.4	4.0
2004	11.8	11.4	0.5	4.9
2005	8.3	8.2	0.4	3.4
2006	7.9	7.8	0.4	3.2

TABLE 2

Pension asset categories as reported in Money Market Directory, 2001-2006

The assumed T-bill rate is 4.1%. The average cost is assumed to be 12%, the average risk premium is assumed to be 7.8%. Relevant assumptions are consistent with Brealey and Myers (2007).

Description	Average asset allocation DB%	Average asset allocation DC Plan%	Assumed Beta
Bonds (as in JMB)	18.2	4.1	0.175
Corporate bonds	1.8	0.3	0.230
Government bonds	2.1	0.5	0.179
Municipal bonds	0.1	0.2	0.205128
Inflation linked bond	2.3	0.6	0.1025
International bonds	1.0	0.2	0.175
High yield bonds	0.6	0.0	0.175
General insurance	0.6	13.4	0.205
Convertible bond	0.2	0.0	0.2051
Small cap value	1.0	0.5	2.012
Small cap growth	1.1	0.5	1.3718
Small cap	5.0	1.3	1
Large cap value	2.5	1.3	1.359
Large cap growth	2.0	1.2	0.717
Large cap	8.1	1.2	1
Growth equities	2.1	1.6	1.044
Value equities	2.6	1.1	1
Indexed equities	8.5	8.2	1
International equity	12.0	2.1	1
Equities	16.9	8.6	1
Cash	2.04	2.5	0.06
Property	2.1	0.2	0.15
Company stock	1.9	35.2	Equity beta
Other investments	5.1	14.6	0.795

TABLE 3
CAPM BETA AND COST OF CAPITAL ESTIMATES
(Averages with standard deviation in brackets)

This table reports the systematic risk and overestimation of cost of operating assets for cases (i) – (iii), and for case (iv), where $E = E_{CE} + E_{EE}$.

Panel A: Systematic Risk of Pension Assets, Liabilities and Operating Assets

Beta of equity are estimated using capital asset pricing model, using data on three-year monthly stock return, obtained from the Center for Research in Security Prices, and the value-weighted return on all stocks on NYSE, AMEX, Nasdaq as the proxy for market. Operating asset beta correct is the operation asset beta when correctly accounting for pension value and risk, Operating asset beta error 1 is the operating asset beta ignoring pension plan altogether, and Operating asset beta error 2 is the operating asset beta counting pension value but misrepresenting pension risk.

	(i) US GAAP (MMD asset allocation)	(ii) Proposed GAAP (no consolidation)	(iii) Proposed GAAP (DC Plan merger)	(iv) Proposed GAAP (DC Plan equity consolidation)
Pension Asset (DB) Beta	0.738 (0.094)	0.798 (0.116)	0.627 (0.167)	0.780 (0.124)
Pension Asset (DC) Beta	-	-	0.627 (0.167)	0.786 (0.201)
Pension Liability (DB) Beta	0.175 (0)	0.214 (0.051)	0.216 (0.032)	0.214 (0.050)
Pension Liability (DC) Beta	-	-	0.216 (0.032)	0.169 (0.083)
Operating Asset Beta (Eqn 1b)	0.957 (0.516)	0.968 (0.713)	0.629 (0.486)	0.604 (0.432)

Panel B: Cost of capital estimates

Case	Cost of capital estimate (%)	Cost of capital estimate error 1 (%)	Percent overestimate for error 1	Cost of capital estimate error 2 (%)	Percent overestimate for error 2
(i) US GAAP (MMD asset allocation)	7.29 (5.86)	8.80 (3.48)	21	7.78 (5.88)	7
(ii) Proposed GAAP (no consolidation)	6.40 (6.08)	8.69 (3.69)	34	7.43 (5.77)	14
(iii) Proposed GAAP (DC Plan merger)	7.62 (7.52)	9.90 (7.81)	30	11.43 (3.41)	18
(iv) Proposed GAAP (DC Plan equity consolidation)	7.20 (7.65)	11.41 (3.41)	58	9.34 (7.60)	30

TABLE 4

CAPM Cost of Capital Estimates - Segmental Breakdown
(standard deviations in brackets)

Panel A: Cost of capital – by year

Case	(i)	(ii)	(iii)	(iv)
2001	4.81	6.66	6.29	8.26
	(4.39)	(3.23)	(3.24)	(3.44)
2002	5.23	6.44	5.94	7.96
	(5.57)	(4.52)	(4.15)	(7.84)
2003	4.57	6.16	5.53	8.19
	(11.57)	(11.19)	(11.51)	(13.44)
2004	3.54	4.80	4.58	6.65
	(5.77)	(5.20)	(4.98)	(4.64)
2005	4.57	6.04	5.73	7.56
	(6.97)	(5.74)	(6.73)	(6.14)
2006	5.38	5.80	5.60	7.15
	(4.65)	(4.36)	(4.34)	(4.57)

Panel B: Cost of capital – by industry

Case	(i)	(ii)	(iii)	(iv)
Mining	5.72	7.32	6.97	8.81
	(2.98)	(2.49)	(2.74)	(2.44)
Manufacturing	4.63	6.02	5.63	7.54
	(6.17)	(4.98)	(4.99)	(6.30)
Utilities	4.85	5.25	5.05	7.42
	(1.41)	(1.18)	(1.18)	(1.60)
Retail	6.16	5.84	7.76	10.13
	(12.71)	(11.99)	(14.06)	(16.70)
Other	2.52	2.3	9.49	12.70
	(10.08)	(9.22)	(3.64)	(3.38)

TABLE 5

Summary Statistics: CAPM estimates of Pension risk

Equity beta is calculated using the market model and up to one year of weekly return data. Average weighted beta for debt and equity is calculated as the market value weighted average beta of debt and equity, where β_{PL} is assumed to be equal to either; (a) weighted average of DB debt (case (i); (b) weighted average of combined DB and DC debt (cases (i) and (iii); and B_{PA} is assumed to be the (b) the weighted average of all DB pension assets as per the Money Market Directory (case (i); or (c) the weighted average of the combined DB and DC pension assets as per the Money Market Directory (cases (iii) and (iv)). There are 163 x 6 years= 972 observations.

Case	Mean	Standard Deviation	Quartile 1	Median	Quartile 3
(i) US GAAP (MMD asset allocation)	0.456	4.014	0.062	0.188	0.854
(ii) Proposed GAAP (no consolidation)	0.050	1.652	0.031	0.014	0.217
(iii) Proposed GAAP (DC/DC Plan merger)	0.377	0.562	0.067	0.236	0.909
(iv) Proposed GAAP (DC/DC Plan equity consolidation)	0.405	1.611	-0.206	0.255	1.187

TABLE 6

Relation Between Pension Risk and Firm Risk: Simple Regression: Non-distressed firms (existing and Proposed GAAP, standard deviation in brackets)

This table reports regression results for the sample from 2001 to 2006 using the procedure described in Jin et al. (2006, 14). The regression being run for cases (i) and (ii) is equation (7a) with $\beta_{DC} = 0$: $\beta_{E+NFL} = a + b\beta_{pension1} + \varepsilon$. All results are estimated with company betas estimated using the market model and one lagged term and with the end of year pension data. The regression is run for each year, controlling for fixed effect at the industry level, and then the time series mean and standard deviation of the regression coefficients are used to make inferences. The standard deviation, reported under each coefficient and in parenthesis is further adjusted for potential time series correlation.

Measure of Distress	Asset allocation /financial distress assumption					
	Book-market ratio		Return on investments		Financial leverage	
	MMD	EFRAG	MMD	EFRAG	MMD	EFRAG
Intercept	0.48 (0.15)	0.62 (0.08)	0.47 (0.01)	0.60 (0.08)	0.49 (0.01)	0.65 (0.09)
Pension risk	-0.07 (0.05)	-0.71 (0.05)	0.02 (0.04)	-0.67 (0.05)	-0.05 (0.05)	-0.73 (0.06)
No. of observations	864	864	864	864	864	864
R-Squared	0.12	0.52	0.01	0.53	0.11	0.53

TABLE 7

List of Control Variables
(following Jin et al., 2007, p. 15)

Variable	Calculation	Compustat Item no.
Market share by value	Calculated using market value and the industry classification codes	DATA24*DATA25
Market share by sales	Calculated using total sales and the industry classification codes	DATA12
Capital intensiveness	Current assets/total assets	DATA4/DATA6
Cash position	Cash and short-term investments/total assets	DATA1/DATA6
Financial leverage	Debt/total assets/	(Data9+Data34)/DATA6
Growth rate	Log(total assets/lagged total assets)	Log(DATA6)/DATA6_lag)
Liquidity	Current assets/current liabilities	DATA4/DATA5
Return on investment	Net income/total assets	DATA172/DATA6
Firm size	Log(total assets)	Log(DATA6)
Research and development	Research and development expense/total assets	DATA46/DATA6
Advertisement	Advertising expense/total assets	DATA45/DATA6

TABLE 8

Relation Between Pension Risk and Firm Risk: Regression: Nondistressed Firms

This table reports regression results for the sample from 2001 to 2006 using the procedure described in Jin et al. (2006, 14) and based on US GAAP. The regression being run is $\beta_{E+NFL} = a + b\beta_{pension1} + \text{control variable} + \varepsilon$. All results are estimated with company betas estimated using the market model and one lagged term and with the end of year pension data. The regression is run for each year, controlling for fixed effect at the industry level, and then the time series mean and standard deviation of the regression coefficients are used to make inferences. The standard deviation, reported under each coefficient and in parenthesis is further adjusted for potential time series correlation.

Panel A: JMB estimates – Existing US GAAP

Measure of Distress	Asset allocation / assumption					
	Book-market ratio		Return on investments		Financial leverage	
	Jin	MMD	Jin	MMD	Jin	MMD
Intercept	0.66 (0.19)	0.66 (0.19)	0.34 (0.20)	0.34 (0.21)	0.56 (0.20)	0.52 (0.19)
Pension risk	-0.03 (0.02)	-0.06 (0.05)	-0.01 (0.02)	-0.01 (0.06)	-0.02 (0.02)	-0.05 (0.05)
Market share by value	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Market share by sales	-0.01 (0.01)	-0.01 (0.01)	-0.02 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Capital intensiveness	-0.03 (0.12)	-0.08 (0.12)	-0.07 (0.12)	-0.08 (0.13)	-0.04 (0.12)	-0.05 (0.12)
Cash position	0.02 (0.23)	0.03 (0.23)	-0.08 (0.24)	-0.05 (0.25)	-0.09 (0.22)	-0.12 (0.22)
Financial leverage	-0.12 (0.13)	-0.12 (0.13)	-0.06 (0.13)	-0.05 (0.13)	-0.18 (0.15)	-0.19 (0.15)
Growth rate	-0.01 (0.08)	-0.01 (0.09)	-0.01 (0.09)	-0.01 (0.09)	-0.01 (0.09)	-0.01 (0.09)
Liquidity	-0.01 (0.02)	-0.01 (0.02)	0.02 (0.03)	0.02 (0.03)	0.01 (0.02)	0.01 (0.02)
Return on investment	-0.13 (0.22)	-0.14 (0.22)	0.05 (0.36)	0.03 (0.37)	-0.11 (0.23)	-0.10 (0.23)
Firm size	-0.01 (0.02)	-0.01 (0.02)	0.02 (0.02)	0.02 (0.02)	0.01 (0.02)	0.01 (0.02)
Advertisement	0.04 (0.46)	0.01 (0.46)	0.18 (0.47)	0.29 (0.50)	0.08 (0.45)	0.15 (0.46)
Research and development	-0.33 (0.64)	-0.35 (0.65)	-0.13 (0.65)	-0.02 (0.69)	0.07 (0.61)	0.12 (0.61)
No. of observations	775	775	782	782	793	793
R-Squared	0.23	0.21	0.14	0.07	0.22	0.20

TABLE 8 (continued)

Relation Between Pension Risk and Firm Risk: Regression: Nondistressed Firms

This table reports regression results for the sample from 2001 to 2006 using the procedure described in Jin et al. (2006, 14) in cases where the pension plan is subject to Proposed GAAP (i.e. discount only accrued pension liabilities using risk –free rate). The regression being run is $\beta_{E_{CE}+NFL} = a + b\beta_{pension2} +$ control variable $+ \varepsilon$. All results are estimated with company betas estimated using the market model and one lagged term and with the end of year pension data. The regression is run for each year, controlling for fixed effect at the industry level, and then the time series mean and standard deviation of the regression coefficients are used to make inferences. The standard deviation, reported under each coefficient and in parenthesis is further adjusted for potential time series correlation.

Panel B: JMB estimates – Proposed GAAP

Measure of Distress	Asset allocation /financial distress assumption					
	Book-market ratio		Return on investments		Financial leverage	
	EFRAG	Merger	EFRAG	Merger	EFRAG	Merger
Intercept	-0.18 (1.35)	0.11 (0.26)	-0.58 (1.40)	0.06 (0.28)	0.98 (1.33)	0.16 (0.29)
Pension risk	-0.70 (0.60)	0.68** (0.11)	-0.67 (0.05)	0.73** (0.12)	-0.84 (0.72)	0.68** (0.13)
Market share by value	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Market share by sales	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)
Capital intensiveness	0.35 (0.86)	0.02 (0.16)	-0.09 (0.91)	0.05 (0.18)	-0.69 (0.82)	-0.09 (0.17)
Cash position	-2.05 (1.60)	0.09 (0.31)	0.74 (1.72)	0.06 (0.34)	-0.10 (1.49)	-0.13 (0.32)
Financial leverage	0.33 (0.92)	-0.05 (0.18)	0.92 (0.96)	0.11 (0.19)	-0.64 (0.84)	0.07 (0.19)
Growth rate	-0.05 (0.65)	-0.01 (0.11)	-0.23 (0.70)	0.09 (0.14)	-0.09 (0.63)	-0.07 (0.13)
Liquidity	0.19 (0.16)	-0.01 (0.03)	0.05 (0.20)	-0.01 (0.04)	0.05 (0.15)	0.01 (0.03)
Return on investment	0.06 (1.65)	-0.05 (0.31)	-1.55 (2.12)	-0.21 (0.42)	0.24 (1.54)	0.21 (0.32)
Firm size	0.05 (0.13)	-0.01 (0.03)	0.11 (0.14)	-0.01 (0.03)	0.01 (0.13)	-0.02 (0.03)
Advertisement	0.84 (3.23)	-0.08 (0.61)	-0.84 (3.43)	0.01 (0.68)	1.46 (3.13)	0.23 (0.67)
Research and development	-2.61 (4.58)	-0.22 (0.88)	-0.44 (4.92)	0.08 (0.98)	1.08 (4.28)	0.03 (0.90)
No. of observations	777	777	782	782	793	793
R-Squared	0.57	0.30	0.56	0.31	0.56	0.29

TABLE 9

RISK MANAGEMENT-BASED FIRM RISK ESTIMATES

(Averages with standard deviation in brackets)

This table shows the effect of revising firm risk estimates based on incorporating risk management assets, which can either be held as insurance, case (iii) or as risk capital, case (iv). Assume OPT =0.

Case	Correct firm risk estimate (%)	Incorrect firm risk estimate (%)	Percent overestimate for error 1	Correct WACC estimate (%)	Incorrect WACC estimate (%)
iii) Proposed GAAP (DC/DC Plan merger)	0.54 (0.37)	0.62 (0.43)	30	8.23 (2.64)	8.84 (3.08)
(iv) Proposed GAAP (DC/DC Plan equity consolidation)	0.55 (0.42)	0.63 (0.49)	58	8.33 (2.91)	8.85 (3.41)

TABLE 10

Relation Between Pension Risk and Firm Risk: Regression: Nondistressed Firms

This table reports regression results for the sample from 2001 to 2006 using the procedure described in Jin et al. (2006, 14). This regression being run is $\beta_{E_{CE}+NFL} = a + b\beta_{pension2} +$ control variable $+ \varepsilon$. For case (iv) it is the extended model applicable to the combined entity of the firm and the sponsored DC/DC Plan; i.e. $\beta_{E_{CE}+NFL} = a + b\beta_{DB2} + c\beta_{DCE} +$ control variable $+ \varepsilon$. All results are estimated with company betas estimated using the market model and one lagged term and with the end of year pension data. The regression is run for each year, controlling for fixed effect at the industry level, and then the time series mean and standard deviation of the regression coefficients are used to make inferences. The standard deviation, reported under each coefficient and in parenthesis is further adjusted for potential time series correlation. This table shows the effect of revising firm risk estimates based on incorporating risk management assets, which can either be held as insurance, case (iii) or as risk capital, case (iv).

Measure of Distress	Financial distress assumption					
	Book-market ratio		Return on investments		Financial leverage	
	Merger	Equity	Merger	Equity	Merger	Equity
Intercept	0.26 (0.24)	-0.77 (1.07)	0.13 (0.32)	0.47 (0.57)	0.26 (0.42)	-1.43 (1.64)
Pension risk1	-0.12 (0.11)	-0.05 (0.39)	0.01 (0.07)	1.14 (0.25)	-0.14 (0.17)	0.83 (0.55)
Pension risk2		-0.20 (0.54)		0.12 (0.36)		-0.14 (0.12)
Market share by value	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.05 (0.13)	0.01 (0.01)	0.01 (0.01)
Market share by sales	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.06 (0.14)	0.01 (0.01)	0.01 (0.01)
Capital intensiveness	0.14 (0.32)	0.02 (0.50)	0.24 (0.48)	0.07 (0.27)	0.25 (0.22)	-0.06 (0.21)
Cash position	-0.20 (0.47)	-0.08 (0.19)	-0.24 (0.63)	0.22 (0.29)	0.32 (0.91)	-0.49 (0.64)
Financial leverage	-0.47 (0.26)	-0.26 (0.46)	-0.41 (0.28)	-0.01 (0.37)	-0.54 (0.27)	0.56 (0.59)
Growth rate	-0.10 (0.25)	-0.02 (0.34)	-0.19 (0.44)	0.02 (0.13)	-0.11 (0.20)	0.02 (0.47)
Liquidity	0.04 (0.08)	-0.04 (0.15)	0.01 (0.07)	0.30 (0.79)	-0.44 (0.94)	-0.01 (0.10)
Return on investment	-0.52 (0.97)	0.00 (0.18)	-0.09 (0.64)	0.05 (0.88)	-0.02 (0.03)	0.01 (0.01)
Firm size	0.03 (0.03)	0.10 (0.14)	0.06 (0.03	-0.04 (0.05)	0.04 (0.05)	0.11 (0.15)
Advertisement	0.23 (1.85)	1.04 (1.57)	-0.02 (2.00)	-0.19 (1.62)	-0.27 (2.06)	0.92 (1.68)
Research and development	-0.82 (1.30)	0.33 (1.12)	-1.18 (0.79)	-0.31 (1.17)	-1.04 (0.96)	0.72 (0.42)
Observations	870	870	870	870	870	870
R-Squared	0.26	0.24	0.22	0.34	0.21	0.26

TABLE 11

Relation Between Pension Risk and Firm Risk: Regression Financially Distressed firms only

This table reports regression results for the sample from 2001 to 2006 using the procedure described in Jin et al. (2006, 14). The regression being run is $\beta_{E+NFL} = a + b\beta_{pension1} + \varepsilon$, where $\beta_{pension1} = \beta_{DB1}$ for case (iii) and for case (iv) it is the extended model applicable to the combined entity of the firm and the sponsored DC Plan; i.e. $\beta_{E_{CE}+NFL} = a + b\beta_{DB} + c\beta_{DCE} + \varepsilon$. All results are estimated with company betas estimated using the market model and one lagged term and with the end of year pension data. The regression is run for each year, controlling for fixed effect at the industry level, and then the time series mean and standard deviation of the regression coefficients are used to make inferences. The standard deviation, reported under each coefficient and in parenthesis is further adjusted for potential time series correlation.

Panel A: JMB estimates – Existing US GAAP

Measure of Distress	Asset allocation /financial distress assumption					
	Book-market ratio		Return on investments		Financial leverage	
	Jin	MMD	Jin	MMD	Jin	MMD
Intercept	0.34 (0.11)	0.30 (0.28)	0.70 (0.22)	0.26 (0.16)	0.11 (0.21)	0.30 (0.29)
Pension risk	-0.01 (0.02)	-0.37 (0.16)**	-0.08 (0.01)	-0.29 (0.09)	0.09 (0.06)	-0.37 (0.16)**
Market share by value	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Market share by sales	-0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)
Capital intensiveness	0.11 (0.12)	-0.72 (0.50)	-0.37 (0.19)**	0.09 (0.35)***	0.04 (0.17)	-0.72 (0.50)
Cash position	0.37 (0.24)	-0.14 (0.71)	0.21 (0.30)	-1.07 (0.70)	0.66 (0.29)**	-0.14 (0.70)
Financial leverage	-0.21 (0.13)	-0.44 (0.42)	-0.49 (0.10)***	-0.48 (0.38)	-0.70 (0.23)***	-0.44 (0.42)
Growth rate	-0.14 (0.13)	0.19 (0.20)	0.07 (0.14)	0.29 (0.38)	0.03 (0.07)	0.19 (0.20)
Liquidity	-0.01 (0.01)	0.26 (0.10)***	0.03 (0.02)	0.04 (0.03)	0.02 (0.05)	0.26 (0.10)**
Return on investment	0.12 (0.13)	1.07 (0.91)	0.03 (0.26)	-1.86 (0.45)***	0.29 (0.21)	1.07 (0.91)
Firm size	0.01 (0.01)	0.01 (0.03)	-0.01 (0.02)	0.01 (0.02)	0.06 (0.02)***	0.01 (0.04)
Advertisement	1.45 (0.78)*	-3.44 (1.91)*	0.27 (0.32)	-0.79 (1.92)	-0.01 (0.51)	-3.44 (1.91)*
Research and development	1.81 (0.66)***	2.79 (4.49)	1.12 (0.51)**	2.28 (1.78)	0.08 (1.62)	2.79 (4.49)
No. of observations	108	108	108	108	108	108
R-Squared	0.31	0.24	0.52	0.33	0.40	0.13

TABLE 11 (continued)

Relation Between Pension Risk and Firm Risk: OLS Regression Financially Distressed firms only

This table reports OLS pooled regression results for the sample from 2001 to 2006 using the procedure described in Jin et al. (2006, 14). The regression being run is $\beta_{E+NFL} = a + b\beta_{pension1} + \varepsilon$, where $\beta_{pension1} = \beta_{DB1}$ for case (iii) and for case (iv) it is the extended model applicable to the combined entity of the firm and the sponsored DC Plan; i.e. $\beta_{E_{CE}+NFL} = a + b\beta_{DB} + c\beta_{DCE} + \varepsilon$. All results are estimated with company betas estimated using the market model and one lagged term and with the end of year pension data. The standard error is parentheses.

Panel B: JMB estimates – Proposed GAAP

	Book to market			ROI			Financial Leverage		
	EFRAG	Merger	Consoli-dation	EFRAG	Merger	Consoli-dation	EFRAG	Merger	Consoli-dation
Intercept	0.37 (0.42)	-0.75 (0.68)	-0.92 (0.94)	1.14 (0.36)	-0.84 (0.78)	-0.59 (1.20)	2.43 (0.84)	-0.09 (0.12)	-0.10 (0.76)
Pension risk 1	-0.09 (0.40)	0.15 (0.15)	-0.69 (0.43)	-1.50 (0.17)***	-0.45 (0.22)*	0.80 (0.53)	0.28 (0.24)	-0.30 (0.86)	0.84 (0.28)***
Pension risk 2			0.03 (0.26)			1.50** (0.74)			-1.51 (0.64)**
Market share by value	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)**
Market share by sales	0.01 (0.01)	-0.01** (0.01)	0.01 (0.01)	(0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)
Capital intensiveness	0.47 (0.41)	0.48 (0.44)	-0.58 (0.70)	-1.19 (0.93)	-0.13 (0.47)	0.22 (0.74)	1.71 (0.69)**	-0.10 (0.54)	0.37 (0.59)
Cash position	0.66 (0.80)	0.79 (0.79)	-1.14 (1.26)	1.47 (1.84)	0.75 (0.98)	-0.07 (1.09)	3.43 (1.04)***	-2.71 (1.37)**	0.59 (0.61)
Financial leverage	-0.18 (0.42)	-1.3*** (0.41)	0.98 (0.65)	0.72 (1.00)	-1.16 (0.61)*	0.36 (0.87)	-3.49 (0.88)***	-0.41 (0.65)	-1.48 (0.79)*
Growth rate	0.04 (0.39)	0.43 (0.44)	0.99 (0.59)*	0.48 (1.03)	0.44 (0.24)	0.05 (0.57)	0.15 (0.27)	-0.08 (0.13)	0.24 (0.14)*
Liquidity	0.04 (0.04)	-0.09 (0.03)**	0.02 (0.04)	0.13 (0.07)	-0.07 (0.03)**	-0.01 (0.04)	-0.59 (0.19)***	0.13 (0.14)	-0.09 (0.17)
Return on investment	-0.59 (0.52)	-1.42 (0.51)**	-0.20 (0.53)	-0.83 (1.23)	-1.95 (0.49)**	-0.54 (0.66)	0.38 (0.84)	-0.01 (0.63)	-0.18 (0.44)
Firm size	0.02 (0.04)	0.19 (0.07)**	0.12 (0.10)	-0.08 (0.07)	0.20 (0.08)**	0.04 (0.13)	-0.05 (0.07)	0.08 (0.06)	0.08 (0.06)
Advertisement	-1.61 (2.29)	-1.33 (2.37)	4.47 (3.87)	-1.54 (5.13)	-0.03 (3.44)	3.73 (2.73)	1.74 (1.98)	1.39 (1.49)	-4.14 (1.67)**
Research and development	0.63 (2.67)	1.82 (2.16)	5.01 (3.37)	8.02 (4.86)	8.12 (2.10)**	1.87 (2.57)	3.10 (6.16)**	2.17 (3.68)*	6.87 (5.53)
No. of observations	108	108	108	108	108	108	108	108	108
R-Squared	0.15	0.33	0.20	0.50	0.63	0.16	0.33	0.21	0.47

TABLE 12

Relation Between Pension Risk and Firm Risk: Regression: Firms by Industry

This table reports regression results by industry classification, with firms classified as either manufacturing or non-manufacturing. The sample period is from 2001 to 2006. We use the Fama-McBeth regression procedure described in Jin et al. (2006, 14). The regression being run is is $\beta_{E+NFL} = a + b\beta_{pension1} + \varepsilon$, where $\beta_{pension1} = \beta_{DB1}$ for case (iii) and for case (iv) it is the extended model applicable to the combined entity of the firm and the sponsored DC Plan; i.e. $\beta_{E_{CE}+NFL} = a + b\beta_{DB} + c\beta_{DCE} + \varepsilon$. All results are estimated with company betas estimated using the market model and one lagged term and with the end of year pension data. The regression is run for each year, controlling for fixed effect at the industry level, and then the time series mean and standard deviation of the regression coefficients are used to make inferences. The standard deviation, reported under each coefficient and in parenthesis is further adjusted for potential time series correlation. This table shows the effect of revising firm risk estimates based on incorporating risk management assets, which can either be held as insurance, case (iii) or as risk capital, case (iv).

Panel A: Manufacturing firms

Measure of Distress	Financial distress assumption					
	Book-market ratio		Return on investments		Financial leverage	
	Merger	Equity	Merger	Equity	Merger	Equity
Intercept	-0.01 (0.29)	-0.77 (1.07)	-0.05 (0.35)	0.60 (0.58)	0.14 (0.42)	-1.37 (1.76)
Pension risk1	-0.12 (0.25)	-0.05 (0.40)	0.03 (0.15)	0.98 (0.42)	-0.09 (0.22)	0.56 (0.36)
Pension risk2		-0.20 (0.54)		0.20 (0.39)		-0.45 (0.24)
Market share by value	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Market share by sales	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Capital intensiveness	0.21 (0.46)	0.06 (0.50)	0.15 (0.49)	-0.26 (0.32)	0.19 (0.50)	0.12 (0.83)
Cash position	-0.62 (0.94)	-0.27 (0.34)	-0.57 (0.73)	0.16 (0.38)	-0.42 (0.79)	0.45 (0.79)
Financial leverage	-0.64 (0.41)	-0.09 (0.36)	-0.55 (0.59)	0.02 (0.57)	-0.65 (0.51)	0.66 (0.72)
Growth rate	-0.20 (0.54)	-0.08 (0.34)	-0.20 (0.46)	0.30 (0.30)	-0.33 (0.49)	0.11 (0.40)
Liquidity	0.10 (0.10)	-0.06 (0.16)	0.09 (0.10)	0.00 (0.09)	0.07 (0.10)	-0.13 (0.13)
Return on investment	-0.27 (1.18)	0.02 (0.05)	-0.88 (1.06)	-0.29 (1.15)	-0.44 (1.09)	0.67 (1.21)
Firm size	0.06 (0.05)	0.10 (0.14)	0.38 (0.79)	-0.04 (0.07)	0.06 (0.05)	0.27 (0.36)
Advertisement	-0.24 (1.92)	1.05 (1.57)	0.52 (1.46)	-0.55 (2.60)	0.29 (1.96)	0.56 (2.54)
Research and development	-1.76 (1.76)	0.33 (1.12)	-0.57 (0.90)	-0.29 (1.32)	-1.09 (2.05)	0.89 (1.31)
Observations	571	571	571	571	571	571
R-Squared	0.35	0.25	0.30	0.39	0.35	0.29

TABLE 12 (continued)

Relation Between Pension Risk and Firm Risk: Regression: Firms by Industry

This table reports regression results by industry classification, with firms classified as either manufacturing or non-manufacturing. The sample period is from 2001 to 2006. We use the Fama-McBeth regression procedure described in Jin et al. (2006, 14). The regression being run is is $\beta_{E+NFL} = a + b\beta_{pension1} + \varepsilon$, where $\beta_{pension1} = \beta_{DB1}$ for case (iii) and for case (iv) it is the extended model applicable to the combined entity of the firm and the sponsored DC Plan; i.e. $\beta_{E_{CE}+NFL} = a + b\beta_{DB} + c\beta_{DCE} + \varepsilon$. All results are estimated with company betas estimated using the market model and one lagged term and with the end of year pension data. The regression is run for each year, controlling for fixed effect at the industry level, and then the time series mean and standard deviation of the regression coefficients are used to make inferences. The standard deviation, reported under each coefficient and in parenthesis is further adjusted for potential time series correlation. This table shows the effect of revising firm risk estimates based on incorporating risk management assets, which can either be held as insurance, case (iii) or as risk capital, case (iv).

Panel B: Non-Manufacturing firms

Measure of Distress	Financial distress assumption					
	Book-market ratio		Return on investments		Financial leverage	
	Merger	Equity	Merger	Equity	Merger	Equity
Intercept	0.36	-0.97	0.73	0.38	0.58	-1.05
	(0.24)	(0.86)	(1.20)	(1.14)	(1.26)	(1.30)
Pension risk1	-0.11	-0.46	-0.13	1.12	0.02	0.73
	(0.10)	(0.40)	(0.44)	(0.86)	(0.35)	(0.93)
Pension risk2		-0.52		0.28		0.55
		(0.50)		(0.50)		(1.18)
Market share by value	0.01	0.01	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Market share by sales	0.01	0.01	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Capital intensiveness	0.12	0.29	0.20	-0.02	0.08	0.28
	(0.33)	(0.40)	(0.59)	(0.36)	(0.47)	(0.27)
Cash position	-0.07	-0.88	0.31	0.38	0.87	-1.50
	(0.62)	(1.28)	(1.11)	(1.00)	(1.11)	(1.11)
Financial leverage	-0.55	-1.01	-0.54	0.29	-0.96	0.09
	(0.11)	(0.88)	(0.81)	(0.25)	(1.30)	(1.85)
Growth rate	-0.25	-0.87	-0.79	-0.07	-0.61	-0.38
	(0.40)	(1.10)	(1.33)	(0.12)	(1.38)	(1.01)
Liquidity	0.01	-0.01	-0.04	-0.01	-0.14	-0.01
	(0.11)	(0.10)	(0.14)	(0.06)	(0.18)	(0.15)
Return on investment	-0.40	0.04	0.19	1.04	-0.24	0.01
	(1.09)	(0.10)	(1.46)	(1.94)	(2.31)	(0.01)
Firm size	0.03	0.15	0.67	-0.37	0.04	0.06
	(0.02)	(0.08)	(0.77)	(0.76)	(0.07)	(0.08)
Advertisement	0.12	6.31	5.51	-0.38	0.26	1.78
	(1.88)	(6.77)	(-2.25)	(4.64)	(7.09)	(3.76)
Research and development	-1.08	-0.52	-2.25	0.57	-1.88	-2.01
	(1.25)	(4.33)	(3.48)	(1.95)	(4.43)	(2.06)
Observations	404	404	404	404	404	404
R-Squared	0.29	0.43	0.51	0.48	0.52	0.41

Appendix

Cost of Capital and Pension Value and Risk

Proof of equation (3).

If both the value and the risk of the pension plans, including DB and DC plans, are ignored, then the estimated operating asset is

$$\widehat{\text{NOA}} = \text{E} + \text{NFL} - \text{OPT} = \text{NOA} + \text{NPA}_{\text{DB}} + \text{NPA}_{\text{DC}}$$

The estimated operating asset beta becomes

$$\hat{\beta}_{NOA} = \frac{E}{\widehat{NOA}}\beta_E + \frac{NFL}{\widehat{NOA}}\beta_{NFL} - \frac{OPT}{\widehat{NOA}}\beta_{OPT}$$

Define $\hat{\varepsilon}_{NOA} = \hat{\beta}_{NOA} - \beta_{NOA}$. Note that $\widehat{\text{NOA}} = \text{NOA} + \text{NPA}_{\text{DB}} + \text{NPA}_{\text{DC}}$. The weighted average betas of NPA and $\widehat{\text{NOA}}$ are given by: $\beta_{NPA} = \frac{PA}{NPA}\beta_{PA} - \frac{PL}{NPA}\beta_{PL}$

and

$$\begin{aligned}
\hat{\beta}_{NOA} &= \frac{NOA}{NOA + NPA_{DB} + NPA_{DC}}\beta_{NOA} + \frac{NPA_{DB}}{NOA + NPA_{DB} + NPA_{DC}}\beta_{NPA_{DB}} \\
&\quad + \frac{NPA_{DC}}{NOA + NPA_{DB} + NPA_{DC}}\beta_{NPA_{DC}} \\
&= \beta_{NOA} + \frac{NPA_{DB}}{NOA + NPA_{DB} + NPA_{DC}}(\beta_{NPA_{DB}} - \beta_{NOA}) + \frac{NPA_{DC}}{NOA + NPA_{DB} + NPA_{DC}}(\beta_{NPA_{DC}} - \beta_{NOA}) \\
&= \beta_{NOA} + \frac{NPA_{DB}}{NOA + NPA_{DB} + NPA_{DC}}(\frac{PA_{DB}}{NPA_{DB}}\beta_{PA_{DB}} - \frac{PL_{DB}}{NPA_{DB}}\beta_{PL_{DB}} - \beta_{NOA}) \\
&\quad + \frac{NPA_{DC}}{NOA + NPA_{DB} + NPA_{DC}}(\frac{PA_{DC}}{NPA_{DC}}\beta_{PA_{DC}} - \frac{PL_{DC}}{NPA_{DC}}\beta_{PL_{DC}} - \beta_{NOA}) \\
&= \beta_{NOA} + \frac{PA_{DB}}{NOA + NPA_{DB} + NPA_{DC}}(\beta_{PA_{DB}} - \beta_{PL_{DB}}) - \frac{NPA_{DB}}{NOA + NPA_{DB} + NPA_{DC}}(\beta_{NOA} - \beta_{PL_{DB}}) \\
&\quad + \frac{PA_{DC}}{NOA + NPA_{DB} + NPA_{DC}}(\beta_{PA_{DC}} - \beta_{PL_{DC}}) - \frac{NPA_{DC}}{NOA + NPA_{DB} + NPA_{DC}}(\beta_{NOA} - \beta_{PL_{DC}})
\end{aligned}$$

$$\hat{\varepsilon}_{OA} = \frac{PA_{DB}}{\widehat{NOA}}(\beta_{PA_{DB}} - \beta_{PL_{DB}}) + \frac{PA_{DC}}{\widehat{NOA}}(\beta_{PA_{DC}} - \beta_{PL_{DC}}) - \frac{NPA_{DB}}{\widehat{NOA}}(\beta_{NOA} - \beta_{PL_{DB}}) - \frac{NPA_{DC}}{\widehat{NOA}}(\beta_{NOA} - \beta_{PL_{DC}})$$

Q.E.D.

Proof of Equation (5). If values of both DB and DC plans are included, then the estimated operating asset is

$$\widehat{\widehat{\text{NOA}}} = \text{NOA} = \text{E} + \text{NFL} - \text{NPA}_{\text{DB}} - \text{NPA}_{\text{DC}} - \text{OPT}$$

The estimated operating asset beta becomes

$$\hat{\hat{\beta}}_{NOA} = \frac{E}{NOA}\beta_E + \frac{NFL - NPA_{DB} - NPA_{DC}}{NOA}\beta_{NFL} - \frac{OPT}{NOA}\beta_{OPT}$$

Define $\hat{\hat{\varepsilon}}_{OA} = \hat{\hat{\beta}}_{OA} - \beta_{OA}$.

$$\hat{\hat{\varepsilon}}_{OA} = \frac{E}{NOA}\beta_E + \frac{NFL - NPA_{DB} - NPA_{DC}}{NOA}\beta_{NFL} - \frac{OPT}{NOA}\beta_{OPT}$$

$$-(\frac{E}{NOA}\beta_E + \frac{NFL}{NOA}\beta_{NFL} - (\frac{PA_{DB}}{NOA}\beta_{PA_{DB}} - \frac{PL_{DB}}{NOA}\beta_{PL_{DB}}) - (\frac{PA_{DC}}{NOA}\beta_{PA_{DC}} - \frac{PL_{DC}}{NOA}\beta_{PL_{DC}}) - \frac{OPT}{NOA}\beta_{OPT})$$

$$= \frac{-(PA_{DB} - PL_{DB}) - (PA_{DC} - PL_{DC})}{NOA}\beta_{NFL} + (\frac{PA_{DB}}{NOA}\beta_{PA_{DB}} - \frac{PL_{DB}}{NOA}\beta_{PL_{DB}}) + (\frac{PA_{DC}}{NOA}\beta_{PA_{DC}} - \frac{PL_{DC}}{NOA}\beta_{PL_{DC}})$$

$$= \frac{PL_{DB}}{NOA}(\beta_{NFL} - \beta_{PL_{DB}}) + \frac{PA_{DB}}{NOA}(\beta_{PA_{DB}} - \beta_{NFL}) + \frac{PL_{DC}}{NOA}(\beta_{NFL} - \beta_{PL_{DC}}) + \frac{PA_{DC}}{NOA}(\beta_{PA_{DC}} - \beta_{NFL})$$

Q.E.D.