Post-Retirement Benefit Plans, Leverage, and Real Investment

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Abstract

This paper shows that defined benefit pension and health care plans are important for firm leverage and real investment around the world. While consolidating off-balance sheet post-retirement plans typically increases effective leverage by 32%, firms reduce their level of regular debt by only 23 cents for every dollar of projected benefit obligation, yielding overall higher total leverage of plan sponsors by 24% compared to similar firms without post-retirement plan. Substitution rates between regular debt and post-retirement obligations are lower in countries with weaker employment laws and protection, more labor market freedom, pension guarantee funds, stricter rule of law as well as larger private bond market capitalization and private credit. Since post-retirement benefit obligations have more flexible terms than regular debt, they can be used to investigate the effect of financial flexibility on real investment. The results show that post-retirement benefit obligations are positively related to R&D, which generates growth options, and negatively related to capital expenditures, which exercises growth options. Compared to an otherwise similar firm without a post-retirement plan, the average plan sponsor has 5% less capital expenditures and 12% more research and development. The results are robust to other dimensions of financial policy, such as debt maturity, dividends, preferred stock, convertible debt, and leverage that also affect real investment.

Keywords: Capital Structure, post-retirement benefits, real investment, financial flexibility, pension, health care
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1 Introduction

In many countries around the world, recent years have witnessed an increasing attention to and debate of pension arrangements of private and public sector employees. In the wake of the financial and economic crisis as well as longer-term trends such as significant demographic transformations, retirement systems have been overhauled to some extent in all OECD countries. There is a notable shift away from Pay-As-You-Go pensions towards funded arrangements, frequently in the form of defined contribution plans. Defined benefit pension plans are often being restructured, contribution levels increased, and final salary schemes modified into arrangements where benefits are a function of average wages. With pension fund assets amounting to 72.4% of GDP on average across OECD countries in 2011, pension plans are economically very significant in many countries.

This paper considers defined benefit post-retirement plans for pensions and health care from a corporate perspective. In particular, its two main objectives are to investigate the role of these plans for corporate capital structure and real investment, based on a sample of more than 33,000 publicly traded non-financial firms from 50 countries during the period 2002-2009. The paper shows that pension assets and liabilities of nonfinancial corporations are substantial in many countries, and that consolidating off-balance sheet plans for pension, health care and other post-retirement benefits typically increases effective leverage.[1] At the same time, the effect of post-retirement benefit plans on regular leverage is negative, i.e. companies with large post-retirement plans tend to have less regular leverage. However, the substitution effect is only partial, leaving plan sponsors with higher leverage after accounting for post-retirement plans. In countries where occupational defined benefit plans are frequent and large, consolidation has a large effect on leverage, while substitution rates are often low, resulting in much higher consolidated leverage of firms with post-retirement plans compared to otherwise similar firms without such plan. The degree of substitution between regular debt and post-retirement obligations varies across countries from 0%-100% as a function of employment laws and protection, labor market freedom, pension guarantee funds, rule of law as well as private bond market capitalization and private credit. While post-retirement obliga-

[1] See Dhaliwal (1986) regarding the measurement of financial leverage in the presence of unfunded pension obligations, and Glaum (2009) for a recent review of empirical research on pension accounting. Graham and Leary (2010) identify variable mis-measurement as one of the key challenges in capital structure research. For the United States, Shivdasani and Stefanescu (2010) and Graham and Tucker (2006) show that there are significant non-debt tax shields for U.S. companies from pension contributions, executive stock options deductions, and other tax sheltering activities (such as leasing, transfer pricing, etc.).

tions share several characteristics of regular debt, they typically have more flexible terms, and thus can be used to investigate how financial flexibility affects real investment. Controlling for other dimensions of financial policy, the results show that the relation is conditional on the type of investment opportunity: Post-retirement benefit obligations are positively related to R&D and negatively related to capital expenditures, which generate and exercise growth options, respectively. Thus, the importance of post-retirement benefit plans extends beyond capital structure to the real operations of a company, and this is an important way in which financing and investment interact.

The fact that contributions to occupational pension plans are tax-deductible and that the inability to make them can result in bankruptcy might suggest that post-retirement obligations effectively reflect borrowing from employees that is substituting for other forms of debt and that is being considered when determining optimal levels of leverage. Thus, in order to obtain more realistic levels of leverage, assets and liabilities of post-retirement benefit plans need to be recognized on the balance sheet and consolidated similar to fully owned subsidiaries, even if they exist in separate legal entities (trusts).[2] In my international sample, firms with defined benefit plans have 20%-70% higher leverage for different measures of gearing once the off-balance sheet assets and liabilities of their post-retirement plans are consolidated, which might help explain the observed conservative levels of leverage noted in the literature. The effect of consolidating the assets and liabilities of post-retirement plans on leverage is counterbalanced by the fact that firms with large post-retirement obligations have less regular debt. Nevertheless, the substitution effect is partial, i.e. firms reduce their level of regular debt by only 23 cents for every dollar of post-retirement obligation. As a result, the net effect of considering defined benefit plans is higher leverage of plan sponsors by 24% compared to non-sponsors holding other firm characteristics constant.

In some countries, such as the UK, Switzerland or the Netherlands, many firms have a defined benefit post-retirement plan and the average projected benefit obligations are large. As a result, consolidating defined benefit plans leads to a statistically and economically significant increase in the leverage of plan sponsors, e.g. by three to four times (depending on the measure of leverage) for UK firms. In contrast, the effect is not significant in about half of the countries, where defined benefit plans are less frequent and smaller. Consequently, there is no need to make the effort of collecting information from the footnotes of the annual reports of firms in these countries to assess their lev-

[2] See also Shivdasani and Stefanescu (2010), Jin, Merton and Bodie (2006), Bulow, Morck, and Summers (2004), Barth et al. (1992), Feldstein and Seligman (1981).

erage. The extent to which projected benefit obligations substitute for regular debt also varies across countries, with perfect substitution in some countries and none in others. In several countries, such as Austria, plan sponsors reduce their regular leverage to a degree that their effective leverage is not significantly different from that of non-sponsors. Nevertheless, firms in countries with large plans often only have low substitution rates, leading to much higher consolidated leverage of firms with defined benefit plans compared to otherwise similar firms without such plans, by as much as 65% in the UK.

Across countries, substitution rates between regular debt and post-retirement obligations are higher in countries with stronger employment protection, stricter employment laws, better social security benefits, and lower labor market freedom, as employees are better protected. Substitution rates are also higher in countries with weaker rule of law, where lenders may be less willing to provide funds to companies with significant post-retirement liabilities since their claims are harder to enforce. Higher substitution rates entail that firms rely less on regular debt for leverage, and consequently are associated with smaller private bond market capitalization and private credit. Finally, substitution rates are lower in countries where pension fund assets are large and thus plans are better funded, while the existence of a guarantee mechanism for post-retirement benefits is associated with lower substitution rates. These differences demonstrate the important role that post-retirement benefit plans play for capital structure internationally.

With regards to leverage, my paper is related to recent work by Shivdasani and Stefanescu (2010) who show that leverage ratios for U.S. firms with pension plans are 35% higher when pension assets and liabilities are incorporated into the capital structure. My paper adds to the insights of their paper by considering forms of post-retirement benefits other than pensions as well and by providing the first international perspective on the capital structure implications of defined benefit plans. This is of particular interest since defined benefit post-retirement plans are often more frequent and economically more important outside the United States. With a frequency of 21.1%, the United States only ranks 18th in the world in terms of popularity of defined benefit plans. At the same time, medical plans are with a frequency of 13.7% more popular in the United States than in any other country. Moreover, there are significant cross-country differences regarding the implications of post-retirement benefit plans for capital structure and tax benefits, which have not been considered in the literature to date, since they are difficult to answer within the same legal/economic framework (e.g. international variation in the strength of labor laws, rule of law, etc.). The interna-

tional sample also benefits from increased statistical power and more cross-sectional variation, and it provides an out-of-sample test for earlier U.S. evidence using an alternative data source in a research area where existing evidence is extremely sparse.

While post-retirement liabilities are corporate obligations that have many similarities with regular debt, they are more flexible in terms of their valuation and the level and timing of contributions (see e.g. Ballester, Fried and Livnat, 2002). To illustrate, companies can manage their earnings through changes to post-retirement benefit plan assumptions (Bergstresser, Desai and Rauh, 2006).[3] Given this optionality, post-retirement obligations can be used to investigate the relation between financial flexibility and real investment, which is the second main objective of the paper. Capital expenditures (CapEx) and research and development expenses (R&D) are both measures of corporate real investment. Nevertheless, they differ in that R&D pertains to generating real options, while CapEx entails exercising real options. Since post-retirement benefits are a measure of financial flexibility, they can be used to investigate whether different degrees of financial flexibility are associated with different types of growth options/investment opportunities.

While existing work on the interactions of financial flexibility and real investment is limited to date, in related work Childs, Mauer and Ott (2005) and MacKay (2003) also motivate the idea of different types of growth options of firms and suggest that they differ in the way they are affected by financial policy. In contrast, Modigliani and Miller (1958) propose that – in the absence of capital market imperfections – financial policies are irrelevant for a firm's investment and operating policies. In a similar vein, Mauer and Triantis (1994) predict that debt financing has a negligible impact on the firm's investment and operating policies, and that firms can thus determine the exercise timing decisions of their real options ignoring the effect of debt financing. My empirical analysis demonstrates that financial policy does significantly affect the real investment of firms. Importantly, it shows, for the first time, that the size of corporate post-retirement liabilities is positively related to R&D, and negatively related to capital expenditures, i.e. more optionality on the liability side of the balance sheet is related to more optionality on the asset side of the balance sheet (after controlling for other firm characteristics).

[3] The flexibility of contributions for firms that have to make mandatory contributions is limited to voluntary contributions (see Rauh, 2006).

The effect is not only statistically significant, but also economically sizable. With the obligations of the average post-retirement benefit plan totaling 11% of total assets, the typical plan sponsor has significantly less capital expenditures (by 5%) and more research and development (by 12%) compared to an otherwise similar non-sponsoring firm. Merck and Texas Instruments are examples of large pharmaceutical and technology companies that have large R&D programs and big post-retirement obligations. The impact of financial flexibility on real investment is robust across countries and industries. Thus, to the extent that post-retirement benefit plans increase financial flexibility, companies undertake more R&D. Additionally, other dimensions of financial policy are also related to firms' real investment, such as debt maturity, preferred stock, convertible debt, leverage and corporate payout. To illustrate, cash is positively related to real investment, while leverage has a negative relation with real investment. These results are important since the existing knowledge on the interaction of corporate investment with financial policies in general and financial flexibility in particular is limited. Providing international evidence on the interactions between investment and financing policies considering a wide range of corporate financial characteristics is thus another contribution of my paper.

In contrast, the literature has focused on the relations of firms' investment with financing constraints and firm value (e.g. Kaplan and Zingales, 1997; Fazzari, Hubbard, and Petersen, 1988), and the empirical results are often limited to the United States. To illustrate, in that line of research, Campbell, Dhaliwal and Schwartz (2012) and Rauh (2006) use mandatory pension contributions to investigate the effect of financing constraints on the cost of capital and investment of a sample of U.S. firms with underfunded plans. In contrast, my paper focusses on financial flexibility, and therefore the variables employed differ from those in the prior literature, even though they are derived from post-retirement plan data as well. To illustrate, mandatory contributions for a fully funded plan are zero, but the size of the plan obligations may be large.

The results in my paper are robust to a number of variations to methodology and data. In particular, I use a range of different estimation techniques that account for self-selection and endogeneity as well as alternative ways of adjusting standard errors such as clustering and Newey-West (1987). The results are also unaffected by limiting the sample to U.S. GAAP or IAS compliant firms, by employing various fixed effects (e.g. for countries, industries, accounting standards, and years) to control for potential differences across accounting standards and time, and/or by analysing different time periods (such the subperiods before and after 2006). I verify the data on post-retirement plans

via a comparison with their recognition and disclosure in annual reports, and I replicate the results for U.S. firms using data from CRSP and Compustat. The results are also robust to the sub-sample of firms where subsidiaries of any type are consolidated to exclude the possibility of firms hiding debt in unconsolidated subsidiaries. Moreover, the analysis tries to avoid omitted variable biases by including large sets of control variables, but the results also hold for larger samples that result from relaxing the restrictions on data availability, and the leverage regressions are also estimated controlling for unidentified time-invariant or transitory components of leverage (Lemmon et al., 2008). Details on these and a number of other robustness tests are provided later in the paper and the Appendix.

Overall, the results of this paper demonstrate a significant role of corporate defined benefit post-retirement schemes both for the liability side (i.e. leverage) as well as for the asset side (i.e. real investment) of non-financial corporations around the world. These results have important implications for policy makers, regulators, rating agencies and market participants that currently have an interest in understanding and regulating corporate leverage (e.g. Volker commission in the United States). The paper documents that in most countries post-retirement liabilities are economically sizable and lead to higher effective leverage of firms once off-balance sheet plans are consolidated on the balance sheet. This result helps explain the low levels of leverage that have been documented in many countries, since off-balance sheet items such as pensions, medical plans, leasing, employee stock option plans, and others are traditionally not incorporated into leverage ratios. Moreover, the paper contributes to our understanding of the interrelationships between financing and operating policies. It not only documents that various dimensions of financial policy affect firms' operations in the United States and internationally, but particularly reveals a relation between financial and operating flexibility. Given the implications of investment for economic growth, the result that financial flexibility relates to the type of real investment that companies undertake is an important insight.

The paper is organized as follows. Section 2 discusses the hypotheses, while the sample and data are covered in Section 3. Section 4 presents the results of the empirical analysis, and Section 5 concludes.

2 Hypotheses

2.1 Leverage

Defined Benefit (DB) pension plans and Defined Contribution (DC) pension plans are the main types of institutional pension arrangements. For defined contribution pension plans, the employer only has a legal obligation to make specific contemporaneous payments into the pension account of the employee. Consequently, the beneficiaries, i.e. the employees, bear the investment risk. In contrast, a defined benefit plan specifies the benefits of the employees at retirement, and the employer bears the investment risk. The employer is legally required to make contributions to the pension plan so that the assets are sufficient to meet the pension obligations. The analysis in this paper focuses on DB plans, since the obligations of the employer are limited to periodic pension contributions in the case of DC plans. While DB plans have been very common in the past, they have lost their popularity in recent years, due to reduced tax advantages, increased costs and competitive pressures given that few companies tend to adopt new DB plans. Changes in demographics lead to longer working lives and thus higher contributions, while longer life expectancies imply higher valuations of pension obligations. Consequently, defined benefit pension plans have often reached the limits of their economic viability, and some employers have recently frozen their DB plans, for instance by closing schemes to new entrants, while existing plans are being restructured, e.g. by limiting the benefits of existing members, and contribution levels are being raised. However, given the slow nature of these changes defined-benefit plans will continue to exist in many cases for a long time in the future.

Pension assets and liabilities are typically treated as off-balance sheet items. Pension contributions, however, show in the cash flow statement (as the actual payment to fund the pension assets), and the income statement shows the pension cost as an expense. It is typically the pension contribution, not the pension expense, that is tax deductible (Rauh, 2006). Pension costs differ from contributions since companies try to smooth pension expenses in order to avoid fluctuations in plan assets and liabilities causing significant variation in corporate accounts, particularly income. The difference between the actual experience and that expected based upon the actuarial assumptions that have not yet been recognized as a component of net periodic benefit cost yields an unrecognized actuarial gain/loss off-balance sheet. The extent to which employers have to make contributions each year depends on the funding status of the pension plan. While companies are required to in-

crease their contributions over a period of time if the plan is severely underfunded (mandatory contributions), they have discretion to make voluntary contributions or not.[4]

Annual reports contain information on the pension scheme both on- and off-balance sheet. The pension liability is measured as the Projected Benefit Obligation (PBO), which reflects the present value of the future benefits to employees, based on current service and future expected salaries.[5] It is a measure of a pension plan's liability at the calculation date assuming that the plan is ongoing and will not terminate in the foreseeable future.[6] In contrast, the pension assets are valued at fair market value. Pension plan assets and liabilities are reported in the footnotes of the annual report, while the balance sheet shows the net amount, i.e. the extent to which pension contributions are above or below pension cost. For severely underfunded pension plans, FASB required U.S. firms until 2006 to recognize an additional minimum liability on the balance sheet that is offset by an intangible asset and, for amounts in excess of unrecognized prior service costs, by a charge to book equity. Pension contributions are typically not reported, but can be inferred as the pension expense plus the change in net prepaid pension costs (Revsine et al., 2005). In addition to pension plans, companies may offer Other Post-retirement Employee Benefits (OPEB), such as medical plans, insurance coverage, and other welfare benefits such as tuition assistance, day care, legal services, and housing subsidies provided after retirement. Provisions for these are largely similar to those for pensions. In particular, the footnotes of the annual report contain the estimated health care benefit obligation and the fair value of the plan assets.[7]

In the United States, FAS 87 and 88 mandate the disclosure of key pension plan information, such as the fair value of the pension assets and the projected benefit obligations, since 1985. FAS 106, issued in 1990, requires similar disclosure for post-retirement benefits other than pensions.

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[4] Panel E of Supplemental Appendix A summarizes funding requirements across countries.

[5] Novy-Marx and Rauh (2011) explain and calculate alternative ways of measuring pension obligations.

[6] IAS19 refers to this item as the Defined Benefit Obligation (DBO).

[7] Much of the accounting for post-retirement benefits other than pensions parallels that required for pensions (e.g. Stice et al., 2011). To illustrate, similar principles are applied to estimate the expected obligations of medical plans and to value the plan assets; plan assets and obligations are disclosed in the footnotes, and only a measure of the net liability is recognized on the balance sheet. Given these similarities, it is sensible to consider plans for pensions and other post-retirement benefits together, and annual reports (and thus WorldScope) typically show the combined prepaid/accrued costs of these plans on the balance sheet, even though they show separate information on their assets and obligations. Similarly, Standard and Poor's combines all benefits plan assets and liabilities. At the same time, there are also a number of differences, such as various additional required assumptions about health care cost trend rates, the tax incentives of contributions, funding levels, and guarantees from industry/government agencies, but the main features of these plans and their accounting treatment are overall similar for the purpose of this paper.

FAS 132 (passed in 1998, revised in 2003) was issued as an amendment to both earlier statements, standardizing the disclosure requirements for pensions and other post-retirement benefits to the extent practicable, requiring additional information on changes in the benefit obligations and fair values of plan assets, and eliminating certain disclosures that were no longer deemed as useful. Since 2006, FAS 158 requires an employer to recognize the funded status of a defined benefit post-retirement plan in its statement of the financial position and to recognize changes in the year of their occurrence. U.S. and international accounting standards are largely similar with regards to the recognition and disclosure of post-retirement benefit plans. IAS 19 was originally issued in 1983 and subsequently revised in 1993, 1998 and 2000. The provisions of IAS 19, which underwent a limited amendment in 2002, are very similar to FAS 87. Following the European Union's IFRS regulation of 19 July 2002, all publicly traded companies in the European Union are required, in most cases since 2005, to prepare their consolidated financial statements in accordance with IFRS. Similarly, this standard is required since 2005 for firms in Australia and South Africa, it is used among many international firms, and in fact many firms adopted IAS already in the 1990s. In the United Kingdom, FRS 17 sets out the accounting treatment for retirement benefits such as pensions and medical care during retirement, replacing SSAP 24 and UIFT Abstract 6. It was issued in 2000 (and revised in 2006), but was fully effective only in 2005 after a long transition period, with early adoption encouraged. Panel A of Supplemental Appendix A provides an overview of the various accounting standards (see also Glaum (2009)).

While these accountings standards are not identical, they apply similar principles in terms of the valuation of the assets and liabilities of post-retirement plans, the disclosure of their full values in footnotes, but only limited recognition in terms of accrued costs/funding deficits on the balance sheet. Similarly, while the recognition of the funded status required by FAS 158 is an important change compared to (net) accrued costs, the actual size of plan assets and liabilities remains off the balance sheet so that consolidation continues to have a significant effect. Nevertheless, in order to control for potential differences across accounting standards and time, the analysis uses various fixed effects e.g. for countries, accounting standards, and years, and the results are robust to estimation by country or by year, for the subperiods before and after 2006, or for U.S. GAAP and IAS compliant firms. Generally, Barth, Landsman, Lang, and Williams (2012) document that IFRS firms' accounting amounts have greater comparability with those of US firms when IFRS firms apply IFRS than when they apply non-US domestic standards.

Given that pension, health care and other post-retirement benefits constitute legal obligations of a company, they should be recognized for corporate capital structure calculations even when they are reported off-balance sheet.[8] Moreover, companies may be able to trade off other forms of compensation against post-retirement benefits. Rating agencies also treat deferred employee compensation, including health care promises, as debt.[9] Consequently, I will consolidate the assets and liabilities of pension and health care plans in order to assess corporate capital structure, following Shivdasani and Stefanescu (2010), Jin, Merton and Bodie (2006), and Credit Suisse First Boston (2005).[10] The effect of post-retirement benefit plans on corporate leverage is likely positive in many cases, i.e. incorporating off-balance sheet liabilities of pension and medical plans into capital structure calculations will often lead to higher effective leverage ratios. To illustrate, assume leverage is calculated as Total Debt (TD) to Total Assets (TA) (with TD < TA). Even if post-retirement benefit plans are fully funded, so that Post-Retirement Assets (PA) correspond to Post-Retirement Obligations (PO) (i.e. PA=PO), leverage will increase since TD/TA < (TD + PO)/(TA + PA). Thus, off-balance sheet post-retirement obligations tend to increase leverage ratios, though the effect is not mechanical and depends, e.g. on the funding level of the pension plan (the subsequent results show significant variation in the effect across firms). In addition, contributions to post-retirement benefit plans will lower the marginal tax rate and thus the tax benefits associated with debt financ-

[8] Post-retirement liabilities may be senior to other claims, as illustrated by case of the city of Vallejo in California, where bondholders were offered 5-10 cents on the dollar, but pension benefits were left untouched when it declared bankruptcy. Most of the time, however, pension claims (unlike wages) do not receive priority over other creditors in bankruptcy as detailed in Panel D of Supplemental Appendix A. For example, U.S. bankruptcy law does not recognize the priority creditor rights given to pensions by the ERISA pension legislation in the 1970s, so that unfunded pension liabilities typically have the standing of general unsecured claims. While retiree medical liabilities do not enjoy the same protection under ERISA, if the benefits are owed under the terms of a labor contract, the company's voiding of the contract in bankruptcy would give rise to a general unsecured claim by employees and retirees. Similarly, while the legislation of the European Union and International Labour Organization provides protection for employees with regards to wages, pensions are not covered. The appendix to FAS 106 notes that case law has not been unequivocal about the legal enforceability or lack thereof of promises to provide postretirement benefits other than pensions, although legal enforceability of certain claims has been demonstrated. To the extent that companies are able to default on post-retirement benefit obligations, these may provide additional degrees of flexibility beyond those discussed and effective leverage might be lower in default than consolidated leverage.

[9] To illustrate, Standard & Poor's Ratings Services *"…views unfunded liabilities relating to defined benefit pension plans and retiree medical plans as debt-like in nature. This also is the case with deferred lump-sum payment schemes, such as termination programs for employees in Italy. By accepting a portion of their compensation on a deferred basis, the employees essentially become creditors of the company. As with conventional debt, these liabilities pose risks to their corporate sponsors from the call on future cash flow they represent."* (Standard and Poor's, 2006, p. 96). See also Kraft (2010) for adjustments of leverage ratios for all the types of off-balance sheet finance that credit rating agencies find important (including pension obligations, operating leases).

[10] There is also an accounting literature that suggests that investors will consider the assets and liabilities of post-retirement benefits (see e.g. Franzoni and Marín, 2006; Coronado and Sharpe, 2003; Barth et al., 1992; Dhaliwal, 1986) as they do for other off-balance sheet items such as operating leases (Ely, 1995; Imhoff, Lipe and Wright, 1993).

ing. These two effects of off-balance sheet obligations provide potential explanations for the low levels of observed leverage (Graham, 2000).

2.2 Financial Flexibility

There are a number of similarities between post-retirement obligations and regular financial debt, but there are also a number of important differences. To illustrate, governments or industry associations may provide additional insurance schemes for corporate pension plans that do not normally exist for other corporate liabilities (except possibly implicitly for politically or systemically important companies or sectors, e.g. financial services). In the United States and the United Kingdom, for example, pensions are guaranteed by the Pension Benefit Guaranty Corporation (PBGC) and Pension Protection Fund (PPF), respectively, and, thus, companies do not bear the full costs of imposing high risk on pension beneficiaries.[11] External providers of funds also exert much more effective monitoring of management than employees, especially if the claims of the latter are insured.[12] Moreover, pension assets cannot be easily liquidated to cover other corporate liabilities. While failure to meet minimum post-retirement benefit plan contributions can trigger bankruptcy, the level and timing of contributions is more flexible than with payments to service regular debt. Companies can take advantage of this feature in order to maximize the associated tax shields by making larger contributions when marginal tax rates are high (note that this discretion is with regards to voluntary contributions, not mandatory contributions).[13] Higher contributions will also reduce required minimum contributions in future years, build financial slack and increase flexibility (Ballester, Fried and Livnat, 2002; Friedman, 1983).[14] At the same time, firms may sometimes reduce or even forgo funding of a

[11] Similar schemes exist in other countries as detailed in Panel C of Supplemental Appendix A. Healthcare benefits tend to be less well protected, though some insurance schemes exist well. To illustrate, in the United States, the Health Coverage Tax Credit (HCTC), a federally funded program administered by the Internal Revenue Service, pays a portion (currently 72.5%) of health-insurance premiums for retirees whose benefits have been reduced or eliminated in bankruptcy proceedings and whose pensions are taken over by the Pension Benefit Guarantee Corp. The program will pay for comprehensive major medical coverage, including prescription drugs and dental and vision care, if they are included in that coverage. In 2009, Congress expanded HCTC coverage to include benefits sponsored by Voluntary Employee Benefit Associations (VEBA), which are trust funds established during the bankruptcy process to provide retiree health benefits.

[12] For institutional investors, local institutions are more effective monitors of corporate behavior because monitoring costs vary inversely with distance (Chhaochharia, Kumar, and Niessen-Ruenzi, 2012)

[13] In Japan, pension regulators grant companies significantly greater flexibility to defer contributions over an extended period than the United States (Standard and Poor's, 2006).

[14] In the United States, a pension plan sponsor is obliged to fund at least the annual service cost computed under the plan, unless the plan is overfunded at the beginning of the year. Because plan contributions are tax deductible (up to a limit for already overfunded plans) while plan earnings are non-taxable to the plan sponsor, there is a tax incen-

period's pension expense ("contribution holiday"), when possible, to meet competing investment or financing cash needs such as plan expansions, corporate acquisitions, debt retirement or dividend increases.

Moreover, the estimates of pension and health care liabilities rely on a number of assumptions, such as discount rates, expected long-term rate of return on plan assets, employee turnover, early retirement, salary scale (typically a function of productivity improvements, inflation, merit or promotional increases, seniority raises), disability, family composition, mortality, retirement age, per capita claims cost by age group, health care cost trend rate, medical coverage to be paid by governmental authorities and other providers of health care benefits, etc. Given the large size and long duration of pension obligations, small changes in the assumptions can have large effects on their valuations.[15] While all areas of financial reporting require management to make estimates and judgments, this is particularly true of accounting for defined benefit plans, which relies on numerous subjective assumptions given the prospective and variable nature of post-retirement promises (Standard and Poor's, 2006). Companies can increase or decrease the size of their post-retirement obligations depending on changes in the fair value of plan assets, which tend to be driven by market movements and to a much lesser extent by changes in interest rates, since fixed income investments generally represent only a fraction of the pension asset portfolio and the maturity of those investments is typically much shorter (Revsine et al., 2005). To illustrate, it has been noted that discount rate assumptions vary significantly more widely among companies than underlying differences in interest rates and workforce demographics would justify.[16] Similarly, there is some choice with regards to how and when to determine the fair value of the plan assets. The resulting degrees of flexibility with regards to the valuation of post-retirement benefits allow companies to use post-retirement benefit plan assumptions to manage their earnings, for example by changing the discount rate applied to value future pension commitments of defined benefit plans (Bergstresser, Desai and Rauh, 2006; Feldstein

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tive to overfund pension plans. While there is a general lack of a tax-effective method for prefunding the promises to provide other post-retirement benefits in the United States, there are some tax-effective means of prefunding retiree medical plans, such as Voluntary Employees' Beneficiary Association (VEBA) trusts. As with pensions, contributions to a VEBA trust are tax-deductible up to a certain limit.

[15] To illustrate, a one percent decrease in the discount rate will typically boost the estimated pension obligation by 10% to 15% (Revsine, Collins, and Johnson, 2005, p. 777).

[16] At the same time, discretion with regards to pension obligations does not impair the quality of financial reporting (Hann, Lu, and Subramanyam, 2007).

and Mørck, 1983).[17] Companies may even use changes to post-retirement plan assumptions to avoid violations on their other liabilities. Given this optionality, post-retirement obligations can be used as a proxy for financial flexibility. At the same time, these differences suggest that projected benefit obligations are not perfect substitutes for other liabilities.

On the asset side, proxies for real investment are capital expenditures and research and development expenses. Both measures of real investment affect the optionality of the assets of the firms, except that R&D increases the degree of optionality, while CapEx reduces it, since R&D leads to the generation of real options, while CapEx effectively exercises these options. I hypothesize that there is a relation between the flexibility of a firm's assets and liabilities. Companies often try to match the characteristics of their assets, such as maturity, currency denomination, etc., with those of their financing, e.g. to hedge against risks such as currency and interest rate fluctuations. Similarly, I suggest that firms with more flexibility on the asset side of their balance sheet may want to have more flexibility on the financing side. For example, R&D intensive firms can use post-retirement plan assumptions to manage earnings instead of cutting R&D expenditures to meet earnings thresholds as part of real earnings management (Eldenburg, Gunny, Hee and Soderstrom, 2011; Cohen, Mashruwala, and Zach, 2010; Cohen, Dey, and Lys, 2008; Roychowdhury, 2006; Bushee, 1998). In contrast, firms with little or no flexibility on the asset side may not need as much financial flexibility. While compared to the use of regular debt post-retirement obligations have the benefit of more flexibility, plan sponsors also have to bear the investment risk associated with the plan assets. Importantly, the investment risk is likely correlated with other firm risks, so that firms find it hard to raise capital when the investments perform badly. Moreover, post-retirement obligations are harder to unwind compared to regular debt. Depending on the funding level, firms may have to make mandatory contributions that limit flexibility and can increase the cost of capital and restrain investment (Campbell, Dhaliwal and Schwartz, 2012; Rauh, 2006). Thus, firms trade off the benefits of defined benefit plans with their costs. Since post-retirement benefits are a measure of financial flexibility, they can be used to investigate the relation between financial flexibility and different types of growth options/investment opportunities.

The related literature motivates and supports the idea that different types of growth options relate differently to financial policy. To illustrate, in Childs, Mauer and Ott (2005), financial flexibility

[17] Comprix, and Muller (2011) show that employers select downward biased accounting assumptions to exaggerate the economic burden of their benefit plans when "hard" freezing their defined benefit pension plans.

has an effect on the firm's initial debt level that depends on the characteristics of the firm's growth option. When exercising the option replaces assets-in-place with a riskier asset underlying the growth option, a firm with dynamic debt will choose a larger initial level of debt than a firm with static debt. This is because the former has the flexibility to later reduce leverage when the growth option is exercised. In contrast, when exercising the growth option expands assets-in-place, a firm with dynamic debt is less aggressive with its choice of initial leverage because it has the flexibility to increase the debt level when the growth option is exercised. Consequently, the optimal debt level is conditional on the type of growth option.[18] Moreover, firms with more financial flexibility are predicted to have higher levels of leverage, while firms with a static debt policy have lower leverage. These predictions can also be tested using corporate post-retirement benefit plans as a measure of financial flexibility, and capital expenditures and research and development as different types of growth opportunities.

Rauh (2006) uses mandatory contributions to DB pension plans as an instrument for available internal cash to investigate the effect of financial constraints of firms with underfunded plans on capital expenditures for a sample of 1,522 U.S. firms during the period 1990-1998. He sources the required detailed information for the calculation of funding requirements and mandatory contributions from the national tax code (IRS 5500), since pension data from SEC filings are insufficient. To illustrate, mandatory contributions are determined at the plan level and are only required for domestic plans, while annual reports aggregate data at the firm level including both domestic and international plans. Moreover, the extent of accounting discretion and the methods for computing pension liabilities and costs differ between SEC filings and IRS reporting. Capital expenditures decline with mandatory contributions to DB pension plans, even when controlling for correlations between the pension funding status itself and a firm's unobserved investment opportunities, while they increase with total contributions and funding level. For the same sample of firms, Franzoni (2009) shows that the price decrease following a pension-induced drop in cash is magnified for firms that appear *a priori* more financially constrained, suggesting a negative effect of financing frictions on investment. Bakke and Whited (2012) find that the strong sensitivity of investment to mandatory contributions in Rauh (2006) stems from heavily underfunded firms that constitute a small fraction of the sample and that are different from the rest of the sample in important ways. Campbell, Dhaliwal and

[18] In contrast, since existing theory models of financing and investment typically have simple structures of corporate assets (i.e., only assets-in-place), operating flexibility plays no role for financial policy, while financial flexibility typically entails lower initial debt levels as firms can increase leverage in the future (see, e.g., Titman and Tsyplakov, 2007; Goldstein et al., 2001; Leland, 1998).

Schwartz (2012) find that for a sample of U.S. firms with bond issues an increase in mandatory pension contributions increases the cost of capital, but only for firms facing greater external financing constraints. In contrast to these papers, the focus of my paper is on financial flexibility and the size of post-retirement plans, and consequently the variables employed to capture these effects, while also utilizing post-retirement plan data, differ from those in these papers.[19]

3 Sample and Data

The initial sample consists of all firms with data available on WorldScope and DataStream. I exclude utility firms (SIC code 49) and financial firms, i.e. banks, insurance companies, etc. (SIC codes 60-64), due to the effect of regulation (such as deposit insurance schemes) on their leverage ratios. I impose a number of filters, because firms can have multiple share classes or listing locations. For example, I screen on the security type, use only primary listings, exclude ADRs, and require that the currency of the stock price is a legal tender in the country of incorporation of the firm. Further, I exclude U.S. OTC Bulletin Board and 'Pink Sheet' stocks, and firms with missing country or firm identifiers. The number of observations in Bahrain, Bermuda, Jordan, Kenya, Lithuania, Oman, Slovenia, Tunisia, United Arab Emirates, and Zimbabwe is small, and thus firms in these countries are excluded from the analysis. The final sample consists of an unbalanced panel of 33,260 companies from 50 countries during the period 2002-2009.[20]

I classify firms as having defined benefit pension and health care plans depending on whether their annual reports show projected benefit obligations for these plans. Firms with either type of plan are classified as having a DB post-retirement plan. Separately for pension and medical plans, WorldScope has information on the projected benefit obligations, the fair value of plan assets, which are reported off-balance sheet, and the net periodic cost. I manually verify the data on post-retirement plans in the WorldScope database via a comparison with their recognition and disclosure in annual reports based on a sub-sample of firms across different countries and years. The items prepaid costs and accrued costs reflect the net recognition of these plans on the balance sheet. They

[19] To illustrate, for a fully funded plan, mandatory contributions and the funding deficit are zero, while actual contributions may be non-zero and the size of the plan obligations may be large.

[20] While the documentation of the WorldScope database indicates that items on pensions and other post-retirement benefits have been collected in a systematic way since 2005, several items have been populated for prior years as well and, thus, have a longer history. The most important items for the analysis in this paper have decent coverage starting in 2002.

combine information on different types of post-retirement benefit plans (e.g. domestic and foreign, pensions and health care, etc.), and thus for consistency I also combine the off-balance sheet information into corresponding variables for all post-retirement plans (as do S&P). Proxies for contributions to defined benefit plans are calculated as the periodic expense (income) plus the change in net prepaid (accrued) costs. As a measure of the size of post-retirement benefit plans, the projected benefit obligation is normalized by consolidated total assets.

Several different leverage ratios are calculated, based on different measures of debt (alternatively total debt, long-term debt plus preferred stock, or long-term debt), market or book values of total assets, including or excluding payables and other liabilities, and with or without netting cash and short-term investments. In addition to regular leverage ratios, consolidated leverage ratios are calculated based on consolidated balance sheets where the accounts are adjusted for off-balance sheet information on post-retirement benefit plans. In particular, all recognized pension and other post-retirement items are removed from the balance sheet, and the true values of the assets and liabilities of post-retirement benefit plans are incorporated. Specifically, consolidated leverage is calculated by redefining assets as total assets minus prepaid costs (including intangible pension asset where applicable) plus fair value of plan assets. Similarly, debt is increased by the present value of the post-retirement plan liabilities minus already recognized post-retirement items (including additional minimum liability where applicable). The consolidated interest expense is calculated as the sum of the regular interest expense and post-retirement contributions.

WorldScope utilizes consolidated account data when it is disclosed. In other cases, where there are no subsidiaries or no requirement to consolidate, only parent company accounts are available. Since information on the consolidation practice is available for only about 40% of all firm-year observations and since the vast majority of these indicate that all subsidiaries are consolidated, my main analysis is based on all observations. Nevertheless, I also perform robustness tests on the subsample of firm-years where the accounts confirm that subsidiaries of any type are consolidated. There may be significant variation across countries how the assets of a firm are valued (current value or historical cost), which cannot be easily corrected for, as discussed in more detail in Rajan and Zingales (1995). To address this concern, to the extent possible, a range of different alternative proxies is used for key variables, particularly leverage.

Weekly stock return data in U.S. Dollars are obtained from DataStream. For firms with returns data available for at least 25 weeks in the observation year I calculate total risk as the annual-

ized standard deviation of returns. Idiosyncratic risk is calculated as the annualized standard deviation of the residuals from a regression of stock returns on the local market index (with one lead and one lag), the world market index, as well as regional and global HML and SMB, following Bekaert, Hodrick and Zhang (2010). Market risk is the annualized square root of the difference between total risk squared and idiosyncratic risk squared. Supplemental Appendix B provides definitions of the main variables used in the paper, and Supplemental Appendix C shows their summary statistics.

4 Results

I first assess how important post-retirement assets and liabilities are for non-financial firms across different countries and industries and look at the development of the importance of DB plans over time. Next, I investigate the effect of incorporating off-balance sheet information about post-retirement benefit plans on leverage ratios by comparing regular and consolidated leverage ratios. I also consider how firm characteristics differ across firms with and without post-retirement plans, and assess the tax benefits of these DB plans. Subsequently, I investigate how post-retirement benefit plans relate to leverage and real investment in portfolio sorts and regression analyses.

4.1 Importance of Post-Retirement Benefit Plans

Defined benefit plans for pensions and health care exist in many countries. Panel A of Table 1 shows the relative importance of these plans by country based on the firms in the sample, where countries are sorted by the percentage of firms with a DB post-retirement plan.[21] Switzerland is on top of the list, with 61.9% of all firms having some type of DB plan. More than 30% of firms have a DB plan in Austria (57.6%), Ireland (54.4%), Mexico (48.1%), the Philippines (45.0%), the Netherlands (42.7%), Taiwan (38.5%), Pakistan (38.2%), Luxembourg (38.0%), Japan (37.6%), and Norway (36.5%). While these plans are also important in the United States, they are in fact more important in many other countries. Overall, pension plans are much more common than medical plans. 13.7% of U.S. firms have a health care plan, which is the highest frequency across countries, followed by Pakistan (10.8%), South Africa (9.4%), the Netherlands (7.3%) and Canada (7.3%).[22]

[21] Note that the consolidated accounts combine information of domestic and foreign plans.

[22] Only about 3% of all firms have both a pension and health care plan. For these firms, the average obligations of health care plans are about a sixth of those of pension plans.

The ratio of projected benefit obligations to consolidated total assets is a measure of the size of post-retirement benefit plans. By this measure, there is also large variation in the economic importance of post-retirement plans across countries, with Venezuela, the United Kingdom, the Netherlands, Switzerland, and Ireland representing the top 5. The size of these plans can be economically quite significant: To illustrate, post-retirement benefit obligations are on average 27.3% of total assets in the United Kingdom.[23] They tend to be larger in countries where many firms sponsor a defined benefit plan. The second to last column in Panel A shows the degree of underfunding of post-retirement benefit plans, calculated as the difference between fair value of plan assets and projected benefit obligations scaled by total assets. Strikingly, the typical plan is underfunded in 48 out of 50 countries: only in South Africa and New Zealand the average plan does not show a deficit. While the average degree of underfunding is 2.6% of total assets, underfunding is much more significant in a number of countries, such as Venezuela (23.9%), the United Kingdom (7.9%), the United States (7.6%), Germany (7.2%), the Netherlands (5.3%), Austria (5.2%), Japan (5.1%) and Ireland (5.0%). There is a high correlation between plan size and degree of underfunding, i.e. the plan deficits are large in countries where plan obligations are large. Finally, the last column of the table shows the net amounts of post-retirement plans recognized on the balance sheet, calculated as prepaid post-retirement costs (and intangible pension asset where applicable) minus accrued post-retirement costs (including additional minimum liabilities where applicable), scaled by total assets. With a 2.3% deficit on average, these amounts tend to be smaller than the true economic levels of underfunding, particularly for plans in countries with the most underfunded plans.

Table 1 also shows summary statistics on other characteristics of defined benefit post-retirement plans, such as the discount rates that are being used to discount future pension liabilities back to the present, as well as about the annual rate of return that is expected on the plan assets. There is significant variation of these measures both across firms and across countries within the range of 1%-12% (see Supplemental Appendix C). Firms in developing countries tend to use high discount rates, for example Qatar (11.4%), Sri Lanka (11.0%), Indonesia (10.4%), the Philippines (10.1%), Pakistan (9.8%) and Brazil (9.6%), and also use high expected returns on the assets of de-

[23] The size and deficits of the pension plans of several large UK companies such as British Airways, British Telecom or BSkyB have been widely publicized. The joke about BA being a large pension fund with some relatively modest airline operation is part of the UK pension industry folklore. BA's defined benefit pension schemes are at least four times larger the company's market capitalization.

fined benefit pension plans. In contrast, firms in Japan, for example, use discount rates of 2.3% and returns on plan assets of 2.5%, on average.

Data on the asset allocation of defined benefit funds is much sparser since firms are not required to disclose this information in their annual reports, so that the numbers have to be taken with care. There is significant variation across countries in the relative fraction of assets invested in different asset classes, with percentages ranging from 8%-74% for equities, 18%-62% for bonds, 0%-17% for property and 0% to 46% for other assets. More than half of the assets are invested in stock in Iceland (74.0%), Argentina (70.0%), Hong Kong (63.0%), Ireland (61.5%), Luxembourg (61.0%), United States (58.3%), Australia (57.7%), United Kingdom (57.6%), Canada (55.8%), Greece (54.9%), Peru (53.0%), South Africa (52.6%), Italy (51.6%), and Israel (50.8%). In contrast, equities only play a small role in the portfolios of firms in the Russian Federation (21.1%), Pakistan (15.0%) and India (8.0%). Fixed income securities account for more than half of the portfolio values in Brazil (62.3%), Pakistan (57.6%), Portugal (51.9%) and Norway (51.5%). Property is generally only a small component of pension portfolios, with the highest percentages in Spain (16.6%), Switzerland (11.2%) and Norway (10.1%). In countries such as India (46.5%), Russian Federation (44.0%) and Belgium (38.4%), other assets account for a significant proportion of pension fund assets. Overall, developed and developing markets differ mostly with regards to holdings of equities and other assets, while showing similar proportions of bonds and property.

Statistics are broken out by industry in Panel B of Table 1. There is significant variation in the popularity of defined benefit plans by this dimension as well: In the industries Aircraft (45.2%), Tobacco Products (44.3%), Shipping Containers (32.6%), Candy & Soda (32.2%), and Automobiles (30.5%) these types of post-retirement benefit plans are most common. In contrast, few firms in Healthcare (9.2%), Mines (7.4%), Trading (4.8%) or Precious Metals (2.5%) have such a plan. Again the frequencies are largely a function of defined benefit pension plans, while health care plans are only more popular with firms in the industries Tobacco Products (22.5%), Aircraft (19.3%), Shipping Containers (13.2%), Defense (11.1%) and Books (10.1%). The largest defined benefit plans exist on average in the industries Defense, Aircraft, Coal, Trading, Tobacco Products, Shipping Containers, and Consumer Goods, where projected benefit obligations amount to more than 15% of total assets. Plans are underfunded in all industries by 4.8%, and the amount recognized on the balance sheet is also negative in all industries (but a smaller deficit of 3.9%). Differences with regards to the asset allocation of defined benefit pension funds are less pronounced across industries than

across countries, with around 50-60% invested in equities, 30-40% invested in bonds, less than 5% in property, and 10-15% in other assets.

Panel C of Table 1 shows the development of post-retirement plans over the sample period of 2002-2009. The relative frequency of firms in the sample with DB post-retirement plans increases from 12.5% in 2002 to 25.0% in 2009 for the United States, and from 5.2% to 25.3% in other countries, which is mostly accounted for by the increase in DB pension plans.[24] DB heath care plans are insignificant outside the United States (2.6% of firms have such a plan in 2009), but 8.4% and 15.9% of U.S. firms have such a plan in 2002 and 2009, respectively. Note that firms are classified as having a defined benefit plan as long as they report liabilities associated with these plans. Consequently, measures such as the number of active participants or the size of defined benefit obligations might be better measures to characterize the popularity of DB plans over time. In line with recent trends away from defined benefit plans, the size of their obligations shows a decreasing trend over time, from 0.10 to 0.05 and from 0.17 to 0.15 for non-U.S. and U.S. firms, respectively. The typical size of post-retirement liabilities of non-U.S. firms is on average about half of that of the typical U.S. firm each year, as is the degree of underfunding and recognition on the balance sheet, but there is huge variation across countries (see Panel A). Figure 1 shows the funding level and recognition on the balance sheet over time. It illustrates that both, in the United States as well as in other countries, the recognition of post-retirement deficits on the balance sheet is less than the actual degree of underfunding, though this gap has narrowed over time. For the United States, the gap closes in 2006, reflecting the introduction of FAS 158 which required the recognition of the funded status in financial statements. The asset allocation of defined benefit pension funds appears quite stable over time, except for the years 2008-2009, where depressed equity market valuations are clearly reflected in much lower proportions of equities in the portfolios of pension funds.

[24] In the face of publicized trends away from defined benefit plans, the increase in the relative number of firms with such plans appears *prima vista* surprising. For the United States, the absolute number of sample firms with defined benefit post-retirement plans actually decreases, but the number of firms without such plans declines even more. Thus, the increasing percentages of firms with defined benefit plan are driven by higher attrition rates of firms without defined benefit post-retirement plans in the 2000s (newer, smaller, technology and dot-com companies) for reasons unrelated to post-retirement plans. Data from Compustat shows similar trends. The absolute number of non-U.S. firms with defined benefit post-retirement plans actually slightly increases over time, which might reflect the significant shift from Pay-As-You-Go plans to funded arrangements (including defined benefit plans) in many countries, while the decrease in the number of firms without such plans is less pronounced.

4.2 Regular and Consolidated Leverage

Traditionally, leverage is measured by forming ratios of different on-balance sheet items, either using book values or market values. These are referred to as regular leverage ratios in this paper. For companies with post-retirement plans, consolidated leverage ratios can be calculated that incorporate off-balance sheet information, in this case with regards to post-retirement benefit plans. While the fair value of plan assets and projected benefit obligations of defined benefit plans are reported off-balance sheet, there are still selected items that are recognized on the balance sheet, such as net prepaid or accrued post-retirement costs. In order to calculate consolidated leverage ratios, all items on the balance sheet are removed and the actual values of assets and liabilities of the post-retirement benefit plans are included instead. Shivdasani and Stefanescu (2010) suggest that post-retirement plans are akin to wholly-owned financial subsidiaries and should be consolidated since the ownership of the plan assets and the responsibility for the plan liabilities lie fully with the firm, which is consistent with evidence in Landsman (1986). Other papers also suggest that the fair market values of plan assets and the plans' projected benefit obligations as opposed to the net amounts (i.e. the funding levels) are relevant for investors to understand the economic implications of corporate post-retirement benefit plans (e.g. Franzoni and Marín, 2006; Coronado and Sharpe, 2003; Barth, Beaver and Landsman, 1992; Barth, 1991). Without considering the off-balance sheet values of pension assets and liabilities, leverage ratios will be biased, and true economic gearing will often be understated. This effect will be larger the larger the plan and the more it is underfunded.

To this end, Table 2 shows results for tests on differences between regular and consolidated leverage ratios. First, Panel A presents results for the full sample of firms with post-retirement benefit plans considering a range of different ways to calculate leverage, including measures used in Rajan and Zingales (1995) for comparing capital structure in an international context. While the top part of the panel shows gross leverage measures, the bottom part shows leverage measures where cash and short-term investments (with missing values set to zero) are subtracted from both the numerator and denominator of gross leverage ratios. Leverage is calculated with alternative measures of debt and either in book values or market values. The results show that regardless of the definition of leverage, the mean and median consolidated leverage ratios are higher than regular leverage ratios.[25]

[25] Beyond the leverage measures in the table, other leverage ratios have been calculated e.g. based on total liabilities in the numerator, or dividing by alternatively Total Assets Market Value (total assets minus book value of common equity plus market value of common equity), Net Total Assets Market Value (total assets minus book value of

Importantly, the differences are not only statistically significant, but also economically. To illustrate, a common measure of gearing based on book values is the ratio of total debt to total assets. For gross leverage, the average regular ratio is 25.7%, but consolidating off-balance sheet post-retirement plans increases effective leverage to a consolidated ratio of 31.7%, which represents a 23% increase. Across different measures of gross leverage, the increase in leverage is 32%. Results are even more dramatic for leverage ratios that net cash and short-term investments, where the average regular and consolidated ratios of total debt to total assets are 12.6% and 21.0%, respectively, representing an increase by 67%. Similarly, the ratio of total debt to the sum of market capitalization, preferred stock and total debt is a commonly used measure of market leverage. Regular and consolidated leverage are 30.2% and 36.7% for gross leverage, and 14.5% and 25.1% for net leverage, on average, representing increases of 22% and 73%.[26]

While off-balance sheet post-retirement benefit plans tend to increase effective (i.e. consolidated) leverage, there is significant variation across countries, as shown in Panel B of Table 2 for selected measures of gearing. Across 36 countries, there is no difference between consolidated and regular leverage for firms in about half the countries at conventional significance levels. These tend to be countries where occupational defined benefit plans are less frequent and smaller. Note, that there is no country where consolidated leverage is significantly less than regular leverage. Thus, while this evidence provides further support for the general direction of the impact of post-retirement plans on leverage, it also documents that the strength and importance of this effect varies significantly across countries. The differences are typically largest in countries where defined benefit plans are popular and large, such as in the United Kingdom, Switzerland, the Netherlands, Ireland, the United States and Canada. In the United States, consolidated leverage ratios are about twice regular leverage ratios (multiples of 1.7-2.2 depending on the measure of leverage), a slightly larger effect than the factor of 1.4 that Shivdasani and Stefanescu (2010) find just considering pensions for their

common equity plus market value of common equity minus accounts payable minus other liabilities), Size Book Value (book value of common equity plus preferred stock plus total debt), and Net Total Assets (total assets minus accounts payable minus other liabilities). Results for these are similar to those reported.

[26] While these tests are two sample comparisons, they are based on the same firm-year observations alternatively with and without consolidating post-retirement plans and thus control for any differences in firm characteristics. The results are also significant in each year.

larger sample of U.S. firms in the years 1991-2005. However, in the United Kingdom, the factor is between three and four, while there are other countries where it is close to one.[27]

Figure 2 shows the average difference between consolidated and regular leverage over time. It suggests that both in the United States as well as in other countries, the difference has somewhat decreased in recent years, both for book value and market value measures of leverage. Still, even in 2009, significant gaps between leverage with and without considering post-retirement benefit plans remain. For the entire sample, consolidated leverage is statistically significantly higher than regular leverage in every year for all leverage ratios. While the differences tend to decrease over time, they remain statistically and economically significant (on average 8% of total assets in 2009).

4.3 Post-Retirement Obligations, Leverage and Real Investment

4.3.1 Multivariate Results for Leverage

In order to investigate the predicted relations, I investigate the associations of projected benefit obligations with leverage and real investment in a multivariate setting. First, I study the relation between regular leverage and post-retirement obligations using the following specification:

$$\begin{aligned} Leverage = {} & a_0 + a_1 PBO + a_2 MarketToBook + a_3 ROAVolatility + a_4 LogTotalRisk + a_5 TaxRate \\ & + a_6 LogTotalAssetsUSD + a_7 Dividend + a_8 TangibleAssets + a_9 NetFXExposure \\ & + a_{10} DebtMaturity + a_{11} GrossProfitMargin + a_{12} PreferredStock + a_{13} NegativeBookEquity \\ & + a_{14} IndustryMedianLeverage + \upsilon \end{aligned} \quad (1)$$

where *Leverage* is the ratio of total debt to consolidated total assets. As in Shivdasani and Stefanescu (2010), *PBO* is the ratio of projected benefit obligations to consolidated total assets (with missing values set to zero), which is a measure of the size of the post-retirement plan. *MarketToBook* is the ratio of market value of equity to book value, *ROA* is the average return on assets over three years, *ROAVolatility* is the standard deviation of the return on assets over the previous 5 years, *LogTotalRisk* is the natural logarithm of the annualized standard deviation of stock returns in U.S. Dollars, *TaxRate* is the average corporate tax rate (or, alternatively, the effective marginal tax rates from

[27] In Germany, both the funded and unfunded portion of pension liabilities are historically reported on the balance sheet (as are the assets held against pension liabilities) (e.g. Rajan and Zingales, 1995). However, over the last two decades, traditionally unfunded plans have been increasingly replaced by funded arrangements (e.g. CTAs), where significant accumulated pension assets are offset against pension liabilities. Consequently, many particularly large, multinational corporations in Germany show similar balance sheet recognition and disclosure of pensions as firms in the United States or UK, and many German firms adopted IAS already in the mid-1990s. This explains the results of a significant increase in leverage for German firms when consolidating post-retirement benefit plans.

Bilicka, Devereux, and Fuest, 2011), and *LogTotalAssetsUSD* is the natural logarithm of total assets in U.S. Dollars.

Dividend is a dummy variable with value one if the company paid a dividend (and zero otherwise), *TangibleAssets* is the difference between total assets and intangible assets scaled by total assets, *NetFXExposure* is the difference between the percentage of foreign sales and the percentage of foreign assets, *DebtMaturity* is the ratio of long-term debt (due more than 1 year) to total debt, and *GrossProfitMargin* is the average gross profit margin over three years. *PreferredStock* is the ratio of preferred stock to the market value of the firm (market capitalization plus preferred stock plus total debt), *NegativeBookEquity* is a dummy variable with value one if the book value of common equity is negative (and zero otherwise), and *IndustryMedianLeverage* is the industry median book leverage at the four-digit SIC level. The set of exogenous variables is motivated by theoretical and empirical research in the literature as well economic intuition. The literature suggests, for instance, that riskier firms choose lower leverage ratios (Berk, Stanton and Zechner, 2009). Other variables, such as firm size, the average tax rate, and the extent of tangible assets are included as controls.

The five different columns of Panel A of Table 3 show results for alternative techniques of estimating the leverage equation, such as models with fixed effects, standard errors adjusted by clustering by firm and year or by using the Newey and West (1987) procedure, accounting for self-selection and endogeneity. The main finding is that the size of post-retirement liabilities is negatively related to regular leverage, indicating that firms with larger pension and health care plans take out less regular debt (controlling for other determinants of leverage). The negative sign is in line with the portfolio sorting results in Table A3. The results in the first column are based on estimating model (1) including year, country and industry fixed effects, which control for possible differences across country, industry and time with regards to regulation, disclosure and recognition, priority in bankruptcy, guarantees of post-retirement plans, etc.[28] The coefficient of -0.227 indicates that both sources of leverage are far from being perfect substitutes (which would imply a coefficient of -1), i.e. for every dollar in post-retirement obligations, firms have on average only 23 cents less in regular debt (or 11% for the average size of post-retirement obligation). In contrast, using consolidated leverage instead of regular leverage yields a positive relation between projected benefit obligations and

[28] The industry dummies are based on the 48 Fama/French industries.

leverage as post-retirement plans contribute to overall leverage, with a coefficient on PBO of 0.622 (results not reported).

In empirical estimations of models based on panel data, the residuals may be correlated across firms or across time, which can potentially bias the standard errors (Petersen, 2009). In order to assess the robustness of the empirical results to these concerns, I estimate the leverage equation using various ways of clustering the standard errors, i.e. by firm, country, industry, year and permutations of these dimensions (dropping country, industry and year fixed effects from the model as necessary). The estimations in columns two and three adjust the standard errors alternatively by clustering by firm and year or by using the Newey and West (1987) procedure. The results show that the significance levels are hardly affected by these changes, as only the *p*-value of the tax rate increases slightly.

In order to address potential concerns about selection bias, a treatment effects model is estimated using the following selection equation (probit):

$$Post\,\mathrm{Re}\,tirementBenefitPlan = b_0 + b_1 LogEmployees + b_2 MarketToBook + b_3 ROA + b_4 ROAVolatility + \varepsilon \qquad (2)$$

where *PostRetirementBenefitPlan* is a dummy variable with value 1 if the firm has a defined benefit plan, and zero otherwise, and *LogEmployees* is the natural logarithm of the number of employees. The adoption of a defined benefit plan is likely positively related to the number of employees (due to economies of scale) and firm profitability, but negatively related to growth opportunities and the volatility of profits.

The final specification in Panel A of Table 3 shows results for a simultaneous equations model estimating the leverage equation jointly with a capital expenditures equation and a research and development equation using 3-stage least squares (3SLS) in order to account for both dependent regressors and cross-equation correlation of the errors. The real investment equations are specified as follows:

$$\begin{aligned} RealInvestment = {} & c_0 + c_1 PBO + c_2 MarketToBook + c_3 LogAge + c_4 Leverage + c_5 LogTotalRisk \\ & + c_6 LogTotalAssetsUSD + c_7 Dividend + c_8 TangibleAssets + c_9 NetFXExposure \\ & + c_{10} DebtMaturity + c_{11} GrossProfitMargin + c_{12} PreferredStock + c_{13} NetPPE \\ & + c_{14} ConvertibleDebt + c_{15} LogCashSTInvestment + \gamma \end{aligned} \qquad (3)$$

where *RealInvestment* is either the ratio of capital expenditures to total assets or the ratio of research and development expenses to total assets, with missing values of CapEx and R&D set to zero. *Log-*

Age is the natural logarithm of the age of the firm, *NetPPE* is the ratio of net property, plant and equipment to total assets, *ConvertibleDebt* is the ratio of convertible debt to total assets, and *Log-CashSTInvestment* is natural logarithm of the ratio of cash and short-term investment to total assets.

As evident from the table, the results for the treatment effects model (in column four) and the simultaneous equations model (in column five) are very similar to those obtained from other estimations approaches. Shivdasani and Stefanescu (2010) also estimate a treatment effects model as one of their specifications and find similar results to their pooled OLS model, and Rauh (2006) argues that self-selection may not be serious issue due to restriction on terminations of post-retirement plans.

The results so far show that consolidating the assets and liabilities of post-retirement plans increase the leverage of plan sponsors (i.e. their consolidated leverage is larger than regular leverage), while at the same time firms with a post-retirement benefit plan have less regular leverage. Since the degree of substitution between regular debt and post-retirement obligations is less than perfect, it seems likely that plan sponsors will have higher total leverage than non-sponsors, but the extent of this effect will depend on the relative size of the two sources of leverage. Thus, in order to assess the net effect of considering post-retirement plans for leverage, I estimate equation (1) using consolidated leverage as dependent variable and replace *PBO* with *PostRetirementBenefitPlan* as explanatory variable. The coefficient on this dummy variable is a measure of the difference in consolidated leverage of firms sponsoring a post-retirement plan compared to otherwise similar firms without such a plan. Panel B of Table 3 shows the results from estimating this leverage equation using alternatively regression models with fixed effects, standard error errors clustered by firm and year or adjusted with the Newey and West (1987) method, treatment effects or using a simultaneous equations model.[29] Results are again similar across different methods showing that post-retirement plans lead on average to a statistically and economically significant increase in consolidated leverage of 5%-6% of total assets or 24% of average leverage when comparing plan sponsors with non-sponsors controlling for other firm characteristics.[30] Results controlling for self-selection are somewhat smaller in this case (3.3%), but still economically and statistically significant. This is an important finding that provides

[29] The treatment effects model uses predicted values from the probit regression (equation (2)) for the probability of a firm having a defined benefit plan.

[30] While higher leverage increases the probability of default, Rauh (2009) finds that the incentive to limit costly financial distress plays a considerably larger role than risk shifting in explaining variation in pension fund investment policy among firms in the United States.

the bottom line of the role of post-retirement plans for corporate leverage: Plan sponsors have higher leverage after consolidating defined benefit plans, and while they use less regular debt, they do end up with higher total leverage compared to firms without post-retirement plans.

4.3.2 Multivariate Results for Real Investment

The relation between projected benefit obligations and real investment is explored in Table 4 in a multivariate regression analysis using model (3). Results in Panel A are based on capital expenditures, while results in Panel B are based on research and development expenses as a proxy for real investment. The table shows results for five different estimation techniques using alternatively fixed effects, standard errors clustered by firm and year or adjusted based on Newey-West, treatment effects or simultaneous equations. The economic magnitudes and levels of statistical significance are overall similar across specifications, so I combine the discussion focusing on the fixed effects model to be conservative since the coefficients tend to be smallest.

The main results of Table 4 are that post-retirement benefit plans have a negative effect on capital expenditures (Panel A), but a positive effect on research and development (Panel B), where the coefficients are of the same absolute magnitude but opposite sign (-0.016 and +0.015, respectively). The effect is not only statistically significant, but also economically sizable. Given an average ratio of post-retirement plan obligations to total assets of 10.5%, the average plan sponsor has 5.0% less capital expenditures and 12.3% more research and development, compared to a firm without post-retirement benefit plan that has otherwise similar characteristics. This result is in line with the prediction that financial and operating flexibility are related as discussed above. To the extent that larger post-retirement obligations entail more flexibility on the financing side, it induces more flexibility and optionality on the asset side, by creating more real options via R&D and by executing fewer options via capital expenditures. Note that companies with a lot of research and development in this study are not small start-up companies, but large pharmaceutical and technology companies. All companies in the sample are publicly listed, and the analysis controls for many dimensions such as firm age, market-to-book, firm size, firm risk, profitability, leverage, net property, plant and equipment, etc. Examples of companies with significant research and development expenses and big post-retirement benefit plans are firms such as Johnson & Johnson, Merck, Nec, Novartis, Pfizer, Pioneer, Sanofi-Aventis, Roche, Texas Instruments, and Toshiba. Overall, the results in this table confirm the predictions and earlier findings from portfolio sorts regarding the relation between invest-

ment and financing flexibility, that is conditional on the type of investment opportunity/growth option.

Even beyond the effect of financial flexibility on real investment, it is interesting and important to understand which firm characteristics relate to different types of corporate investment, in general and particularly internationally where little is known about these relations. The *RealInvestment* equations show that, contrary to some theoretical predictions of no or little effect of financial policy on operating policies, various facets of financial policy matter for real investment: Leverage, debt maturity, dividends, preferred stock, convertible debt and cash holdings are all significantly related to CapEx or R&D. Firms with lower levels of regular leverage, longer debt maturity, less preferred stock and more liquidity have higher capital expenditures, while firms with lower levels of regular leverage, smaller dividends, more preferred stock, convertible debt and liquidity have more research and development. Contrary to predictions by Childs, Mauer and Ott (2005) that the (optimal) debt level is conditional on the type of investment opportunity, my results show that leverage is negatively related to both capital expenditures and research and development. Purnanandam and Rajan (2013) argue that the effect of growth option exercise on leverage depends on the degree to which information asymmetry is reduced when a firm invests and find a negative relation between the leverage and capital expenditures of U.S. firms.

4.3.3 Multivariate Results by Country

While the pooled results are important in themselves, it is interesting to explore possible differences in the role of occupational post-retirement plans for leverage and real investment across countries. To this end, the regression models are estimated by country (for countries with at least 90 observations) as well as separately for firms in developed and developing countries (defined based on the MSCI classification as of June 2006). While the results in Tables 3 and 4 control for country (as well as industry and year) fixed effects, the by-country analysis allows investigating the extent to which the direction and strength of the effects conform or differ across countries (and at the same time ensures that the pooled results are not driven by the large number of U.S. firms in the sample or by imperfect controls for institutional differences of post-retirement plans across country). The results are shown in Table 5, with separate columns for regular leverage, consolidated leverage, capital expenditures and research and development expenses. The underlying regression framework is the same multivariate set-up as in Tables 3 and 4, but the estimation is performed by country, and the

table only reports the coefficients and associated *p*-values of *PBO* for regular leverage, capital expenditures and research and development and of *PostRetirementPlan* for consolidated leverage.

The results in the first column of Table 5 show that the effect of post-retirement obligations on regular leverage is negative in most countries with sufficient observations. At the same time, the size of the effect varies significantly across countries. In some countries, such as Taiwan (-1.094), Norway (-0.793), Hong Kong (-0.747), Indonesia (-0.672) or Austria (-0.647), post-retirement obligations are effectively perfect substitutes of regular debt since the coefficient estimates are not significantly different from -1. In contrast, the effect is small and not significantly different from zero in other countries, such as South Africa (-0. 079), Malaysia (-0.016), and Denmark (0.243), suggesting that there is no substitution effect between PBO and regular debt in these countries. The coefficient of -0.226 for the United States is of similar order of magnitude as the estimate of -0.36 that Shivdasani and Stefanescu (2010) obtain for just pension obligations of their sample of U.S. firms in an earlier period. The effect is significant in both developed and developing countries, but almost double in the latter. In contrast, the effect of PBO on consolidated leverage is positive in all but one country (not reported).

It is insightful to consider this variation across countries in the rate of substitution between regular debt and post-retirement obligations in the context of the results for consolidated leverage in the second column of Table 5. While the results in Panel B of Table 3 show that firms with post-retirement plans have on average higher consolidated leverage, the results in Table 5 show that there is significant variation underlying this average: In 10 out of 20 countries, plan sponsors have significantly higher consolidated leverage, but in 6 countries there is no statistically significant difference between the effective leverage of firms with and without plan, and in 4 countries plan sponsors actually have (marginally) less consolidated leverage. This outcome is the result of several effects. As shown in Table 1, countries differ with regards to the frequency and size of defined benefit plans. Firms in countries where defined benefit plans are popular tend to have larger post-retirement obligations, which leads to larger differences between consolidated leverage and regular leverage for plan sponsors (Table 2), and to higher consolidated leverage of firms that sponsor a plan compared to those without plan (second column of Table 5). In contrast, the degree of substitution (first column of Table 5) works to reduce the effect of consolidating post-retirement plans on leverage. Indeed, the coefficients from the first and second columns for regular leverage and consolidated leverage in

Table 5 are positively correlated, i.e. the difference in consolidated leverage between plan sponsors and non-sponsors is lower in countries with larger rates of substitution.

Whether plan sponsors have higher effective leverage than non-sponsors is then the result of the relative magnitudes of these effects. Based on the sign and significance level of the coefficient in the consolidated leverage equation of Table 5, three groups of countries can be identified. First, there a several countries where sponsors have significantly higher consolidated leverage, for example the United Kingdom, Switzerland and the Netherlands. Due to high popularity of defined benefit schemes and large post-retirement obligations, consolidating defined benefit plans leads to large increases in leverage in these countries. In contrast, while there is a significant substitution effect between regular leverage and post-retirement obligations, the degree of substitution is too low, resulting in the average plan sponsor ending up with higher leverage of up to 65% (e.g. in the UK) compared to non-sponsors. Countries within this group where the difference in consolidated leverage between firms with and without plan is smaller tend to have less frequent, smaller plans and higher rates of substitution. Extreme cases are South Africa and Denmark, where the rate of substitution is effectively zero.

The group of countries where the indicator variable of having a defined benefit plan is insignificant (e.g. Indonesia, Finland, Austria, Malaysia) is not entirely homogenous with regards to plan characteristics, though they tend to have smaller obligations. Most of these countries are, however, characterized by quite a high substitution rate, which in three out of six countries is not significantly different from -1. This combination of modest plan size and high rates of substitution yields effective leverage of plans sponsors that is not different from that of non-sponsors.

Finally, there is a small group of countries (Norway, Taiwan, India, and France), where firms with post-retirement plans actually seem to have less consolidated leverage than firms without a plan. Defined benefit plans in these countries are not necessarily infrequent, but the plan obligations are small. Firms in these countries significantly reduce regular leverage when having post-retirement obligations, which yields overall slightly smaller effective leverage compared to firms without defined benefit plan. These relationships are also borne out when comparing countries by degree of development: Developing countries have smaller, less frequent plans, and firms reduce regular leverage by about twice as much for every dollar of post-retirement obligation. As a result, the difference in effective leverage between firms with and without defined benefit plan is insignificant in these countries.

It is interesting to consider what country characteristics, beyond the size and prevalence of DB plans, may be related to the extent of substitution between regular debt and post-retirement obligations. To this end, Table 6 shows estimated rates of substitution separately for subsamples of firms in countries split by various characteristics at the country median. The results show that firms in countries with stronger employment protection, stricter employment laws, better social security benefits, and lower labor market freedom have significantly higher substitution rates, as employees are better protected. This finding is in line with predictions and evidence of a negative effect of labor protection on leverage (Simintzi, Vig and Volpin, 2012). Differences in substitution rates for other dimensions of labor market characteristics tend to be small.

While the strength of creditor rights does not seem to be important, the rates of substitution between regular debt and post-retirement obligations are much higher in an environment of weaker rule of law, where claims may be more difficult to enforce and thus lenders are less willing to provide funds to companies with significant post-retirement liabilities. Higher substitution rates entail that firms rely more on post-retirement obligations for leverage, and consequently, regular forms of debt are less important, as evidenced by smaller markets for debt in terms of bonds or private credit being associated with higher substitution rates.

Finally, other characteristics of the pension system might affect substitution rates. The results show that they are lower in countries with large pension fund assets (as measured by the OECD), i.e. better funding, ceteris paribus. Substitution rates are also slightly higher for firms in countries where mandatory pension programs are more generous as measured by the net salary replacement rate. At the same time, the existence of guarantee mechanisms/funds leads to lower substitution rates, which is an important insight for countries such as the UK that recently introduced the Pension Protection Fund. In contrast, the rating of the overall adequacy, sustainability and integrity of a country's entire pension system does not seem to impact how firms substitute between different forms of corporate leverage.[31]

With regards to real investment, Table 5 shows that defined benefit plans have a negative relation to capital expenditures in most countries (16 out of 20) and for subsamples of firms split by the degree of development, even though the effect is not always significant (but it is never positive

[31] Other factors that might affect the degree of substitution but are more difficult to capture/measure empirically are the pricing of guarantees for post-retirement benefits, and the degree of immunization of plan assets and liabilities.

and significant). The countries with the largest coefficients are Finland (-0.206), Taiwan (-0.136), and Australia (-0.109). The effect appears stronger in developed countries, where the pooled coefficient is -0.020 and highly significant, while the coefficient for developing countries is of similar size (-0.017) but not significant. Similarly, the effect of PBO on R&D is positive in most countries, with large coefficients for Denmark (0.212), Taiwan (0.146) and Norway (0.055).[32] The effect is twice as large in developing countries (0.021) compared to developed countries (0.011), but significant in both sub-samples. Surprisingly, the coefficient for Switzerland is negative and significant.

I also estimate the models by industry (but include year and country dummies). This is an interesting test since one would expect research and development and capital expenditures to cluster by industry, with less variation within industry, which makes it tough to demonstrate the relation between financial and operating flexibility. Moreover, statistical power will be lower with many industries. Nevertheless, the results confirm the earlier findings (not reported). There is a negative relation between post-retirement obligations and regular leverage in 32 out of 36 industries with sufficient number of observations. Except for 7 industries, where the difference is insignificant, firms with a defined benefit plan always have significantly higher consolidated leverage compared to similar firms without such a plan. The relation between post-retirement obligations and CapEx is typically negative (in 28 industries, in 13 of which it is significant at the 10% level or better), and the largest coefficients occur in Recreation (-0.075), Telecom (-0.072), and Medical Equipment (-0.067). The relation of post-retirement benefits with R&D is positive in 28 industries (and significant in 20 at the 10% level or better), with the largest coefficients in Oil (0.106), Drugs (0.084), Agriculture (0.068), Aircraft (0.065) and Measuring and Control Equipment (0.060). In the same vein, the results are robust to estimating the model separately for firms split into quintiles based on firm size.

5 Conclusion

This paper is the first international study of occupational defined benefit plans. It shows that post-retirement benefit plans play an economically important role for non-financial corporations around the world both for the liability side (i.e. leverage) as well as for the asset side (i.e. real investment). Similarities between regular debt and post-retirement obligations suggest that off-balance sheet as-

[32] The coefficient on PBO in the R&D equation is insignificant for the United States, which might be due to the fact that there are many other ways of financing R&D available to U.S. firms (such as venture capital and others). The coefficient is positive but insignificant when using data from Compustat and CRSP.

sets and liabilities of post-retirement plans should be consolidated on the balance sheet. To the extent that companies perceive projected benefit obligations as substitutes for regular debt along some dimensions, recognizing them on the balance sheet would yield more realistic measures of effective leverage. The analysis shows that consolidated leverage ratios are on average 20-70% higher than regular leverage ratios, which might help explaining the observed low levels of (regular) leverage. While firms with large post-retirement obligations typically have lower regular leverage, the substitution is imperfect, so that firms with post-retirement plans end up with around 24% higher consolidated leverage compared to similar firms that do not sponsor such a plan. However, consolidating defined benefit plans has no effect on leverage for firms in about half the sample countries, and the extent to which firms substitute regular debt with projected benefit obligations varies between 0% and 100% across countries. In particular, countries where occupational defined benefit plans are less common and smaller, the effect on leverage of consolidating these plans tends to be small, and the degree of substitution between regular leverage and post-retirement obligations is relatively high. In contrast, consolidating post-retirement plans of firms in countries where these plans are popular and large leads to economically and statistically significant increases in the leverage of plan sponsors. At the same time, while firms in these countries also take out significantly lower levels of regular debt, the degree of substitution is relatively low and generally not high enough to offset the effect of consolidation. As a result, plan sponsors are left with higher consolidated leverage, in some cases by 40%-60%, compared to otherwise similar firms without a defined benefit plan.

Across countries, substitution rates between regular debt and post-retirement obligations are higher in countries where employees enjoy stronger employment protection, stricter employment laws, better social security benefits, and lower labor market freedom. Moreover, better rule of law is associated with lower substitution rates, as contracts are easier to enforce. Finally, substitution rates are lower in countries with large pension plan assets, large markets for private bonds/credit, and pension guarantee funds. These differences illustrate that it is important to consider post-retirement benefit arrangements across countries in order to understand capital structure internationally. Moreover, contributions to defined benefit plans are sizable and provide plan sponsors with significant tax shield benefits that are as large as a third of the tax shields of interest expenses.

Given that post-retirement obligations have more flexible terms compared to regular debt, they can be used to investigate the relation between financial flexibility and real investment. This relation is hypothesized to be conditional on the type of growth option. The empirical results show

indeed a positive relation of post-retirement obligations with research and development (which enhances optionality on the asset side) and a negative relation with capital expenditures (which reduces optionality on the asset side). The typical plan sponsor has 5% less capital expenditures and 12% more research and development in comparison to a similar firm without post-retirement benefit plan. Consequently, post-retirement plans are important not just for the capital structure, but also for the real operations of a company. More flexibility on the liability side of the balance sheet is related to more flexibility on the asset side of the balance sheet, which is an important way in which financing and investment interact. Moreover, the study provides international evidence that other dimensions of financial policy, such as debt maturity, preferred stock, convertible debt, leverage and corporate payout, have an impact on firms' real investment, despite some theoretical predictions of a limited role of financial policies for operating policies. *In summa*, the paper documents that corporate defined benefit post-retirement schemes matter internationally both for leverage and real investment of non-financial firms. Future research should formalize the relation between financial and operating flexibility that is being revealed in this paper.

References

Almeida, H., and T. Philippon, 2007. The risk-adjusted cost of financial distress. Journal of Finance 62, 2557-2586.

Andrade, G., and S.N. Kaplan, 1998. How costly is financial (not economic) distress? Evidence from highly leveraged transactions that became distressed. Journal of Finance 53, 1443-1493.

Bakke, R.-E., and T.M. Whited, 2012. Threshold Events and Identification: A Study of Cash Shortfalls. Journal of Finance 67 (3), 1083-1111.

Ballester, M., D. Fried, and J. Livnat, 2002. Pension Plan Contributions, Free Cash Flows and Financial Slack. New York University Working Paper.

Barth, M.E., 1991. Relative Measurement Errors among Alternative Pension Asset and Liability Measures. Accounting Review 66(3), 433–463.

Barth, M.E., and G. Clinch, 1996. International Accounting Differences and their Relation to Share Prices: Evidence from U.K., Australian, and Canadian Firms. Contemporary Accounting Research 13 (1), 135-171.

Barth, M.E., W.H. Beaver, and W. R. Landsman, 1992. The market valuation implications of net periodic pension cost components. Journal of Accounting and Economics 15, 27-62.

Barth, M.E., W.R. Landsman, M. Lang, 2008. International Accounting Standards and Accounting Quality. Journal of Accounting Research 46 (3), 467-498.

Barth, M.E., W.R. Landsman, M. Lang, and C. Williams, 2012. Are IFRS-based and US GAAP-based accounting amounts comparable? Journal of Accounting and Economics 54, 68-93.

Beck, T., and A. Demirgüç-Kunt, 2009. Financial Institutions and Markets Across Countries and over Time: Data and Analysis. World Bank Policy Research Working Paper No. 4943.

Bekaert, G., R.J. Hodrick, and X. Zhang, 2010. International Stock Return Comovements. Journal of Finance 64, 2591-2626.

Bergstresser, D., M.A. Desai, and J. Rauh, 2006. Earnings Manipulation, Pension Assumptions and Managerial Investment Decisions. Quarterly Journal of Economics 121, 157–95.

Berk, J., R. Stanton, and J. Zechner, 2009. Human Capital, Bankruptcy and Capital Structure. Journal of Finance, forthcoming.

Bilicka, K., M. Devereux, and C. Fuest, 2011. G20 Corporate tax ranking 2011. Research Report. Centre for Business Taxation at Oxford University.

Botero, J., S. Djankov, R. La Porta, F. Lopez de Silanes and A. Shleifer, 2004. The Regulation of Labor. Quarterly Journal of Economics, November, 1339-1382.

Bulow, J., R. Morck, and L.H. Summers, 2004. How Does the Market Value Unfunded Pension Liabilities? NBER Working Paper No. 1602.

Bushee, B., 1998. The influence of institutional investors on myopic R&D investment behavior. Accounting Review 73 (3), 305–333.

Campbell, J.L., D.S. Dhaliwal, and W.C. Schwartz, 2012. Financing Constraints and the Cost of Capital: Evidence from the Funding of Corporate Pension Plans. Review of Financial Studies 25 (3), 868-912.

Chhaochharia, V., A. Kumar, and A. Niessen-Ruenzi, 2012. Local Investors and corporate governance. Journal of Accounting and Economics 54, 42-67.

Childs, P.D., D.C. Mauer, and S.H. Ott, 2005. Interactions of Corporate Financing and Investment Decisions: The Effect of Agency Conflicts. Journal of Financial Economics 76, 667-690.

Cohen, D.A., A. Dey, and T.Z. Lys, 2008. Real and accruals-based earnings management in the pre- and post-Sarbanes-Oxley periods. Accounting Review 83 (3), 757–787.

Cohen, D.A., R. Mashruwala, and T. Zach, 2010. The use of advertising activities to meet earnings benchmarks: Evidence from monthly data. Review of Accounting Studies 15 (4), 808–832.

Comprix, J., and K.A. Muller III, 2011. Pension plan accounting estimates and the freezing of defined benefit pension plans. Journal of Accounting and Economics 51, 115-133.

Coronado, J.L., and S.A. Sharpe, 2003. Did Pension Plan Accounting Contribute to a Stock Market Bubble? Brookings Papers on Economic Activity 1, 323–359.

Credit Suisse First Boston, 2005. The Magic of Pension Accounting Part III. Credit Suisse First Boston.

Dhaliwal, D.S., 1986. Measurement of Financial Leverage in the Presence of Unfunded Pension Obligations. Accounting Review 61(4), 651-661.

Djankov, S., C. McLiesh, and A. Shleifer, 2007. Private credit in 120 countries. Journal of Financial Economics 84, 299-329.

Eldenburg, L.G., K.A. Gunny, K.W. Hee and N. Soderstrom, 2011. Earnings management using real activities: Evidence from nonprofit hospitals. Accounting Review 86 (5), 1605-1630.

Ely, K.M., 1995. Operating lease accounting and the market's assessment of equity risk. Journal of Accounting Research 33(2), 397-415.

Faulkender, M., and M. Petersen, 2006. Does the source of capital affect capital structure? Review of Financial Studies 19, 45-79.

Fazzari, S., G. Hubbard, and B. Petersen, 1988. Financing Constraints and Corporate Investment. Brookings Papers on Economic Activity 1, 141–195.

Feldstein, M., and R. Mørck, 1983. Pension Funding Decisions, Interest Rate Assumptions and Share Prices. In Z. Bodie and J. Shoven, eds. Financial Aspects of the U. S. Pension System, University of Chicago Press, Chicago, pp. 177–210.

Feldstein, M., and S. Seligman, 1981. Pension Funding, Share Prices, and National Savings. Journal of Finance 36 (4), 801-824.

Frank, M., 2002. The impact of taxes on corporate defined benefit plan asset allocation. Journal of Accounting Research 40 (4), 1163-1190.

Franzoni, F., 2009. Underinvestment vs. overinvestment: Evidence from price reactions to pension contributions. Journal of Financial Economics 92, 491-518.

Franzoni, F., and J.M. Marín, 2006. Pension plan funding and stock market efficiency. Journal of Finance 61, 921–956.

Friedman, B.M., 1983. Pension Funding, Pension Asset Allocation, and Corporate Finance: Evidence from Individual Company Data. In Z. Bodie and J. Shoven, eds. Financial Aspects of the U. S. Pension System, University of Chicago Press, Chicago, pp. 107–147.

Glaum, M., 2009. Pension accounting and research: A review. Accounting and Business Research 39 (3), 273-311.

Goldstein, R.S., N. Ju, and H.E. Leland, 2001. An EBIT-based model of dynamic capital structure. Journal of Business 74, 483–512.

Graham, J.R., 2000. How big are the tax benefits of debt? Journal of Finance 55, 1901-1941.

Graham, J.R., and A.L. Tucker, 2006. Tax shelters and corporate debt policy. Journal of Financial Economics 81, 563-594.

Graham, J.R., and M.T. Leary, 2010. A Review of Empirical Capital Structure Research and Directions for the Future. Duke University Working Paper.

Hann, R.N., Y.Y. Lu, and K.R. Subramanyam, 2007. Uniformity versus Flexibility: Evidence from Pricing of the Pension Obligation. Accounting Review 82(1), 107-137.

Imhoff, E.A., Jr., R. Lipe, and D.W. Wright, 1993. The Effects of Recongition Versus Disclosure on Shareholder Risk and Executive Compensation. Accounting, Auditing and Finance 8 (4), 335-368.

Jin, L., R.C. Merton, and Z. Bodie, 2006. Do a firm's equity returns reflect the risk of its pension plan? Journal of Financial Economics 81, 1-26.

Kaplan, S., and L. Zingales, 1997. Do Investment–Cash Flow Sensitivities Provide Useful Measures of Financing Constraints? Quarterly Journal of Economics 112, 169–215.

Kraft, P., 2010. Rating Agency's Adjustments to GAAP Financial Statements and Their Effect on Ratings and Bond Yields. NYU Working Paper.

Landsman, W.R., 1986. An empirical investigation of pension fund property rights. Accounting Review 61 (4), 662-691.

Lawson, R.A., and E. Bierhanzl, 2004. Labor Market Flexibility: An Index Approach to Cross-Country Comparisons. Journal of Labor Research 25 (1), 117-126.

Leland, H.E., 1998. Agency costs, risk measurement, and capital structure. Journal of Finance 53, 1213–1243.

Lemmon, M.L., M.R. Roberts, and J.F. Zender, 2008. Back to the beginning: Persistence and the cross-section of corporate capital structure. Journal of Finance 63, 1575-1608.

MacKay, P., 2003. Real Flexibility and Financial Structure: An Empirical Analysis. Review of Financial Studies 16 (4), 1131-1165.

Mauer, D.C., and A.J. Triantis, 1994. Interactions of Corporate Financing and Investment Decisions: A Dynamic Framework. Journal of Finance 49 (4), 1253-1277.

Mercer, 2009. Melbourne Mercer Global Pension Index. October 2009. Melbourne Centre for Financial Studies (Melbourne).

Modigliani, F., and M. Miller, 1958. The Cost of Capital, Corporation Finance and the Theory of Investment. American Economic Review 48 (3), 261–297.

Molina, C. A., 2005. Are firms underleveraged? An examination of the effect of leverage on default probabilities. Journal of Finance 60(3), 1427-1459.

Novy-Marx, R., and J. Rauh, 2011. Public Pension Promises: How Big Are They and What Are They Worth?, Journal of Finance 66 (4), 1211-1249.

OECD, 2008. Indicators on Employment Protection. Employment protection annual time-series data 1985-2008. OECD (Paris).

Petersen, M.A., 1992. Pension Reversions and Worker-Stockholder Wealth Transfers. Quarterly Journal of Economics 107 (3), 1033-1056.

Petersen, M.A., 1994. Cash flow variability and firm's pension choice: A role for operating leverage. Journal of Financial Economics 36, 361-383.

Petersen, M.A., 2009. Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches. Review of Financial Studies 22 (1), 435-480.

Purnanandam, A, and U. Rajan, 2013. Growth Option Exercise and Capital Structure, University of Michigan Working Paper.

Rajan, R.G., and L. Zingales, 1995. What do we know about capital structure: Some evidence from international data. Journal of Finance 50, 1421-1460.

Rauh, J.D., 2006. Investment and financing constraints: Evidence from the funding of corporate pension plans. Journal of Finance 61, 33-71.

Rauh, J.D., 2009. Risk Shifting versus Risk Management: Investment Policy in Corporate Pension Plans. Review of Financial Studies 22 (7), 2687-2733.

Revsine, L., D.W. Collins, and W.B. Johnson, 2005. Financial Reporting and Analysis, 3rd ed., Upper Saddle River, NJ: Pearson Prentice Hall.

Roychowdhury, S., 2006. Earnings management through real activities manipulation. Journal of Accounting and Economics 42 (3), 335–370.

Schallheim, J., and K. Wells, 2006. Debt and taxes: A new measure for non-debt tax shields, working paper, University of Utah.

Shivdasani, A., and I. Stefanescu, 2010. How Do Pensions Affect Corporate Capital Structure Decisions? Review of Financial Studies 23 (3), 1287-1323.

Simintzi, E., V. Vig, and P. Volpin, 2012. Labor Bargaining Power and Access to Finance. London Business School Working Paper.

Standard and Poor's, 2006. Corporate Ratings Criteria. Standard & Poor's/McGraw-Hill (New York).

Standard and Poor's, 2011. Global Ratings Portal: Defined-Benefit Obligations Still Weigh on Financial Risk Profiles Of European Companies And Are Likely To Worsen. Standard & Poor's/McGraw-Hill (New York).

Stewart, F., 2007a. Benefit Security Pension Fund Guarantee Schemes. OECD Working Papers on Insurance and Private Pensions, No. 5.

Stewart, F., 2007b. Benefit Protection: Priority Creditor Rights for Pension Funds. OECD Working Papers on Insurance and Private Pensions, No. 6.

Stice, E.K., J.D. Stice, and W.S. Albrecht, 2011. Financial Accounting Principles. 11th edition. South-Western.

Titman, S., and S. Tsyplakov, 2007. A dynamic model of optimal capital structure. Review of Finance 11, 401-451.

Wald, J.K., 1999. How firm characteristics affect capital structure: an international comparison. Journal of Financial Research 22 (2), 161-187.

Whitehouse, E., 2007. Pensions Panorama: Retirement-Income Systems in 53 Countries. The International Bank for Reconstruction and Development / The World Bank (Washington D.C.).

Yermo, J., and C. Severinson, 2010. The Impact of the Financial Crisis on Defined Benefit Plans and the Need for Counter-Cyclical Funding Regulations. OECD Working Papers on Finance, Insurance and Private Pensions, No. 3.

Figure 1: Funding Level and Recognition on the Balance Sheet

The figure shows the average funding level and recognition of net pension liabilities on the balance sheet for the period 2002-2009. The funding level is calculated as the difference between fair value of plan assets and projected benefit obligation of pension and health care benefits, scaled by total assets. It is shown as dotted lines. The amount recognized on the balance sheet is prepaid post-retirement costs (including intangible pension asset where applicable) minus accrued post-retirement costs (including additional minimum liabilities where applicable), scaled by total assets. It is shown as solid lines. Results are shown by year and separately for U.S. firms (blue lines) and firms in countries other than the United States (black lines).

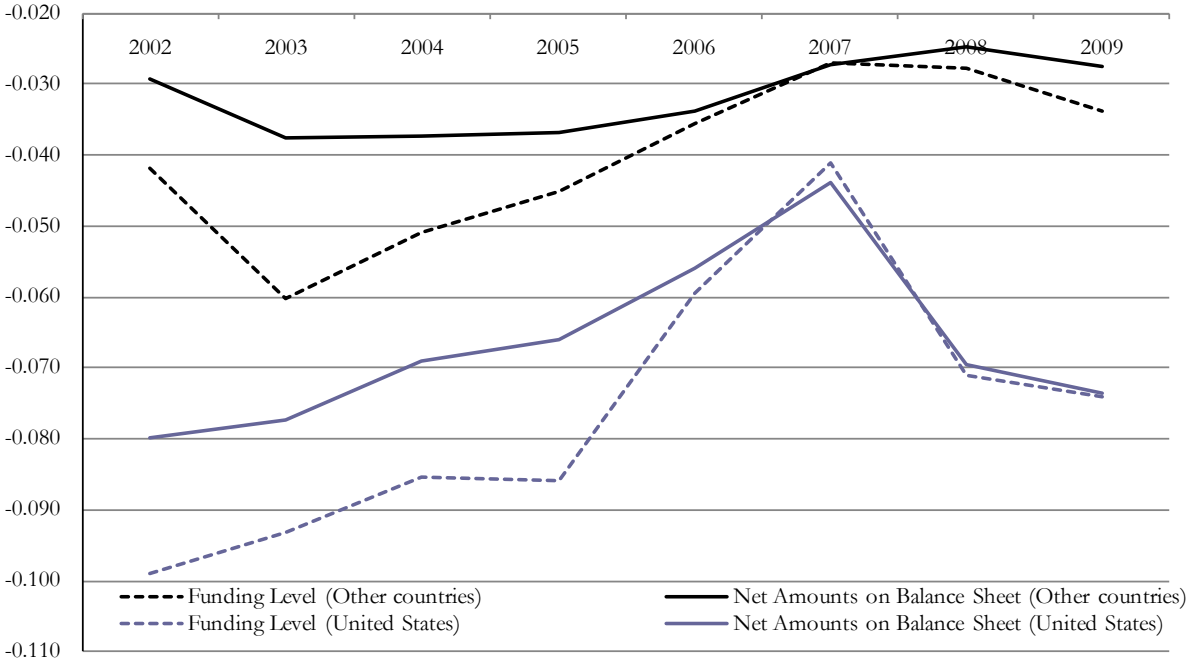

Figure 2: Differences Between Consolidated and Regular Leverage

The figure shows the differences between consolidated leverage and regular leverage by year for the period 2002-2009. Leverage is calculated as Total Debt divided by Size Market Value (the sum of total debt, preferred stock, and market value of equity) (dotted lines) and Total Debt divided by Total Assets (solid lines), respectively. For all firms with post-retirement benefits, consolidated leverage ratios are calculated by subtracting accrued post-retirement costs (including additional minimum liabilities where applicable) from total debt and adding projected benefit obligations, as well as by subtracting prepaid post-retirement costs (including intangible pension asset where applicable) from size and adding fair value of plan assets. The figure shows the difference in mean values of consolidated and regular leverage. Results are shown by year and separately for U.S. firms (blue lines) and firms in countries other than the United States (black lines).

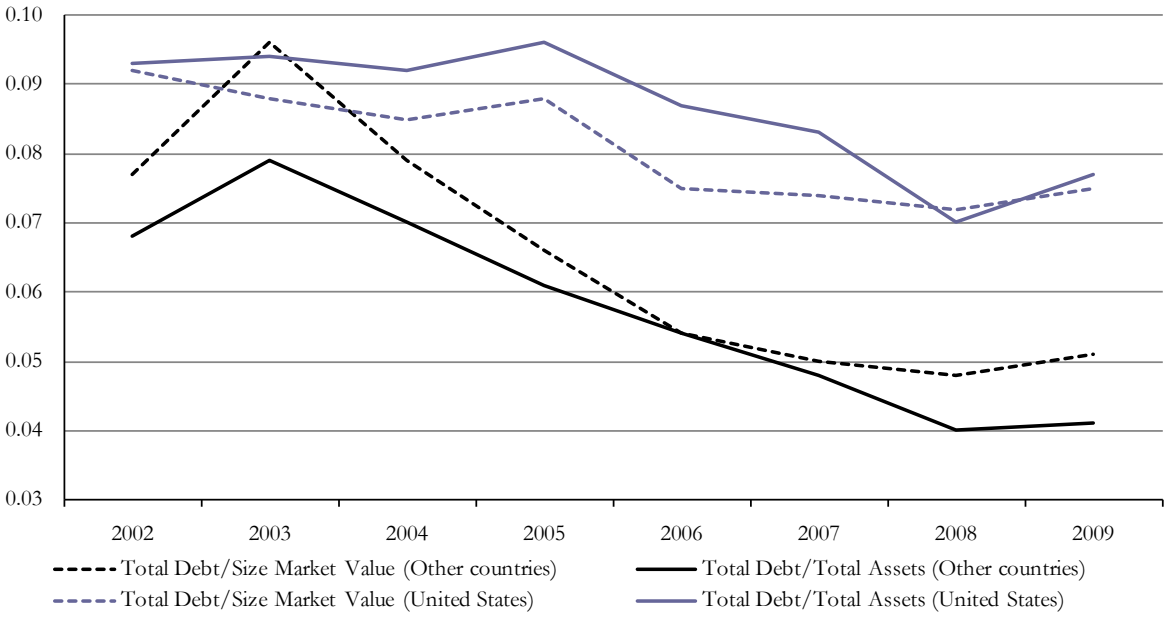

Table 1: Importance and Characteristics of Post-Retirement Benefit Plans

The table shows statistics on the importance and further characteristics of post-retirement benefit plans. Panel A shows results by country, separately for firms in developed and developing countries (defined based on the MSCI classification as of June 2006), as well as for firms in all countries. In particular, it shows the number of firms, the percentage of firms with defined benefit post-retirement benefit plan, pension plan and health care plan, as well as the ratios of projected benefit obligations (PBO) to total assets, the plan funding level to total assets, and the net recognition of post-retirement benefit plans on the balance sheet to total assets. It also shows the discount rate and the expected return on plan assets as well as the percentage of plan assets invested in equities, bonds, property or other assets. The funding level is calculated as the difference between fair value of plan assets and projected benefit obligations of pension and health care benefits, scaled by total assets. The amounts recognized on the balance sheet are prepaid post-retirement costs (including intangible pension asset where applicable) minus accrued post-retirement costs (including additional minimum liabilities where applicable), scaled by total assets. Averages are calculated by country (or by degree of development, or for all firms), first averaging across firms, then across years. The observations are sorted in descending order by the relative frequency of defined benefit post-retirement benefit plans. Panel B shows statistics on the same measures by industry based on 48 Fama/French industries. Averages are calculated by industry, first averaging across firms, then across years. The observations are sorted in descending order by the relative frequency of defined benefit post-retirement benefit plans. Panel C shows statistics by year. Averages are calculated separately for U.S. and non-U.S. firms, first averaging across firms by country and year, then across counties.

(continued)

Table 1: Importance and Characteristics of Post-Retirement Benefit Plans (continued)

Panel A: Results by Country

		Percentage of Firms				Funding	Net Amounts	Discount	Expected	Asset Allocation (%)			
	Number of Firms	Post-Retirement Benefit Plan	Pension Plan	Health Care Plan	PBO/Total Assets	Level/ Total Assets	on Balance Sheet/ Total Assets	Rate (%)	Return on Plan Assets (%)	Equities	Bonds	Property	Other
Switzerland	173	61.9	61.7	6.5	0.206	-0.032	-0.026	3.9	4.5	31.5	42.6	11.2	14.7
Austria	56	57.6	57.6	0.3	0.069	-0.052	-0.036	5.0	5.2	32.2	45.1	5.1	17.6
Ireland	46	54.4	54.4	4.4	0.167	-0.050	-0.033	5.3	5.7	61.5	26.6	4.9	7.0
Mexico	104	48.1	48.1	1.5	0.074	-0.017	-0.009	5.6	6.5	46.3	40.0	0.0	13.6
Philippines	122	45.0	45.0	0.0	0.026	-0.012	-0.011	10.1	8.8	33.7	33.0	4.1	29.1
Netherlands	121	42.7	42.7	7.3	0.220	-0.053	-0.046	5.3	6.2	41.8	46.2	4.8	7.2
Taiwan, Province Of China	1,396	38.5	38.5	0.0	0.022	-0.014	-0.011	3.2	3.0				
Pakistan	98	38.2	35.2	10.8	0.048	-0.007	-0.014	9.8	9.5	15.0	57.6	0.0	27.3
Luxembourg	8	38.0	38.0	2.6	0.038	-0.037	-0.038	5.9	4.4	61.0	36.2	0.0	2.8
Japan	3601	37.6	37.6	0.0	0.098	-0.051	-0.040	2.3	2.5	44.0	31.4	0.3	24.3
Norway	190	36.5	36.5	0.6	0.065	-0.028	-0.018	5.1	6.1	28.4	51.5	10.1	10.0
Germany	691	29.3	29.3	1.5	0.099	-0.072	-0.068	5.2	5.4	40.0	40.6	5.6	13.8
Finland	114	29.0	29.0	4.6	0.088	-0.023	-0.018	5.1	5.5	40.3	43.7	6.0	10.0
Belgium	104	28.1	28.1	3.5	0.116	-0.045	-0.046	5.2	5.4	33.4	27.1	1.0	38.4
Indonesia	261	27.5	27.4	0.4	0.026	-0.021	-0.020	10.4	9.6				
United Kingdom	1543	26.1	26.1	2.0	0.273	-0.079	-0.053	5.6	6.0	57.6	30.8	2.0	9.6
France	672	22.9	22.9	3.7	0.059	-0.029	-0.029	4.9	5.7	43.7	44.6	2.5	9.3
United States	4,899	21.1	20.0	13.7	0.153	-0.076	-0.067	6.0	7.8	58.3	32.2	1.7	7.8
Greece	256	20.9	20.9	0.7	0.018	-0.014	-0.012	4.9	4.5	54.9	26.5	6.1	12.5
Russian Federation	90	18.8	18.8	0.1	0.019	-0.018	-0.013	8.6	9.1	21.1	34.9	0.0	44.0
Portugal	49	17.7	17.7	5.6	0.063	-0.032	-0.033	5.0	4.9	27.9	51.9	9.1	11.0
Denmark	117	17.5	17.5	0.9	0.048	-0.011	-0.014	5.1	5.8	36.3	45.7	7.8	10.2
Sweden	345	17.3	17.3	1.1	0.105	-0.041	-0.031	4.9	5.7	43.3	43.6	2.7	10.5
South Africa	270	17.1	13.7	9.4	0.092	0.002	-0.015	8.9	8.8	52.6	25.7	1.7	20.1
India	1,236	13.1	13.0	0.7	0.023	-0.010	-0.012	6.9	7.0	8.0	45.2	0.3	46.5
Brazil	233	12.6	12.3	5.2	0.096	-0.016	-0.020	9.6	9.7	32.1	62.3	4.0	1.6
Canada	1195	12.5	12.1	7.3	0.102	-0.033	-0.018	5.9	7.0	55.8	36.0	1.4	6.7
Israel	72	11.3	10.6	1.7	0.038	-0.010	-0.023	4.9	5.9	50.8	44.2	0.0	5.0
Iceland	8	10.7	10.7	0.0	0.077	-0.001	-0.001	5.6	7.0	74.0	17.9	5.9	2.1
Italy	206	9.8	9.8	2.0	0.049	-0.030	-0.028	4.9	7.0	51.6	31.2	2.0	15.3
Sri Lanka	19	9.5	9.5	0.0	0.014	-0.012	-0.011	11.0	9.0				
Malaysia	818	8.2	8.2	0.0	0.016	-0.013	-0.012	6.6	5.6				
Spain	100	7.1	7.1	0.0	0.021	-0.009	-0.009	7.7	6.7	40.6	26.1	16.6	16.7
Slovakia	11	6.8	6.8	0.0	0.003	-0.003	-0.003	6.3					
Hong Kong	847	4.8	4.8	0.3	0.044	-0.006	-0.008	4.6	5.6	63.0	18.9	0.3	17.8
Argentina	53	4.5	4.5	0.2	0.006	-0.004	-0.004	7.0	5.9	70.0	30.0	0.0	0.0
Venezuela	16	3.8	3.8	3.8	0.334	-0.239	-0.179	8.1	7.1	28.4	42.7	0.0	28.9
Australia	1,318	3.7	3.7	0.1	0.053	-0.005	-0.010	5.6	6.7	57.7	24.2	5.5	12.7
Morocco	15	3.3	3.3	2.4	0.013	-0.013	-0.018	4.8					
Turkey	176	3.0	3.0	0.0	0.015	-0.014	-0.013	7.2	7.1				
New Zealand	97	2.7	2.7	0.0	0.082	0.003	-0.011	4.8	5.7	42.6	27.7	8.7	21.1
Qatar	15	1.6	1.6	1.6	0.005	-0.002	-0.007	11.4	6.0				
Singapore	588	1.4	1.4	0.1	0.029	-0.009	-0.015	7.6	6.4	35.7	47.0	3.7	13.7
Peru	50	1.2	1.2	1.0	0.053	-0.020	-0.019	5.7	8.8	53.0	46.3	0.0	0.8
Kuwait	53	1.1	1.1	0.0	0.043	-0.010	-0.011	5.0	5.9				
Hungary	26	1.0	1.0	0.0	0.010	-0.010	-0.006	5.6					
Thailand	401	0.5	0.5	0.0	0.015	-0.015	-0.015	6.0					
Poland	240	0.2	0.2	0.0	0.014	-0.005	-0.005	5.3	3.5				
Korea, Republic Of	986	0.1	0.1	0.0	0.014	-0.002	-0.002	6.8	5.0				
China	1,249	0.0	0.0	0.0	0.001	-0.001	-0.001						
Developed countries	17,343	22.5	22.2	5.0	0.132	-0.056	-0.046	4.5	5.3	54.8	33.3	2.5	9.4
Developing countries	8,253	13.9	13.8	0.8	0.029	-0.014	-0.012	5.5	4.7	32.3	35.8	1.5	30.4
All countries	25,596	19.7	19.5	3.6	0.109	-0.047	-0.038	4.8	5.2	53.5	33.1	2.4	11.0

(continued)

Table 1: Importance of Post-Retirement Benefit Plans (continued)

Panel B: Results by Industry

		Percentage of Firms								Asset Allocation (%)			
	Number of Firms	Retirement Benefit Plan	Pension Plan	Health Care Plan	PBO/Total Assets	Funding Level/ Total Assets	Net Amounts on Balance Sheet/ Total Assets	Discount Rate (%)	Expected Return on Plan Assets (%)	Equities	Bonds	Property	Other
Aircraft	72	45.2	44.5	19.3	0.226	-0.098	-0.075	5.7	7.2	58.9	29.5	2.3	9.3
Tobacco Products	31	44.3	43.1	22.5	0.181	-0.055	-0.050	6.2	7.3	48.3	35.5	2.2	14.0
Shipping Containers	103	32.6	32.3	13.2	0.164	-0.063	-0.051	5.4	6.0	55.0	33.8	1.4	9.8
Candy & Soda	140	32.2	30.9	9.5	0.135	-0.050	-0.037	5.3	6.0	60.2	29.3	2.0	8.5
Automobiles	567	30.5	30.1	6.9	0.140	-0.075	-0.060	4.6	5.1	52.8	36.2	2.1	8.9
Business Supplies	363	29.9	29.7	8.7	0.142	-0.059	-0.045	5.2	5.7	52.9	34.3	1.8	11.0
Books	232	29.2	28.4	10.1	0.145	-0.047	-0.036	5.3	6.3	55.4	32.0	2.4	10.1
Machinery	975	28.1	27.7	6.7	0.148	-0.071	-0.055	4.5	5.1	51.0	35.8	2.7	10.4
Defense	22	27.6	27.6	11.1	0.343	-0.105	-0.080	5.4	7.3	53.6	33.3	3.4	9.7
Transportation	881	26.7	26.3	5.3	0.119	-0.051	-0.039	5.0	5.6	53.7	34.1	3.9	8.3
Chemicals	931	26.3	26.0	6.2	0.127	-0.054	-0.044	4.8	5.4	52.4	32.7	2.1	12.8
Steel	773	26.3	26.2	5.0	0.120	-0.052	-0.041	4.9	5.2	52.3	35.6	2.7	9.4
Construction	804	25.7	25.4	1.0	0.107	-0.044	-0.035	4.0	4.0	53.2	33.8	2.3	10.8
Rubber	274	25.3	24.3	4.5	0.141	-0.064	-0.049	4.2	4.5	57.0	33.0	1.2	8.7
Beer & Liquor	155	25.2	25.0	4.7	0.104	-0.039	-0.027	5.3	6.0	54.4	29.7	3.4	12.5
Consumer Goods	526	23.9	23.7	4.2	0.158	-0.069	-0.056	4.9	5.4	51.1	34.0	2.3	12.6
Retail	1,230	23.5	22.9	3.4	0.080	-0.028	-0.025	4.5	5.0	56.6	32.0	2.4	9.0
Construction Materials	918	23.3	22.9	4.7	0.117	-0.051	-0.040	5.3	5.6	55.0	31.6	2.2	11.2
Food Products	709	23.2	23.0	4.8	0.117	-0.049	-0.038	5.2	5.6	55.0	30.2	2.7	12.1
Electrical Equipment	428	23.1	22.9	4.0	0.140	-0.065	-0.053	4.3	4.8	54.2	31.5	1.9	12.4
Measuring and Control Equipment	318	22.8	22.5	3.8	0.139	-0.055	-0.045	4.3	4.9	46.2	36.3	3.1	14.4
Telecom	721	22.6	22.1	6.6	0.096	-0.035	-0.028	6.0	6.9	53.3	35.1	2.9	8.6
Electronic Equipment	1,630	21.9	21.8	1.8	0.075	-0.032	-0.027	3.8	3.9	52.5	33.0	2.9	11.7
Fabricated Products	136	21.6	21.6	5.6	0.120	-0.057	-0.046	5.0	5.6	52.7	30.2	3.4	13.7
Ships	73	21.2	21.2	4.6	0.126	-0.063	-0.042	5.0	6.2	56.6	30.6	1.4	11.4
Wholesale	1,709	21.0	20.7	2.5	0.087	-0.031	-0.026	4.4	4.6	55.7	31.4	2.2	10.8
Recreation	226	20.8	20.8	3.0	0.092	-0.045	-0.037	4.1	4.8	54.2	33.8	2.3	9.7
Apparel	257	19.9	19.9	2.1	0.132	-0.044	-0.039	4.8	5.3	55.0	29.2	2.4	13.4
Restaurants	494	19.3	18.9	2.6	0.070	-0.023	-0.022	4.9	5.4	53.6	31.5	1.7	13.2
Textiles	509	18.9	18.8	1.2	0.082	-0.043	-0.036	4.9	4.5	48.2	34.3	0.9	16.6
Coal	97	18.9	18.0	7.7	0.184	-0.110	-0.106	6.5	7.3	65.1	27.0	1.2	6.7
Computers	803	18.8	18.8	1.7	0.087	-0.041	-0.032	3.7	3.8	55.3	30.3	2.4	12.1
Medical Equipment	393	16.7	16.4	4.5	0.094	-0.035	-0.030	4.7	5.3	49.9	33.0	3.2	13.9
Oil	875	15.1	14.9	6.5	0.064	-0.029	-0.026	5.9	7.0	53.4	34.2	2.3	10.0
Personal Services	256	12.9	12.9	0.4	0.094	-0.043	-0.040	4.7	6.1	57.3	27.1	0.1	15.5
Drugs	948	12.7	12.4	3.0	0.101	-0.044	-0.035	4.7	5.2	47.7	35.0	3.1	14.2
Entertainment	460	12.6	12.5	0.9	0.036	-0.010	-0.013	4.7	4.9	58.3	27.9	1.3	12.5
Agriculture	272	12.2	12.0	1.1	0.079	-0.023	-0.024	6.1	5.6	52.8	34.1	2.1	11.1
Miscellaneous	154	11.7	11.2	1.5	0.100	-0.038	-0.037	4.2	4.6	52.5	33.4	0.8	13.3
Business Services	3,318	11.6	11.4	1.5	0.111	-0.044	-0.038	4.8	5.2	54.5	32.8	2.4	10.2
Real Estate	194	10.8	10.8	0.0	0.041	-0.019	-0.020	5.3	4.8	42.5	46.7	0.0	10.8
Healthcare	268	9.2	9.1	0.7	0.061	-0.026	-0.025	5.2	6.1	57.9	25.5	3.0	13.6
Mines	642	7.4	6.9	3.2	0.092	-0.033	-0.028	6.2	6.9	51.6	32.9	2.0	13.5
Trading	197	4.8	4.8	0.5	0.182	-0.027	-0.021	6.8	6.5	27.4	57.0	1.9	13.7
Precious Metals	515	2.5	2.1	1.3	0.025	-0.011	-0.011	7.0	7.5	46.9	44.7	0.6	7.9

(continued)

Table 1: Importance and Characteristics of Post-Retirement Benefit Plans (continued)

Panel C: Results by Year

		2002	2003	2004	2005	2006	2007	2008	2009
Post-Retirement Plan (% of firms)	Non-U.S.	5.2	8.4	11.9	18.5	20.1	21.1	23.7	25.3
	United States	12.5	19.1	21.2	21.4	22.0	22.4	25.0	25.0
Pension Plan (% of firms)	Non-U.S.	5.2	8.3	11.7	18.3	19.9	20.9	23.6	25.2
	United States	11.9	18.1	19.8	20.3	20.8	21.3	23.8	23.9
Health Care Plan (% of firms)	Non-U.S.	0.4	0.9	1.4	2.1	2.2	1.9	2.4	2.6
	United States	8.4	12.2	13.5	14.0	14.5	14.6	16.2	15.9
PBO/Total Assets	Non-U.S.	0.10	0.09	0.08	0.07	0.07	0.06	0.06	0.05
	United States	0.17	0.16	0.15	0.16	0.15	0.14	0.14	0.15
Funding Level/Total Assets	Non-U.S.	-0.03	-0.04	-0.03	-0.03	-0.03	-0.02	-0.02	-0.02
	United States	-0.10	-0.09	-0.09	-0.09	-0.06	-0.04	-0.07	-0.07
Net Amounts on Balance Sheet/Total Assets	Non-U.S.	-0.03	-0.03	-0.03	-0.03	-0.02	-0.02	-0.02	-0.02
	United States	-0.08	-0.08	-0.07	-0.07	-0.06	-0.04	-0.07	-0.07
Discount Rate (%)	Non-U.S.	6.6	6.2	6.0	5.6	5.7	6.1	6.6	6.2
	United States	6.6	6.1	5.9	5.5	5.6	5.9	6.2	5.9
Expected Return on Plan Assets (%)	Non-U.S.	6.8	6.6	6.3	6.2	6.1	6.1	6.4	5.9
	United States	8.5	8.0	7.9	7.8	7.6	7.6	7.5	7.4
Equities (%)	Non-U.S.	44.8	42.3	46.6	47.6	45.2	43.7	34.6	36.6
	United States	57.2	61.6	61.9	61.4	60.9	58.9	51.6	52.5
Bonds (%)	Non-U.S.	44.6	37.6	37.6	37.4	39.4	37.1	39.2	38.3
	United States	32.3	29.8	30.0	30.6	30.4	31.5	36.9	36.4
Property (%)	Non-U.S.	4.7	4.2	3.3	3.3	3.9	3.9	4.9	4.1
	United States	1.7	1.3	1.4	1.4	1.6	1.9	2.2	1.7
Other (%)	Non-U.S.	6.0	15.9	12.5	11.7	11.5	15.4	21.4	21.0
	United States	8.8	7.2	6.8	6.6	7.1	7.7	9.4	9.3
Number of Firms	Non-U.S.	18,356	19,456	20,499	21,020	22,209	22,067	21,390	20,575
	United States	5,389	5,459	5,429	5,329	5,100	4,698	4,004	3,785

Table 2: Differences between Regular and Consolidated Leverage

The table shows the results of tests of differences between regular and consolidated leverage for firms with defined benefit post-retirement benefit plans. Panel A shows tests for selected measures of market value leverage, i.e. alternatively total debt, long-term debt plus preferred stock, or long-term debt, divided by Size Market Value (the sum of market capitalization, preferred stock and total debt). It also shows tests for selected measures of book value leverage, which are the same measures of debt as for market value leverage divided by Total Assets. While the top part of Panel A shows gross leverage measures, the bottom part of the panel shows leverage measures where cash and short-term investments (with missing values set to zero) are subtracted from both the numerator and denominator of gross leverage ratios. For consolidated leverage ratios, accrued post-retirement costs (including additional minimum liabilities where applicable) are subtracted from the respective measure of debt, and projected benefit obligations are added. Similarly, prepaid post-retirement costs (including intangible pension asset where applicable) are subtracted from the measure of firm size, and the fair value of plan assets is added. For each measure, the panel shows the number of observations, the mean, median and standard deviation of both consolidated and regular leverage, the difference in means and medians, as well as *p*-values of *t*-tests and Wilcoxon tests. Panel B shows tests of differences between consolidated leverage and regular leverage by country. For each country, the table shows the number of firm/year observations as well as the average difference between consolidated and regular leverage using alternatively total debt, long-term debt plus preferred stock, or long-term debt, divided by alternatively Size Market Value (i.e. the sum of market capitalization, preferred stock and total debt) or Total Assets. The panel also shows significance levels based on non-parametric Wilcoxon tests. * (**, ***) denotes significance at the 10% (5%, 1%) significance level.

Panel A: Alternative Measures of Leverage

		Consolidated Leverage			Regular Leverage			Difference		*p*-values	
	N	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Means	Medians	*t*-Test	Wilcoxon
Gross Leverage											
Total Debt/Total Assets	38,387	0.317	0.304	0.190	0.257	0.236	0.184	0.060	0.067	[0.00]	[0.00]
(Long-Term Debt + Preferred Stock)/Total Assets	35,481	0.245	0.210	0.181	0.180	0.144	0.166	0.065	0.066	[0.00]	[0.00]
Long-Term Debt/Total Assets	35,311	0.241	0.208	0.178	0.176	0.142	0.158	0.065	0.066	[0.00]	[0.00]
Total Debt/Size Market Value	37,024	0.367	0.333	0.245	0.302	0.255	0.234	0.065	0.078	[0.00]	[0.00]
(Long-Term Debt + Preferred Stock)/Size Market Value	34,266	0.270	0.228	0.206	0.197	0.154	0.178	0.073	0.073	[0.00]	[0.00]
Long-Term Debt/Size Market Value	34,101	0.267	0.225	0.203	0.193	0.152	0.173	0.073	0.073	[0.00]	[0.00]
Leverage Net of (Cash + Short-Term Investments)											
Total Debt/Total Assets	38,387	0.210	0.238	0.289	0.126	0.158	0.358	0.084	0.079	[0.00]	[0.00]
(Long-Term Debt + Preferred Stock)/Total Assets	35,481	0.137	0.134	0.266	0.050	0.058	0.311	0.087	0.076	[0.00]	[0.00]
Long-Term Debt/Total Assets	35,311	0.133	0.131	0.263	0.046	0.056	0.307	0.088	0.075	[0.00]	[0.00]
Total Debt/Size Market Value	36,830	0.251	0.253	0.350	0.145	0.165	0.457	0.106	0.087	[0.00]	[0.00]
(Long-Term Debt + Preferred Stock)/Size Market Value	34,123	0.146	0.142	0.313	0.029	0.059	0.424	0.116	0.083	[0.00]	[0.00]
Long-Term Debt/Size Market Value	33,958	0.142	0.139	0.310	0.025	0.057	0.421	0.116	0.082	[0.00]	[0.00]

(continued)

Table 2: Differences between Regular and Consolidated Leverage (continued)

Panel B: Results By Country

		Consolidated Leverage - Regular Leverage					
Country	N	Total Debt/ Size Market Value	(Long-Term Debt + Preferred Stock)/Size Market Value	Long-Term Debt/Size Market Value	Total Debt/ Total Assets	(Long-Term Debt + Preferred Stock)/ Total Assets	Long-Term Debt/Total Assets
Argentina	18	0.004	0.004	0.004	0.003	0.003	0.003
Australia	382	0.027 **	0.027 **	0.028 ***	0.032 ***	0.030 ***	0.030 ***
Austria	244	0.034 *	0.037 **	0.037 **	0.030 **	0.031 ***	0.031 ***
Belgium	231	0.047 **	0.049 ***	0.049 ***	0.043 ***	0.043 ***	0.042 ***
Brazil	225	0.048 **	0.060 ***	0.060 ***	0.053 ***	0.059 ***	0.059 ***
Canada	1,137	0.066 ***	0.072 ***	0.073 ***	0.068 ***	0.071 ***	0.071 ***
Denmark	158	0.019	0.021	0.021	0.021	0.024	0.024
Finland	255	0.044 **	0.052 ***	0.052 ***	0.048 ***	0.054 ***	0.054 ***
France	1,161	0.026 ***	0.031 ***	0.031 ***	0.023 ***	0.025 ***	0.025 ***
Germany	1,523	0.028 ***	0.032 ***	0.032 ***	0.025 ***	0.028 ***	0.028 ***
Greece	396	0.006	0.009	0.009	0.005	0.007	0.007
Hong Kong	295	0.031 *	0.039 ***	0.039 ***	0.028 **	0.032 ***	0.032 ***
India	1,822	0.011	0.014 **	0.013 **	0.009	0.009 **	0.011 **
Indonesia	536	0.008	0.009	0.009	0.002	0.005	0.006
Ireland	189	0.104 ***	0.105 ***	0.105 ***	0.102 ***	0.096 ***	0.098 ***
Israel	65	0.013	0.015	0.017	0.010	0.007	0.010
Italy	160	0.019	0.023	0.023	0.018	0.020	0.020
Japan	9,962	0.069 ***	0.080 ***	0.080 ***	0.052 ***	0.057 ***	0.057 ***
Luxembourg	24	0.000	0.001	0.001	0.004	0.005	0.005
Malaysia	512	0.005	0.007	0.007	0.004	0.005	0.005
Mexico	340	0.019	0.022	0.023	0.017	0.019	0.019
Netherlands	379	0.129 ***	0.132 ***	0.134 ***	0.132 ***	0.136 ***	0.137 ***
New Zealand	22	0.032	0.035	0.035	0.044	0.047	0.047
Norway	525	0.034 **	0.038 ***	0.039 ***	0.034 ***	0.037 ***	0.037 ***
Pakistan	251	0.017	0.015 *	0.015	0.024	0.023 **	0.021 **
Philippines	380	0.019	0.025 *	0.027 **	0.013	0.017 **	0.017 **
Portugal	66	0.019	0.022	0.022	0.020	0.023	0.023
Russian Federation	149	0.008	0.008	0.008	0.007	0.007	0.007
Singapore	69	0.002	0.016	0.016	0.006	0.011	0.011
South Africa	350	0.057 ***	0.074 ***	0.072 ***	0.061 ***	0.074 ***	0.075 ***
Spain	53	0.003	0.005	0.007	0.005	0.006	0.006
Sweden	466	0.053 ***	0.058 ***	0.057 ***	0.055 ***	0.057 ***	0.057 ***
Switzerland	791	0.142 ***	0.158 ***	0.158 ***	0.148 ***	0.159 ***	0.159 ***
Taiwan, Province Of China	3,952	0.011 **	0.013 ***	0.013 ***	0.010 ***	0.011 ***	0.011 ***
Turkey	40	0.006	0.006	0.006	0.005	0.005	0.005
United Kingdom	2,984	0.204 ***	0.214 ***	0.218 ***	0.195 ***	0.199 ***	0.202 ***
United States	7,586	0.081 ***	0.089 ***	0.089 ***	0.087 ***	0.089 ***	0.091 ***

Table 3: Regression Analysis of Post-Retirement Plans and Leverage

The table reports results from estimations of multivariate regression models with regular leverage (Panel A) and consolidated leverage (Panel B), respectively, as dependent variable. Regular leverage is measured by the ratio of total debt to consolidated total assets. Consolidated leverage is calculated by subtracting accrued post-retirement costs (including additional minimum liabilities where applicable) from total debt and adding projected benefit obligations, as well as by subtracting prepaid post-retirement costs (including intangible pension asset where applicable) from total assets and adding fair value of plan assets. For each equation, the table shows the estimated coefficients and associated *p*-values, the use of country, industry or year fixed effects, information on the clustering of standard errors (SE), as well as the adjusted R-squared and the number of observations. Industry fixed effects are based on the 48 Fama/French industries. The first column of the table shows results from estimating the model using OLS with country, industry and year fixed effects. The second column shows results from estimating the model using OLS where there standard errors are clustered by firm and year. The third column shows results from estimating the model using OLS where the standard errors are corrected using the Newey and West (1987) procedure. The fourth column shows the results from estimating a treatment effects model where the probability of a firm having a defined benefit plan is a function of the natural logarithm of the number of employees, the market-to-book ratio, the three-year average of the return on assets, and the natural logarithm of the volatility for the return on assets, as well as country, industry and year fixed effects. Results for consolidated leverage use predicted values from the probit regression for the probability of a firm having a defined benefit plan. The fifth column shows results from estimating the equations for leverage, capital expenditures and research and development jointly in a system of simultaneous equations using 3SLS. Definitions of all variables are provided in Supplemental Appendix B.

(continued)

Table 3: Regression Analysis of Post-Retirement Plans and Leverage (continued)

Panel A: Regular Leverage

	OLS with Fixed Effects		OLS with Clustered Standard Errors		OLS with Newey-West Standard Errors		Treatment Effects Model		Simultaneous Equations Model	
Variable	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value
PBO/Total Assets	-0.227	[0.00]	-0.278	[0.00]	-0.278	[0.00]	-0.211	[0.00]	-0.228	[0.00]
Market-to-Book	0.006	[0.00]	0.006	[0.00]	0.006	[0.00]	0.006	[0.00]	0.006	[0.00]
Volatility of ROA (log)	-0.011	[0.00]	-0.011	[0.00]	-0.012	[0.00]	-0.007	[0.00]	-0.010	[0.00]
Total Risk (log)	0.055	[0.00]	0.037	[0.00]	0.051	[0.00]	0.050	[0.00]	0.055	[0.00]
Tax Rate	0.018	[0.00]	0.013	[0.03]	0.014	[0.00]	0.041	[0.00]	0.017	[0.00]
Total Assets in USD (log)	0.013	[0.00]	0.011	[0.00]	0.012	[0.00]	0.015	[0.00]	0.013	[0.00]
Dividend	-0.033	[0.00]	-0.024	[0.00]	-0.021	[0.00]	-0.040	[0.00]	-0.033	[0.00]
Tangible Assets/Total Assets	-0.126	[0.00]	-0.077	[0.00]	-0.082	[0.00]	-0.184	[0.00]	-0.126	[0.00]
Net FX-Exposure	-0.035	[0.00]	-0.047	[0.00]	-0.047	[0.00]	-0.037	[0.00]	-0.035	[0.00]
Debt Maturity	0.106	[0.00]	0.090	[0.00]	0.089	[0.00]	0.101	[0.00]	0.106	[0.00]
Gross Profit Margin (3-year average)	-0.057	[0.00]	-0.063	[0.00]	-0.060	[0.00]	-0.067	[0.00]	-0.058	[0.00]
Preferred Stock/Size Market Value	-0.206	[0.00]	-0.250	[0.00]	-0.256	[0.00]	-0.150	[0.04]	-0.205	[0.00]
Negative Book Equity	0.431	[0.00]	0.433	[0.00]	0.430	[0.00]	0.290	[0.00]	0.430	[0.00]
Industry Median Leverage	0.527	[0.00]	0.546	[0.00]	0.550	[0.00]	0.451	[0.00]	0.521	[0.00]
Intercept	-0.013	[0.20]	0.004	[0.83]	-0.011	[0.20]	-0.005	[0.80]	-0.012	[0.21]
Country fixed effects	yes		no		no		yes		yes	
Industry fixed effects	yes		no		no		yes		yes	
Year fixed effects	yes		no		yes		yes		yes	
SE Cluster	none		Firm, Year		none		none		none	
Adjusted R^2	0.32		0.29		0.29				0.32	
Observations	32,854		32,854		32,854		32,854		32,854	

(continued)

Table 3: Regression Analysis of Post-Retirement Plans and Leverage (continued)

Panel B: Consolidated Leverage

	OLS with Fixed Effects		OLS with Clustered Standard Errors		OLS with Newey-West Standard Errors		Treatment Effects Model		Simultaneous Equations Model	
Variable	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value
Post-Retirement Benefit Plan	0.062	[0.00]	0.054	[0.00]	0.057	[0.00]	0.033	[0.00]	0.062	[0.00]
Market-to-Book	0.007	[0.00]	0.007	[0.00]	0.007	[0.00]	0.007	[0.00]	0.007	[0.00]
Volatility of ROA (log)	-0.008	[0.00]	-0.007	[0.00]	-0.008	[0.00]	-0.008	[0.00]	-0.008	[0.00]
Total Risk (log)	0.048	[0.00]	0.024	[0.00]	0.039	[0.00]	0.043	[0.00]	0.048	[0.00]
Tax Rate	0.021	[0.00]	0.015	[0.05]	0.014	[0.00]	0.021	[0.00]	0.020	[0.00]
Total Assets in USD (log)	0.016	[0.00]	0.012	[0.00]	0.013	[0.00]	0.018	[0.00]	0.016	[0.00]
Dividend	-0.028	[0.00]	-0.021	[0.00]	-0.017	[0.00]	-0.021	[0.00]	-0.028	[0.00]
Tangible Assets/Total Assets	-0.100	[0.00]	-0.098	[0.00]	-0.105	[0.00]	-0.098	[0.00]	-0.100	[0.00]
Net FX-Exposure	-0.033	[0.00]	-0.026	[0.00]	-0.027	[0.00]	-0.031	[0.00]	-0.033	[0.00]
Debt Maturity	0.105	[0.00]	0.099	[0.00]	0.097	[0.00]	0.107	[0.00]	0.106	[0.00]
Gross Profit Margin (3-year average)	-0.078	[0.00]	-0.074	[0.00]	-0.071	[0.00]	-0.087	[0.00]	-0.079	[0.00]
Preferred Stock/Size Market Value	-0.237	[0.00]	-0.220	[0.02]	-0.234	[0.00]	-0.235	[0.00]	-0.236	[0.00]
Negative Book Equity	0.472	[0.00]	0.484	[0.00]	0.481	[0.00]	0.481	[0.00]	0.471	[0.00]
Industry Median Leverage	0.507	[0.00]	0.563	[0.00]	0.564	[0.00]	0.509	[0.00]	0.502	[0.00]
Intercept	-0.057	[0.00]	0.011	[0.55]	-0.007	[0.44]	-0.079	[0.00]	-0.056	[0.00]
Country fixed effects	yes		no		no		yes		yes	
Industry fixed effects	yes		no		no		yes		yes	
Year fixed effects	yes		no		yes		yes		yes	
SE Cluster	none		Firm, Year		none		none		none	
Adjusted R^2	0.34		0.30		0.31				0.34	
Observations	32,854		32,854		32,854		32,854		32,854	

Table 4: Regression Analysis of Post-Retirement Plans and Real Investment

The table reports results from estimations of multivariate regression models with real investment measured by the ratio of capital expenditures to total assets (Panel A) and research and development expenses to total assets (Panel B), respectively, as dependent variable. For each equation, the table shows the estimated coefficients and associated *p*-values, the use of country, industry or year fixed effects, information on the clustering of standard errors (SE), as well as the adjusted R-squared and the number of observations. Industry fixed effects are based on the 48 Fama/French industries. The first column of the table shows results from estimating the model using OLS with country, industry and year fixed effects. The second column shows results from estimating the model using OLS where there standard errors are clustered by firm and year. The third column shows results from estimating the model using OLS where the standard errors are corrected using the Newey and West (1987) procedure. The fourth column shows the results from estimating a treatment effects model where the probability of a firm having a defined benefit plan is a function of the natural logarithm of the number of employees, the market-to-book ratio, the three-year average of the return on assets, and the natural logarithm of the volatility for the return on assets, as well as country, industry and year fixed effects. The fifth column shows results from estimating the equations for leverage, capital expenditures and research and development jointly in a system of simultaneous equations using 3SLS. Definitions of all variables are provided in Supplemental Appendix B.

(continued)

Table 4: Regression Analysis of Post-Retirement Plans and Real Investment (continued)

Panel A: Capital Expenditures

	OLS with Fixed Effects		OLS with Clustered Standard Errors		OLS with Newey-West Standard Errors		Treatment Effects Model		Simultaneous Equations Model	
Variable	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value
PBO/Total Assets	-0.016	[0.00]	-0.018	[0.00]	-0.019	[0.00]	-0.017	[0.00]	-0.019	[0.00]
Leverage	-0.005	[0.00]	-0.018	[0.00]	-0.018	[0.00]	-0.007	[0.00]	-0.020	[0.00]
Market-to-Book	0.001	[0.00]	0.002	[0.00]	0.002	[0.00]	0.001	[0.00]	0.001	[0.00]
Age (log)	-0.009	[0.00]	-0.010	[0.00]	-0.010	[0.00]	-0.004	[0.00]	-0.009	[0.00]
Total Risk (log)	0.004	[0.00]	0.008	[0.01]	0.008	[0.00]	0.004	[0.00]	0.005	[0.00]
Total Assets in USD (log)	0.000	[0.64]	0.001	[0.04]	0.000	[0.00]	0.001	[0.01]	0.000	[0.42]
Dividend	0.001	[0.38]	0.000	[0.78]	-0.001	[0.41]	0.005	[0.00]	0.000	[0.83]
Tangible Assets/Total Assets	0.011	[0.00]	0.006	[0.01]	0.006	[0.00]	0.015	[0.00]	0.010	[0.00]
Net FX-Exposure	-0.005	[0.00]	0.000	[0.89]	0.001	[0.65]	-0.008	[0.00]	-0.006	[0.00]
Debt Maturity	0.003	[0.00]	0.008	[0.00]	0.008	[0.00]	0.004	[0.00]	0.004	[0.00]
Gross Profit Margin (3-year average)	0.014	[0.00]	0.008	[0.00]	0.009	[0.00]	0.019	[0.00]	0.013	[0.00]
Preferred Stock/Size Market Value	-0.042	[0.00]	-0.026	[0.06]	-0.025	[0.07]	-0.039	[0.04]	-0.035	[0.01]
Net PPE/Total Assets	0.150	[0.00]	0.147	[0.00]	0.148	[0.00]	0.136	[0.00]	0.151	[0.00]
Convertible Debt/Size Market Value	-0.004	[0.51]	0.002	[0.86]	0.002	[0.79]	0.014	[0.10]	-0.002	[0.81]
(Cash + Short-Term Investments)/Total Assets (log)	0.002	[0.00]	0.001	[0.08]	0.001	[0.00]	0.001	[0.00]	0.001	[0.00]
Intercept	0.025	[0.00]	0.028	[0.00]	0.022	[0.00]	-0.003	[0.65]	0.025	[0.00]
Country fixed effects	yes		no		no		yes		yes	
Industry fixed effects	yes		no		no		yes		yes	
Year fixed effects	yes		no		yes		yes		yes	
SE Cluster	none		Firm, Year		none		none		none	
Adjusted R^2	0.38		0.33		0.34				0.38	
Observations	32,854		32,854		32,854		32,854		32,854	

(continued)

Table 4: Regression Analysis of Post-Retirement Plans and Real Investment (continued)

Panel B: Results for Research and Development

	OLS with Fixed Effects		OLS with Clustered Standard Errors		OLS with Newey-West Standard Errors		Treatment Effects Model		Simultaneous Equations Model	
Variable	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value
PBO/Total Assets	0.015	[0.00]	0.026	[0.00]	0.026	[0.00]	0.021	[0.00]	0.017	[0.00]
Leverage	-0.010	[0.00]	-0.015	[0.00]	-0.015	[0.00]	-0.013	[0.00]	-0.001	[0.66]
Market-to-Book	0.000	[0.00]	0.000	[0.00]	0.000	[0.00]	0.000	[0.00]	0.000	[0.00]
Age (log)	0.002	[0.00]	0.003	[0.00]	0.003	[0.00]	0.001	[0.09]	0.002	[0.00]
Total Risk (log)	0.004	[0.00]	0.003	[0.02]	0.004	[0.00]	0.002	[0.00]	0.003	[0.00]
Total Assets in USD (log)	0.000	[0.88]	0.000	[0.30]	0.000	[0.00]	0.001	[0.00]	0.000	[0.30]
Dividend	-0.004	[0.00]	-0.006	[0.00]	-0.006	[0.00]	0.000	[0.55]	-0.004	[0.00]
Tangible Assets/Total Assets	0.013	[0.00]	0.016	[0.00]	0.015	[0.00]	0.013	[0.00]	0.014	[0.00]
Net FX-Exposure	0.017	[0.00]	0.023	[0.00]	0.023	[0.00]	0.011	[0.00]	0.017	[0.00]
Debt Maturity	-0.001	[0.31]	-0.001	[0.51]	-0.001	[0.37]	-0.002	[0.00]	-0.002	[0.00]
Gross Profit Margin (3-year average)	0.048	[0.00]	0.051	[0.00]	0.051	[0.00]	0.053	[0.00]	0.048	[0.00]
Preferred Stock/Size Market Value	0.056	[0.00]	0.046	[0.08]	0.045	[0.02]	-0.007	[0.56]	0.052	[0.00]
Net PPE/Total Assets	-0.010	[0.00]	-0.024	[0.00]	-0.024	[0.00]	-0.013	[0.00]	-0.010	[0.00]
Convertible Debt/Size Market Value	0.021	[0.00]	0.050	[0.00]	0.049	[0.00]	0.012	[0.03]	0.019	[0.00]
(Cash + Short-Term Investments)/Total Assets (log)	0.002	[0.00]	0.002	[0.00]	0.002	[0.00]	0.000	[0.01]	0.002	[0.00]
Intercept	0.003	[0.26]	-0.007	[0.10]	-0.008	[0.00]	-0.021	[0.00]	0.002	[0.27]
Country fixed effects	yes		no		no		yes		yes	
Industry fixed effects	yes		no		no		yes		yes	
Year fixed effects	yes		no		yes		yes		yes	
SE Cluster	none		Firm, Year		none		none		none	
Adjusted R^2	0.35		0.21		0.21				0.34	
Observations	32,854		32,854		32,854		32,854		32,854	

Table 5: Regression Analysis by Country

The table reports results from estimations of multivariate regression models with leverage and real investment, respectively, as dependent variable. Regular leverage is measured by the ratio of total debt to consolidated total assets. Consolidated leverage is calculated by subtracting accrued post-retirement costs (including additional minimum liabilities where applicable) from total debt and adding projected benefit obligations, as well as by subtracting prepaid post-retirement costs (including intangible pension asset where applicable) from total assets and adding fair value of plan assets. Real investment is measured by the ratio of capital expenditures to total assets and research and development expenses to total assets, respectively. The regression setup is the same as in column one of Tables 3 and 4 using OLS with fixed effects, but the table shows for each equation only the estimated coefficients and associated *p*-values of projected benefit obligations for regular leverage, capital expenditures and research and development and of post-retirement plans for consolidated leverage, and the last column shows the number of observations. The model is estimated by country and separately for developed and developing countries (defined based on the MSCI classification as of June 2006). For the leverage equation, the regression coefficient on the size of the post-retirement obligations is tested again zero (H_0=0) and minus one (H_0=-1). Countries are sorted by the size of the coefficient in the Consolidated Leverage column. All models include year and industry fixed effects (based on the 48 Fama/French industries). Models for firms in developed and developing countries also include country fixed effects. Definitions of all variables are provided in Supplemental Appendix B.

	Regular Leverage			Consolidated Leverage		Capital Expenditures		R&D Expense		Observations
	Coef	H_0=0 *p*-value	H_0=-1 *p*-value	Coef	*p*-value	Coef	*p*-value	Coef	*p*-value	
United Kingdom	-0.195	[0.00]	[0.00]	0.208	[0.00]	-0.011	[0.02]	0.023	[0.00]	2,880
Switzerland	-0.171	[0.00]	[0.00]	0.137	[0.00]	-0.001	[0.87]	-0.030	[0.04]	425
Netherlands	-0.274	[0.00]	[0.00]	0.125	[0.00]	-0.025	[0.10]	0.023	[0.06]	265
Sweden	-0.305	[0.00]	[0.00]	0.105	[0.00]	0.000	[0.99]	-0.023	[0.33]	426
South Africa	-0.079	[0.17]	[0.00]	0.081	[0.00]	-0.036	[0.10]	0.019	[0.00]	377
United States	-0.226	[0.00]	[0.00]	0.067	[0.00]	-0.010	[0.01]	-0.001	[0.69]	9,217
Denmark	0.243	[0.39]	[0.00]	0.064	[0.00]	-0.102	[0.33]	0.212	[0.01]	190
Australia	-0.270	[0.00]	[0.00]	0.042	[0.00]	-0.109	[0.01]	0.018	[0.49]	863
Japan	-0.144	[0.00]	[0.00]	0.034	[0.00]	-0.001	[0.93]	0.038	[0.00]	5,387
Canada	-0.283	[0.00]	[0.00]	0.032	[0.00]	-0.063	[0.06]	0.022	[0.12]	754
Finland	-0.612	[0.00]	[0.06]	0.018	[0.50]	-0.206	[0.01]	-0.067	[0.30]	218
Indonesia	-0.672	[0.00]	[0.14]	-0.006	[0.79]	0.020	[0.79]	0.003	[0.56]	514
Malaysia	-0.016	[0.95]	[0.00]	-0.015	[0.31]	0.002	[0.98]	0.052	[0.00]	1,089
Hong Kong	-0.747	[0.00]	[0.16]	-0.016	[0.19]	-0.083	[0.19]	0.010	[0.48]	1,433
Germany	-0.398	[0.00]	[0.00]	-0.016	[0.17]	-0.029	[0.03]	0.039	[0.00]	906
Austria	-0.647	[0.04]	[0.25]	-0.020	[0.65]	0.039	[0.73]	0.037	[0.36]	120
France	-0.533	[0.00]	[0.00]	-0.020	[0.10]	-0.003	[0.90]	-0.009	[0.77]	645
India	-0.671	[0.00]	[0.03]	-0.036	[0.00]	0.004	[0.94]	0.004	[0.80]	1,220
Taiwan, Province Of China	-1.094	[0.00]	[0.54]	-0.039	[0.10]	-0.136	[0.02]	0.146	[0.00]	1,510
Norway	-0.793	[0.00]	[0.44]	-0.076	[0.02]	-0.104	[0.39]	0.055	[0.03]	153
Developed countries	-0.163	[0.00]	[0.00]	0.079	[0.00]	-0.020	[0.00]	0.011	[0.00]	25,501
Developing countries	-0.310	[0.00]	[0.00]	0.002	[0.77]	-0.017	[0.36]	0.021	[0.00]	7,353

Table 6: Substitution Rates by Country Characteristics

The table reports results from estimations of multivariate regression models with regular leverage as dependent variable. Models are estimated separately for firms in countries with characteristics above (high) or below (low) the country median for various criteria. Regular leverage is measured by the ratio of total debt to consolidated total assets. The regression setup is the same as in column one of Table 3 using OLS with fixed effects, but the table shows only the estimated coefficients and associated *p*-values of projected benefit obligations, i.e. the substitution effect. All models include year, country and industry fixed effects (based on the 48 Fama/French industries). Definitions of all variables are provided in Supplemental Appendix B.

	Country Characteristic	
	High	Low
Labor Market		
EmploymentProtection1	-0.391	-0.218
EmploymentProtection2	-0.392	-0.217
EmploymentProtection3	-0.486	-0.218
Collective Relations Laws	-0.201	-0.238
Labor Union Power	-0.211	-0.237
Union Density	-0.227	-0.206
Employment Laws	-0.368	-0.214
Labor Market Freedom	-0.218	-0.307
Social Security Laws	-0.236	-0.207
Civil Rights	-0.205	-0.238
Creditor Rights and Debt Markets		
Creditor Rights	-0.237	-0.212
Rule of Law	-0.216	-0.300
Private Bond Market Capitalization/GDP	-0.202	-0.249
Private Credit by Deposit Money Banks/GDP	-0.218	-0.244
Private Credit/GDP	-0.213	-0.341
Pension System		
Pension Fund Assets/GDP	-0.220	-0.311
Gross Replacement Rate	-0.228	-0.226
Net Replacement Rate	-0.271	-0.221
Guarantee	-0.211	-0.344
Pension Index	-0.230	-0.241

Appendix

Comparison of Firms With and Without DB Plan

It is interesting to consider how firms with post-retirement benefit plans compare to firms without such plans in general and with regards to leverage in particular. Given that the economic effect of considering off-balance sheet defined benefit plans is higher effective leverage on average, firms with such plans might take out less regular debt. Interestingly, the results in Table A1 suggest that, *prima facie*, this does not seem to be the case: Even before considering the effect of consolidating off-balance sheet assets and liabilities of post-retirement benefit plans, firms with DB plans actually have significantly higher regular leverage by all measures. Moreover, given higher regular leverage as well as additional leverage via post-retirement plans, one would expect that plan sponsors are able to lower their taxes via interest payments and plan contributions. Nevertheless, they actually have higher average tax rates, a finding similar to Shivdasani and Stefanescu (2010) for the United States.

In this context it is important to consider that the two groups of firms are significantly different along many important dimensions, as the statistics on the bottom of the table document. In particular, plan sponsors have higher and more stable returns on assets, have less risk (total risk, market risk and idiosyncratic risk), are larger, have fewer growth options (smaller market/book ratio), undertake more real investment (in terms of R&D and capital expenditures), have more property, plant and equipment (PPE), are more likely to pay dividends, have higher Z-Scores, and are older. Thus, firms with DB plans share characteristics that allow them to bear more debt (such as larger size, higher Z-Score and profitability, see Graham, 2000) and thus do not necessarily have lower tax rates. These differences in firm characteristics call for a multivariate analysis of leverage ratios that controls for other firm characteristics.

Given the complexities of national tax systems, it is challenging to derive good measures of marginal tax rates for the sample of international firms. Nevertheless, a rough idea of the tax benefits plan that sponsors derive from post-retirement benefit plans can be obtained using average tax rates (Panel A), which are available on WorldScope for many firms. Alternatively, results in Panel B of the table are based on the effective marginal corporate tax rates from Bilicka, Devereux, and Fuest (2011). Table A2 shows results by year as well as for the entire sample period for the interest expense ratio as well as for estimates of the present value of the total tax benefits from contributions to post-retirement plans and

interest expenses on debt.[33] The interest expense ratio is the ratio of consolidated interest rate payments (defined as the sum of contributions to DB plans plus interest expense on debt) to interest expense on debt. Since some firms have DB plan contributions but only small interest rate payments, the interest expense ratio is highly skewed and thus the table focuses on median values for this variable. Present value calculations of tax benefits assume perpetual tax shields discounted alternatively at 5% or at the estimated average interest rate on debt (from WorldScope), scaled alternatively by total assets or market capitalization. The median interest expense ratio is 1.27 for all post-retirement benefit plans, and the by-year results show that it is typically between 1.11 and 1.49. Thus, contributions are economically significant compared to other, standard sources of financial leverage. In terms of present values, the average total, combined tax benefit is 11% (18%) relative to total assets, and 27% (46%) relative to market capitalization, using 5% (the estimated average interest rate on debt) as discount rate. The present values together with the interest expense ratio give an idea of the relative importance of contributions to post-retirement plans for the overall tax benefit: With a median interest expense ratio of 1.27 and an average present value of 18% of total assets, 14.2% would be attributable to interest expense on debt, and 3.8% to plan contributions. The last two rows in the table show that the median interest expense ratio is 1.13 for the United States but 1.33 for other countries. The present values of the tax benefits are typically slightly larger for non-U.S. firms as well.

The last two panels of Panel A show that both pension and health care plans provide companies with tax benefits. For pension benefits, non-U.S. firms have larger interest expense ratios (1.32) compared to U.S. firms (1.10) (which is similar to the ratio of 1.09 for pensions of U.S. firms in Shivdasani and Stefanescu, 2010), but the associated present values tend to be comparable. In contrast, very few firm have defined benefit health care plans (see Table 1), and while medical plans are much more common in the United States, the associated interest expense ratios are actually similar to those in other countries, and lower than those of pensions for firms outside the United States. Consequently, the tax benefits of health care plans are generally modest, and there are only few companies that obtain these benefits.[34] The results based on effective marginal tax rates in Panel B tend to be slightly smaller on average, but the relative magnitudes are broadly similar to those in Panel A.

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[33] Tax credits are available in most countries, with the exception of tax regimes where the tax benefit is realized in advance of funding or payment (Standard and Poor's, 2011). Panel B of Supplemental Appendix A summarizes the tax treatment of employer contributions in different countries.

[34] Note that these calculations are very approximate since they rely on a number of simplifying assumptions about marginal tax rates, the timing and size of plan contributions, the appropriate discount rate, etc. Moreover, the tax benefits of

Univariate Results and Correlations

Table A3 presents firm characteristics based on sorting observations into 5 groups from low to high, as well as tests between the extreme portfolios (high and low). Panel A shows results where quintiles are formed based on the size of the post-retirement benefit plan as measured by projected benefit obligations (scaled by consolidated total assets). The panel shows that with larger benefit plans, the fair value of the plan assets also increases, but to a lesser degree, resulting in larger plans also showing larger deficits (consistent with the evidence in Table 1). Moreover, there is an increase in the interest expense ratio across quintiles, and the total tax benefits from both plan contributions and interest expenses on debt increase also. As post-retirement liabilities increase, regular leverage tends to decrease, while consolidated leverage tends to increase. This suggests an imperfect substitution effect between financial debt and post-retirement obligations, where firms with large projected benefit obligations reduce regular leverage, but less than by what it increases through post-retirement plans. The panel also shows evidence of the hypothesized opposite effect of post-retirement benefit plans on different types of real investment: Capital expenditures decrease with larger defined benefit plans, while research and development expenses increase.

Results in Panel B of Table A3 are based on sorting observations by consolidated leverage. As consolidated leverage increases, both regular leverage and post-retirement obligations increase, despite the earlier negative relation between PBO and regular leverage. Across quintiles, the interest expense ratio drops suggesting that high levels of consolidated leverage require substantial financial debt as well, while, as one would expect, the total tax shield benefits increase. Capital expenditures (research and development expenses) increase (decrease) with higher leverage. Finally, results in Panel C are based on using regular leverage as the sorting characteristic. Since regular leverage contributes to consolidated leverage, the latter increases across quintiles, while PBO tends to decrease. As before, capital expenditures increase with leverage, while research and development expenses decrease.

Before investigating the relations between post-retirement benefit plans, leverage and real investment in a regression framework, it is useful to take a look at the correlations between variables to be used in the analysis. These are shown in Table A4. In line with the results from portfolio sorts, CapEx and R&D show correlations with PBO of opposite sign and similar magnitude (-0.091 and 0.092, respec-

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health care plans are likely overstated since the tax benefits often arise when the benefits are paid as opposed to when contributions are made, which reduces their present value (though there are some tax effective means of prefunding retiree medical plans). Consequently, these results are to be taken with a grain of salt.

tively), and the relation between regular leverage and PBO is negative, but small (-0.011), while the relation between consolidated leverage and PBO is positive (0.386). Comparing the correlations of CapEx and R&D with other variables, it is clear that these two dimensions of real investment capture different effects, as the sign of the relations with several variables are of opposite sign, such as ROA, Age, Z-Score, Net PPE, Dividends, Tangible Assets, Net FX-Exposure, Preferred Stock, Convertible Debt, Negative Book Equity, and Cash and Short-Term Investments.[35] While regular and consolidated leverage are highly correlated (0.907) and often show similar associations with other variables, there are cases, such as the correlation with Age or PBO, where the size and the sign differ.

Robustness Tests

A number of additional tests are undertaken to verify the robustness of the results. Rajan and Zingales (1995) note that for capital structure tests in an international context, attention has to be paid to requirements to report consolidated accounting data. Companies without consolidated accounts could hide debt in a subsidiary that is not being consolidated and would thus appear to have lower leverage than otherwise similar companies with fully consolidated accounts. While the availability of information on the degree of consolidation is limited, a robustness test is conducted that restricts the sample to firm-year observations where subsidiaries of any type, significant or not, domestic and foreign, are consolidated. The results are reported in Supplemental Appendix D and are very similar to the earlier results (in Tables 3 and 4), both in terms of the size of the coefficients as well as their significance levels. In further robustness tests, I also perform a separate estimation of the models for firms reporting under U.S. GAAP, IAS/IFRS[36] (Supplemental Appendix E). Alternatively, I estimate the models on the full sample when including additional fixed effects for the respective accounting standards used to prepare an annual report. The results are comparable, and the main findings of the paper maintain economic and statistical significance of similar magnitude.

The large set of exogenous variables in the regression models ensures that the results are as robust as possible to omitted variable biases, but it comes at the expense of a reduction in the number of observations with non-missing values of all variables. To this end, Supplemental Appendix F shows re-

[35] Since the equity to debt ratio is one component of the *Z-Score*, the correlations between *Z-Score* and *Leverage* are high (-0.53), so that I do not include *Z-Score* in the *Leverage* equation. Similarly, *NetPPE* and *CapEx* are highly correlated (0.55), as are *PBO* and *PostRetirementBenefitPlan* (0.55), so that I do not include these variables at the same time either.

[36] Barth, Landsman, and Lang (2008) show that across firms from 21 countries firms reporting under IAS show higher accounting quality than those that do not. IFRS firms have greater accounting system and value relevance comparability with US firms when they apply IFRS as opposed to domestic standards, especially if IFRS adoption is mandatory and in more recent years (Barth, Landsman, Lang, and Williams, 2012).

sults for an alternative specification where the variables that have the biggest effect on sample size are excluded, namely the tax rate, convertible debt, net FX exposure, and the number of employees. This increases the number of observations from 32,854 to 128,492. Remarkably, the results are very robust, with only small variation in the size of coefficients.

However, even in the presence of large sets of control variables, capital structure regressions can be mis-specified if they ignore unidentified time-invariant or transitory components of leverage, causing omitted variable biases and/or inefficient parameter estimates. Lemmon et al. (2008) show that these determinants of leverage, particularly unobserved firm-specific components, can be important, and suggest regressions, for example, with firm fixed effects and serially correlated errors as robustness tests to provide greater confidence in the identification of marginal effects of capital structure determinants, even though this approach cannot identify what is responsible for the majority of the variation in leverage ratios since it removes the cross-sectional variation and autocorrelation in leverage. To this end, I estimate the leverage equation including firm and year fixed effects as well as a lagged dependent variable (i.e. lagged leverage) as exogenous variables. Similar to results in Lemmon et al. (2008), the fixed effects tend to reduce the magnitude of most determinants of leverage, even though most regression coefficients remain highly significant. However, in line with the results of defined benefit pension obligations for a sample of U.S. firms in Shivdasani and Stefanescu (2010), the coefficient on post-retirement obligations drops only slightly to -0.132 (and remains highly significant), which is in contrast to Lemmon et al. (2008) who find that the coefficients of traditional determinants of leverage decline on average by approximately 60-80%. In the same vein, I also estimate the investment equations including firm and year fixed effects and lagged investment and find that the coefficients on post-retirement obligations remain significant with somewhat smaller estimates of -0.013 and 0.009 in the capital expenditures and research and development equations, respectively.

Another potential concern is the use of the firm-level average tax rate as a proxy for the corporate marginal tax rate. While it seems difficult to determine the marginal tax rate for each firm in the sample, I conduct robustness tests using the effective marginal tax rates from Bilicka, Devereux, and Fuest (2011). The results show that this variation has no effect on the conclusions of the paper, as the sign, size and significance levels of the variables of interest are not affected by this substitution.

Finally, I also split the sample by the size of the post-retirement obligations or alternatively the funding level (both scaled by total assets) and estimate the models separately for large plan sponsors (above the median) and small plan sponsors (below median). The results show that the size of the pen-

sion plan is negatively related to capital expenditures and positively related to research and development for both firms with large and small plans. In the same vein, I investigate the conjecture that R&D intensive firms may sponsor very small benefit plans (e.g. for key employees), whereas capital expenditure intensive firms are sponsoring much larger plans. While information on the number of participants in the post-retirement plans is not available, I use PBO scaled alternatively by total assets and the number of employees as a measure of the size of the benefit plan. While the patterns across quintiles are not always entirely monotonic, it appears that firms with the most R&D have larger PBO (scaled by either measure) compared to firms with the least R&D. In contrast, firms with the most CapEx have less PBO than firms with the least capital expenditure. Overall, there is little evidence that firms with high research and development (capital expenditures) sponsor small (large) plans.

Table A1: Characteristics of Firms with and without Post-Retirement Benefit Plan

The table shows various characteristics of firms with and without post-retirement benefit plan. For each characteristic, the table shows the number of observations (N), the mean, median and standard deviation for firms with post-retirement benefit plan and those without. In addition, it reports the difference in means and medians, as well as *p*-values of *t*-tests and non-parametric Wilcoxon tests. The table shows statistics for several measures of leverage, i.e. total debt divided by alternatively Size Market Value (market capitalization plus preferred stock plus total debt) or Total Assets. In addition to regular leverage, consolidated leverage ratios are calculated for all firms with post-retirement benefits by subtracting accrued post-retirement costs (including additional minimum liabilities where applicable) from total debt and adding projected benefit obligations, as well as by subtracting prepaid post-retirement costs (including intangible pension asset where applicable) from size and adding fair value of plan assets. The table also shows results for the average corporate income tax rate, the average return on assets over three years (ROA), the natural logarithm of the volatility of the return on assets (calculated as the standard deviation of the return on assets over the prior five years), the natural logarithm of total assets in U.S. Dollars, the natural logarithm of annualized idiosyncratic risk (calculated as the standard deviation of residuals from regressions with local market, world market, world and regional SMB and HML), the natural logarithm of annualized market risk (calculated as the square root of the difference between total risk squared and idiosyncratic risk squared), the natural logarithm of total risk (calculated as the standard deviation of weekly returns in U.S. Dollars), the ratio of market value of equity to book value of equity, the ratio of research and development expenses (with missing values set to zero) to total assets, the ratio of capital expenditures (with missing values set to zero) to total assets, net property, plant and equipment (PPE) to total assets, a dummy variable with value of one if book equity is negative (and zero otherwise), a dummy variable with value one if the firms pays a dividend (and zero otherwise), the Altman (2000) Z-Score, and the natural logarithm of firm age.

	Firms with Post-Retirement Benefit Plan				Firms without Post-Retirement Benefit Plan				Difference		*p*-value	
	N	Mean	Median	Std. Dev.	N	Mean	Median	Std. Dev.	Means	Medians	*t*-Test	Wilcoxon
Gross Leverage												
Total Debt/Size Market Value	39,230	0.28	0.23	0.24	147,410	0.24	0.15	0.26	0.04	0.08	[0.00]	[0.00]
Total Debt/Size Market Value (consolidated)	36,514	0.37	0.33	0.25								
Total Debt/Total Assets	40,603	0.24	0.22	0.19	163,093	0.22	0.17	0.23	0.02	0.05	[0.00]	[0.00]
Total Debt/Total Assets (consolidated)	37,780	0.32	0.30	0.19								
Leverage Net of (Cash + Short-Term Investments)												
Total Debt/Size Market Value	38,946	0.10	0.14	0.51	144,614	-0.01	0.05	0.66	0.11	0.09	[0.00]	[0.00]
Total Debt/Size Market Value (consolidated)	36,412	0.25	0.25	0.35								
Total Debt/Total Assets	40,602	0.08	0.14	0.47	162,791	-0.25	0.05	1.40	0.33	0.08	[0.00]	[0.00]
Total Debt/Total Assets (consolidated)	37,780	0.21	0.24	0.29								
Tax Rate	31,535	0.34	0.33	0.18	98,099	0.29	0.28	0.20	0.05	0.05	[0.00]	[0.00]
ROA (3-year average)	40,118	0.05	0.05	0.10	153,571	-0.04	0.03	0.26	0.09	0.01	[0.00]	[0.00]
Volatility of ROA (log)	39,471	-3.61	-3.61	1.02	161,163	-3.04	-3.04	1.28	-0.57	-0.57	[0.00]	[0.00]
Idiosyncratic Risk (log)	37,901	-1.26	-1.28	0.47	159,625	-0.76	-0.81	0.65	-0.49	-0.47	[0.00]	[0.00]
Market Risk (log)	37,901	-1.47	-1.49	0.53	159,625	-1.28	-1.29	0.62	-0.19	-0.20	[0.00]	[0.00]
Total Risk (log)	37,901	-0.97	-0.99	0.46	159,625	-0.58	-0.62	0.62	-0.39	-0.38	[0.00]	[0.00]
Total Assets in USD (log)	40,602	13.4	13.4	1.76	163,291	11.1	11.2	1.92	2.31	2.18	[0.00]	[0.00]
Market-to-Book	39,236	2.05	1.47	3.18	147,609	2.34	1.41	4.90	-0.29	0.06	[0.00]	[0.00]
R&D Expense/Total Assets	40,617	0.02	0.00	0.03	285,093	0.01	0.00	0.05	0.00	0.00	[0.00]	[0.00]
Capital Expenditures/Total Assets	40,617	0.05	0.04	0.05	285,093	0.03	0.00	0.06	0.02	0.03	[0.00]	[0.00]
Net PPE/Total Assets	40,596	0.32	0.29	0.20	162,374	0.30	0.25	0.24	0.02	0.04	[0.00]	[0.00]
Negative Book Equity	40,617	0.03	0.00	0.17	285,093	0.04	0.00	0.19	-0.01	0.00	[0.00]	[0.00]
Dividend (dummy)	40,617	0.77	1.00	0.42	285,093	0.26	0.00	0.44	0.50	1.00	[0.00]	[0.00]
Z-Score	37,397	2.49	2.49	2.45	138,197	1.04	1.80	4.43	1.45	0.69	[0.00]	[0.00]
Firm Age (log)	40,616	2.84	3.00	0.70	284,966	2.40	2.57	0.76	0.44	0.43	[0.00]	[0.00]

Table A2: Tax Benefits and Post-Retirement Benefit Plans

The table shows the tax benefits of interest expense on debt and contributions to post-retirement benefit plans, based on firm-level average tax rates Panel A) and country-level effective marginal tax rates (from Bilicka, Devereux, and Fuest, 2011), respectively. In particular, the table shows separately for post-retirement benefit plans, pension plans, and health care benefit plans the number of observations (N), the interest expense ratio (ratio of consolidated interest expense to regular interest expense), the ratio of tax benefits to total assets (assuming perpetual tax shields discounted at 5%), the ratio of tax benefits to total assets (assuming perpetual tax shields discounted at the estimated average interest rate on debt), the ratio of tax benefits to market capitalization (assuming perpetual tax shields discounted at 5%), and the ratio of tax benefits to market capitalization (assuming perpetual tax shields discounted at the estimated average interest rate on debt). The table shows the median interest expense ratio and average values of tax benefits by year, the mean, median and standard deviation of all variables across all years, as well as the median interest expense ratio and the average tax benefits for firms in the United States and for firms in all other countries.

	Post-Retirement Benefit Plans						Pension Plans						Health Care Plans					
Year	N	Interest Expense Ratio	Tax Benefits (5%)/Total Assets	Tax Benefits (Avg)/Total Assets	Tax Benefits (5%)/ Market Cap	Tax Benefits (Avg)/ Market Cap	N	Interest Expense Ratio	Tax Benefits (5%)/Total Assets	Tax Benefits (Avg)/Total Assets	Tax Benefits (5%)/ Market Cap	Tax Benefits (Avg)/ Market Cap	N	Interest Expense Ratio	Tax Benefits (5%)/Total Assets	Tax Benefits (Avg)/Total Assets	Tax Benefits (5%)/ Market Cap	Tax Benefits (Avg)/ Market Cap
Panel A: Average Tax Rate																		
2002	1,930	1.12	0.11	0.13	0.28	0.36	1,896	1.10	0.15	0.12	0.34	0.25	564	1.09	0.10	0.13	0.27	0.35
2003	3,831	1.44	0.14	0.24	0.38	0.75	3,773	1.40	0.15	0.11	0.27	0.20	853	1.10	0.14	0.24	0.37	0.75
2004	4,497	1.49	0.13	0.23	0.27	0.56	4,423	1.46	0.13	0.10	0.21	0.15	950	1.09	0.13	0.23	0.26	0.56
2005	5,096	1.31	0.10	0.19	0.20	0.42	5,026	1.28	0.12	0.09	0.19	0.14	1,019	1.07	0.10	0.19	0.19	0.42
2006	5,156	1.30	0.11	0.18	0.18	0.33	5,089	1.30	0.12	0.09	0.16	0.12	1,018	1.05	0.11	0.18	0.17	0.33
2007	5,256	1.38	0.13	0.18	0.22	0.35	5,194	1.37	0.12	0.09	0.19	0.14	969	1.04	0.12	0.18	0.22	0.36
2008	5,828	1.11	0.10	0.14	0.30	0.45	5,769	1.11	0.12	0.10	0.28	0.22	985	1.04	0.09	0.13	0.30	0.45
2009	5,840	1.17	0.11	0.16	0.36	0.55	5,784	1.17	0.11	0.09	0.20	0.17	940	1.03	0.11	0.16	0.36	0.55
Mean	37,434	4.77	0.11	0.18	0.27	0.46	36,954	4.79	0.13	0.10	0.22	0.17	7,298	1.25	0.11	0.18	0.26	0.47
Median	37,434	1.27	0.08	0.10	0.10	0.13	36,954	1.25	0.09	0.08	0.09	0.08	7,298	1.06	0.08	0.09	0.10	0.13
Std. Dev.	37,434	15.3	0.17	0.31	0.53	1.01	36,954	15.6	0.14	0.08	0.42	0.28	7,298	0.67	0.17	0.31	0.53	1.01
United States	7,522	1.13	0.14	0.12	0.23	0.19	7,183	1.10	0.13	0.11	0.23	0.17	5,122	1.07	0.13	0.11	0.22	0.19
Other Countries	29,912	1.33	0.11	0.20	0.28	0.53	29,771	1.32	0.11	0.08	0.20	0.15	2,176	1.04	0.11	0.20	0.28	0.53
Panel B: Effective Marginal Tax Rate																		
Mean	37,434	4.77	0.09	0.12	0.27	0.40	36,954	4.79	0.10	0.07	0.41	0.25	7,298	1.25	0.08	0.12	0.27	0.40
Median	37,434	1.27	0.07	0.08	0.10	0.13	36,954	1.25	0.08	0.06	0.09	0.08	7,298	1.06	0.07	0.08	0.10	0.12
Std. Dev.	37,434	15.3	0.12	0.19	0.63	0.85	36,954	15.6	0.09	0.05	1.50	0.72	7,298	0.67	0.12	0.19	0.61	0.84
United States	7,522	1.13	0.11	0.08	0.31	0.26	7,183	1.10	0.11	0.08	0.49	0.29	5,122	1.07	0.10	0.08	0.30	0.24
Other Countries	29,912	1.33	0.08	0.14	0.26	0.45	29,771	1.32	0.08	0.06	0.24	0.16	2,176	1.04	0.08	0.14	0.26	0.45

Table A3: Portfolio Sorts of Post-Retirement Plans, Leverage and Real Investment

The table shows characteristics of corporate post-retirement benefit plans, tax benefits of post-retirement benefit plans, regular leverage, consolidated leverage and real investment. Observations are sorted into five groups (Low to High) based on the ratio of projected benefit obligations of post-retirement benefit plans to total assets (Panel A), consolidated leverage (Panel B), and regular leverage (Panel C), respectively. For each group, the table reports average characteristics of post-retirement benefit plans, i.e. the ratio of projected benefit obligations to consolidated total assets, the ratio of plan assets to consolidated total assets, and the ratio of the funding level to total assets. It further reports characteristics related to the tax benefits of post-retirement benefit plans and interest expense on debt, i.e. the median interest expense ratio, the average ratio of tax benefits to total assets (assuming perpetual tax shields discounted at 5%), the average ratio of tax benefits to total assets (assuming perpetual tax shields discounted at the estimated average interest rate on debt), the average ratio of tax benefits to market capitalization (assuming perpetual tax shields discounted at 5%), and the average ratio of tax benefits to market capitalization (assuming perpetual tax shields discounted at the estimated average interest rate on debt). The table also reports average regular and consolidated leverage ratios, i.e. total debt divided by alternatively Total Assets or Size Market Value (market capitalization plus preferred stock plus total debt). For consolidated leverage ratios, accrued post-retirement costs (including additional minimum liabilities where applicable) are subtracted from the respective measure of debt, and projected benefit obligations are added. Similarly, prepaid post-retirement costs (including intangible pension asset where applicable) are subtracted from the measure of firm size, and the fair value of plan assets is added. For real investment, the table reports the ratios of capital expenditures to total assets and research and development expenses to total assets, respectively, where missing values of capital expenditures and research and development expenses are set to zero. The table also reports the difference between the high group and the low group, as well as *p*-values of non-parametric Wilcoxon tests.

Panel A: Sorts by Size of Post-Retirement Obligations

	PBO/Total Assets						
	Low	2	3	4	High	High-Low	*p*-value
Post-Retirement Plans							
PBO/Total Assets	0.01	0.02	0.06	0.13	0.32	0.32	[0.00]
Fair Value of Plan Assets/Total Assets	0.00	0.01	0.03	0.08	0.23	0.23	[0.00]
Funding Level/Total Assets	0.00	-0.01	-0.03	-0.05	-0.12	-0.11	[0.00]
Tax Benefits							
Interest Expense Ratio	1.04	1.14	1.46	2.02	2.01	0.97	[0.00]
Tax Benefits (5%)/Total Assets	0.08	0.08	0.11	0.13	0.16	0.08	[0.00]
Tax Benefits (Avg)/Total Assets	0.10	0.11	0.19	0.25	0.24	0.14	[0.00]
Tax Benefits (5%)/Market Capitalization	0.21	0.21	0.28	0.31	0.34	0.13	[0.04]
Tax Benefits (Avg)/Market Capitalization	0.28	0.29	0.56	0.63	0.56	0.28	[0.00]
Regular Leverage							
Total Debt/Total Assets	0.26	0.24	0.24	0.24	0.23	-0.04	[0.01]
Total Debt/Size Market Value	0.29	0.28	0.29	0.29	0.27	-0.02	[0.43]
Consolidated Leverage							
Total Debt/Total Assets	0.29	0.27	0.29	0.32	0.45	0.16	[0.00]
Total Debt/Size Market Value	0.32	0.31	0.35	0.38	0.50	0.18	[0.00]
Real Investment							
Capital Expenditures/Total Assets	0.064	0.051	0.046	0.044	0.044	-0.020	[0.00]
R&D/Total Assets	0.013	0.015	0.013	0.018	0.022	0.009	[0.00]

(continued)

Table A3: Portfolio Sorts of Post-Retirement Plans, Leverage and Real Investment (continued)

Panel B: Sorts by Consolidated Leverage

	Total Debt / Total Assets						
	Low	2	3	4	High	High-Low	*p*-value
Consolidated Leverage							
Total Debt/Total Assets	0.08	0.21	0.31	0.41	0.61	0.53	[0.00]
Total Debt/Size Market Value	0.11	0.26	0.37	0.49	0.64	0.53	[0.00]
Regular Leverage							
Total Debt/Total Assets	0.05	0.16	0.25	0.34	0.49	0.44	[0.00]
Total Debt/Size Market Value	0.08	0.21	0.31	0.41	0.52	0.44	[0.00]
Post-Retirement Plans							
PBO/Total Assets	0.05	0.08	0.10	0.13	0.20	0.15	[0.00]
Fair Value of Plan Assets/Total Assets	0.02	0.05	0.06	0.09	0.14	0.12	[0.00]
Funding Level/Total Assets	-0.03	-0.03	-0.04	-0.05	-0.07	-0.05	[0.00]
Tax Benefits							
Interest Expense Ratio	1.94	1.40	1.23	1.23	1.16	-0.78	[0.00]
Tax Benefits (5%)/Total Assets	0.06	0.09	0.12	0.15	0.21	0.15	[0.00]
Tax Benefits (Avg)/Total Assets	0.11	0.17	0.18	0.20	0.25	0.14	[0.00]
Tax Benefits (5%)/Market Capitalization	0.11	0.19	0.27	0.38	0.59	0.48	[0.00]
Tax Benefits (Avg)/Market Capitalization	0.24	0.37	0.45	0.58	0.83	0.59	[0.00]
Real Investment							
Capital Expenditures/Total Assets	0.044	0.052	0.053	0.052	0.053	0.009	[0.08]
R&D/Total Assets	0.022	0.017	0.013	0.013	0.012	-0.010	[0.00]

Panel C: Sorts by Regular Leverage

	Total Debt / Total Assets						
	Low	2	3	4	High	High-Low	*p*-value
Regular Leverage							
Total Debt/Total Assets	0.01	0.12	0.22	0.33	0.53	0.51	[0.00]
Total Debt/Size Market Value	0.02	0.16	0.28	0.40	0.57	0.54	[0.00]
Consolidated Leverage							
Total Debt/Total Assets	0.10	0.20	0.30	0.38	0.56	0.46	[0.00]
Total Debt/Size Market Value	0.13	0.25	0.35	0.45	0.60	0.47	[0.00]
Post-Retirement Plans							
PBO/Total Assets	0.11	0.12	0.12	0.10	0.09	-0.02	[0.16]
Fair Value of Plan Assets/Total Assets	0.07	0.08	0.08	0.07	0.06	-0.02	[0.02]
Funding Level/Total Assets	-0.04	-0.05	-0.05	-0.04	-0.04	0.00	[0.79]
Tax Benefits							
Interest Expense Ratio	4.35	1.73	1.34	1.19	1.09	-3.27	[0.00]
Tax Benefits (5%)/Total Assets	0.06	0.09	0.12	0.14	0.20	0.13	[0.00]
Tax Benefits (Avg)/Total Assets	0.13	0.16	0.17	0.19	0.24	0.11	[0.00]
Tax Benefits (5%)/Market Capitalization	0.10	0.17	0.25	0.35	0.59	0.48	[0.00]
Tax Benefits (Avg)/Market Capitalization	0.25	0.35	0.41	0.54	0.85	0.59	[0.00]
Real Investment							
Capital Expenditures/Total Assets	0.039	0.048	0.051	0.054	0.056	0.017	[0.00]
R&D/Total Assets	0.026	0.019	0.015	0.011	0.009	-0.017	[0.00]

Table A4: Correlation Analysis

The table shows correlations (in percentages) between the main variables used in the empirical analysis. Definitions of all variables are provided in Supplemental Appendix B. Suffixes a (b, c) indicate significance at the 1% (5%, 10%) significance level. Regular leverage is the ratio of total debt to total assets. For consolidated leverage, accrued post-retirement costs (including additional minimum liabilities where applicable) are subtracted from total debt, and projected benefit obligations are added. Similarly, prepaid post-retirement costs (including intangible pension asset where applicable) are subtracted from the measure of firm size, and the fair value of plan assets is added. For capital expenditures to total assets and research and development expenses to total assets, missing values of capital expenditures and research and development expenses are set to zero. For projected benefit obligations, missing values of PBO to total assets are set to zero.

	PBO/Total Assets	Consolidated Leverage	Regular Leverage	Industry Median Leverage	Total Risk (log)	Capital Expenditures/ Total Assets	R&D Expense/ Total Assets	Employees (log)	Market-to-Book	ROA (3-year average)	Volatility of ROA (log)	Age (log)	Tax Rate	Total Assets in USD (log)	Net PPE/Total Assets	Dividend	Tangible Assets/ Total Assets	Net FX-Exposure	Debt Maturity	Gross Profit Margin (3-year average)	Preferred Stock/ Size Market Value	Convertible Debt/ Size Market Value	Negative Book Equity
Consolidated Leverage	38.6 a																						
Regular Leverage	-1.1 b	90.7 a																					
Industry Median Leverage	3.0 a	30.4 a	32.1 a																				
Total Risk (log)	-18.3 a	0.0	7.6 a	-6.6 a																			
Capital Expenditures/Total Assets	-9.1 a	5.7 a	9.6 a	11.0 a	3.6 a																		
R&D Expense/Total Assets	9.2 a	-11.3 a	-15.9 a	-28.1 a	3.4 a	-9.3 a																	
Employees (log)	27.4 a	17.4 a	8.4 a	6.5 a	-25.4 a	0.8	-0.4																
Market-to-Book	2.3 a	0.1	-0.6	-11.0 a	-4.5 a	5.8 a	10.0 a	5.6 a															
ROA (3-year average)	-5.5 a	-12.6 a	-11.6 a	-1.8 a	-10.6 a	17.4 a	-6.8 a	8.8 a	19.4 a														
Volatility of ROA (log)	-5.6 a	-6.8 a	-5.6 a	-18.7 a	31.0 a	1.7 a	15.6 a	-23.8 a	9.7 a	-4.3 a													
Age (log)	29.6 a	9.7 a	-1.6 a	8.3 a	-23.9 a	-11.8 a	4.3 a	25.7 a	-7.2 a	-10.7 a	-14.9 a												
Tax Rate	7.1 a	4.8 a	3.0 a	1.2 b	-4.6 a	-6.3 a	-2.3 a	4.3 a	-4.5 a	-14.7 a	-13.6 a	9.7 a											
Total Assets in USD (log)	26.8 a	22.7 a	14.8 a	7.9 a	-27.4 a	0.4	1.6 a	79.0 a	5.4 a	5.8 a	-27.5 a	29.0 a	8.7 a										
Net PPE/Total Assets	-4.6 a	20.1 a	23.8 a	34.4 a	-7.1 a	54.5 a	-22.1 a	2.9 a	-8.6 a	1.8 a	-12.4 a	3.2 a	-3.4 a	6.5 a									
Dividend	15.2 a	-1.6 a	-7.7 a	12.0 a	-31.1 a	1.8 a	-10.9 a	22.8 a	-3.1 a	19.5 a	-31.8 a	14.2 a	-1.4 b	24.0 a	10.4 a								
Tangible Assets/Total Assets	-5.7 a	-11.5 a	-10.1 a	17.1 a	3.4 a	20.8 a	-6.3 a	-12.6 a	-8.2 a	2.6 a	-8.4 a	5.1 a	-4.3 a	-16.0 a	38.7 a	17.0 a							
Net FX-Exposure	8.6 a	-3.8 a	-7.8 a	-12.8 a	-0.2	-7.5 a	22.4 a	7.0 a	3.2 a	0.5	9.3 a	5.0 a	-4.0 a	8.8 a	-14.8 a	-6.5 a	-8.0 a						
Debt Maturity	9.9 a	28.1 a	26.6 a	5.5 a	-6.3 a	10.8 a	0.3	20.2 a	6.2 a	2.9 a	0.7	6.8 a	4.3 a	29.7 a	13.6 a	-9.3 a	-30.3 a	6.3 a					
Gross Profit Margin (3-year average)	-2.7 a	-6.1 a	-5.6 a	-20.3 a	-6.8 a	3.3 a	30.4 a	-3.1 a	16.5 a	21.5 a	9.3 a	-4.6 a	2.2 a	6.1 a	-3.4 a	-9.7 a	-26.6 a	10.9 a	17.0 a				
Preferred Stock/Size Market Value	0.9	6.1 a	6.0 a	0.0	8.4 a	-2.3 a	2.3 a	-5.4 a	-4.5 a	-10.5 a	8.8 a	1.7 a	-1.9 a	-5.3 a	-1.5 a	-6.5 a	-3.7 a	-0.3	3.3 a	-0.4			
Convertible Debt/Size Market Value	-3.6 a	13.1 a	15.8 a	-4.9 a	4.3 a	-1.9 a	8.0 a	3.7 a	-1.9 a	-9.0 a	5.4 a	2.1 a	2.3 a	7.3 a	-4.5 a	-11.5 a	-6.7 a	6.3 a	16.9 a	4.5 a	0.7		
Negative Book Equity	7.8 a	27.9 a	28.0 a	0.5	11.6 a	-2.6 a	3.1 a	-4.1 a	-30.7 a	-6.4 a	13.7 a	-2.1 a	-1.9 a	-6.3 a	-2.9 a	-11.6 a	-2.4 a	0.40	4.2 a	2.0 a	26.0 a	3.1 a	
(Cash + Short-Term Investments)/Total Assets (log)	-4.2 a	-30.9 a	-31.7 a	-24.5 a	4.6 a	-12.6 a	23.6 a	-2.4 a	8.6 a	5.1 a	13.3 a	-7.2 a	-4.2 a	-3.6 a	-30.8 a	0.5	15.5 a	12.3 a	-16.2 a	13.5 a	-3.4 a	5.9 a	-1.9 a