The role of actuaries in defined-benefit pension reporting

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This study examines the role of the pension actuary in the choice of discount rate assumptions used in defined-benefit pension accounting, to estimate pension obligations on corporate balance sheets. Clients of larger actuarial firms (which are presumably subject to stronger litigation- and reputation-based incentives to remain independent of their clients) use more conservative (i.e., obligation-increasing) discount rates, than clients of smaller actuarial firms. Within actuarial firms, clients that are economically important (to their actuarial practice-office, and to the individual actuary responsible) use more aggressive (i.e., obligation-reducing) discount rates, compared to less important clients. The effect of actuarial client importance is concentrated in highly leveraged plan sponsors with poorly funded pension plans, that are strongly motivated to understate reported pension obligations by managing assumptions, and in plan sponsors with weak auditor oversight. Finally, there is some evidence that the effect of client importance is driven by smaller plans (that might be subject to lower external scrutiny) in combination with smaller actuarial practice-offices. Overall, the results show that variation in the nature and incentives of the pension actuary translate into observable differences in the pension assumptions used. This, in turn, suggests that actuaries and their incentives play a role in the plan sponsor's ability to manage assumptions so as to improve reported pension funding.

Keywords: defined-benefit pensions, pension accounting, actuarial assumptions, actuaries, independence

I am indebted to Eli Amir, Sharad Asthana, John Bury, Woo-jin Chang, Matt Cedergren, Liz Chuk, Joseph Comprix, Paquita Davis-Friday, Alberto Dominguez, Jennifer Gaver, Sally Gunz, Bikki Jaggi, Bjorn Jorgensen, Robin Knowles, S.P. Kothari, Kaitlin Morecraft, Lars Oxelheim, Stephen Penman, Avri Ravid, Alex Sannella, Bharat Sarath, Yong Yu, Yuan Zhang, Daniel Taylor (discussant) and participants at the AAA Financial Accounting and Reporting Section Meetings 2011, Kris Allee (discussant) and participants at the Conference on Financial Economics and Accounting 2011, Clive Lennox (discussant) and participants at the HKUST Accounting Symposium 2011, the University of North Carolina-Charlotte, Yeshiva University, the Midwest Finance Association 2011 meetings, the AAA Mid-Atlantic Regional Meeting 2011, the AAA Annual Ethics Research Symposium 2012, and the AAA Annual Meeting 2013 for useful comments on the manuscript. I am indebted to many members of the actuarial and accounting professions for generously sharing their knowledge and experience. All errors are my own. Comments and suggestions are greatly appreciated.

1. INTRODUCTION

The actuarial assumptions used in defined-benefit pension accounting are often chosen strategically, to make plans appear better funded or plan costs appear smaller than they actually are (Feldstein and Morck, 1983; Asthana, 1999; Bergstresser et al., 2006). As pension assets, liabilities and costs are an economically significant part of corporate financial statements, even small changes in pension assumptions can impact earnings and balance sheets substantially. While managers of the firm sponsoring the plan ("plan sponsor") are ultimately responsible for choosing pension assumptions, these assumptions are typically chosen on the recommendation of the pension actuary. In spite of this vital role that actuaries play, little is known about their effect on pension reporting. I examine the role of the pension actuary in the financial reporting of pension obligations, and examine whether the incentives of the actuary affect actuarial assumptions used.

Actuaries are self-regulated, with an institutional framework similar to that of the accounting profession prior to the Sarbanes-Oxley Act. Researchers note that "*the issues surrounding the professional independence of actuaries are not, in principle, unlike those that faced the audit profession before the regulatory changes early this century*" (Gunz et al., 2009). Actuaries render opinions for a fee, making them susceptible to conflicts between providing advice based on objective analysis, and serving the needs of plan sponsor clients, when the two diverge. This conflict has long been a subject of discussion within the actuarial profession—for example, "*…as long as a client can threaten to find another actuary to provide actuarial services, the implied leverage might well have an effect on the actuary's work product*" (American Academy of Actuaries Task Force, 2006)—across all areas where actuaries function, such as pensions and insurance

(Feldblum, 1993; White and Atkinson, 1993, Carmichael, 1997).[1] Vaughan, Cooper, and Frank (1993), in a survey of insurance actuaries, report that "*responding to pressure from clients or management to change assumptions*" was considered the most serious ethical challenge facing the profession. These issues have received some wider attention,[2] but the generally low visibility of the profession and lack of public exposure to its work has limited a robust debate on actuarial independence from developing in the United States.

These concerns about the professional independence of actuaries, when juxtaposed with academic evidence on firms' strategic use of pension assumptions, beg the question of whether the pension assumptions that plan sponsors ultimately use are affected by actuaries' economic incentives, i.e., whether certain plan sponsors successfully exert pressure on actuaries to tilt assumptions in a specific direction. If the threat of losing fee revenues from a client affects the actuary's work product, this might manifest in actuarial assumptions that better fit the client's reporting objectives. Actuaries do, however, face countervailing incentives to resist client pressure - from the threat of litigation, the need to maintain reputation, and perhaps more fundamentally from

[1]In other examples, "*An actuary can only really claim independence if the advice given is totally open and public, and is capable of being relied on by any interested party. The fiduciary relation which a consulting actuary has with his or her client (not to mention the receipt of a fee) implies that they are beholden to their client...*" in published comments to Bellis (2000)'s speech to the Institute of Actuaries. In the insurance arena, Feldblum (1993) argues in a discussion paper of the Casualty Actuarial Society that the insurance actuary is "*torn between the two roles*" of professional expert (certifying to insurance regulators that loss reserves are reasonable) and business manager (seeking to optimize company performance), and provides the interesting example that "*almost all major insurers have unqualified actuarial opinions*", but yet "*most actuaries believe that industry reserves are seriously deficient on a statutory basis*".

[2]For example, there is ""*subtle pressure on the actuary to come up with numbers that make the pension fund look good*" (Mary Williams Walsh, "Actuaries scrutinized on pensions", *The New York Times*, May 21, 2008). Warren Buffett, in his 2007 letter to shareholders, famously decried pension expected rate-of-return assumptions for being unrealistic, adding that somehow, "*the auditors and actuaries charged with vetting these return assumptions seem to have no problem with it"*. Standard & Poors' insurance analyst Steven J. Dreyer asserts, "*The accounting profession has come in for a lot of criticism in recent years. Meanwhile, the insurance industry has done something almost as egregious by, in effect, overstating prior-year earnings by billions of dollars. Somehow, actuaries have avoided the spotlight for abetting this."* (Dreyer, Steven J., Siddhartha Ghosh, John Iten, Robert G. Partridge, and Mark Puccia. "Insurance Actuaries: A crisis of credibility." November 19, 2003. Standard & Poor's RatingsDirect: New York, NY.)

personal integrity and professional codes of conduct. Whether these incentives dominate economic considerations, is an empirical question.

In this study, I focus on one actuarial recommendation – the discount rate with which projected future benefit payments are discounted to present value to estimate pension obligations — and examine first, whether this assumption varies systematically across actuarial firms, and second, whether it varies, within actuarial firms, with the economic importance of the plan sponsor to its actuary. Following prior literature in the auditing setting (e.g., DeAngelo, 1981; Becker et al., 1998), I expect larger actuarial firms to recommend more conservative assumptions, due to their presumably stronger litigation- and reputation-based incentives to remain independent. Further, if economic considerations do overwhelm these incentives to remain independent, we would expect to see actuaries recommending more aggressive assumptions to their relatively more important clients, the loss of whom would affect fee revenues more substantially.

I focus on the discount rate first because its determination is a key responsibility of the pension actuary (Patel and Daykin, 2010). The discount rate is crucially dependent on the duration of pension obligations, which in turn depends on the timing of expected cash outflows from the plan. The timing of cash outflows further depends on demographic assumptions about employee retirement, termination, mortality, etc., which the actuary is primarily responsible for determining. Second, the pension obligation and pension expense are both very sensitive to the discount rate, making it a powerful lever of these numbers and thereby susceptible to manipulation (Naughton, 2011; Brown, 2013).

In a sample of 4,169 firm-years from 2000-2008, there is evidence that clients of the largest actuarial firms use systematically lower, or more conservative (i.e., obligation-

increasing) discount rate assumptions, consistent with larger actuarial firms having incentives to enforce conservative pension valuations. Within actuarial firms, there is strong evidence that economically important clients (i.e., that account for a greater proportion of their actuary's client portfolio) use higher, or more aggressive (obligation-reducing) discount rates, compared to less important clients. Examining client importance at three levels – the actuarial firm level, the actuarial practice-office level, and the level of the individual actuary signing the actuarial report, client importance at both practice-office and individual levels is incrementally associated with higher discount rates.

Partition tests show that the effects of client importance are driven, as expected, by client firms with strong incentives to overstate discount rates - highly leveraged plan sponsors with poorly-funded pension plans ("financially weak" plans). This effect exists both within actuarial firms (across their client portfolio), and within client firms (over time). In these plans, there is some evidence that client importance effects at the practice-office level are stronger when auditor oversight of actuarial valuations is weak.

Finally, the effect of client importance manifests in both large and small actuarial firms. Interestingly, however, sorting plans by absolute size shows that the effect of client importance is driven by relatively small plans in combination with smaller practice-offices. In other words, the plan sponsors that appear to successfully exert pressure for aggressive assumptions are not the very largest plans by absolute size (these plans may face significant external scrutiny that constrains manipulation) but rather, smaller plans that happen to be *relatively* important to their practice-office.

This study makes three contributions. First and most important, while many studies have shown that pension assumptions are managed to achieve reporting

objectives, this study sheds some light on the *how*, by illustrating one mechanism that allow plans sponsors to implement the desired window-dressing of pension status. If the actuary's sign-off on pension assumptions is necessary for the auditor's vetting of pension reporting, then plan sponsors that are strongly motivated to manipulate assumptions may resort to exerting pressure on actuaries to produce numbers that better fit their reporting objectives. The evidence in this study is consistent with this picture — not for all plan sponsors or actuaries, but for subgroups of highly motivated plan sponsors in combination with certain actuarial practice-offices. To take another perspective, extant research has focused on identifying plan sponsors' *incentives* to manipulate assumptions, assuming implicitly that managers' *ability* to manipulate does not vary. I focus on ability, and shows that it varies with the nature and incentives of the pension actuary.

Second, even though actuaries play a key role in pensions and insurance, empirical evidence on their role in financial reporting is scarce, the sole exception being Gaver and Paterson (2001), who study actuaries in property-casualty insurance reporting. The many layers of evidence here: first, that actuarial firm fixed-effects are highly significant determinants of discount rates; then, that clients of large and small actuarial firms use systematically different discount rates; and finally, within actuarial firms, that important clients use more aggressive discount rates – combine to suggest that actuaries' incentives do matter, and are a heretofore-unconsidered force in pension reporting. Taking a broader perspective, even though I focus on pensions sponsored by public firms, the approach used here to characterize actuaries' incentives could be relevant in other

arenas where actuaries set assumptions: pension plans of non-public firms, not-for-profit institutions, and governments; multi-employer plans; and insurance reporting.[3]

Third, this study contributes to an interdisciplinary literature examining professional independence in auditors, compensation consultants (Cadman et al., 2010; Murphy and Sandino, 2010) and equity analysts (e.g., Michaely and Womack, 1999).[4] Research has found limited evidence of impaired independence in audit firms for economically important clients, leading to the conclusion that auditors have strong countervailing incentives — from the desire to maintain their reputations, and to avoid litigation — to resist client pressure (DeFond et al., 2002; Hope and Langli, 2010). The findings here suggest that such incentives, on average, are weaker for actuaries, potentially for many reasons: the subjective, complex and uncertain nature of the pension actuary's work, and the lack of transparent disclosure on how assumptions are determined. Finally, the fact that litigation risk has historically been low for actuarial firms compared to accounting firms - which, in turn, could relate to the low visibility of and lack of public exposure to actuaries' work, could be an important driving force behind the findings (Bellis, 2000; Collins, Dewing, and Russell, 2009).[5,6]

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[3] One in five workers in U.S. private industry are covered by defined-benefit plans (Bureau of Labor Statistics' National Compensation Survey: http://www.bls.gov/ncs/). Almost 80% of state and local government employees are covered only by defined-benefit plans (Munnell, Aubry, and Muldoon 2008).

[4] The auditor independence literature is extensive: see Antle et al. (2006) for a review. Murphy and Sandino (2010) find that consultants who also provide actuarial services to their clients recommend higher CEO pay. This study takes a different perspective: that of the actuarial firm itself, examining whether clients that are more influential (within the portfolio of actuarial work) have differing pension reporting outcomes.

[5] These differences are highlighted by the contrasting effects of client importance to the actuary versus auditor. Controlling for client importance to the actuary, client importance to the auditor associates with *more* conservative assumptions, consistent with auditors' litigation- and reputation-based incentives incentivizing them to be stricter with large clients (e.g., Reynolds and Francis 2001).

[6] Gaver and Paterson (2001) find in their study of property-casualty insurers that auditors who use third-party actuarial firms estimate loss reserves less conservatively than auditors who rely on actuaries from the Big Six accounting firms. They conclude that stand-alone actuarial firms are less likely to be attuned to auditors' liability exposure, as actuarial firms are only infrequently sued. In this study, I arrive at a similar conclusion but in the context of pension reporting.

The disclosure of the identity of the individual actuary responsible also allows insights into the way in which economic bonding functions, that are not available in the U.S. audit setting where signing partner names are not disclosed. A key issue in the literature on economic bonding is what the appropriate level of analysis is. While the audit literature has evolved from firm- to office-level analysis of client importance, DeFond and Francis (2005) suggest drilling down further to the engagement partner-level. Although the very different environments facing actuaries vis-à-vis auditors in the U.S. make it difficult to transfer inferences directly, finding in the actuary setting that both office-level and individual-level client importance matter incrementally, first, supports the argument for drilling down. Second, the fact that client importance matters in spite of the "accountability effect" from requiring disclosure of the individual responsible, suggests that disclosure of identities alone could be ineffective at constraining manipulation, unless accompanied by litigation or professional sanctions.

These findings are also of interest to regulators. In the United Kingdom, the highly visible failure of the Equitable Life Insurance Company and resulting revelations of actuarial conflicts of interests that contributed to its collapse, led to intense public scrutiny and a government review of the actuarial profession that overhauled its regulatory framework to address conflicts of interest (Morris, 2005).[7] These events have led to a robust debate in the U.K. ever since on how to maintain the quality and independence of actuaries' work. In Australia, governmental enquiry revealed that client

[7] The Morris review concluded: "*professional standards have been weak, ambiguous or too limited in range, and perceived as influenced by commercial interests*". Consequently, the actuarial profession lost its purely self-regulated status and was brought under the oversight of the Financial Reporting Council ("FRC", the U.K.'s independent regulator of financial reporting and corporate governance), in a sequence of events similar to the U.S. accounting profession's shift from self-regulation to statutory regulation in 2002. The FRC explains that its oversight of the actuarial profession is necessitated by the fact that "*many of the FRC's stakeholders, from institutional investors to individual insurance policyholders to pension fund members, rely, either directly or indirectly, on actuarial work.*"

pressure on the actuary had contributed similarly to the severe under-estimation of the asbestos liabilities of James Hardie Limited, the dominant Australian producer of asbestos (Gunz and van der Laan, 2011). A self-review of the U.S. profession (American Academy of Actuaries Task Force, 2006) recognizes that "*actuaries face the same potential conflicts of interest as anyone working in the business world*", but concludes that "*the profession has done a good job of balancing these pressures*". The empirical evidence in this study has the potential to inform this discussion.

2. INSTITUTIONAL BACKGROUND ON THE ACTUARIAL PROFESSION

2.1. The actuarial profession in the United States, and what pension actuaries do

Actuaries are professionals trained in evaluating the current financial implications of future contingent events (Hager and Chretien, 1982); they work usually in insurance and pension sectors. In the U.S., actuaries belong to a self-regulated profession with four designation-granting professional organizations. The profession's Code of Professional Conduct requires actuaries to act honestly and in a manner that "*fulfills the profession's responsibility to the public*" (American Academy of Actuaries, 2009). Actuaries must also follow generally accepted actuarial principles, codified as Actuarial Standards of Practice (ASOPs), opinions, recommendations, and interpretations.

Pension benefits are paid far into the future, based on when employees retire, what form of benefit they elect, how long they live, who survives them, etc. Valuing such long-term liabilities hence requires assumptions about the future. The pension actuary sets these assumptions, and combines them with participant data and benefits formulae to project benefit payments and value plan liabilities. She then estimates the contributions required to fund those promises over a period of time.

Assumptions are of two kinds. Demographic assumptions relate to the composition and expected behavior of the beneficiary pool, e.g., how long participants continue to work (termination, disability, and retirement assumptions) and how long retirees will live (mortality assumptions). Economic assumptions relate to how market forces affect the cost of the plan, e.g., the expected rate of return (ERR) on plan assets, the discount rate, and the rate at which salaries grow over service lives. As the future is uncertain and the "*selection of assumptions is not a precise mathematical process*", the actuary applies considerable professional judgment to determine a best-estimate range for each assumption, and then select a specific point from within the range, using generally accepted actuarial principles (Actuarial Standards Board, 1996).

2.2. The pension actuary's role in pension funding and pension accounting

The Employee Retirement Income Security Act 1974 (ERISA), enacted to improve retirement income security for private industry workers, expanded the role of the pension actuary greatly. ERISA created the Joint Board for Enrolment of Actuaries, which regulates any actuary who performs services for plans under ERISA (an "Enrolled Actuary"). It also requires all qualified plans with more than 100 participants to engage an actuary to perform periodic valuations of plan liabilities and assets, to certify the contribution estimated as necessary to eliminate the plan's funding deficit (if any), and to justify any changes in assumptions, in a yearly report to the Department of Labor (DOL) and the IRS.[8] ERISA imposes a statutory duty on the actuary to act on behalf of the plan participants (as opposed to the plan sponsor), and to use independent judgment in choosing methods and assumptions (Hager and Chretien, 1982).

[8]The actuary also states that all costs and liabilities are determined with reasonable actuarial assumptions and methods, which in combination offer her best estimate of anticipated experience for the plan.

For pension funding (i.e., reporting to the DOL through the Form 5500), the actuary is responsible for selecting the assumptions used to estimate plan liabilities, and certifies them in the actuarial report. For pension accounting (i.e., reporting in plan sponsor's financial statements filed with the SEC), the managers of the plan sponsor, by virtue of being responsible for all information in financial statements, are also responsible for the assumptions chosen. But even though managers are ultimately responsible for the assumptions used in pension accounting, the institutional environment effectively constrains managers to choose from within the actuary's recommended range. First, as pension assumptions fall within the specialist domain of the actuary, auditors vetting these assumptions typically request written confirmation from actuaries that assumptions have been chosen in accordance with SFAS 87, and are unlikely to allow assumptions that are outside the actuary's explicit sign-off (Society of Actuaries, 1986; Rezaee, 1982; Zuber, 1988). Furthermore, it is standard audit practice to test the data, methods and assumptions used by the actuary in her Form 5500 valuation report filed with the DOL, and to compare assumptions across 10-K filings and DOL filings (where the actuary certifies assumptions), to check that they are similar, if not identical, except only when GAAP and ERISA explicitly prescribe differing treatment (Brown, 2013).

2.3. The discount rate assumption: how it is determined, and sources of discretion

The pension liability ("projected benefit obligation" or "PBO", which is the present value of expected future benefit payments) and pension plan assets net out to the pension funding status, which appears as a liability (asset) on the corporate balance sheet if the firm's pensions are under- (over-) funded. As the discount rate is used to discount

future benefit payments to present value, a higher discount rate leads to lower PBO, and stronger funding status, *ceteris paribus*.

The discount rate is the rate at which pension benefits can effectively be settled, and is estimated by the yield on a hypothetical portfolio of high-quality corporate bonds whose coupons and maturities match the plan's projected benefit payments (SEC, 2005). To determine this rate, the actuary first estimates the stream of future cash outflows of the plan, which in turn requires demographic assumptions, such as retirement, early retirement, disability and involuntary termination rates, the forms of benefit employees will choose (e.g., annuity or lump-sum), and pre- and post-retirement mortality. Then, each cash flow is discounted to present value with an interest rate applicable to its maturity, from a yield curve developed to comply with SFAS 87 (e.g., the Citigroup Pension Discount Curve, or firm-specific curves). These present values are summed up to arrive at the PBO. The discount rate reported in the financial statements is the single rate that, if applied to all cash flows, would produce this same PBO (Naughton, 2011).

While there is some discretion available in determining the yield curve (for example, what securities to include, how to eliminate outliers, how to extrapolate yields beyond the 30-year duration of traded securities), it is still a highly visible, market-determined parameter that is difficult to manipulate, even in the presence of strong incentives to do so. Furthermore, conversations with actuaries indicate that the universe of bonds included in the yield curve is often determined at the actuarial firm-level, leaving individual actuaries or offices with little discretion to add or remove bonds.

The larger source of discretion lies more fundamentally in determining the stream of future cash flows itself (which is subject to many assumptions based on plan

demographics and features of the benefits contract), which is the domain of the pension actuary. These assumptions, and consequently, the stream of cash flows that results, are subject much more to professional judgment on the part of the actuary, and could be skewed in a particular direction based on incentives. Any discretion in cash flow forecasts, in turn, manifests in the discount rate, as it is the yield on a hypothetical portfolio that mirrors the amounts and maturities of the plan's cash outflows.

3. HYPOTHESES

3.1. Incentives to acquiesce to pressure, and countervailing forces

The potential conflicts of interest faced by actuaries resemble those faced by accountants, or any professional giving an opinion for a fee. When the actuary receives substantial revenues from a client, the resulting dependence may make the actuary more willing to acquiesce to client pressure. This could translate into recommending assumptions that help clients fulfill their financial reporting objectives (DeAngelo, 1981; Gunz et al., 2009). The complexity of pension accounting in turn could enable such window-dressing (e.g., Picconi, 2006). Further, assumption-setting does involve judgment, and ASOPs recognize that there is an acceptable range for many assumptions. If fear of termination forces actuaries to be indifferent over a range of values, difficulty in detecting manipulation *ex ante* or in disentangling it from honest error in good-faith estimates *ex post* could facilitate misreporting (Asthana, 1999, 2007; Brown, 2013).[9]

Still, actuaries have many reasons to resist client pressure, both intrinsic — the desire to maintain integrity and adhere to professional codes of conduct), and extrinsic —

[9] It is unclear if investors can see through manipulated assumptions: Feldstein and Morck (1983) and Brown (2013) conclude that they can, but Amir and Gordon (1996) and Coronado and Sharpe (2003) find the opposite. Even if investors are able to see through, managers could still have incentives to manipulate if other stakeholders (employees, creditors, regulators) cannot completely see through (Brown, 2013).

sanctions from the profession, and the risk of compromising reputation. Finally, even though managers are finally responsible for assumptions in financial statements, actuaries can be, and are, sued by third parties (such as plan beneficiaries) for failing to advice plan sponsors in a way that ensures sufficient funds to pay benefits. Actuarial liability can arise under federal statute (ERISA), and under state common law that applies to malpractice by any professional.[10] Moreover, audit literature has shown that auditor litigation risk is higher for economically important clients (Lys and Watts, 1994); if this is true for actuaries, it could act as a constraint against acquiescing to pressure, even (or especially) from important clients.

It is unclear whether litigation risk affects actuaries as significantly as it does auditors. There is anecdotal evidence that malpractice insurance premia are low relative to accounting firms (Ladbury, 1995; Gaver and Paterson, 2001). The largest actuarial firms also commonly ask pension clients to sign retainers that cap actuaries' liability for malpractice (Morse, 2003). Litigation has however increased since the 1990s, fueled by widespread pension deficits (Dailey and Selznick, 2002; Harrington, 2008; Walsh, 2008), as has the size of malpractice settlements. [11] Hence, it remains an empirical question as to whether these incentives are significant enough to counteract economic considerations.

3.2. Identifying variation in actuaries' incentives

A stream of research has shown that plan sponsors have incentives to understate plan liabilities (and overstate the reported funding status). One way to do this is to choose

[10] Dailey and Selznick (2002) provide a comprehensive history of litigation against actuaries.

[11] 2010 saw one of the largest actuarial malpractice settlements in the history of lawsuits against actuaries ($500m, against a $2.8b damage claim), paid by Mercer to the Alaska public employees' retirement system, for failures to properly estimate health care cost increases, exacerbating severe funding deficiencies in Alaska's plans. This case made actuarial malpractice insurance prohibitively expensive for a period of time (Gretchen Morgenson. "Mercer's Little Alaska Problem", The New York Times, December 19, 2009.).

an aggressively high discount rate. Blankley and Swanson (1995) find that the majority of firms choose discount rates higher than published benchmarks for the average yield on high-quality corporate bonds. A higher discount rate (and stronger funding status) benefits the plan sponsor in many ways: it translates into a healthier balance sheet, which lowers the cost of raising financing (Feldstein and Morck, 1983), avoids violating debt covenants (Amir and Gordon, 1996), and reduces negative attention from the media and regulators (Bodie et al., 1987; Mittelstaedt, 1989; Asthana, 1999).

From the actuary's perspective, an aggressively high discount rate makes the plan appear better funded than it really is, and so allows sponsors to reduce contributions into the plan. This eventually erodes benefit security for employees by reducing the likelihood of sufficient funds being available to pay benefits as they become due, and increases the likelihood of lawsuits against the actuarial firm. So when there is client pressure for an aggressive discount rate, the actuary faces a trade-off: by acquiescing to this pressure, she retains the client's business on the one hand; but on the other hand, runs the risk of un-conservative actuarial valuations being (eventually) revealed, and then costs associated with lawsuits from beneficiaries, loss of reputational capital, and loss of revenues from other clients who depart at that point.

This trade-off is similar to that faced by auditors. To understand better the trade-offs facing actuaries, I apply to this setting some insights from frameworks in the auditing literature that aim to predict when auditors will compromise independence (for e.g., Chung and Kallapur, 2003).

3.2.1. Large versus small actuarial firms

Many factors from the Chung and Kallapur (2003) framework suggest that incentives to acquiesce to client pressure are weaker for large actuarial firms, compared to the smaller actuarial firms. First, the large roster of clients such firms have makes each client less important on average. Second, these firms are likely to have larger clients, who are subject to more scrutiny from analysts, investors, unions and regulators, increasing the risk of detection. Third, the costs of being detected are likely to be higher. Extrapolating from the audit setting, the most prominent actuarial firms could face higher litigation exposure than small firms (even though we do not have well-organized data on lawsuits against actuaries to confirm this conjecture), as also greater reputational consequences from the revelation of manipulation (Becker et al., 1998). If larger actuarial firms do have stronger incentives to remain independent, we would expect larger actuaries to recommend more conservative (i.e., obligation-increasing) discount rates on average. The first hypothesis follows:

Hypothesis 1 (H1): *Clients of large actuarial firms use lower (i.e., more obligation-increasing) discount rates than clients of small actuarial firms.*

Actuaries have, however, increasingly expanded into providing "non-actuarial services" such as benefits administration and compensation consulting. While large actuaries may face higher costs to acquiescing to client pressure, they may also face more pressure to cross-sell such services to clients. The lack of public disclosures on fees from such services makes it difficult to assess their importance in actuarial firms' decisions.[12]

3.2.2. The effect of client importance within actuarial firms

If actuaries' incentives to remain independent are not strong enough to overwhelm the incentives to acquiesce to client pressure, this could manifest in their

[12] Fees for compensation consulting services are available from proxy statements post-2006, but they are usually small compared to fees for other services provided by actuaries (Murphy and Sandino, 2010).

allowing aggressive (i.e., obligation-reducing) discount rates for at least some clients. This is more likely with influential clients that account for a large proportion of the actuary's revenues, as the benefits of acquiescing to pressure (i.e., retaining client revenues) are more likely to exceed the costs, with larger clients (Chung and Kallapur, 2003). To the contrary, if incentives to resist client pressure dominate, then client importance need not have any relation with discount rates, or could even lead to *more* conservative assumptions, akin to findings in the audit setting (Reynolds and Francis, 2001; Gaver and Paterson, 2007). The second hypothesis (in alternative form) follows:

Hypothesis 2 (H2): *Economically important clients of an actuary use higher (i.e., more obligation-reducing) discount rates than less important clients of the actuary.*

3.2.3. The effect of client importance: partitioning on plan sponsor incentives

The actuary's incentive to acquiesce to client pressure is stronger when the client is strongly motivated to improve its reported funding status, and so highly likely to switch actuaries in the face of resistance (Chung and Kallapur, 2003). Not all plan sponsors have similar incentives to use aggressive discount rates: this incentive is stronger for plan sponsors with poorly-funded plans, and where the plan sponsor is also financially constrained from borrowing to fund the plan, e.g., because it is already highly leveraged (Feldstein and Morck, 1983; Asthana, 1999). If client importance affects discount rates, then the effect of client importance should manifest primarily in such highly leveraged plan sponsors with poorly funded plans ("financially weak" plans).[13]

Hypothesis 3 (H3): *The effect of client importance on discount rates is stronger in, or driven by, financially weak plans.*

[13] Taking the perspective of the plan sponsor, most financially weak sponsors have strong incentives to inflate discount rates. However, not all these sponsors may have the *ability* to obtain an aggressively high discount rate. If influence over the actuary is an underlying requirement to achieving a higher discount rate, and if client importance captures that influence, then within this group of 'high-incentive' firms, we should observe the economically important clients being better able to realize the desired discount rate assumption.

3.2.4. The effect of client importance: partitioning on plan sponsor opportunities

External auditors ultimately test the assumptions recommended by actuaries and chosen by managers. Even though auditors rely on actuaries' work, they are expected to vet actuaries' data, assumptions and methods. Stronger auditor oversight may hence weaken opportunities to manipulate assumptions. If auditor oversight effectively constrains discretion in estimates, then even economically important clients will not be able to discount pension cash flows at inflated rates. The fourth hypothesis follows:

Hypothesis 4 (H4): *The effect of client importance on discount rates is stronger in, or driven by, plan sponsor clients with weak auditor oversight.*

Finally, the actuary's opportunities to manipulate, even for economically important clients, could be lesser in larger actuarial firms, which are likely to have internal checks and balances, and firm-wide standards that individual actuaries cannot deviate from. If this is true, any increase in client importance need not translate into higher discount rates in these firms. The final hypothesis follows:

Hypothesis 5 (H5): *The effect of client importance on discount rates is stronger in, or driven by, smaller actuarial firms.*

3.3. How about downward manipulation of discount rates?

Even though I focus on plan sponsors' attempts to improve the reported funding status by manipulating discount rates upwards, plan sponsors also have incentives to worsen the reported funding status by manipulating discount rates downward, e.g., to maximize tax-deductible contributions to the plan (Asthana, 1999), or to exaggerate the apparent economic burden of maintaining the plan, so as to ease negotiations with unions to freeze the plan (Amir and Gordon, 1996; Comprix and Muller, 2011).

Choosing lower (conservative) discount rates increases the reported pension liability and necessitates larger contributions into the plan, whereas lawsuits against

actuaries usually involve allegations that actuaries under-estimated liabilities, leaving insufficient funds to eventually pay benefits (Dailey and Selznick, 2002).[14] Therefore, it is hard to define what the cost (or trade-off) is for the actuary who acquiesces to client pressure for a conservative discount rate. As actuaries might presumably be willing to recommend conservative assumptions to all clients, not just economically important ones, we do not obtain the same prediction on client importance in this setting.

4. DATA, RESEARCH DESIGN, AND DESCRIPTIVE STATISTICS

4.1. Data and sample selection

The key piece of data required for this study is the identity of the pension actuary, which is not disclosed on the plan sponsor's SEC filings. Every qualified defined-benefit plan, however, is required to file an annual report (Form 5500) with the IRS, DOL, and the Pension Benefit Guaranty Corporation, which includes a statement from the plan's Enrolled Actuary, with her name, enrolment number, and name and address of the actuarial firm. The database of Form 5500 filings, obtained from the DOL's Employee Benefits Security Administration, consists of almost 400,000 filings for 2000-2008 ("the universe" of plan filings); filings for 2000-2007 (2008) are complete (incomplete).[15] Each plan files a separate Form 5500, with multiple filings possible for a firm in a year. Note

[14] Landmark cases against actuaries include *Mertens v. Hewitt Associates*, where beneficiaries of Kaiser Steel's pension plan sued Hewitt for assumptions that led to inadequate funding and eventual plan termination. The actuary was also accused of delegating assumption-setting to the sponsor. Claims have also centered on specific assumptions, e.g., *Steiner Corp Retirement Plan v. Johnson & Higgins* (annuities versus lump sum payments), *Pappas v. Buck Consultants* (discount rates) that under-estimated plan liabilities. In another landmark case, the Pension Benefit Guaranty Corporation (PBGC) sued George Buck Actuaries for aggressive assumptions that led to funding deficits that the PBGC eventually had to cover.

[15] I start the sample in 2000 as some key plan features required as controls (*%FROZEN, %CASHBAL*) are unavailable in the pre-2000 format. I end the sample in 2008 as the new format post-2008, to accommodate Pension Protection Act (PPA) 2006 requirements, made other controls (e.g., for plan duration) unavailable or defined differently. A partial set of 2008 filings (for which measurement year ended before the new rules phased in) exists under the pre-2007 format.

that all entities with ERISA-qualified plans file Form 5500s, including privately held firms, foreign firms unlisted in the U.S., partnerships, and not-for-profit entities.

To conduct the study, data on discount rates, firm characteristics, and auditors from SEC filings have to be matched to the Form 5500 data. All data from SEC filings are obtained from Compustat Fundamental, Compustat Pensions, and Audit Analytics; there are 6,657 firm-year observations with sufficient data (the "potential sample"). Matching Compustat to Form 5500s is challenging, as there is no common firm-level identifier. The Form 5500 identifies plan sponsors by name and Employer Identification Number (EIN), while Compustat provides EINs; but when firms have multiple EINs, Compustat provides only one. Hence, I match the data in a multiple-step, iterative process (detailed in Appendix A), which matches 73% (80%) of the potential sample for 2000-2008 (2000-2007) to Form 5500s, yielding 4,864 matched observations. I drop all observations from 2005 –Form 5500s are available for this year but many fields (e.g., the number of beneficiaries) are "0" for almost all filings, indicating widespread coding errors for that year. The final sample has 4,169 firm-year observations. As assumptions in financial reporting are disclosed at the firm-level (and not individual plan-level), all tests are run at the firm-year level; control variables from the Form 5500 are aggregated across all plans sponsored by the firm in that year.

4.2. Measuring client importance

4.2.1. Size-based measure of client importance

Conceptually, client importance is the ratio of quasi-rents from each client, to the professional's total quasi-rents from all sources (DeAngelo, 1981; Chung and Kallapur, 2003). Assuming that fee revenues from each client are a good proxy for quasi-rents, the

audit literature has often used the ratio *fee revenues from each client / total fee revenues of the professional in that period* to measure client importance. Data on actuarial fees, however, are problematic for a few reasons detailed in the next section. Prior to required disclosure of audit fees, the literature defined client importance as the size of each client relative to the combined size of the auditor's client portfolio in that period.[16] This requires the assumption that quasi-rents from each client are strongly correlated with client size. I follow this approach to create a size-based measure of client importance to the actuary, using the number of beneficiaries to measure plan size:

EIMP = Number of employee beneficiaries of each client firm's plans/Total number of employee beneficiaries of all plan clients of that actuary in that period

A key issue here is what level at which to define the client portfolio in the denominator. While audit literature has considered both firm and practice-office levels, the practice-office is believed to be more relevant, as it is the decision-making unit that contracts with clients and makes recommendations (Reynolds and Francis, 2001). With the data available in this setting, I measure client importance at three levels: the actuarial firm level ('national' - $EIMP_{NAT}$), the practice-office level ('office' - $EIMP_{OFF}$), and level of the Enrolled Actuary signing the Form 5500 ('individual' - $EIMP_{IND}$).

4.2.2. Fee-based measure of client importance

Actuarial fee data suffer from many limitations. First, data on professional fees paid by the plan appear on the Form 5500's Schedule H, which is required only for 'large plans' (with more than 100 participants), which are only about 25% of the universe of filings. Second, fee data are missing even for about 45% of large plan filings, as fees are only disclosed when paid directly by the plan (as opposed to by the plan sponsor).

[16] Examples of such client importance measures are found in Stice (1991), DeFond (1992), Lys and Watts (1994), Krishnan and Krishnan (1996), Reynolds and Francis (2001), and Gaver and Paterson (2007).

Finally, Schedule H requires only aggregated information on total professional fees paid; not only to the actuary but also to benefit plan auditors, valuation experts, and lawyers.[17]

Notwithstanding these limitations, I construct a fee-based measure of client importance to supplement *EIMP*. I first assume that professional fees largely reflect actuarial fees, as disaggregated fee data (available for 1992-1998, due to different erstwhile disclosure requirements) show that actuarial (accounting) fees comprise 85% (8%) of total fees for the median firm, with legal and valuation fees only negligible. The larger issue is that fees are unavailable for much of the universe of plan filings, making measurement of the denominator (total fees from the actuary's client portfolio) very incomplete. As a solution, I first construct a plan-level model to explain fees, for all filings with available data, and then use coefficients from this model to predict fees for filings without fee data. I then measure total fees for the actuary's client portfolio with disclosed fees when available, and predicted fees otherwise. In this manner, I construct fee-based measures of client importance ($FEEIMP_{NAT}$, $FEEIMP_{OFF}$, $FEEIMP_{IND}$) for all plan sponsors for which the numerator (fees paid by that plan sponsor) is disclosed.

Appendix B presents the model for plan professional fees. I look to audit fee models (e.g., Whisenant et al., 2003) to motivate determinants. Actuarial effort, and fees, should increase with plan size (measured in beneficiaries, liabilities, and assets), and with plan complexity, which is a many-faceted concept. I capture many aspects of it: duration (plans with active beneficiaries have uncertainties in actuarial estimates of retirement, form of benefit, etc., which have largely been resolved in plans with mostly retired beneficiaries); financial status (weaker plans require the effort to calculate required

[17] Disaggregated fees are disclosed on the Form 5500 Schedule C, but Schedule C data also suffer from incomplete samples. Fees also have to be disaggregated only when they exceed $5,000 each.

contributions, how to amortize deficits, etc.); and other aspects, such as actuarial methods used. I include fixed-effects for year, year-end, sponsor's industry, location, and actuary. The adjusted R^2 is 55.3%, lower than those in audit fee models (which are in the 70-80% range) but still reasonable. Most of the R^2 comes from plan size, similar to audit fee models; this also helps to justify the size-based measure to some extent.

On the one hand, fees may more closely reflect quasi-rents, but fee data are low quality; on the other hand, size, while only a surrogate for quasi-rents, is broadly available and measured consistently. I use both *EIMP* and *FEEIMP* measures in baseline tests, recognizing the limitations of each, to triangulate the evidence. Due to the many issues with fee data, however, I view *EIMP* as the primary measure of client influence.

4.3. Specification

I use the following specification to test the hypotheses.

Discount rate = *f*(*Client importance*, *actuary size*, fundamental determinants of the discount rate, plan characteristics, firm characteristics, auditor characteristics) + ε

$$DR = \alpha_0 + \alpha_1*IMP + \alpha_2*EMKT1\text{-}5\% + \alpha_3*EMKT5\text{-}10\% + \alpha_4*EMKT10\% + \beta_1*CPLI + \beta_2*\%ACTUNVEST + \beta_3*\%ACTVEST + \beta_4*\%RETIRED + \beta_5*NORMCOST + \beta_6*DISBURSE + \beta_7*\%FROZEN + \beta_8*\%CASHBAL + \beta_9*SC/SCIC + \beta_{10}*HORIZON + \gamma_1*LnFVPA + \gamma_2*LnEMPS + \gamma_3*\%FUNDING_{EXP} + \gamma_4*\%UNION + \gamma_5*COMPLEXITY + \delta_1*LnFIRMSIZE + \delta_2*LEV + \delta_3*MTR + \delta_4*ROA + \delta_5*CFO + \delta_6*SIGMACFO + \lambda_1*\%F5500BIG4 + \lambda_2*\%LIMSCOPE + \lambda_3*10KBIG4 + \lambda_4*AUDFEEIMP + \lambda_5*AUDOFFICEN + Year\ dummies + Fiscal\ year\text{-}end\ dummies + \varepsilon \quad \text{(Equation 1)}$$

All variables are measured as of the end of fiscal year or plan measurement year. Appendix C defines each variable in detail. The dependent variable *DR* is the discount rate used to estimate the PBO on the plan sponsor's financial statements. I include three indicators to test *H1* on the difference between large and small actuarial firms: *EMKT1-5%* (*EMKT5-10%*, *EMKT10%*), to represent actuarial firms with 1-5% (5-10%, >10%)

size-weighted market share of the Form 5500 universe. *H1* predicts that α_2 (α_3, α_4) < 0. *IMP* stands for the client importance measures, and *H2* predicts that $\alpha_1 > 0$.

The model includes four groups of control variables. First, observed variation in discount rates could be driven either by real economic differences across plans and time periods, or by the discretionary choice of assumptions. Therefore, it is essential to control for non-discretionary, or fundamental variation in the discount rate, which is a function of the prevailing yield on high-quality bonds as well as the duration of the liability. To capture prevailing high-quality bond yields, I include the Citigroup Pension Liability Index for the fiscal year-end month (*CPLI*). This is derived from the Citigroup Pension Discount Curve, a SFAS 87-compliant yield curve commonly used by plan sponsors.

As pension duration is not required disclosure either in 10-Ks or in Form 5500s, I use available disclosures to construct a series of proxies. Following Naughton (2011), I break the pension liability down into active unvested (*%ACTUNVEST*), active vested (*%ACTVEST*), terminated, and retired (*%RETIRED*) components. Active unvested liabilities have the highest duration (as these employees were hired relatively recently), followed by active vested liabilities. Retired beneficiaries (already receiving benefits) have the lowest duration. Per Naughton (2011), I incorporate the 'normal cost', or benefits accrued during the year — which will be higher for plans with beneficiaries still actively accruing benefits (*NORMCOST*); and benefits expected to be disbursed in the year — which separates plans that expect to pay down benefits quickly, e.g., due to lump sum withdrawals (*DISBURSE*). I also include the proportion of employees in hard-frozen plans (%*FROZEN*), as these plans have stopped accruing benefits and so have declining durations (Fried et al., 2010), and in cash-balance plans (%*CASHBAL*), for which lump-

sum withdrawals are more common. Finally, I include two common proxies for duration constructed from 10-K disclosures: the ratio of service cost to interest cost (*SC/SCIC*), which should be higher for longer-duration plans, and the weighted-average remaining service life of beneficiaries (*HORIZON*), inferred from the relation between the projected benefit obligation and the accumulated benefit obligation (Amir and Benartzi, 1999).

Second, I control for plan characteristics associated with incentives or ability to manipulate discount rates: plan size, with the natural logarithm of fair value of plan assets (*LnFVPA*) and total beneficiaries (*LnEMPS*), and funding status ($\%FUNDING_{EXP}$), as larger plans and underfunded plans have stronger incentives to choose obligation-reducing assumptions. As the funding status itself is a function of the assumptions chosen, I estimate a hypothetical, 'non-discretionary' PBO and funding status assuming an industry-median discount rate and salary growth rate, and standard post-retirement life expectancy of 15 years, following Hann, Lu and Subramanyam (2007). I also control for collective bargaining (%*UNION*), as union presence could make it harder to reduce benefits, making managers resort to managing assumptions to lower the reported PBO. I also incorporate an index capturing the complexity of the actuarial valuation in the current year, in terms of methods used and changes thereof (*COMPLEXITY*).

Third, I control for the plan sponsor's financial health: the natural logarithm of assets (*LnFIRMSIZE*), leverage (*LEV*), marginal tax rate (*MTR*), profitability (*ROA*), and level (*CFO*) and volatility (*SIGMACFO*) of operating cash flows. Fourth, as auditors can constrain attempts at manipulation, I control for quality of the 10-K auditor with a Big 4 indicator (*10KBIG4*) and practice-office size (*AUDOFFICEN*) (Francis and Yu, 2009). One concern is that *EIMP* or *FEEIMP*, being correlated with client size, is picking up

client importance to the *auditor*, who may be more inclined to allow obligation-reducing assumptions for larger clients. I hence control for the client's fee importance to its audit office (*AUDFEEIMP*). I also control for quality of the Form 5500 audit with indicators for Big 4 (*%F5500BIG4*) and limited-scope audits (*%LIMSCOPE*), which are common in this setting. The model includes fixed-effects for year, fiscal year-end, and for actuarial firm, to allow for systematic differences in practices across actuarial firms, so as to more cleanly isolate the effects of actuarial firm-size tier and client importance.

4.4. Descriptive statistics

Table 1, Panel A, describes the discount rate *DR*. It drops steadily from a mean (median) of 7.53% (7.50%) in 2000 to 5.85% (5.75%) in 2004, and then rises, with annual standard deviation ranging from 23-33 bps. Panel B describes controls. The *CPLI* broadly tracks movement in, but is consistently lower than *DR*. The median plan has 4% (39%) active unvested (vested), and 41% retired liabilities, with median normal cost (disbursement) 3.8% (5.3%) of the liability. On average, 3% (19.1%) of plan assets are in hard-frozen (cash-balance) plans. The service life remaining is 3.6 (2.7) years.

The mean (median) plan has about $1.5bn ($218m) in assets and 18,700 (4,500) employees. Non-discretionary funding status is 87.4% (84.2%). On average, 25% of plan assets are in collectively bargained plans. The median plan sponsor has about $2bn in assets, debt of 28.2% of assets, and earnings (CFO) of 4.5% (8.9%) of assets (before pension expense or contributions).[18] 61% (63%) of plan assets, on average, have big 4 benefit plan auditors (a limited-scope benefit plan audit). Almost 96% of firms have a

[18] Sample firms are larger, more profitable, and have stronger cash flows than plan sponsors excluded from the sample. Their plans tend to be larger, with more retirees, cash-balance features, and unionization.

Big 4 auditor for the 10-K. The mean (median) sponsor accounts for 14.7% (5.6%) of audit practice-office fees, and the number of clients of the practice-office is 56 (26).

Table 2, Panel A, describes the actuarial services market. The 'large' actuarial firms, defined as those with over 10% size-weighted market share, hold about 60% of the market. [19] Medium-size actuarial firms with 1-10% market share hold another 22%, with the rest going to 170 small firms. Panel B describes size-based client importance, separated by the largest actuarial firms and the rest. The average client is 8.1% of the national portfolio of a small actuary but only 0.4% that of a large actuary. This difference narrows at the practice-office level, 15.6% (for a small actuary) versus 9.1% (for a large actuary), but interestingly, reverses at the individual level, with the average client being 39.6% of an individual portfolio at a small actuary, but 44% at a large actuary. So even though large actuaries' practice-offices have more clients, their ratio of personnel to clients is also higher. Fee-based client importance (Panel C) exhibits similar patterns.[20]

4.5. Correlations

Table 3 displays selected Spearman correlations. *DR* is strongly negatively correlated with *EMKT10%*, and positively correlated with $EIMP_{NAT}$ and $EIMP_{OFF}$, but insignificantly correlated with *FEEIMP* measures. *EIMP* and *FEEIMP* measures at each level are positively correlated with each other (correlations range from 0.64-0.73). *DR* is strongly correlated with most economic determinants (except *SC/SCIC*) in the expected direction. Smaller, more leveraged, less profitable firms with poor and volatile cash flows

[19] The large (medium-size) firms are Towers Perrin, Mercer, Watson Wyatt, Hewitt, and Segal (Buck, Mellon, Aon, Milliman, PwC, PRIAC, JP Morgan Benefit Strategies, and Chicago Consulting Actuaries).
[20] A caveat is that these measures only capture the importance of each sponsor relative to the actuary's portfolio of ERISA-qualified defined-benefit plans for which it does actuarial valuation work. Actuaries have other sources of revenue (for e.g., non-actuarial services) for which data are not available and so are excluded from the denominator.

use higher discount rates, while firms with high marginal tax rates use lower discount rates, consistent with Bodie et al. (1987) and Asthana (1999). Larger actuarial firms attract larger plan sponsor clients. Economically important clients have older beneficiaries, lower accruals, and more upcoming disbursements (i.e., lower duration).

5. EMPIRICAL RESULTS

5.1. Does actuary firm size and client importance associate with discount rates?

Table 4, Panel A, presents Equation (1), incorporating $EIMP_{NAT}$, $EIMP_{OFF}$, and $EIMP_{IND}$ in turn, and then simultaneously. As expected, *CPLI*, *%ACTUNVEST*, *NORMCOST* (*DISBURSE*, *%FROZEN*, *%CASHBAL*) are positively (negatively) associated with discount rates. Larger plans in smaller firms use higher discount rates, possibly due to stronger incentives to understate the PBO when it is an economically significant liability. Less profitable firms with poorly funded plans also use aggressive discount rates. *SC/SCIC* is inexplicably negative and significant in all specifications.

All specifications incorporate actuarial firm fixed-effects. The actuarial firm fixed-effects are jointly significant at <1% level, indicating that there are systematic differences across actuarial firms in the methodologies and practices used to determine discount rates. Across all models, *EMKT1-5%*, *EMKT5-10%*, and *EMKT10%* are negative, and *EMKT10%* is always significant at the 10% level or less. The coefficients indicate that clients of the largest actuarial firms, on average, use discount rates about 7-10 bps lower than clients of the smallest firms. Of client importance measures, $EIMP_{NAT}$ is insignificant, but $EIMP_{OFF}$ and $EIMP_{IND}$ are both significant at 5% level or less, individually. The relative insignificance of national-level client importance suggests that the office and the individual are the more relevant decision-making units in this setting.

$EIMP_{OFF}$ and $EIMP_{IND}$ continue to be significant in the final model with all three levels of *EIMP* included. These results are, therefore, broadly consistent with *H1* and *H2*.

Many controls that are new to the literature show interesting coefficients. Firms with union presence have more conservative rates, consistent with unions monitoring pension reporting. When actuarial valuations are more complex, discount rates again tend to be lower. I conjecture that actuaries (defensively) set assumptions conservatively when there is more complexity. Further, sponsors that are important clients of their *auditors* use *more* conservative discount rates. The effect of audit client importance, while opposite to that of actuary client importance, is consistent with the Reynolds and Francis (2001) and Gaver and Paterson (2007) findings that auditors require more conservative reporting of important clients, because they face potentially heightened litigation risk for such clients. Larger audit offices also enforce more conservative assumptions.

Panel B replicates the tests with fee-based measures, for the smaller sample for which plan sponsor fees (for the numerator of client importance) are disclosed. $FEEIMP_{NAT}$ is insignificant, while $FEEIMP_{OFF}$ and $FEEIMP_{IND}$ are significant, individually and in conjunction. The coefficient on *EMKT10%*, while negative, is however insignificant. In untabulated tests, it becomes significant when *EMKT1-5%* and *EMKT5-10%* are removed, i.e., when comparing the largest actuarial firms to all other firms. Coefficients on control variables are broadly consistent with Panel A. As results with *FEEIMP* measures mostly confirm results with *EIMP* measures, I focus on *EIMP* measures in further tests.

5.2. The effect of client importance: partitioning by client incentives and opportunities

H3 posits that the effect of client importance is stronger in, or driven by, financially weak plan sponsors that have inherently strong incentives to inflate discount rates. Table 5 presents results of estimating each specification from Table 4, separately within subsamples by 'total' leverage (*TLEV*), which combines plan sponsor leverage with any underfunding in pension and healthcare plans. The low (high) *TLEV* subsample has a mean *TLEV* of 20% (43%). In the low-*TLEV* subsample, all three levels of client importance are insignificant, individually and simultaneously. In the high-*TLEV* subsample, on the other hand, $EIMP_{OFF}$ and $EIMP_{IND}$ are strongly significant, individually and incrementally to each other. Financially weak plan sponsors hence drive the effect of client importance, consistent with *H3*.[21] An interquartile shift in $EIMP_{OFF}$ and $EIMP_{IND}$ together translates into about 5 bps shift in *DR*. While this is only a modest effect in absolute terms, it is about 15% of the annual standard deviation in *DR*. Further, for comparison, an interquartile shift in $\%FUNDING_{EXP}$, a key determinant from prior work, translates into a 2.6 bps shift in *DR*.[22]

H4 and *H5* posit that the effect of client importance manifests more in, or is driven by firms for which other aspects of the monitoring environment are weak, allowing more opportunities for manipulation. Audit oversight is one such aspect of

[21] Throughout the study, I present results of estimating Eq. (1) separately within subsamples, rather than presenting an interacted model of the form $DR = \alpha_0 + \alpha_1 * EIMP + \alpha_2 * SUBSAMPLE + \alpha_3 * SUBSAMPLE * EIMP$. The objective here is to establish whether client importance matters, and if so, when and in what groups of firms. Hence, in the above model, the coefficient of interest is not α_3 (which captures how, e.g., *TLEV* affects the association between *EIMP* and *DR*), but α_1 and $\alpha_1 + \alpha_3$, which capture the effect of *EIMP* in each subgroup. I conclude that a partially interacted model (i.e., interacting only *EIMP* while restraining coefficients on controls to be the same across groups) is not appropriate, as coefficients on many controls differ significantly across groups. Running a fully interacted model (i.e., interacting the full Eq. 1 with subsample indicators) and testing $\alpha_1=0$ and $\alpha_1 + \alpha_3=0$, gives virtually identical results to those documented.

[22] Interquartile shifts in *DISBURSE*, *AUDFEEIMP*, and *AUDOFFICEN* (all significant regressors) imply 2 bps, 1 bps, and 1.5 bps shift in *DR*. There is also some indication that client importance effects are non-linear: in alternative specification that replaces $EIMP_{OFF}$ with indicators for levels of $EIMP_{OFF}$ (<1%, 1-5%, 5-25%, >25%), the largest clients' discount rates are 12 bps higher than the smallest clients'.

monitoring that could constrain manipulation, even (or especially) for important clients. To identify variation in auditor oversight of the actuary's work, I exploit an institutional feature specific to this setting. In addition to the financial statements audit (by SEC requirement), defined-benefit plans are also subject to an independent, plan-level regulatory audit (by ERISA requirement), which requires an audit report filed with the Form 5500. ERISA, however, allows plans to obtain only a limited-scope audit, under certain circumstances.[23] In such audits, the auditors usually disclaim an opinion on plan statements. It is unclear what audit procedures have been performed in such audits, and so the level of assurance provided is low (DOL, 2012). I partition the sample by whether plans have been subject to a full-scope or limited-scope audit (*%LIMSCOPE*).

As the effects of client importance are concentrated in high-*TLEV* firms, I partition the high-*TLEV* sample by *%LIMSCOPE* (Table 6). $EIMP_{OFF}$ is positively significant only in firms with limited-scope audits; in fact, when all three measures are included together, $EIMP_{OFF}$ becomes negative and marginally significant in the subsample with full-scope audits. The effect of $EIMP_{IND}$, however, manifests in both full-scope and limited-scope subsamples. Overall, Table 6 only shows only weak and mixed evidence in support of *H4*. The size of the actuarial firm could also affect opportunities to manipulate (*H5*). Table 7 presents results of partitioning the high-*TLEV* sample by *EMKT10%*. Interestingly, $EIMP_{OFF}$ and $EIMP_{IND}$ are positive and significant in both large and small actuarial firms. Separating actuarial firms into small, medium (1-10% market share), and large (more than 10% share) also does not change inferences. Overall, there is no evidence to support *H5*.

[23] Plans may request auditors not to perform procedures to test assets (for existence, valuation, etc.), as long as this information is prepared and certified by a trustee or custodian who is a bank/insurance carrier/ institution that is regulated and supervised by a government agency (ERISA 103(a)(3)(C)).

One interesting pattern from the subsample tests is that the negative coefficients on large actuary indicators from the baseline tests, appear confined to subsamples of financially strong, well-funded clients whose incentives to inflate *DR* are expected to be weak (Table 5), and to clients with strong auditor oversight (Table 6). Table 5, for example, shows the largest actuaries are associated with discount rates about 20 basis points lower than the smallest (a very economically significant difference), but only amongst clients that are not strongly motivated to inflate discount rates. Within strongly motivated clients, these differences are insignificant.

6. DISCUSSION OF RESULTS AND ADDITIONAL ANALYSIS

The results so far suggest that proxies for actuaries' incentives associate with observable differences in clients' discount rates. While broadly consistent with important clients using influence to tilt actuarial recommendations in the desired direction, these findings call for careful interpretation, and in turn raise many more questions.

6.1. Interpreting coefficients on size-based client importance measures

The association tests presented here are subject to the concern of correlated omitted variables. Client importance is essentially a measure of relative size (the size-based measure in particular, but to some extent even the fee-based measure, as fees correlate strongly with size); so larger plans tend to be more important plans, on average.

One key point here is that plan size has no *intrinsic* relation to the discount rate, which is only a function of the yield curve on high-quality bonds, and the plan duration. In other words, in the absence of manipulation, if discount rates were set purely based on economic fundamentals, there is no conceptual reason to expect larger plans to have higher discount rates. This is in contrast to other assumptions such as the ERR: larger

plans not only have economies of scale in investment administration and management, but also have access to a broader set of investment opportunities, both of which predict higher ERRs for larger plans, even in the absence of manipulation. Moreover, empirically, larger plans tend to also be older plans, with shorter durations (Table 3). Assuming an upward-sloping yield curve (as is the case in the sample period), shorter-duration plans have lower discount rates, predicting a *negative* association between plan size and *DR*. Thus, to the extent to which duration has not been fully controlled for, it biases *against* finding a positive relation of client importance to the discount rate. [24]

6.1.1. Looking within client firms to mitigate correlated omitted variable concerns

A major concern with the use of size-based client importance measures, is that larger plans simply have stronger incentives to inflate discount rates – as any '*x*' basis points rise in *DR* translates into a larger absolute reduction in obligations for larger plans. Therefore, the positive coefficient on *EIMP* could simply be capturing the correspondingly stronger incentives of large plans to inflate discount rates. This concern is mitigated by the similar results with *FEEIMP*, but *FEEIMP* measures come with many caveats, and even fees are ultimately strongly correlated with plan size.

While larger plans have stronger incentives to inflate *DR*, it is not immediately obvious that they have the ability to do so. Holding actuarial client importance constant, larger plans – and larger firms – face more scrutiny from analysts, investors, unions, regulators, and auditors, which could constrain their ability to manipulate assumptions. But while the ultimate direction of this effect is unclear, the broader issue of correlated

[24] However, larger actuaries attract larger clients (Table 3), with lower duration, and so lower discount rates. This works in the same direction as *H1*, and is difficult to disentangle, in the absence of perfect controls for duration. The specifications here use a set of duration controls that are much more comprehensive than extant literature, and control for it to the extent possible with publicly available data.

omitted factors at the plan sponsor-level remains (e.g., corporate culture, governance, monitoring technology, manipulability of other accounts).

To mitigate effects of firm-specific unobservables, I rerun the tests with fixed-effects at the client firm level (Table 8). As shown, $EIMP_{OFF}$ is insignificant in the whole sample, but is significant at <5% level in the high-*TLEV* subsample (and insignificant in the low-*TLEV* subsample). As these specifications use only within-client, over-time variation in *EIMP*, and as plan size itself is sticky over time, over-time variation in *EIMP* comes mainly from switching actuaries, and from other changes to the actuary's client portfolio. This is confirmed by restricting the high-*TLEV* sample to clients that have switched actuaries at least once in the period (Column 4): $EIMP_{OFF}$ is highly significant in this group, but insignificant in firms that do not switch (untabulated). In contrast to the Table 4 results, $EIMP_{IND}$ is insignificant, possibly due to the much lower testing power in these specifications. *EMKT10%* is also insignificant, possibly due to the fact that clients do not appear to switch actuary size categories often.[25] Overall, the robust effect of $EIMP_{OFF}$, even in the stricter within-client specifications, adds confidence that $EIMP_{OFF}$ coefficients are not an artifact of firm-specific, time-invariant, unobservable factors.[26]

6.1.2. Looking within partitions by plan size

[25] Out of the 511 actuary switches (in high- and low-*TLEV* samples together), only 21% are switches from *EMKT10%*=1 to *EMKT10%*=0 (or reverse), with a majority of the switches within actuaries of similar size.

[26] Client importance could also capture complexity. Complex plans could have greater uncertainty, leading to a wider recommended range, and more leeway for managers to use a higher rate from within the range. First, while uncertainty can widen the range, there is no reason to expect a widening of the range to always correspond to its upper bound moving to the right, in the absence of client pressure for an aggressive assumption; e.g., a recommendation of 7-7.5% might just as well widen to 6.75–7.75%, or even to 6.5-7.5%, as to 7-8%. Second, it is not clear that larger clients always bring more uncertainty. Note that much uncertainty with inputs has been resolved in plans with older beneficiaries, and, so larger plans, which are typically also older plans, might actually be *less* complex. Third, effects of complexity are mitigated by extensive controls for its various aspects (to the extent to which they are time-varying), and by the within-client firm specifications (to the extent to which they remain constant over time).

EIMP (or *FEEIMP*), while correlated with absolute plan size, really measures *relative* size (especially as the model controls for absolute plan size). It is, hence, driven not only by the size of each plan sponsor, but also by its choice of actuary, how many other clients that actuarial practice-office has, and how big those clients are. To further verify this interpretation of *EIMP*, I separate the high-*TLEV* sample into subgroups by plan size, and examine the effect of *EIMP* separately within each subgroup. The idea is to hold absolute plan size constant, and so isolate more cleanly the variation in, and effect of relative size. If *EIMP* effects in the baseline tests are driven by absolute plan size, then *EIMP* will not necessarily load strongly *within* any of the subgroups.

I partition the sample into quartiles, to strike a balance between homogenous size and a reasonable number of observations in each subgroup (Table 9). The results are very interesting. $EIMP_{OFF}$ is significant even within these quartiles, but not uniformly so: it is insignificant in the two higher quartiles, but significant in the two lower quartiles with smaller plans. These results raise two key points. First, the fact that *EIMP* loads even within subgroups suggests that its effect is not entirely an artifact of absolute plan size, and that *relative* size is an important driver of the *EIMP* effect. Second, however, the fact that $EIMP_{OFF}$ is not uniformly significant in all subgroups suggests that absolute size matters too, as a conditioning variable. For plans that are large in absolute terms, relative size (*EIMP*) does not matter – they do not have more aggressive assumptions even when they are important clients of their actuaries, perhaps because they face more constraints to manipulation (greater external scrutiny, stronger governance mechanisms, etc.).

While these results pinpoint the source of the effects more clearly, they are also relevant to correlated omitted variables concerns relating to plan size. Putting the two

observations together, the plans that successfully exert pressure are not necessarily the largest in absolute terms. In fact, they are amongst the smaller plans in the sample, but happen to be important to their actuary. Small plans that are also high-$EIMP_{OFF}$ must have chosen a small actuarial practice-office. This suggests that the phenomenon documented here is driven by smaller plans (which are subject to less scrutiny) combined with smaller practice-offices (which, perhaps, have fewer checks and balances).

6.2. Who drives the observed discount rate: the actuary or the manager?

Thinking about actuarial recommendations as a range raises a key question: what if the range recommended by the actuary is appropriate, but managers exercise their own discretion to pick a higher point within the range? If so, actuaries are not directly involved with aggressive choices. Here, it is the financial reporting environment – where representations must be audited (by auditors, who in turn have strong incentives to be objective and exercise due care), that effectively constrains managers from choosing their own estimate minus involvement from the actuary. From descriptions of current audit practice and conversations with auditors and actuaries, it is highly unlikely that auditors will accept an assertion from management about any assumption, in the absence of sign-off from the designated specialist — in this case, the actuary. Further, once a certain practice (such as using the mid-point of the recommended range) has been established, attempts to change will be met with auditor scrutiny. In such an environment, managers motivated to manipulate assumptions would need the implicit consent of the actuaries, who must ultimately certify to auditors that the assumptions are reasonable.

Even so, this study does not take the actuary's involvement for granted – to the contrary, the tests here can be viewed as an empirical examination of this very question:

are managers acting on their own in choosing aggressive discount rates, or do actuaries also have to be complicit, or involved, in any such effort? If aggressive discount rate choices are driven purely by managerial discretion in choosing point estimates within the recommended range, then we would not necessarily expect a positive association between the importance of the plan sponsor *to the actuary*, and the discount rate chosen, as potentially any manager, regardless of whether or not he is an important client of his actuary, can choose a higher rate, subject only to other constraints such as scrutiny from directors, auditors and analysts. But if any effort to choose aggressive rates requires actuaries to act in concert with managers, then actuaries are more likely to acquiesce to more influential clients, which in turn predicts the positive association between client importance and discount rates. Therefore, managers being constrained from acting on their own – and actuaries being involved – in attempts to raise assumptions, is a necessary condition for observing that client importance matters.

6.3. Who drives the observed discount rate: the actuary or the auditor?

The results make it evident that both actuaries and auditors play key roles in pension reporting. Their roles are different but related: client importance from the perspective of both actuary and auditor is incrementally associated with discount rates; and the effect of actuarial client importance is, to some degree, conditional on auditor oversight. This study's focus on the actuary should not be interpreted to mean that the actuary's role is more important than the auditor's. If data on (pre-audited) internal recommendations made by actuaries were available (which they are not), they could then be contrasted with the final assumptions used, which might differ from pre-audited

numbers due to the auditors' adjustments. While this would help disentangle the auditor's effect on the process from the actuary's, lack of data makes such a test infeasible.

6.4. Expanding the scope to other actuarial assumptions

Demographic assumptions also have considerable impact on the PBO, and in many ways provide an ideal setting to examine the actuary's role. These assumptions are, however, not disclosed in a tractable form on the Form 5500.[27] One economic assumption that also affects the PBO is the salary growth rate. In an effort to capture discretion in both *DR* and the salary growth rate together, I estimate the 'discretionary' funding status ($\%FUNDING_{DISC}$) with reported minus non-discretionary funding status ($\%FUNDING - \%FUNDING_{EXP}$), and replace *DR* with $\%FUNDING_{DISC}$. $EIMP_{OFF}$ and $EIMP_{IND}$ remain strongly positively associated with $\%FUNDING_{DISC}$.

7. CONCLUSIONS

I examine whether incentives of the pension actuary affect the discount rate assumption used to estimate pension obligations on plan sponsor financial statements. With a sample from 2000-2008, I find first that clients of larger actuarial firms (that are presumably subject to stronger litigation- and reputation-based incentives to remain independent) use more conservative (obligation-increasing) discount rates, and second that economically important clients use more aggressive rates, compared to less important clients of the same actuary. The effect of client importance is driven by financially weak plans that have strong underlying incentives to decrease the reported pension obligation,

[27] For example, plans have to identify the mortality table used from a list of options on the Form 5500, but about 30% of plans pick the "Other" category without specifying the table they actually use; many other plans use modified versions of the tables listed. Another interesting demographic assumption disclosed is the weighted-average retirement age. A lower (i.e., early) retirement age implies more years of benefits paid, but also implies reduced benefit levels, making the overall effect on the obligation difficult to predict.

but further analysis also suggests that the effects are driven by smaller plans in combination with smaller actuarial practice-offices.

Overall, these findings are consistent with actuaries playing a key role in pension reporting. Yet, this study takes only the first step in examining that role, and suffers from many limitations. First, the assumptions originally recommended by the actuary are not available; only the assumptions finally used are. Second, actuaries set many economic and demographic assumptions together, not simply the discount rate. Third, the fundamentals drivers of the discount rate are incompletely specified, as pension duration is not available. Fourth, client importance is measured with noise, and in particular does not consider non-actuarial services, for which data are mostly unavailable. Finally, cross-sectional associations cannot establish that client importance exerts a causal effect on assumptions. If the relevant data should eventually become available, addressing these issues would expand upon, and test the robustness of, the results presented here.

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Appendix A: Sample selection and matching 10-K filings to Form 5500s

Table A.1: Sample evolution

Sample selection criterion	*Observations*
Firm-year observations in Compustat Pensions for 2000-2008	27,223
Observations with non-missing, non-zero pension liabilities	20,566
Observations with all data available from Compustat Fundamentals & Pensions for dependent & control variables	7,933
Observations with auditor data available from Audit Analytics ("Potential Sample")	6,657
Observations with all Form 5500 data	4,864
Observations for 2005 removed (due to Form 5500 Schedule B Introduction information uniformly set to "0" for majority of filings)	(695)
Final sample	4,169

Procedure for matching Potential Sample to Form 5500s

1. The only common identifier across Compustat and Form 5500s is the Employer Identification Number (EIN). The EIN does not provide an exact match, though, as a firm may have multiple EINs (Single-unit firms, defined as those with only one establishment, have only one EIN. Multi-unit firms – firms with at least two establishments – could have a cluster of many EINs). It is common for firms to make Form 5500 filings under different EINs, making an automated match on EINs noisy and incomplete. As a first step, I expand on the list of Compustat-provided EINs and make it more complete. Unfortunately, no comprehensive, public database of EINs exists, or any lookup service for the same. However, some private data providers offer these services. I turn over all *GVKEY*s from Compustat Pensions with non-zero pension liabilities to Judy Diamond Associates, Inc, which offers an EIN Finder service with a database of over 7 million EINs. This service identified many EINs missing from Compustat, and additional EINs for multi-unit firms. With this information, I do the first round of automated matching on EINs.
2. I then look up each *GVKEY* in the Potential Sample that is still unmatched, by hand, in the Form 5500 database, by firm name. As matching on name is fuzzy, I declare a match only if the firm name, business description, and location of business all match. The Form 5500 universe consists of 396,500 filings, with 42,000-47,000 plan-level filings per year from 2000-2007, and a partial set of filings (~7,000) for 2008. When the plan measurement date does not correspond to the fiscal year-end, I match so as to minimize the difference between the plan measurement year-end month and Compustat fiscal year-end month.
3. Firms could still remain unmatched at this stage, if for example, their plans are foreign (i.e., provide benefits to non-U.S. workers), or if the Form 5500 filing is made by a majority- or fully-owned subsidiary of the firm listed on Compustat. For the unmatched firms, I search through 10-Ks and Bloomberg Businessweek online to identify subsidiary names, and repeat Step (2). This process yields many more matches particularly for utilities and to a lesser extent for financial firms, which are often held in complex ownership structures. I also look up corporate websites of the firms still unmatched to identify any name changes, and look up Form 5500 filings by old name(s). For firms still unmatched, I try to identify the reason (for example, foreign plan).

Table A.2: Match rates of Potential Sample to Form 5500 data

Year	*Potential Sample*	*Observations (%) matched to Form 5500*
Total sample 2000-2008	6,657	4,864 (73.0%)
Sample 2000-2007*	5,937	4,774 (80.4%)

*Form 5500 filings database is incomplete for 2008.

Table A.3: Potential Sample that is unmatched: Possible reasons

Possible reason	*% sample*
GVKEY-EIN match found but no Form 5500 filing for that year	36.3%
Foreign plan	20.7%
Utility: parent or subsidiary already matched	7.9%
No match found	35.1%

Appendix B: The actuarial fee model

*, **, *** indicate statistical significance at 10%, 5%, and 1% level. Robust standard errors are in parentheses. The ordinary least squares regression is run at the plan-year level for 2000-2008, with all plan filings that have non-missing, non-zero data on professional fees paid (the dependent variable) and sufficient data for all explanatory variables. All variables are from the Form 5500 and are at the plan-level.

The dependent variable is the natural logarithm of (1+total professional fees paid) ($LnFEE_{PLAN}$), where total professional fees paid are the total fees paid by the plan to actuaries, auditors, lawyers, and valuation/appraisal experts (Schedule H Item 2(i)(1)). Explanatory variables are as follows:

Plan size: $LnASSETS_{PLAN}$ is the natural logarithm of [1+current value of plan assets (Schedule B Item 1(b)(1))]. $LnLIABS_{PLAN}$ is the natural logarithm of [1+RPA '94 current liability (Schedule B Item 2(b)(4), Col (3))]. $LnEMPS_{PLAN}$ is the natural logarithm of [1+number of employee-beneficiaries (Introduction Section 7(f))].

Plan duration: $\%ACTUNVEST_{PLAN}$ (proportion of pension liabilities accrued toward active unvested participants), $\%ACTVEST_{PLAN}$ (proportion of pension liabilities accrued toward active vested participants), $\%TERMINATED_{PLAN}$ (proportion of pension liabilities accrued toward terminated participants), $\%NORMCOST_{PLAN}$ (expected increase in pension liabilities due to benefits accruing during the year), and $\%DISBURSE_{PLAN}$ (expected plan disbursements for the year) are all defined as in Appendix C, but at the plan-level. $TERMINATED_{PLAN}$, $FROZEN_{PLAN}$, and $CASHBAL_{PLAN}$ are indicator variables set to one for terminated, frozen, and cash-balance plans respectively (Introduction Item 8(a)).

Plan funding status: $FUNDING_{PLAN}$ is $ASSETS_{PLAN}$ / $LIABS_{PLAN}$. $FUNDING^2_{PLAN}$ is the square of $FUNDING_{PLAN}$.

Other aspects of plan complexity: The following are indicator variables set to one if the respective actuarial cost method is used as the basis for estimating plan liabilities for that year, and to zero otherwise: Attained Age Normal (AAN_{PLAN}), Entry Age Normal (EAN_{PLAN}), Projected Unit Credit (PUC_{PLAN}), Aggregate (AGG_{PLAN}), Frozen Initial Liability (FIL_{PLAN}), Individual Level Premium (ILP_{PLAN}), and Individual Aggregate ($IAGG_{PLAN}$) (Schedule B Items 5(a)-(g)). The following are indicator variables set to one if each of the following scenarios is true: if any change has been made in the funding method for this plan-year ($FUNDING\_METHOD\_CHG_{PLAN}$) (Form 5500 Schedule B Item 5(i)), if any waiver of funding deficiency was granted in this plan-year ($FUNDING\_DEF\_WAIVED_{PLAN}$) (Form 5500 Schedule B Item 8(a)), if any alternative methods or rules were used this plan-year ($ALT\_RULES\_USED_{PLAN}$) (Form 500 Schedule B Item 8(b)), if any changes were made to actuarial assumptions (interest rate, retirement age, mortality tables, withdrawal rates, salary scales, investment return) in this plan-year ($ACTRL\_ASS\_CHG_{PLAN}$) (Form 5500 Schedule B Item 11), and if the plan is covered by the PBGC insurance program ($INSURED_{PLAN}$) (Introduction Item 8(a)).

Fixed effects: The model also includes fixed-effects by year, plan year-end month, plan sponsor's industry by 6-digit NAICS code (Introduction Item 2(d)), plan sponsor's location by 5-digit zip code (Introduction Item 2(a)), and fixed-effects for each actuarial firm with >5% size-weighted market-share and for each actuarial practice-office and individual with >1% size-weighted market-share (with size measured by number of employee-beneficiaries of each plan).

Coefficients from Column 4 are used to compute a predicted fee for all plan filings for which fee data are missing ($FEEHAT_{PLAN}$).

	(1)	(2)	(3)	(4)
Dependent variable		$LnFEE_{PLAN}$		
$LnEMPS_{PLAN}$	**0.092*****	**0.083*****	**0.081*****	**0.076*****
	(0.00)	(0.00)	(0.00)	(0.00)
$LnASSETS_{PLAN}$	**0.013**	**0.042*****	**0.043*****	**0.041*****
	(0.01)	(0.01)	(0.01)	(0.01)
$LnLIABS_{PLAN}$	**0.449*****	**0.409*****	**0.408*****	**0.382*****
	(0.01)	(0.01)	(0.01)	(0.01)
$\%ACTUNVEST_{PLAN}$		**0.001**	**0.001**	**0.001**
		(0.00)	(0.00)	(0.00)
$\%ACTVEST_{PLAN}$		**0.001**	**0.001**	**0.001**
		(0.00)	(0.00)	(0.00)
$\%TERMINATED_{PLAN}$		**-0.005****	**-0.005****	**-0.004****
		(0.00)	(0.00)	(0.00)
$\%NORMCOST_{PLAN}$		**-0.002**	**-0.002**	**-0.002**
		(0.00)	(0.00)	(0.00)
$\%DISBURSE_{PLAN}$		**0.011****	**0.010****	**0.010****
		(0.00)	(0.00)	(0.00)
$TERMINATED_{PLAN}$		**0.303*****	**0.294*****	**0.281*****
		(0.07)	(0.07)	(0.07)
$FROZEN_{PLAN}$		**-0.050****	**-0.049****	**0.004**
		(0.02)	(0.02)	(0.02)
$CASHBAL_{PLAN}$		**0.351*****	**0.342*****	**0.335*****
		(0.02)	(0.02)	(0.02)
$FUNDING_{PLAN}$		**-0.394*****	**-0.491*****	**-0.487*****
		(0.05)	(0.06)	(0.06)
$FUNDING^2_{PLAN}$		**0.160*****	**0.158*****	**0.132*****
		(0.02)	(0.02)	(0.02)
AAN_{PLAN}		**-0.185***	**-0.107**	**-0.047**
		(0.11)	(0.11)	(0.11)
EAN_{PLAN}		**0.100****	**0.115****	**0.018**
		(0.05)	(0.05)	(0.05)
PUC_{PLAN}		**0.211*****	**0.209*****	**0.105****
		(0.05)	(0.05)	(0.05)
FIL_{PLAN}		**-0.031**	**-0.021**	**-0.014**
		(0.05)	(0.05)	(0.05)
ILP_{PLAN}		**0.284**	**0.278**	**0.226**
		(0.43)	(0.43)	(0.40)
AGG_{PLAN}		**-0.079**	**-0.074**	**-0.022**
		(0.05)	(0.05)	(0.05)
$IAGG_{PLAN}$		**0.029**	**0.055**	**0.011**
		(0.08)	(0.08)	(0.08)
$FUNDING\_METHOD\_CHG_{PLAN}$		**0.013**	**0.014**	**0.037*****

		(0.01)	(0.01)	(0.01)
FUNDING_DEF_WAIVED$_{PLAN}$		**0.136**	**0.141**	**0.274****
		(0.13)	(0.13)	(0.13)
ALT_RULES_USED$_{PLAN}$		**0.117****	**0.140*****	**0.152*****
		(0.05)	(0.05)	(0.05)
ACTRL_ASS_CHG$_{PLAN}$		**0.053*****	**0.049*****	**0.004**
		(0.01)	(0.01)	(0.01)
INSURED$_{PLAN}$		**-0.039***	**-0.051****	**-0.016**
		(0.02)	(0.02)	(0.02)
Constant	**2.414*****	**2.778*****	**2.975**	**2.717**
	(0.05)	(0.08)	(15.50)	(30.94)
Year & year-end FE	No	No	Yes	Yes
Actuarial firm, office & individual FE	No	No	No	Yes
Sponsor industry FE	No	No	No	Yes
Sponsor zip code FE	No	No	No	Yes
Observations	46,982	46,982	46,982	46,982
Adjusted R^2	0.46	0.472	0.475	0.553

Appendix C: Variable definitions

Compustat Fundamental or Pension variable names are prefixed with "#". As all Form 5500 data are at the individual plan-level and each plan sponsor could have more than one plan, all measures constructed with Form 5500 data are rolled-up to the plan sponsor-level.

Variable name	*Definition and data source*
Dependent variable	
DR	The discount rate used to discount projected future benefit payments to present value (#PBARR).
Key independent variables	
EMKT1-5% (EMKT5-10%, EMKT10%)	Indicator set to one if the actuarial firm has 1-5% (5-10%, >10%) share in the actuarial client market that year, and to zero otherwise, with market share calculated on a size-weighted basis, and client size measured by number of employee beneficiaries (Form 5500 Introduction Item 7(f)).
$EIMP_{NAT}$ ($EIMP_{OFF}$, $EIMP_{IND}$)	Size of each plan sponsor client in a particular year / Sum of sizes of all plan clients of that actuary in that year, where size is measured by the number of employee-beneficiaries of each plan (Form 5500 Introduction Item 7(f)). When a firm has more than one plan, and (i) all plans have the same actuary, the numerator is the total size of all plans of the sponsor; (ii) all plans do not have the same actuary, the actuary who handles the largest group of plans is used. The denominator is defined at the actuarial firm- (i.e., national) level for $EIMP_{NAT}$, at the actuary practice office-level for $EIMP_{OFF}$, where offices are defined using the zip code of the Enrolled Actuary's office, and at the individual Enrolled Actuary-level for $EIMP_{IND}$, where Enrolled Actuaries are identified using enrolment number with the Joint Board for Enrolment of Actuaries. Zip codes are often missing in the Form 5500 data and are manually looked up using office address. In all three cases, denominator totals are constructed using the entire universe of Form 5500 filings for single- and multi-employer plans with Schedule B (actuarial information) available and the

actuary's name listed on the Schedule B (there are ~396,500 individual filings in total, with 42,000-47,000 filings each year except 2008, which is incomplete with about 8,000 filings). The Form 5500 Schedule B must be filed by all plans subject to the minimum funding requirement of ERISA (1974).

$FEEIMP_{NAT}$ ($FEEIMP_{OFF}$, $FEEIMP_{IND}$) Professional fees from each plan sponsor client in a particular year / Sum of fees from all plan clients of that actuary in that year. The denominator is constructing by summing up disclosed professional fees (FEE_{PLAN} from Appendix B) wherever it is non-missing and non-zero, and predicted professional fees ($FEEHAT_{PLAN}$) otherwise. The measure is defined only for clients with the numerator (FEE_{PLAN}) disclosed. When a plan sponsor has more than one plan, the procedure described for *EIMP* is used. The denominator is defined at the actuarial firm-, practice-office-, or individual Enrolled Actuary-level for $FEEIMP_{NAT}$, $FEEIMP_{OFF}$, and $FEEIMP_{IND}$ respectively.

Controls for the non-discretionary variation in the discount rate

CPLI The Citigroup Pension Liability Index rate, derived from the Citigroup Pension Discount Curve (CPDC) published by Citigroup Global Markets. The CPDC is one of the yield curves developed specifically to meet the requirements of SFAS 87 (Naughton 2011). It is constructed by (i) taking the universe of non-callable corporate bonds rated Aa/AA, (ii) dividing the bonds into five buckets by maturity, ranging from 1-3 years to 25+ years, (iii) applying outlier filters to eliminate bonds with a spread more than two standard deviations away from the average spread in the bucket, (iv) calculating market-weighted average spread of the bonds remaining in each bucket, (v) interpolating the rest of the curve from these averages, and (vi) combining this curve with the Treasury Model Par Curve, converting the result into a spot curve and annualizing. The resulting curve consists of zero-coupon interest rates for 30 years in 60 half-year periods. Detailed methodology is described in Bernstein, M., 31 December 2010 "Citigroup Pension Liability Index: Revised Methology", *Citigroup Global Markets Portfolio Strategies-US.* [Source: Society of Actuaries Professional Resources: http://www.soa.org/professional-interests/pension/resources/pen-resources-pension.aspx]

%ACTUNVEST Proportion of pension liabilities accrued toward active unvested participants at the beginning of the year, calculated as Retirement Protection Act (RPA) '94 current liability accrued toward active unvested participants / Total RPA '94 current liability. [Source: Form 5500 Schedule B, (Item 2(b)(3), Col (3) – Item 2(b)(3), Col (2)) / Item 2(b)(4), Col (3)]

%ACTVEST Proportion of pension liabilities accrued toward active vested participants at the beginning of the year, calculated as RPA'94 current liability accrued toward active vested participants / Total RPA '94 current liability. [Source: Form 5500 Schedule B, Item 2(b)(3), Col (2) / Item 2(b)(4), Col (3)]

%RETIRED Proportion of pension liabilities accrued toward retired plan participants at the beginning of the year, calculated as RPA '94 current liability accrued toward retired participants / Total RPA '94 current liability. [Source: Form 5500 Schedule B, Item 2(b)(1), Col (3) / Item 2(b)(4), Col (3)]

NORMCOST Expected increase in pension liabilities due to benefits accruing during the plan year / Total RPA '94 current liability [Source: Form 5500 Schedule B, Item 1(d)(2)(b) / Item 2(b)(4), Col (3)]

DISBURSE Expected plan disbursements for the year / Total RPA '94 current liability [Source: Form 5500 Schedule B, Item 1(d)(3) / Item 2(b)(4), Col (3)]

%FROZEN Proportion of employees in hard-frozen plans [Plan employees from Form 5500 Introduction Item 7(f), Frozen plans from Introduction Item 8(a)].

%CASHBAL Proportion of employees in cash-balance plans [Plan employees from Form 5500 Introduction Item 7(f), Cash-balance plans from Introduction, Item 8(a)].

SC/SCIC Annual pension service cost (#PPSC) / [service cost + interest cost (#PPIC)].

HORIZON Weighted-average expected remaining service life of beneficiaries, estimated from the relation between projected benefit obligation "PBO" (#PBPRO), accumulated benefit obligation "ABO" (#PBACO), and assumed annual salary growth rate "SGR" (#PPRCI): $PBO = ABO*[1+(SGR/100)]^{HORIZON}$.

Controls for plan characteristics

LnFVPA Natural logarithm of [1+fair value of pension assets (# PPLAO)]

LnEMPS Natural logarithm of [1+number of employee-beneficiaries (Form 5500 Introduction Item 7(f))]

%FUNDING Fair value of pension assets (#PPLAO)/ PBO (#PBPRO).

%FUNDING _EXP The hypothetical, non-discretionary pension funding status, calculated as the fair value of assets / non-discretionary PBO. Non-discretionary PBO is estimated using industry (2-digit SIC code)-median discount rate and salary growth rate instead of firms' chosen assumptions, and life expectancy of 15 years post-retirement, following Hann, Lu and Subramanyam (2007).

%UNION Proportion of employees in collectively bargained plans [Plan employees from Form 5500 Introduction Item 7(f), collectively-bargained plans from the Form 5500 Introduction, Item C].

COMPLEXITY The complexity index is the sum of the following, all from the Form 5500 Schedule B: (i) the proportion of employees in plans for which Projected Unit Credit actuarial cost method is used (Item 5(a)-(h)) (ii) proportion of employees in plans for which any change has been made in the funding method this plan-year (Item 5(i)), (iii) proportion of employees in plans for which any waiver of funding deficiency was granted this plan-year (Item 8(a)) (iv) proportion of employees in plans for which any alternative methods or rules were used this plan-year (Item 8(b)) (v) proportion of employees in plans for which any changes were made to actuarial assumptions (interest rate, retirement age, mortality tables, withdrawal rates, salary scales, investment return) this plan-year (Item 11).

Controls for plan sponsor characteristics

LnFIRMSIZE Natural logarithm of [1+total assets (#AT)] of plan sponsor at fiscal year-end.

LEV (Long-term debt (#DLTT) + Debt in current liabilities (#DLC) + OPEB underfunding) / Total assets (#AT). OPEB underfunding is explained in *TLEV*.

MTR Pre-financing marginal tax rates, constructed in Blouin, J., J.E. Core, and W. Guay. 2010. "Have the tax benefits of debt been overestimated?" *Journal of Financial Economics* 98(2): 195-213.

ROA Income before extraordinary items and pension expense (#IB + #PPC) / Total assets (#AT).

CFO Cash flow from operations before pension contributions (#OANCF + #PBEC)/Total assets (#AT).

SIGMACFO Standard deviation of CFO over years [t-4, t]; minimum 3 years' data required.

Controls for auditor characteristics

%F5500BIG4 Proportion of pension assets that are in plans with a Big 4 or erstwhile Big 5 benefit plan auditor [The benefit plan auditor is identified from the Form 5500 Schedule H Item 3(c), only from those plans that file Schedule H].

%LIMSCOPE Proportion of pension assets in plans receiving limited-scope audits. [Limited-scope audits are identified from Form 5500 Schedule H, Item 3(b), only from those plans that file Schedule H]

10KBIG4 Set to one if plan sponsor's financial statements are audited by a Big 4 (or

erstwhile Big 5) firm, set to zero otherwise. [Auditor from Compustat #AU].

AUDFEEIMP Measures the importance of the plan sponsor to its financial statements auditor; defined as (audit fees from each plan sponsor in a particular year / Total audit fees received from all clients of the audit practice-office in that year) for the audit firm signing the plan sponsor's financial statements, with data from Audit Analytics. Audit practice-offices are identified with a combination of signing audit firm name and zip code. The denominator is restricted to clients covered by Audit Analytics.

AUDOFFICEN The size of the audit practice-office signing the plan sponsor's financial statements, in number of audit clients.

Partitioning variables

TLEV Estimate of 'total' firm leverage including debt and any underfunding in pension and Other Post-Employment Benefit (OPEB) plans, defined as [long-term debt + debt in current liabilities + pension underfunding + OPEB underfunding] / total assets. Pension underfunding is the non-discretionary projected benefit obligation – fair value of plan assets when non-discretionary projected benefit obligation > fair value of plan assets; set to zero when non-discretionary projected benefit obligation <= fair value of plan assets. OPEB underfunding is the OPEB projected benefit obligation (#PRAA)– fair value of plan assets (#PRBO) whenever the OPEB projected benefit obligation > fair value of plan assets; set to zero when the firm has no OPEB plan, or when the OPEB projected benefit obligation <= fair value of plan assets.

Table 1: Descriptive statistics of discount rates and control variables

Panel A: Discount rates

DR	*P5*	*P25*	*P50*	*P75*	*P95*	*Mean*	*SD*
Year 2000	7.00	7.50	7.50	7.75	8.00	7.528	0.328
Year 2001	6.80	7.10	7.25	7.41	7.63	7.236	0.292
Year 2002	6.25	6.50	6.75	6.80	7.25	6.740	0.320
Year 2003	5.80	6.00	6.25	6.25	6.50	6.162	0.232
Year 2004	5.50	5.75	5.75	6.00	6.25	5.848	0.290
Year 2006	5.30	5.75	5.85	6.00	6.25	5.824	0.282
Year 2007	5.75	6.00	6.25	6.41	6.60	6.226	0.289
Year 2008	5.90	6.20	6.60	7.10	8.00	6.721	0.648
Whole sample	5.64	5.95	6.25	6.95	7.60	6.426	0.665

Panel B: Control variables

	P5	*P25*	*P50*	*P75*	*P95*	*Mean*	*SD*
Economic determinants							
CPLI	5.680	5.900	6.050	6.640	7.270	6.282	0.543
%ACTUNVEST	0.002	0.019	0.038	0.064	0.141	0.049	0.044
%ACTVEST	0.132	0.287	0.386	0.502	0.732	0.401	0.177
%RETIRED	0.039	0.266	0.405	0.517	0.670	0.386	0.184
NORMCOST	0.005	0.024	0.038	0.056	0.111	0.046	0.039
DISBURSE	0.015	0.040	0.053	0.070	0.109	0.057	0.031
%FROZEN	0	0	0	0	0.008	0.032	0.167
%CASHBAL	0	0	0	0	1	0.191	0.377
SC/SCIC	0.126	0.254	0.331	0.416	0.559	0.337	0.134
HORIZON	0.263	1.531	2.735	4.425	8.328	3.557	5.084
Plan characteristics							
FVPA ($m)	8	55	218	872	6,566	1,544	5,589
LnFVPA	2.161	4.032	5.391	6.772	8.790	5.419	1.980
EMPS	88	1,317	4,480	15,396	78,995	18,677	44,830
LnEMPS	4.489	7.184	8.408	9.641	11.277	8.188	2.310
%FUNDING	0.557	0.727	0.846	0.978	1.304	0.877	0.270
%FUNDING$_{EXP}$	0.551	0.722	0.842	0.973	1.300	0.874	0.268
%UNION	0	0	0	0.444	1	0.253	0.379
COMPLEXITY	0	1	2	2	3	1.693	0.744
Firm characteristics							
FIRMSIZE ($m)	107	632	2,160	7,857	43,091	16,133	84,456
LnFIRMSIZE	4.683	6.450	7.678	8.969	10.671	7.697	1.907
LEVERAGE	0.016	0.167	0.282	0.400	0.640	0.302	0.220
MTR	0.233	0.328	0.343	0.350	0.350	0.327	0.045
ROA	-0.044	0.019	0.045	0.081	0.149	0.049	0.108
CFO	-0.007	0.054	0.089	0.132	0.214	0.095	0.073
SIGMACFO	0.008	0.018	0.031	0.050	0.097	0.039	0.033
Auditor characteristics							

%F5500BIG4	0	0	1	1	1	0.612	0.483
%LIMSCOPE	0	0	1	1	1	0.633	0.475
10KBIG4	1	1	1	1	1	0.958	0.201
AUDFEEIMP	0.004	0.019	0.056	0.168	0.673	0.147	0.217
AUDOFFICEN	3	11	26	60	248	56.261	77.602

Statistics are for the final sample of 4,169 firm-years. *P5*, *P25*, *P50*, *P75*, and *P95* represent the 5^{th}, 25^{th}, 50^{th}, 75^{th}, and 95^{th} percentiles of the distribution respectively. "SD" stands for standard deviation.

DR is the discount rate used to discount projected future benefit payments to present value. *CPLI* is the Citigroup Pension Liability Index rate for the fiscal year-end month, from the Citigroup Pension Discount Curve. *%ACTUNVEST (%ACTVEST, %RETIRED)* is the proportion of pension liabilities accrued toward active unvested (active vested, retired) participants. *NORMCOST* is the expected increase in pension liabilities due to benefits accruing during the plan year. *DISBURSE* is benefits expected to be disbursed to participants during the year. *%FROZEN (%CASHBAL)* is the proportion of employees in hard-frozen (cash-balance) plans. *SC/SCIC* is the ratio of annual pension service cost to the sum of service cost and interest cost. *HORIZON* is the weighted-averaged remaining service life of beneficiaries, estimated from the relation between the projected and accumulated benefit obligation.

FVPA is the fair value of plan assets, and *LnFVPA* is the natural logarithm thereof. *EMPS* is the number of beneficiaries of the firm's plans, and *LnEMPS* is the natural logarithm thereof. *%FUNDING* is the fair value of plan assets scaled by the projected benefit obligation. $\%FUNDING_{EXP}$ is the fair value of plan assets scaled by the non-discretionary projected benefit obligation, defined using an industry-median discount rate, salary growth rate, and constant life expectancy. %*UNION* is the proportion of employees in collectively bargained plans. *COMPLEXITY* is an index capturing various factors that make actuarial valuation more complex.

FIRMSIZE is total assets of the plan sponsor, and *LnFIRMSIZE* is the natural logarithm thereof. *LEV* is long-term debt plus short-term debt + Max(OPEB liability – OPEB plan assets, 0) scaled by total assets. *MTR* is the firm's pre-financing marginal tax rate. *ROA* is income before extraordinary items and pension expense, scaled by total assets. *CFO* is cash flow from operations before pension contributions, scaled by total assets. *SIGMACFO* is the standard deviation of $CFO_{[t-4,\ t]}$, with a minimum of three years' data required.

%F5500BIG4 is the proportion of plan assets with a Big 4 benefit plan auditor. *%LIMSCOPE* is the proportion of plan assets with only a limited-scope review from the benefit plan auditor. *10KBIG4* is set to one if the financial statements auditor is a Big 4 firm. *AUDFEEIMP* measures the fee importance of the plan sponsor to the audit practice-office that signs its financial statements (audit fees for this client / total audit fees received by the audit office from all clients). *AUDOFFICEN* is the number of clients of the audit practice-office signing the plan sponsor's financial statements. Detailed variable definitions are in Appendix C.

Table 2: Descriptive statistics of actuary size and client importance measures

Panel A: Actuary size measures

Actuary size indicator	*Proportion of sample*
EMKT1-5%=1	10.43%
EMKT5-10%=1	11.68%
EMKT10%=1	60.71%

Panel B: Descriptive statistics of size-based client importance measures

	Sample	*P5*	*P25*	*P50*	*P75*	*P95*	*Mean*	*SD*
$EIMP_{NAT}$	All	0.00	0.00	0.00	0.01	0.13	0.034	0.138
$EIMP_{NAT}$	*EMKT10%*=0	0.00	0.00	0.01	0.03	0.63	0.081	0.211
$EIMP_{NAT}$	*EMKT10%*=1	0.00	0.00	0.00	0.00	0.02	0.004	0.010
$EIMP_{OFF}$	All	0.00	0.01	0.03	0.11	0.61	0.116	0.206
$EIMP_{OFF}$	*EMKT10%*=0	0.00	0.01	0.04	0.16	0.86	0.156	0.253
$EIMP_{OFF}$	*EMKT10%*=1	0.00	0.01	0.03	0.09	0.45	0.091	0.163
$EIMP_{IND}$	All	0.01	0.09	0.33	0.76	1	0.422	0.356
$EIMP_{IND}$	*EMKT10%*=0	0.01	0.08	0.28	0.72	1	0.396	0.355
$EIMP_{IND}$	*EMKT10%*=1	0.01	0.10	0.36	0.80	1	0.440	0.356

Panel C: Descriptive statistics of fee-based client importance measures

	Sample	*P5*	*P25*	*P50*	*P75*	*P95*	*Mean*	*SD*
$FEEIMP_{NAT}$	All	0.00	0.00	0.00	0.01	0.09	0.028	0.121
$FEEIMP_{NAT}$	*EMKT10%*=0	0.00	0.00	0.01	0.03	0.47	0.073	0.197
$FEEIMP_{NAT}$	*EMKT10%*=1	0.00	0.00	0.00	0.00	0.01	0.004	0.010
$FEEIMP_{OFF}$	All	0.00	0.01	0.03	0.09	0.49	0.101	0.186
$FEEIMP_{OFF}$	*EMKT10%*=0	0.00	0.01	0.04	0.14	0.78	0.144	0.238
$FEEIMP_{OFF}$	*EMKT10%*=1	0.00	0.01	0.03	0.07	0.37	0.077	0.145
$FEEIMP_{IND}$	All	0.02	0.10	0.29	0.68	1	0.397	0.337
$FEEIMP_{IND}$	*EMKT10%*=0	0.02	0.08	0.26	0.66	1	0.379	0.340
$FEEIMP_{IND}$	*EMKT10%*=1	0.02	0.11	0.30	0.69	1	0.407	0.335

Statistics in Panel A and statistics marked "All" in Panel B are for the final sample of 4,169 firm-years, except $EIMP_{IND}$, which is for 3,997 firm-years. Statistics in Panel C are for the sample of 2,375-2,483 firm-years with available data. *EMKT1-5%* (*EMKT5-10%*, *EMKT10%)* is an indicator for actuarial firms with 1-5% (5-10%, >10%) size-weighted market share in the actuarial client market that year, with size measured by number of employee-beneficiaries. Statistics marked "*EMKT10%*=1" ("*EMKT10%*=0") are for the subsample of firm-years with actuaries who service more than (less than) 10% of the actuarial client market in that year. *P5*, *P25*, *P50*, *P75*, and *P95* represent the 5^{th}, 25^{th}, 50^{th}, 75^{th}, and 95^{th} percentiles of the distribution respectively. "SD" stands for standard deviation. $EIMP_{NAT}$ ($EIMP_{OFF}$, $EIMP_{IND}$) is the size of each plan sponsor client / Sum of sizes of all plan clients of that actuarial firm (practice-office, Enrolled Actuary) in that year, where size is measured by the number of employee-beneficiaries of each plan sponsor's plans. $FEEIMP_{NAT}$ ($FEEIMP_{OFF}$, $FEEIMP_{IND}$) is the professional fees from each plan sponsor client / Sum of fees from all plan clients of that actuarial firm (practice-office, Enrolled Actuary) in that year, with the denominator composed of disclosed fees when available, and predicted fees otherwise. Detailed variable definitions are in Appendix C.

Table 3: Spearman correlations

	DR	*EMKT10%*	$EIMP_{NAT}$	$EIMP_{OFF}$	$EIMP_{IND}$	$FEEIMP_{NAT}$	$FEEIMP_{OFF}$	$FEEIMP_{IND}$
EMKT10%	-0.105***							
$EIMP_{NAT}$	0.046***	-0.365***						
$EIMP_{OFFICE}$	0.051***	-0.117***	0.748***					
$EIMP_{IND}$	0.030*	0.065***	0.527***	0.628***				
$FEEIMP_{NAT}$	0.019	-0.410***	0.639***	0.419***	0.276***			
$FEEIMP_{OFFICE}$	0.028	-0.145***	0.420***	0.638***	0.347***	0.711***		
$FEEIMP_{IND}$	0.032	0.054***	0.298***	0.352***	0.732***	0.471***	0.565***	
Economic determinants								
CPLI	0.783***	-0.108***	0.044***	0.035**	0.015	0.026	0.039*	0.028
%ACTUNVEST	0.082***	0.086***	-0.039**	-0.006	0.054***	-0.070***	-0.040**	0.022
%ACTVEST	0.027*	-0.094***	-0.111***	-0.129***	-0.139***	-0.074***	-0.079***	-0.070***
%RETIRED	0.011	0.110***	0.110***	0.126***	0.131***	0.067***	0.085***	0.091***
NORMCOST	0.115***	-0.071***	-0.083***	-0.091***	-0.077***	-0.048**	-0.065***	-0.038*
DISBURSE	-0.101***	0.130***	0.059***	0.112***	0.130***	0.063***	0.097***	0.108***
%FROZEN	-0.165***	0.013	0.040**	0.054***	0.041**	0.024	0.047**	0.007
%CASHBAL	-0.092***	0.128***	0.122***	0.146***	0.184***	0.072***	0.085**	0.132***
SC/SCIC	-0.076***	-0.076***	-0.089***	-0.121***	-0.093***	-0.033*	-0.082***	-0.054***
HORIZON	0.225***	-0.065***	-0.119***	-0.124***	-0.111***	-0.031	-0.069***	-0.079***
Plan characteristics								
LnFVPA	-0.113***	0.289***	0.395***	0.468***	0.460***	0.190***	0.266***	-0.337***
LnEMPS	-0.014	0.290***	0.586***	0.658***	0.642***	0.231***	0.283***	0.376***
$\%FUNDING_{EXP}$	0.174***	0.045**	0.111***	0.106***	0.100***	0.075***	0.069***	0.073***
%UNION	-0.025	0.039**	0.129***	0.107***	0.119***	0.049**	0.037*	0.095***
COMPLEXITY	-0.072***	0.188***	0.002	0.073***	0.126***	-0.057***	-0.018	0.002
Firm characteristics								
LnFIRMSIZE	-0.145***	0.268***	0.336***	0.412***	0.408***	0.189***	0.254***	0.314***
LEVERAGE	0.048***	0.032**	0.035**	0.075***	0.090***	0.042**	0.085***	0.085***
MTR	-0.122***	0.166***	0.084***	0.133***	0.164***	0.043**	0.086***	0.109***

ROA	-0.133***	0.070***	-0.012	-0.021	0.029*	-0.049**	-0.049**	-0.023
CFO	-0.031**	0.072***	-0.007	0.001	0.053***	-0.041**	-0.016	0.023
SIGMACFO	0.058***	-0.105***	-0.079***	-0.118***	-0.119***	-0.032	-0.066***	-0.126***
Auditor characteristics								
%F5500BIG4	0.177***	0.047***	0.079***	0.117***	0.123***	0.007	0.025	0.035*
%LIMSCOPE	-0.131***	0.016	-0.067***	-0.040**	-0.031**	-0.033*	-0.048**	-0.064*
10KBIG4	-0.003	0.154***	0.010	0.085***	0.110***	-0.034*	0.067***	0.089***
AUDFEEIMP	0.012	0.091***	0.223***	0.284***	0.201***	0.117***	0.141***	0.131***
AUDOFFICEN	-0.129***	0.050***	-0.006	-0.070***	0.039***	0.018	-0.015	0.068***

*, **, *** indicate statistical significance at 10%, 5% and 1% respectively. All correlations are for the maximum observations available. *DR* is the discount rate used to discount projected future benefit payments to present value. *EMKT10%* is an indicator set to 1 if the actuarial firm has >10% size-weighted market share in the actuarial client market that year, and to zero otherwise. $EIMP_{NAT}$ ($EIMP_{OFF}$, $EIMP_{IND}$) is the size of each plan sponsor client / Sum of sizes of all plan clients of that actuarial firm (practice-office, Enrolled Actuary) in that year, where size is measured by the number of employee-beneficiaries of each plan sponsor's plans. $FEEIMP_{NAT}$ ($FEEIMP_{OFF}$, $FEEIMP_{IND}$) is the professional fees from each plan sponsor client in a particular year / Sum of fees from all plan clients of that actuarial firm (practice-office, Enrolled Actuary) for that year, with the denominator composed of disclosed fees when available, and predicted fees otherwise. All other variable definitions are in Appendix C.

Table 4: Are actuarial firm size and client importance associated with discount rate assumptions?

Panel A: Models with the size-based client importance measure

	(1)	*(2)*	*(3)*	*(4)*
Dependent variable		*DR*		
$EIMP_{NAT}$	**0.062**			**-0.040**
	(0.13)			(0.13)
$EIMP_{OFF}$		**0.084****		**0.074****
		(0.03)		(0.03)
$EIMP_{IND}$			**0.048*****	**0.041*****
			(0.01)	(0.01)
EMKT1-5%	**-0.055**	**-0.048**	**-0.052**	**-0.046**
	(0.03)	(0.03)	(0.03)	(0.03)
EMKT5-10%	**-0.060**	**-0.046**	**-0.043**	**-0.034**
	(0.04)	(0.04)	(0.04)	(0.04)
EMKT10%	**-0.104****	**-0.088****	**-0.084***	**-0.074***
	(0.04)	(0.04)	(0.04)	(0.04)
CPLI	**0.466*****	**0.466*****	**0.456*****	**0.455*****
	(0.03)	(0.03)	(0.03)	(0.03)
%ACTUNVEST	**0.195**	**0.213***	**0.215**	**0.226**
	(0.13)	(0.13)	(0.13)	(0.13)
%ACTVEST	**0.033**	**0.034**	**0.039**	**0.041**
	(0.08)	(0.08)	(0.09)	(0.09)
%RETIRED	**-0.002**	**0.003**	**0.013**	**0.016**
	(0.08)	(0.08)	(0.08)	(0.08)
%NORMCOST	**0.712****	**0.704****	**0.673****	**0.664****
	(0.29)	(0.28)	(0.28)	(0.28)
%DISBURSE	**-0.704*****	**-0.692*****	**-0.650*****	**-0.638*****
	(0.20)	(0.20)	(0.21)	(0.20)
%FROZEN	**-0.161*****	**-0.162*****	**-0.160*****	**-0.161*****
	(0.04)	(0.04)	(0.04)	(0.04)
%CASHBAL	**-0.029****	**-0.029****	**-0.028****	**-0.028****
	(0.01)	(0.01)	(0.01)	(0.01)
SC/SCIC	**-0.238*****	**-0.238*****	**-0.241*****	**-0.240*****
	(0.06)	(0.06)	(0.06)	(0.06)
HORIZON	**-0.001**	**-0.001**	**-0.001**	**-0.001**
	(0.00)	(0.00)	(0.00)	(0.00)
LnFVPA	**0.019****	**0.016***	**0.015***	**0.013**
	(0.01)	(0.01)	(0.01)	(0.01)
LnEMPS	**0.015*****	**0.013*****	**0.012*****	**0.011*****
	(0.00)	(0.00)	(0.00)	(0.00)
$\%FUNDING_{EXP}$	**-0.122*****	**-0.121*****	**-0.119*****	**-0.118*****

	(0.04)	(0.04)	(0.04)	(0.04)
%UNION	**-0.038*****	**-0.037*****	**-0.041*****	**-0.040*****
	(0.01)	(0.01)	(0.01)	(0.01)
COMPLEXITY	**-0.015****	**-0.014****	**-0.012****	**-0.012***
	(0.01)	(0.01)	(0.01)	(0.01)
LnFIRMSIZE	**-0.027*****	**-0.027*****	**-0.027*****	**-0.027*****
	(0.01)	(0.01)	(0.01)	(0.01)
LEV	**0.002**	**0.003**	**0.003**	**0.004**
	(0.02)	(0.02)	(0.02)	(0.02)
MTR	**0.152**	**0.166**	**0.179**	**0.189**
	(0.18)	(0.18)	(0.17)	(0.17)
ROA	**-0.090*****	**-0.090*****	**-0.099*****	**-0.099*****
	(0.03)	(0.03)	(0.04)	(0.04)
CFO	**-0.053**	**-0.053**	**-0.035**	**-0.034**
	(0.10)	(0.10)	(0.11)	(0.10)
SIGMACFO	**-0.082**	**-0.083**	**-0.150**	**-0.147**
	(0.15)	(0.15)	(0.16)	(0.16)
%F5500BIG4	**0.005**	**0.004**	**0.002**	**0.002**
	(0.01)	(0.01)	(0.01)	(0.01)
%LIMSCOPE	**-0.021****	**-0.020****	**-0.017***	**-0.016***
	(0.01)	(0.01)	(0.01)	(0.01)
10KBIG4	**-0.033**	**-0.034**	**-0.029**	**-0.030**
	(0.04)	(0.04)	(0.04)	(0.04)
AUDFEEIMP	**-0.052****	**-0.056****	**-0.056****	**-0.060*****
	(0.02)	(0.02)	(0.02)	(0.02)
AUDOFFICEN (times 1000)	**-0.372*****	**-0.365*****	**-0.373*****	**-0.366*****
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	**4.457*****	**4.451*****	**4.507*****	**4.507*****
	(0.25)	(0.26)	(0.27)	(0.27)
Year & fiscal year-end FE	Yes	Yes	Yes	Yes
Actuary firm FE	Yes	Yes	Yes	Yes
Observations	4169	4169	3997	3997
Adjusted R^2	0.835	0.835	0.839	0.839
F-test of actuary FE	4.48***	4.51***	4.48***	4.46***

*, **, *** indicate statistical significance at 10%, 5%, and 1% level. Robust standard errors are in parentheses. The dependent variable is *DR*, the discount rate assumption used to discount projected future benefit payments to present value. $EIMP_{NAT}$, $EIMP_{OFF}$, and $EIMP_{IND}$ capture (the size of each plan sponsor client / sum of sizes of all plan clients of that actuary in that year), with size measured by the number of employee-beneficiaries, and denominator defined at the actuarial firm-, practice-office-, and individual actuary-level respectively. *EMKT1-5%*, *EMKT5-10%*, and *EMKT10%* are indicators for actuarial firm with 1-5%, 5-10%, or >10% size-weighted market share that year. All other variables are defined in Appendix C. "FE" denotes "fixed-effects". The last row presents F-tests for joint significance of actuarial firm FE.

Panel B: Models with the fee-based client importance measure

	(1)	*(2)*	*(3)*	*(4)*
Dependent variable		*DR*		
$FEEIMP_{NAT}$	**0.100**			**-0.069**
	(0.12)			(0.13)
$FEEIMP_{OFF}$		**0.166*****		**0.113*****
		(0.03)		(0.04)
$FEEIMP_{IND}$			**0.079*****	**0.061*****
			(0.01)	(0.02)
EMKT1-5%	**0.078**	**0.094****	**0.071**	**0.080***
	(0.05)	(0.04)	(0.05)	(0.05)
EMKT5-10%	**-0.021**	**0.019**	**-0.005**	**0.016**
	(0.10)	(0.10)	(0.11)	(0.10)
EMKT10%	**-0.068**	**-0.022**	**-0.042**	**-0.017**
	(0.10)	(0.09)	(0.10)	(0.10)
CPLI	**0.468*****	**0.469*****	**0.444*****	**0.446*****
	(0.06)	(0.06)	(0.07)	(0.06)
%ACTUNVEST	**0.108**	**0.135**	**0.172**	**0.177**
	(0.21)	(0.21)	(0.20)	(0.20)
%ACTVEST	**0.097**	**0.101**	**0.107**	**0.110**
	(0.09)	(0.09)	(0.09)	(0.09)
%RETIRED	**0.004**	**0.010**	**0.043**	**0.045**
	(0.08)	(0.08)	(0.08)	(0.08)
%NORMCOST	**0.590**	**0.594**	**0.567**	**0.573**
	(0.37)	(0.36)	(0.36)	(0.37)
%DISBURSE	**-0.870*****	**-0.854*****	**-0.857*****	**-0.832*****
	(0.20)	(0.19)	(0.24)	(0.24)
%FROZEN	**-0.156*****	**-0.156*****	**-0.143****	**-0.144*****
	(0.05)	(0.05)	(0.06)	(0.06)
%CASHBAL	**-0.022***	**-0.024***	**-0.020**	**-0.021**
	(0.01)	(0.01)	(0.02)	(0.02)
SC/SCIC	**-0.223****	**-0.230****	**-0.234****	**-0.237****
	(0.11)	(0.11)	(0.11)	(0.11)
HORIZON	**-0.001**	**-0.002**	**-0.001**	**-0.001**
	(0.00)	(0.00)	(0.00)	(0.00)
LnFVPA	**0.016**	**0.012**	**0.008**	**0.006**
	(0.01)	(0.01)	(0.01)	(0.01)
LnEMPS	**0.017*****	**0.016*****	**0.015*****	**0.015*****
	(0.00)	(0.00)	(0.00)	(0.00)
$\%FUNDING_{EXP}$	**-0.135*****	**-0.132*****	**-0.119*****	**-0.119*****
	(0.03)	(0.03)	(0.03)	(0.03)
%UNION	**-0.013**	**-0.011**	**-0.019****	**-0.018***

	(0.01)	(0.01)	(0.01)	(0.01)
COMPLEXITY	**-0.007**	**-0.006**	**-0.004**	**-0.004**
	(0.01)	(0.01)	(0.01)	(0.01)
LnFIRMSIZE	**-0.027*****	**-0.027*****	**-0.024****	**-0.024****
	(0.01)	(0.01)	(0.01)	(0.01)
LEV	**-0.030**	**-0.026**	**-0.041**	**-0.037**
	(0.04)	(0.04)	(0.04)	(0.04)
MTR	**0.111**	**0.113**	**0.121**	**0.119**
	(0.20)	(0.21)	(0.18)	(0.18)
ROA	**-0.155**	**-0.145**	**-0.187**	**-0.179**
	(0.11)	(0.11)	(0.13)	(0.13)
CFO	**-0.038**	**-0.039**	**0.003**	**0.003**
	(0.09)	(0.09)	(0.09)	(0.09)
SIGMACFO	**-0.060**	**-0.034**	**-0.101**	**-0.092**
	(0.18)	(0.18)	(0.19)	(0.20)
%F5500BIG4	**0.004**	**0.004**	**0.006**	**0.005**
	(0.01)	(0.01)	(0.01)	(0.01)
%LIMSCOPE	**-0.036*****	**-0.036*****	**-0.030*****	**-0.030*****
	(0.01)	(0.01)	(0.01)	(0.01)
10KBIG4	**-0.040**	**-0.040**	**-0.029**	**-0.030**
	(0.04)	(0.04)	(0.03)	(0.03)
AUDFEEIMP	**-0.058****	**-0.060****	**-0.065****	**-0.066****
	(0.02)	(0.03)	(0.03)	(0.03)
AUDOFFICEN (times 1000)	**-0.400****	**-0.383****	**-0.426*****	**-0.410*****
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	**4.432*****	**4.384*****	**4.531*****	**4.504*****
	(0.42)	(0.41)	(0.47)	(0.47)
Year & fiscal year-end FE	Yes	Yes	Yes	Yes
Actuary firm FE	Yes	Yes	Yes	Yes
Observations	2483	2481	2375	2372
Adjusted R^2	0.841	0.842	0.847	0.847
F-test of actuary FE	2.83***	2.86***	2.89***	2.87***

*, **, *** indicate statistical significance at 10%, 5%, and 1% level. Robust standard errors are in parentheses. The dependent variable is *DR*, the discount rate assumption used to discount projected future benefit payments to present value. $FEEIMP_{NAT}$, $FEEIMP_{OFF}$, and $FEEIMP_{IND}$ capture (total professional fees from each plan sponsor client / sum of fees from all plan clients of that actuary in that year), with denominator defined at the actuarial firm-, practice-office-, and individual actuary-level respectively. The denominator is composed of disclosed fees when available, and predicted fees otherwise, as explained in Appendix B. *EMKT1-5%, EMKT5-10%,* and *EMKT10%* are indicators for actuarial firms with 1-5%, 5-10%, or >10% size-weighted market share that year. All other variables are defined in Appendix C. "FE" denotes "fixed-effects". The last row presents F-tests for joint significance of all actuarial firm FE.

Table 5: The effects of actuarial firm size and client importance: Partitioning on plan and plan sponsor financial status

	(1a)	*(1b)*	*(2a)*	*(2b)*	*(3a)*	*(3b)*	*(4a)*	*(4b)*
	Low TLEV	*High TLEV*	*Low TLEV*	*High TLEV*	*Low TLEV*	*High TLEV*	*Low TLEV*	*High TLEV*
	Strong plans	*Weak plans*	*Strong plans*	*Weak plans*	*Strong plans*	*Weak plans*	*Strong plans*	*Weak plans*
Dependent variable					*DR*			
$EIMP_{NAT}$	**0.088**	**-0.019**					**-0.018**	**-0.071**
	(0.16)	(0.12)					(0.17)	(0.12)
$EIMP_{OFF}$			**0.054**	**0.109*****			**0.061**	**0.091****
			(0.05)	(0.04)			(0.04)	(0.04)
$EIMP_{IND}$					**0.031**	**0.059*****	**0.025**	**0.050*****
					(0.02)	(0.01)	(0.02)	(0.01)
EMKT1-5%	**-0.063***	**-0.031**	**-0.062***	**-0.026**	**-0.073****	**-0.027**	**-0.066***	**-0.023**
	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
EMKT5-10%	**-0.149*****	**0.057**	**-0.142*****	**0.063**	**-0.135*****	**0.071***	**-0.121*****	**0.070***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)
EMKT10%	**-0.231*****	**0.054**	**-0.224*****	**0.065**	**-0.210*****	**0.066**	**-0.196*****	**0.067**
	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
All controls from Eq. (1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year & fiscal year-end FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Actuary firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2086	2083	2086	2083	1999	1998	1999	1998
Adjusted R^2	0.827	0.853	0.827	0.854	0.831	0.857	0.831	0.857
F-test of actuary FE	3.56***	4.28***	3.57***	4.32***	3.54***	4.37***	3.53***	4.36***

*, **, *** indicate statistical significance at 10%, 5%, and 1% level. Robust standard errors are in parentheses. "Strong plans" ("Weak plans") are the subsample of firms with *TLEV* below (above) the annual median, with *TLEV* (total leverage) defined as financial leverage plus any underfunding in pension and OPEB plans. *DR* is the discount rate used to discount projected future benefit payments to present value. $EIMP_{NAT}$, $EIMP_{OFF}$, and $EIMP_{IND}$ are (the size of each plan sponsor client / sum of sizes of all plan clients of that actuary in that year), with size measured by the number of beneficiaries, and denominator at actuarial firm-, practice-office-, and individual-level respectively. *EMKT1-5%*, *EMKT5-10%*, and *EMKT10%* are indicators for actuarial firms with 1-5%, 5-10%, or >10% market share. All variables are defined in Appendix C. "FE" is "fixed-effects".

Table 6: The effects of actuarial firm size and client importance in financially weak plans: Partitioning on auditor oversight

High TLEV sample, partitioned by	*(1a)* *%LIMSCOPE =0* *Full audit*	*(1b)* *%LIMSCOPE >0* *Limited audit*	*(2a)* *%LIMSCOPE =0* *Full audit*	*(2b)* *%LIMSCOPE >0* *Limited audit*	*(3a)* *%LIMSCOPE =0* *Full audit*	*(3b)* *%LIMSCOPE >0* *Limited audit*	*(4a)* *%LIMSCOPE =0* *Full audit*	*(4b)* *%LIMSCOPE >0* *Limited audit*
Dependent variable				*DR*				
$EIMP_{NAT}$	**-0.321**	**-0.109**					**0.022**	**-0.161**
	(0.40)	(0.10)					(0.60)	(0.10)
$EIMP_{OFF}$			**-0.011**	**0.116****			**-0.092***	**0.138****
			(0.06)	(0.05)			(0.05)	(0.05)
$EIMP_{IND}$					**0.059****	**0.040****	**0.069****	**0.029**
					(0.03)	(0.02)	(0.03)	(0.02)
EMKT1-5%	**-0.327*****	**0.098****	**-0.329*****	**0.107****	**-0.323*****	**0.101****	**-0.332*****	**0.104****
	(0.08)	(0.04)	(0.08)	(0.05)	(0.07)	(0.05)	(0.07)	(0.05)
EMKT5-10%	**-0.211****	**0.110**	**-0.213****	**0.128**	**-0.271****	**0.121**	**-0.279****	**0.113**
	(0.10)	(0.09)	(0.10)	(0.09)	(0.12)	(0.09)	(0.11)	(0.09)
EMKT10%	**-0.173***	**0.117**	**-0.176***	**0.143**	**-0.259****	**0.149**	**-0.268*****	**0.148**
	(0.10)	(0.10)	(0.10)	(0.11)	(0.11)	(0.11)	(0.10)	(0.10)
Controls from Eq. (1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year, fiscal year-end & actuary FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	714	1369	714	1369	687	1311	687	1311
Adjusted R^2	0.855	0.858	0.855	0.859	0.861	0.862	0.861	0.862
F-test of actuary FE	3.68***	3.36***	3.67***	3.40***	3.70***	3.31***	3.71***	3.35***

*, **, *** indicate statistical significance at 10%, 5%, and 1% level. Robust standard errors are in parentheses. Tests are with "High *TLEV*" sample partitioned by *%LIMSCOPE*, the % of assets in plans subject only to limited-scope benefit plan audit. *DR* is the discount rate used to discount projected future benefit payments to present value. $EIMP_{NAT}$, $EIMP_{OFF}$, and $EIMP_{IND}$ are (the size of each plan sponsor client / total size of all plan clients of that actuary in that year), with size measured by the number of beneficiaries, and denominator at actuarial firm-, practice-office-, and individual-level respectively. *EMKT1-5%*, *EMKT5-10%*, and *EMKT10%* are indicators for actuarial firms with 1-5%, 5-10%, or >10% market share. All variables are defined in Appendix C. "FE" is "fixed-effects".

Table 7: The effects of actuarial client importance in financially weak plans: Partitioning into large and small actuarial firms

High TLEV sample, partitioned by:	*(1a) EMKT10% =1*	*(1b) EMKT10% =0*	*(2a) EMKT10% =1*	*(2b) EMKT10% =0*	*(3a) EMKT10% =1*	*(3b) EMKT10% =0*	*(4a) EMKT10% =1*	*(4b) EMKT10% =0*
	Large	*Small*	*Large*	*Small*	*Large*	*Small*	*Large*	*Small*
Dependent variable					*DR*			
$EIMP_{NAT}$	**0.280**	**-0.067**					**0.378**	**-0.147**
	(1.60)	(0.12)					(1.78)	(0.11)
$EIMP_{OFF}$			**0.093****	**0.116***			**0.069****	**0.101**
			(0.03)	(0.06)			(0.02)	(0.08)
$EIMP_{IND}$					**0.048*****	**0.087*****	**0.042****	**0.073****
					(0.01)	(0.03)	(0.01)	(0.03)
EMKT1-5%	-	**-0.030**	-	**-0.026**	-	**-0.025**	-	**-0.022**
	-	(0.04)	-	(0.04)	-	(0.04)	-	(0.04)
EMKT5-10%	-	**0.010**	-	**0.012**	-	**0.022**	-	**0.016**
	-	(0.05)	-	(0.05)	-	(0.05)	-	(0.05)
Controls from Eq. (1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year & fiscal year-end FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Actuary firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1279	804	1279	804	1215	783	1215	783
Adjusted R^2	0.854	0.844	0.854	0.845	0.860	0.845	0.860	0.845
F-test of actuary FE	2.76**	4.24***	2.79**	4.28***	2.41**	4.25***	2.33*	4.24***

*, **, *** indicate statistical significance at 10%, 5%, and 1% level. Robust standard errors are in parentheses. Tests are with the "High *TLEV*" sample, partitioned by *EMKT10%*, an indicator for actuarial firms with >10% size-weighted share of the actuarial client market that year ("large firms"). *DR* is the discount rate used to discount projected future benefit payments to present value. $EIMP_{NAT}$, $EIMP_{OFF}$, and $EIMP_{IND}$ are (the size of each plan sponsor client / total size of all plan clients of that actuary in that year), with size measured by the number of beneficiaries, and denominator at the actuarial firm-, practice-office-, and individual-level respectively. *EMKT1-5%* and *EMKT5-10%* are indicators for actuarial firms with 1-5% or 5-10% market share that year. All variables are defined in Appendix C. "FE" is "fixed-effects".

Table 8: Are actuarial firm size and client importance associated with discount rate assumptions? Within-client firm tests

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
	Whole-sample	*Low TLEV*	*High TLEV*	*High TLEV and changed actuarial firms at least once*	
Dependent variable			*DR*		
$EIMP_{NAT}$					**0.038**
					(0.09)
$EIMP_{OFF}$	**0.046**	**-0.014**	**0.098****	**0.143****	**0.164****
	(0.04)	(0.06)	(0.05)	(0.06)	(0.07)
$EIMP_{IND}$					**-0.005**
					(0.04)
EMKT1-5%	**0.041**	**0.012**	**0.073**	**0.083**	**0.096**
	(0.04)	(0.05)	(0.05)	(0.07)	(0.07)
EMKT5-10%	**0.044**	**0.054**	**0.038**	**0.016**	**0.030**
	(0.03)	(0.04)	(0.04)	(0.05)	(0.06)
EMKT10%	**0.038**	**0.046**	**0.027**	**0.032**	**0.041**
	(0.03)	(0.04)	(0.04)	(0.04)	(0.05)
CPLI	**0.477*****	**0.404*****	**0.597*****	**0.599*****	**0.580*****
	(0.04)	(0.04)	(0.05)	(0.09)	(0.09)
%ACTUNVEST	**0.090**	**0.237**	**-0.034**	**-0.026**	**0.095**
	(0.21)	(0.34)	(0.29)	(0.53)	(0.55)
%ACTVEST	**-0.005**	**-0.118**	**0.136**	**-0.095**	**-0.074**
	(0.09)	(0.10)	(0.15)	(0.19)	(0.19)
%RETIRED	**0.010**	**0.010**	**0.065**	**-0.093**	**-0.130**
	(0.12)	(0.15)	(0.18)	(0.20)	(0.20)
%NORMCOST	**0.397**	**0.749****	**0.336**	**0.581**	**0.400**
	(0.24)	(0.35)	(0.39)	(0.48)	(0.49)
%DISBURSE	**-0.685****	**-0.708***	**-0.629***	**-0.601**	**-0.438**
	(0.27)	(0.43)	(0.34)	(0.53)	(0.53)
%FROZEN	**-0.078***	**-0.102**	**-0.046**	**-0.001**	**-0.006**
	(0.04)	(0.06)	(0.05)	(0.09)	(0.08)
%CASHBAL	**-0.042**	**-0.048**	**-0.037**	**-0.002**	**-0.022**
	(0.03)	(0.05)	(0.03)	(0.04)	(0.04)
SC/SCIC	**-0.180****	**-0.293****	**-0.078**	**-0.125**	**-0.140**
	(0.09)	(0.13)	(0.11)	(0.20)	(0.20)
HORIZON	**-0.001**	**-0.003****	**0.001**	**0.001**	**0.001**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LnFVPA	**0.063*****	**0.112*****	**0.002**	**0.017**	**0.015**
	(0.02)	(0.04)	(0.03)	(0.06)	(0.06)
LnEMPS	**0.004**	**0.004**	**0.001**	**-0.000**	**-0.001**
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)

%FUNDING$_{EXP}$	**-0.165*****	**-0.254*****	**-0.017**	**0.122**	**0.130**
	(0.05)	(0.07)	(0.08)	(0.15)	(0.15)
%UNION	**-0.006**	**0.019**	**-0.011**	**-0.011**	**-0.022**
	(0.02)	(0.03)	(0.03)	(0.04)	(0.05)
COMPLEXITY	**-0.009**	**0.002**	**-0.016**	**-0.004**	**0.003**
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
LnFIRMSIZE	**0.006**	**-0.006**	**0.011**	**-0.020**	**-0.022**
	(0.02)	(0.04)	(0.03)	(0.05)	(0.05)
LEV	**0.010**	**0.280****	**-0.078**	**-0.032**	**-0.032**
	(0.04)	(0.11)	(0.05)	(0.07)	(0.07)
MTR	**0.117**	**0.293**	**0.019**	**-0.089**	**-0.131**
	(0.14)	(0.22)	(0.18)	(0.29)	(0.29)
ROA	**-0.058****	**-0.018**	**-0.046**	**-0.038**	**0.010**
	(0.03)	(0.03)	(0.09)	(0.13)	(0.14)
CFO	**-0.063**	**0.094**	**-0.188***	**-0.239**	**-0.287***
	(0.08)	(0.15)	(0.11)	(0.15)	(0.15)
SIGMACFO	**0.042**	**-0.021**	**0.115**	**0.314**	**0.334**
	(0.22)	(0.31)	(0.36)	(0.48)	(0.47)
%F5500BIG4	**0.017**	**0.019**	**0.009**	**0.023**	**0.030**
	(0.01)	(0.02)	(0.02)	(0.04)	(0.04)
%LIMSCOPE	**-0.010**	**0.000**	**-0.025**	**-0.092****	**-0.097*****
	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
10KBIG4	**-0.005**	**0.021**	**-0.008**	**0.054**	**0.054**
	(0.04)	(0.05)	(0.05)	(0.07)	(0.07)
AUDFEEIMP	**0.018**	**0.030**	**-0.019**	**-0.069**	**-0.073**
	(0.04)	(0.06)	(0.06)	(0.09)	(0.09)
AUDOFFICEN	**-0.000*****	**-0.000*****	**-0.000***	**-0.000**	**-0.000**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	**3.911*****	**4.167*****	**2.690*****	**3.177*****	**3.341*****
	(0.33)	(0.39)	(0.48)	(0.81)	(0.84)
Year & fiscal year-end FE	Yes	Yes	Yes	Yes	Yes
Client firm FE	Yes	Yes	Yes	Yes	Yes
Observations	4169	2086	2083	872	838
Adjusted R^2	0.889	0.873	0.904	0.894	0.895

*, **, *** indicate statistical significance at 10%, 5%, and 1% level. Robust standard errors are in parentheses. The dependent variable is *DR*, the discount rate assumption used to discount projected future benefit payments to present value. *EIMP$_{NAT}$*, *EIMP$_{OFF}$*, and *EIMP$_{IND}$* capture (the size of each plan sponsor client / sum of sizes of all plan clients of that actuary in that year), with size measured by the number of employee-beneficiaries, and denominator defined at the actuarial firm-, practice-office-, and individual actuary-level respectively. *EMKT1-5%*, *EMKT5-10%*, and *EMKT10%* are indicators for actuarial firms with 1-5%, 5-10%, or >10% size-weighted market share that year. All other variables are defined in Appendix C. "FE" denotes "fixed-effects".

Table 9: Partitioning client firms by absolute plan size

High TLEV sample, partitioned by LnEMPS:	*(1) Quartile 1 (smallest)*	*(2) Quartile 2*	*(3) Quartile 3*	*(4) Quartile 4 (largest)*
Dependent variable		*DR*		
$EIMP_{OFF}$	**0.271****	**0.394****	**-0.096**	**-0.055**
	(0.11)	(0.20)	(0.09)	(0.07)
EMKT1-5%	**0.217**	**-0.135**	**-0.036**	**0.163**
	(0.14)	(0.09)	(0.09)	(0.10)
EMKT5-10%	**0.219**	**-0.043**	**-0.128****	**0.076**
	(0.15)	(0.09)	(0.06)	(0.08)
EMKT10%	**0.017**	**-0.037**	**-0.040**	**0.011**
	(0.12)	(0.09)	(0.05)	(0.07)
CPLI	**0.552*****	**0.522*****	**0.531*****	**0.599*****
	(0.05)	(0.09)	(0.08)	(0.13)
%ACTUNVEST	**0.662**	**-0.468**	**1.073**	**-0.004**
	(0.50)	(0.40)	(0.86)	(0.66)
%ACTVEST	**0.667*****	**-0.428***	**0.309**	**-0.069**
	(0.23)	(0.23)	(0.32)	(0.45)
%RETIRED	**0.465***	**-0.230**	**0.606**	**-0.301**
	(0.25)	(0.22)	(0.46)	(0.48)
%NORMCOST	**-1.039**	**0.353**	**1.255**	**-0.797**
	(0.65)	(0.54)	(1.17)	(1.17)
%DISBURSE	**-1.010***	**0.242**	**-1.339****	**-0.424**
	(0.58)	(0.74)	(0.62)	(0.92)
%FROZEN	**-0.279*****	**-0.013**	**-0.185***	**0.097**
	(0.07)	(0.10)	(0.11)	(0.09)
%CASHBAL	**0.054**	**0.009**	**0.117**	**-0.029**
	(0.04)	(0.09)	(0.13)	(0.07)
SC/SCIC	**-0.186**	**-0.071**	**-0.065**	**0.077**
	(0.20)	(0.14)	(0.30)	(0.24)
HORIZON	**0.016*****	**0.013***	**-0.002**	**0.001**
	(0.01)	(0.01)	(0.00)	(0.00)
LnFVPA	**0.016**	**-0.091**	**0.050**	**0.003**
	(0.05)	(0.09)	(0.08)	(0.11)
LnEMPS	**-0.005**	**0.109**	**-0.045**	**0.055**
	(0.01)	(0.07)	(0.08)	(0.07)
$\%FUNDING_{EXP}$	**-0.057**	**-0.093**	**0.062**	**0.134**
	(0.14)	(0.18)	(0.18)	(0.21)
%UNION	**-0.080**	**0.021**	**0.035**	**-0.012**
	(0.08)	(0.18)	(0.06)	(0.06)
COMPLEXITY	**-0.040***	**0.012**	**-0.011**	**-0.045****

	(0.02)	(0.02)	(0.03)	(0.02)
LnFIRMSIZE	**0.145***	**-0.018**	**-0.033**	**0.070**
	(0.08)	(0.05)	(0.08)	(0.06)
LEV	**0.345****	**-0.084**	**-0.319***	**-0.177**
	(0.17)	(0.07)	(0.18)	(0.14)
MTR	**-0.277**	**0.109**	**-0.137**	**-0.349**
	(0.44)	(0.22)	(0.33)	(0.38)
ROA	**0.299**	**-0.000**	**0.116**	**-0.193***
	(0.33)	(0.13)	(0.28)	(0.11)
CFO	**-0.090**	**-0.353***	**-0.539**	**-0.065**
	(0.16)	(0.18)	(0.42)	(0.28)
SIGMACFO	**2.434*****	**0.425**	**-2.493***	**-0.148**
	(0.77)	(0.30)	(1.09)	(0.88)
%F5500BIG4	**-0.073***	**-0.000**	**0.003**	**0.013**
	(0.04)	(0.06)	(0.05)	(0.04)
%LIMSCOPE	**-0.090****	**-0.050**	**-0.012**	**0.068****
	(0.04)	(0.04)	(0.07)	(0.03)
10KBIG4	**-0.186****	**0.171***	**0.096**	**-0.073**
	(0.09)	(0.10)	(0.15)	(0.09)
AUDFEEIMP	**-0.348***	**-0.015**	**0.094**	**0.124**
	(0.19)	(0.11)	(0.16)	(0.09)
AUDOFFICEN	**-0.123**	**-0.629****	**-0.433***	**-0.078**
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	**2.228*****	**3.620*****	**3.835*****	**2.250***
	(0.69)	(0.95)	(1.01)	(1.15)
Year & fiscal year-end FE	Yes	Yes	Yes	Yes
Client firm FE	Yes	Yes	Yes	Yes
Observations	524	519	522	518
Adjusted R^2	0.904	0.901	0.916	0.922

*, **, *** indicate statistical significance at 10%, 5%, and 1% level. Robust standard errors are in parentheses. The subsamples are quartiles by annual distributions of *LnEMPS*. *DR* is the discount rate used to discount projected future benefit payments to present value. $EIMP_{OFF}$ is (the size of each plan sponsor client / sum of sizes of all plan clients of that actuarial practice-office in that year), with size measured by number of employee-beneficiaries. *EMKT1-5%*, *EMKT5-10%*, and *EMKT10%* are indicators for actuarial firms with 1-5%, 5-10%, or >10% size-weighted market share that year. All variables are defined in Appendix C. "FE" is "fixed-effects".