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The Economic Consequences of Pension Accounting

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LIST OF ABBREVIATIONS

AG	Aktiengesellschaft (Stock corporation)
AGL	Actuarial Gains and Losses
AnlV	Anlageverordnung
BaFin	Bundesanstalt für Finanzdienstleistungsaufsicht (Federal Financial Supervisory Authority)
BaKred	Bundesaufsichtsamt für das Kreditwesen (Federal Banking Supervisory Office)
BAV	Bundesaufsichtsamt für das Versicherungswesen (Federal Insurance Supervisory Office)
BaWe	Bundesaufsichtsamt für den Wertpapierhandel (Federal Securities Supervisory Office)
BaKred	Bundesaufsichtsamt für das Kreditwesen (Federal Banking Supervisory Office)
BetrAVG	Betriebsrentengesetz (Occupational Pension Act)
CTA	Contractual trust arrangements
DBO	Defined Benefit Obligation
E.g.	Exempli gratia (for example)
ERISA	Employment Retirement Income Security Act
EStG	Einkommensteuergesetz (German Income Tax Act)
Et al.	Et alii (and others)
EU	European Union
Euro Stoxx 50	European Stock Market Index (comprising 50 publicly listed companies)
FASB	Financial Accounting Standards Board
FRS	Financial Reporting Standards
GAAP	Generally Accepted Accounting Principles
HDAX	German Stock Market Index (comprising 120 publicly listed companies)
IAS	International Accounting Standard(s)
IASB	International Accounting Standards Board
IASC	International Accounting Standards Committee
IFRS	International Financial Reporting Standard(s)
I.e.	Id est (that is)
MSCI World	Global Stock Market Index (comprising 1585 publicly listed companies)
OCI	Other Comprehensive Income

OECD	Organisation for Economic Co-operation and Development
PBGC	Pension Benefit Guarantee Corporation
PFKapAV	Pensionsfonds-Kapitalanlagenverordnung (Pension Fund Investment Regulation)
PIMCO	Pacific Investment Management Company, LLC
PSVaG	German statutory pension insurance fund
P&L	Profit and Loss Statement
SAC	Standards Advisory Council
SFAS	Statement of Financial Accounting Standards
SIC	Standard industrial classification
S&P 500	U.S. Stock Market Index (comprising 500 publicly listed companies)
UK	United Kingdom
U.S.	United States
U.S.-GAAP	United States Generally Accepted Accounting Principles
VAG	German Insurance Supervision Act
Vs.	Versus

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1 INTRODUCTION

“You can’t ship it [pension liabilities] offshore or anything like that.
And those are big numbers, really big numbers.”
(Warren Buffet, 2019)¹

In 2009, General Motors filed for government-assisted bankruptcy protection (so-called Chapter 11). Its pension fund, on which more than a million Americans depend on, leaves behind a lack of \$13 billion.² General Motors is only one example of major international companies that struggle to finance their corporate pension plans as the annual Milliman Corporate Pension Funding Study shows. The study ascertains that the underfunding of the 100 largest US corporate pension plans accounts for about \$232 billion at the end of 2020, despite legal requirements to fund these plans (Wadia et al., 2021).

Corporate pension plans traditionally have been defined benefit pension plans that guarantee a certain income for beneficiaries. Usually, they are funded by firms that indirectly choose the kind of investments and bear the investment risk, respectively. The examples above highlight a development that the UK pension expert John Ralfes (Jackson, 2009) summarizes as follows: “Increasingly, the external risks and volatility of these [defined benefit pension] schemes cannot be afforded by the companies themselves”.

The funding of an increasing level of pension obligations as well as the risks associated with such obligations are only two out of many factors that stress the importance of pension obligations in financially assessing a company. However, this evaluation is considered to be very complex due to the long-term nature of pension obligations, complicated calculations that require many inputs, which vary over time as well as the accounting and presentation of these information. The latter is regulated by the accounting standard IAS 19, *Employee Benefits* that offers firms various choices in using different accounting methods and ways of presenting this information with the goal of providing financial statement users a true and fair view of corporate pension schemes.³

¹ Warren Buffet on the burden of unfunded corporate pension plans in an interview with Jacqueline Pitts on CNBC in February 2019 (Pitts, 2019).

² The example of General Motors and other major companies struggling with financial burdens of their pension plans is widely covered in business media, e.g., Keefe (2009) and Braithwaite (2009).

³ IAS 19 Employee Benefits is applicable for firms using IFRS as accounting standard. Firms applying U. S. GAAP use SFAS 158 in the accounting for their pension schemes. I will advise about noteworthy similarities and differences between both standards throughout the thesis.

In this thesis, I investigate the economic consequences of pension accounting in a German IFRS accounting regime. Specifically, I investigate several discretionary choices that are provided by IAS 19 and test whether and how these choices affect economic outcomes.

Regarding the analysis alternative options of IAS 19, the first two studies of this thesis make use of the latest major revision in pension accounting that is the transition from IAS 19 to IAS 19R in 2013. This transition affects the number and kind of choices in pension accounting for firms. Complementary, the third study extends the period of investigation to a long-term perspective by assessing the economic consequences of different accounting recognition methods for alternative ways of funding pension obligations. Regarding the economic consequences of pension accounting, I analyze the economic consequences of two different stakeholders. A firm perspective is applied in the first paper by looking at firms' investment decision for pension assets. The second and third paper change the perspective and concentrate on investigating the economic consequences on market values of firms from an equity investor angle.

I investigate these questions on the economic consequences of firm's choices in pension accounting standards in a single country setting, namely German firms reporting under IFRS. The German setting offers several explicit advantages for investigating each of the research questions that are outlined in detail in the respective papers. In short, Germany offers a sufficient large number of firms that use different choices in accounting for pension plans. Moreover, German regulation allows different ways of funding corporate pension plans leading to a unique variation in the level of funding these plans that is not observable in other countries. Overall, in terms of addressing the research questions of the thesis, the limitations of a single country setting are outweighed by the advantages of using this variation in identifying and analyzing the economic consequences of pension accounting. As outlined above, the thesis comprises three empirical research papers that make use of this setting by addressing questions whether and how pension accounting choices affect economic outcomes.

The first study "The Impact of Accounting Standards on Pension Investment Decisions" is presented in chapter 2. The paper is co-authored with Thorsten Sellhorn and Vicky Kiosse and was published in the *European Accounting Review* in 2019. In this paper we examine the economic consequences of the revised pension accounting standard IAS 19R on pension investment decisions of firms. IAS 19R eliminates the choice between different methods of recognizing actuarial gains and losses. By removing the use

of the so-called “corridor method”, which smoothes the effect of yearly changes in actuarial gains and losses, the expected pension-induced equity volatility was increased. Multivariate difference-in-differences analyses show that firms, which used to apply the corridor method increase the percentage of pension assets invested in bonds at the cost of equity investments, relative to control firms. Further tests indicated that this shift is mainly due to the mandatory change from the corridor method to the “OCI method” that recognizes actuarial gains and losses in other comprehensive income. Accordingly, this study contributes to the literature on economic consequences of accounting standards by showing the real effects of changes in pension accounting rules on the pension asset investment decision of firms. Furthermore, results of this paper should help standard setters to better evaluate and shape the future role of other comprehensive income.

The second paper, presented in chapter 3, also makes use of the setting of the introduction of IAS 19R. However, it changes the focus from consequences on pension asset investment decisions by managers to consequences on firm values assessed by equity investors. In doing so, the study investigates the question, whether the revisions of IAS19R change equity valuations by investors. Beside the elimination of the corridor method, the paper examines the replacement of the expected rate of return of pension assets and changes of disclosure requirements. Characteristics of the German research setting help to identify the individual effect of each of these three changes on the equity value of firms. Using an event-study methodology, results indicate that events leading to the publication of IAS 19R differently affect firm values depending on the kind of change to the standard described above. Accordingly, the elimination of the corridor method and the change in disclosure requirements are perceived as net costly by investors. These findings support the view that higher pension-induced equity volatility has negative adverse effects on firm values by increasing the risk and cost of contractual arrangements of firms and the estimation risk of investors. In contrast, the elimination of using an expected rate of return on plan assets is perceived as value increasing, supporting the hypothesis that this change reduces the incentive of managers to increase the risk of pension asset investments or manipulate earnings by inflated expectations on future returns of plan assets. The significance of findings is subject to cross-sectional differences among firms, especially regarding firms’ exposure to the risks of pension plans. Findings of this paper contributes to two streams of prior literature. The first shows how firms alter pension asset investment decisions and thus the risk-return and cash flow profile of pension plans in reaction to IAS 19R (e.g., Barthelme et al., 2019; Anantharaman & Chuk,

2018) and the second more broader stream of literature investigates the value relevance of pension accounting information (e.g., Yu, 2013; Bergstresser, Desai and Rauh, 2006; Hann, Hefflin and Subramanayam, 2007). This study extends both streams of literature by identifying and more directly testing various channels that are expected to affect firm valuations.

The third study of the thesis in chapter 4 extends the time span of the two prior papers from the period around the introduction of IAS 19R to a long-term perspective on pension accounting of 22 years. Specifically, I examine firm value implications of alternative ways of funding defined benefit obligations. The German setting allows for two different ways of funding defined benefit obligations. First, funding with the help of separately managed plan assets as described in the first two papers (external funding). Second, funding with the help of operating or financial assets within a firm (internal funding). The decision between these two ways of funding heavily affects the amount of defined benefit obligations that have to be recognized as pension liability on the balance sheet. In the case of external funding, accounting standards allow the offsetting of pension assets against pension obligations in calculating the pension liability. However, this method of offsetting is not allowed for internal funding. Therefore, by looking at the pension liability on the balance sheet without consulting the notes of the annual report, financial statement users can't distinguish between pension liabilities that are internally funded and pension liabilities that are externally funded but lack sufficient assets to cover all related obligations (unfunded pension obligations). Results of the value relevance research design applied in this study show, on average, no valuation difference between internal funding and unfunded pension plans, indicating that investors do not apply the same valuation multiple on internal funding as on external funding. Though, taking cross-sectional differences in information intermediaries and in risk characteristics into account, the valuation of internal funding does differ to unfunded DBO, but not to the valuation of external funding anymore. These findings contribute to the literature on whether and how corporate pension plans affect firm value. Taken together, prior literature provides strong empirical evidence that the level of funding is relevant for investors to assess the market value of a firm. It also suggests that shareholder have problems to incorporate information on the economics of pension plans into firm valuation (e.g., Franzoni and Marín, 2006; Picconi, 2006). Yet, the vast majority of prior studies investigate these questions with the help of US firms, which are not allowed to use internal funding for their pension plans. Furthermore, a certain level of external

funding is required by law, leading to overall low levels of underfunding of US firms. This study closes the lack of evidence by leveraging the German research setting that allows on the one hand, high levels of underfunding and on the other hand, enables to investigate the use of internal funding. Therefore, the results of this paper also highlight the importance of investigating empirical questions across jurisdictions to fully assess the implications of the accounting for defined benefit pension plans.

Chapter 5 closes the thesis by summarizing the results of the studies and by providing suggestions for future research.

2 THE IMPACT OF ACCOUNTING STANDARDS ON PENSION INVESTMENT DECISIONS⁴

2.1 Introduction

This study examines whether accounting standards influence firms' 'real' investment decisions regarding the allocation of pension plan assets to asset classes of different risk. Specifically, we analyze the effect of IAS 19R, which eliminated the corridor method, a smoothing device for recognizing actuarial gains and losses under IFRS, on the allocation of plan assets to equities and bonds.

Risk from pension plans is partly driven by the allocation of plan assets. Empirical research on the determinants of the pension asset allocation identifies the funding status of the pension plan (e.g., Bader, Leibowitz, & Brothers, 1991), taxes (e.g., Tepper & Affleck, 1974), regulation (e.g., Harrison & Sharpe, 1983), and the demography of pension plan participants (e.g., Cocco, Gomes, & Maenhout, 2005), as factors influencing pension investment decisions. However, much of the cross-sectional and time-series variation in pension asset allocations remains unexplained (Rauh, 2009). In particular, evidence on the impact of accounting standards on pension asset allocations is limited (e.g., Kiosse & Peasnell, 2009).

We investigate whether accounting standards influence the pension asset allocation in a German IFRS setting. Specifically, we use the transition from IAS 19 to IAS 19R in

⁴ This chapter is based on: "Barthelme, C., Kiosse, P. V., & Sellhorn, T. (2019). The impact of accounting standards on pension investment decisions. *European Accounting Review*, 28(1), 1-33.". Minor deviations to the published paper include formal changes due to formal requirements of this thesis, e.g., section references within the paper, a list of references at the end of the thesis and including the online appendix within the thesis.

2013, which alters the recognition of actuarial gains and losses. Under IAS 19, firms were able to smooth pension-induced equity volatility by deferring recognition of actuarial gains and losses under the so-called ‘corridor method’. IAS 19R eliminates this smoothing device – instead mandating immediate recognition of actuarial gains and losses in other comprehensive income (the so-called ‘OCI method’). Consequently, firms that used to apply the corridor method under IAS 19 are required to adopt the OCI method under IAS 19R. This switch increases expected volatility of pension liabilities, equity book values, and OCI amounts.

The German IAS 19R adoption setting has several distinct advantages that facilitate a difference-in-differences research design to identify whether eliminating the corridor method affects pension asset allocations, and how that effect varies with cross-sectional differences in pension plan characteristics. First, in contrast to many other IFRS jurisdictions, the German setting offers a sufficiently large treatment sample, as well as a group of control firms unaffected by the accounting change of interest (i.e., firms that already applied the OCI method before IAS 19R mandated it). Second, sample firms exhibit sufficient variation in their exposure to defined benefit pension plans that allows us to examine whether such exposure moderates the effect of the accounting change on the pension asset allocation. Third, this single-country setting allows us to effectively limit potential alternative explanations for observed changes in pension asset allocations between treatment and control firms.

Drawing on theory as well as interview-based evidence and firms’ public statements, we derive and test two empirical predictions. First, we reason that treatment firms, *ceteris paribus*, expect their adoption of IAS 19R to increase pension-induced volatility in comprehensive income amounts, equity book values, and pension liabilities. Higher levels of volatility could increase credit spreads (Stracke, 2013) and the likelihood of debt covenant violations. Pension-induced volatility can be mitigated by shifting pension assets out of asset classes that are volatile, and that are positively correlated with fluctuations in net pension liabilities. Accordingly, to mitigate this expected increase in volatility, we predict that, on average, treatment firms reduce the portion of pension plan assets allocated to equities relative to control firms that already apply the OCI method. Second, we expect this effect to vary according to treatment firms’ exposure to pension plans and treatment firms’ pension plan funding levels.

Univariate comparisons and multivariate regression tests support these predictions. We find that treatment firms significantly reduce (increase) their portion of equity (bond)

investments relative to control firms after IAS 19R adoption. This finding is consistent with firms using the allocation of pension assets to mitigate expected volatility arising from exposure to pension plans. In line with the second hypothesis, we show that these effects are attenuated for treatment firms with exposure to larger and better funded pension plans.

In supplemental analyses, we further explore the source of this “IAS 19R effect”. Specifically, in addition to changing the accounting for actuarial gains and losses (“OCI effect”), IAS 19R simultaneously alters the calculation of net periodic pension expense by replacing the expected rate of return assumption by the discount rate assumption. Employing a difference-in-differences test that effectively isolates this ‘expected rate of return effect’ (hereinafter: “ERR effect”), we find evidence inconsistent with the “ERR effect” driving our main findings. These results differ from those reported in a concurrent study of Canadian firms (Anantharaman & Chuk, 2017), highlighting the need for careful jurisdiction-level studies, as the effect of (changes in) accounting standards will likely differ across countries.

Several sensitivity analyses support the robustness of our main results. Specifically, we repeat the main tests using an alternative propensity score matching approach, several alternative treatment dates and measurement windows, additional and alternatively specified control variables, as well as subsamples. Overall, these sensitivity analyses are consistent with the main findings, although some are weaker, presumably due to lower test power.

The contribution of this study is threefold. First, we add to the literature on accounting standards as a determinant of pension asset allocations (e.g., Amir & Benartzi, 1999; Amir, Guan, & Oswald, 2010; Anantharaman & Chuk, 2017). Our identification strategy and interview evidence allow us to document a plausibly causal effect of a change in accounting standards on firms’ pension asset allocations. Second, we extend prior literature on the economic consequences of accounting standards. Specifically, findings are consistent with the notion that firms adjust their ‘real’ activities, including their investment behavior, to mitigate the undesired impact of recognition rules on the volatility of equity book values and other key financial statement items (e.g., Zhang, 2009; Choudhary, Rajgopal, & Venkatachalam, 2009). Third, this study also informs the ongoing deliberations on accounting standards for defined benefit pension plans, as it suggests that managers’ concerns about equity volatility complement widely documented concerns about earnings volatility in influencing manager behavior. These results also

inform standard setters' considerations regarding the future role of OCI. Finally, taken together with concurrent work in this field, our study highlights that the effects of accounting standards can vary across countries, reinforcing the need for jurisdiction-level analyses to understand and possibly predict these effects and their drivers.

Section 2.2 provides background and develops our predictions. Section 2.3 explains the research design and identification strategy and describes the sample and data. Section 2.4 presents the main findings, alternative analyses, and robustness tests. Section 2.5 concludes. Supplemental material is included in a comprehensive Appendix.

2.2 Background and Hypotheses

2.2.1 Accounting Change of Interest: IAS 19R

2.2.1.1 Accounting for Defined Benefit Pension Plans under IFRS

Firms account for their defined benefit pension plans under IAS 19 *Employee Benefits* (originally adopted in 1998). IAS 19R, an amendment issued in June 2011 (IFRS Foundation, 2011), alters the expected equity volatility of affected firms (i.e., the treatment group). We expect IAS 19R to change how treatment firms allocate their pension assets, relative to an unaffected control group. IAS 19R introduces two noteworthy changes: The first relates to the balance sheet depiction of defined benefit plans (herein referred to as the “OCI effect”), and the second affects their income statement presentation (the “ERR effect”).⁵

Describing these effects requires some background. The pension liability (or asset) is the net amount of the defined benefit obligation (DBO) and any externally funded plan assets. This net funded status is either a funding deficit (plan assets < DBO) or surplus (plan assets > DBO). IAS 19 allowed firms to recognize a net pension liability on the balance sheet that adjusts this net amount for any actuarial gains and losses.⁶ Specifically,

⁵ We thank an anonymous reviewer for stressing that IAS 19R requires additional pension-related disclosures that could also influence affected firms' de-risking behavior through a ‘real effect’ (e.g., Kanodia, 2007; Leuz & Wysocki, 2016). However, since these new disclosure requirements affect both treatment and control firms, our difference-in-differences research design should eliminate their effects. Hence, although we consider the de-risking effects of pension disclosures to be an important research question, the present setting is not particularly conducive to studying them.

⁶ Actuarial gains and losses arise for DBOs and plan assets if firms experience adjustments to actuarial assumptions or change these assumptions for future periods. Actuarial assumptions relating to the DBO include the discount rate, mortality rates, and salary trends. For example, actuarial losses (gains) result when the pension discount rate decreases (increases), which increases (decreases) the DBO.

IAS 19 provides a choice between three different methods of accounting for actuarial gains and losses: (1) deferred recognition in profit or loss (corridor method); (2) immediate recognition in other comprehensive income (OCI method); and (3) immediate recognition in profit or loss.⁷

2.2.1.2 *The “OCI effect”*

The corridor method and the OCI method differ dramatically in their effects on firms’ balance sheets. Under the corridor method, firms recognize actuarial gains and losses only in part, and only if the cumulative amount exceeds a certain threshold, commonly referred to as the ‘corridor’. Consequently, corridor method balance sheets fail to fully display pension plans’ funded status, which allows firms to largely avoid undesirable pension-induced equity volatility and leverage. In contrast, the OCI method requires all actuarial gains and losses to be recognized when incurred, bringing the pension plan’s full funded status onto the balance sheet. Of note, earnings under the OCI method still do not reflect the volatility of net pension liabilities, as actuarial gains and losses are recognized in OCI rather than profit or loss.

IAS 19R eliminates the corridor method (method 1 above) and immediate P&L recognition (method 3 above), making the OCI method mandatory. Therefore, the treatment group (control group) consists of firms using the corridor method (OCI method) before IAS 19R took effect. When adopting IAS 19R, treatment firms recognize their unrecognized actuarial gains or losses on the balance sheet.⁸ In subsequent periods, net pension liabilities reflect any actuarial gains and losses when incurred, making equity amounts and leverage ratios more volatile. We refer to this aspect of IAS 19R – the full recognition of actuarial gains or losses on the balance sheet and within OCI – as the “OCI effect” of IAS 19R. Appendix B presents a comprehensive numerical example illustrating IAS 19R’s “OCI effect”.

⁷ Method (3) was virtually nonexistent in the initial sample (see Table 1 and Glaum, Keller, & Street, 2018).

⁸ In 2012, treatment firms’ mean unrecognized actuarial losses were €981 million, or 10% of equity book value.

2.2.1.3 The “ERR effect”

The second noteworthy change in IAS 19R relates to the income statement depiction of defined benefit pension plans. Income statements display a net periodic pension cost that captures service cost, interest cost, and the expected yield on plan assets. Under the original IAS 19, interest cost was calculated by applying the pension discount rate to the DBO, whereas the expected asset yield reflected the expected rate of return on plan assets (ERR), given the current asset allocation. Under IAS 19R, interest cost and the expected return on plan assets are combined into a net interest cost, calculated as the funded status times the discount rate. Where the expected rate of return on plan assets (say, 6%) exceeds the discount rate (say, 2%), net interest cost under IAS 19R ($DBO \times 2\%$ less plan assets $\times 2\%$) is larger than net interest cost under the original IAS 19 ($DBO \times 2\%$ less plan assets $\times 6\%$). We label this aspect of IAS 19R – the elimination of the expected rate of return assumption – the “ERR effect”. Evidence in Bergstresser, Desai, and Rauh (2006) and Chuk (2013) is consistent with managers increasing risk in pension asset allocations to justify inflated ERRs, which – before IAS 19R – directly increased reported earnings. Based on these findings, Anantharaman and Chuk (2017) expect and find evidence consistent with IAS 19R’s ERR causing reduced risk-taking in pension asset allocations for a sample of Canadian firms.

2.2.1.4 Relevance of IAS 19R for the Allocation of Pension Assets

Any “ERR effect” notwithstanding, we expect IAS 19R to affect firms’ pension asset allocation decisions through the “OCI effect”, which increases expected pension-induced equity volatility, i.e., volatility in accounting amounts and related ratios caused by the recognition of actuarial gains and losses in OCI and the net pension liability. Recall that the “ERR effect” operates through managers losing their incentive to invest in risky pension assets as a justification for inflated ERRs and higher earnings. In contrast, the “OCI effect” does not assume previously biased asset allocations. Rather, it is based on managers expecting increased equity volatility under IAS 19R. Whereas firms were able to avoid this volatility under the corridor method, IAS 19R eliminates this possibility. Furthermore, we argue that the “OCI effect” is of high potential magnitude. For example, Volkswagen AG, the German automaker, recognized a €7,929b pre-tax actuarial loss in OCI in 2013, which amounts to 8.8% of book equity. The “ERR effect”, in comparison,

would have amounted to roughly 0.04% of book equity.⁹ As further developed in section 2.2.3, firms could mitigate expected pension-induced equity volatility by shifting investments into (1) less volatile asset classes, and/or (2) asset classes that provide a natural hedge against expected volatility in the defined benefit obligation.¹⁰

2.2.2 Prior Literature

By analyzing firms' pension asset allocation decisions in response to a change in pension accounting standards, this paper relates to two streams of literature: First, the 'real effects' literature is interested in the impact of accounting standards on firms' 'real' operating, investing, and financing decisions (e.g., Kanodia, 2007). For example, extant findings suggest that managers alter business decisions to influence accounting outcomes (e.g., Graham, Harvey, & Rajgopal, 2005; Chuk, 2013), and to mitigate the impact of mandated accounting changes (e.g., Choudhary et al., 2009; Zhang, 2009). As defined benefit pensions are economically large, changes in pension accounting are likely to trigger such 'real' effects. For example, Beaudoin, Chandar, and Werner (2010) show that the adoption of SFAS 158 (which also introduced the OCI method) in the U.S. is associated with firms' decisions to freeze defined benefit pension plans.

Second, a series of papers in finance explain variation in pension asset allocations by the demographics of employees, regulation, taxation, and corporate financial policy; however, unexplained variation remains (e.g., Rauh, 2009). At the same time, practitioners and academics have long held that accounting standards also influence the pension asset investment strategy through their effects on financial statement volatility (Kiosse & Peasnell, 2009).

Several prior studies straddle these two lines of research, seeking to assess firms' use of pension asset allocations to mitigate the undesired impact of changes in accounting

⁹ The "ERR effect" is difficult to calculate precisely from public disclosures. For example, Volkswagen reports separate discount rates and expected rates of return on plan assets for Germany versus all other countries, but does not provide the same disaggregation for the DBO and the fair value of plan assets. However, assuming that Volkswagen replaced the 2012 expected rate of return on plan assets for Germany (4.12%) with the 2013 discount rate for Germany (3.70%) and applied the difference (0.42 percentage points) to the fair value of plan assets at the end of 2012 (€7.288b), this would have led to a pension expense that would have been higher by €31m, or 0.04 of book equity. Clearly, however, the magnitude of the "ERR effect" is driven by (1) a firm's fair value of plan assets, and (2) its spread between the discount rate and the expected rate of return on plan assets.

¹⁰ In section 2.4.3, we consider whether IAS 19R's "ERR effect" is associated with shifts in firms' pension asset allocations. This test amounts to a replication of Anantharaman and Chuk (2017) for the German setting.

standards.¹¹ Amir and Benartzi (1999) suggest that firms avoid the recognition of an additional pension liability under SFAS 87 by reducing the volatility of pension assets. These inferences are based on cross-sectional tests that control for other known and observable determinants of the pension asset allocation. Amir et al. (2010) provide evidence consistent with firms changing their pension asset allocations to mitigate expected equity volatility from pension accounting changes in the U.K. and U.S. Inferences rely on pre-post comparisons of pension asset allocations around the relevant changes in accounting standards, again using control variables.¹²

We complement these papers in several important ways: First, our single-country difference-in-differences research design mitigates potential concerns that omitted cross-sectional (i.e., across-firm) or time-series (i.e., within-firm) factors could explain the observed effects. Second, this study is the first to provide IFRS-based insights from a Continental-European perspective, and thus speaks to the external validity of prior work. Third, in addition to relying on archival data, we provide insights into key assumptions and mechanisms based on interviews with sample firms' Chief Accounting Officers. Fourth, analyzing the percentage of bonds in addition to equities allows us to assess the extent to which firms not only shift *out of* risky assets, but also whether this is accompanied by a shift *into* another asset class consistent with the theoretical predictions of this literature.

In a concurrent study, Anantharaman and Chuk (2017) investigate the “ERR effect” of IAS 19R in Canada, using U.S. firms as a control group. The authors document a reduced percentage of equity investments after mandatory IAS 19R adoption, in absolute terms as well as relative to the control group. Our study complements Anantharaman and Chuk (2017) in three important ways: First, whereas Anantharaman and Chuk (2017) are interested in IAS 19R’s “ERR effect”, we focus on IAS 19R’s “OCI effect”.¹³ Doing so matters, as eliminating the corridor method, a highly salient and effective smoothing device, had an economically significant impact. Second, the German single-country

¹¹ These papers are complemented by several studies that document accrual earnings management in the pension context, typically using actuarial assumptions (e.g., Glaum, 2009 for a review).

¹² Mashruwala (2008) reports similar findings in the U.K. setting by documenting that U.K. firms reduce equity allocations by approximately 8 percentage points following the introduction of FRS 17.

¹³ As discussed in section 2.4.3, we cannot cleanly separate the “OCI and ERR effects” in our main setting. However, we complement the main tests with alternative analyses that allow isolation of the “ERR effect”. (We discuss an empirical approach to isolating the “OCI effect”, but data availability constraints prevent us from implementing it.)

setting arguably provides a cleaner control group relative to a cross-country design. Third, our findings suggest that German firms' incentives related to the "ERR effect" differ from those of Canadian firms, and that these differences seem to matter. Overall, we complement Anantharaman and Chuk (2017) and prior work in investigating the effect of accounting standards on firms' pension asset allocations.

2.2.3 Hypotheses Development

2.2.3.1 Key Assumptions and Supporting Evidence

We predict that treatment firms rebalance their pension asset allocations due to concerns about expected equity volatility caused by IAS 19R. This prediction, developed in section 2.3.2 below, follows from three conditions: Treatment firms (1) expect IAS 19R to increase equity volatility; (2) have incentives to avoid such volatility; and (3) view plan asset reallocation as an effective, efficient (i.e., relatively low-cost), and *de-facto* feasible countermeasure. In this section, we discuss theory and evidence suggesting that these conditions hold. Our evidence stems from two sources: (a) seven semi-structured interviews with Chief Accounting Officers (CAO) of sample firms¹⁴, and (b) stakeholders' public statements and comment letters to the IASB.

Regarding condition (1), the discussion in section 2.2.1 and Appendix B illustrates the volatility-increasing effect of IAS 19R on treatment firms' book value of equity. But were firms sufficiently *aware* of this "OCI effect" to be concerned? Interviewed CAOs uniformly indicate their clear expectation that IAS 19R would increase the volatility of equity (and, in the case of accumulated unrecognized actuarial losses, decrease its magnitude) for treatment firms. Consistent with this view, Deutsche Lufthansa AG states that "changes in the discount rate ... and ... fluctuations in the market value of plan assets, can in particular result in considerable, unpredictable fluctuations in the balance sheet and shifts between equity and liabilities." Lufthansa comments as follows on the elimination of the corridor method: "the 10-per cent corridor rule previously used ... to avoid annual fluctuations in the balance sheet will then no longer be allowed." (Deutsche Lufthansa AG, 2012, both quotes). Deutsche Post AG also expressed concerns in relation to the

¹⁴ Refer to Appendix C for summary information on these interviews. We present this evidence in the spirit of Gow, Larcker, and Reiss (2016, p. 479), which argues "that evidence on the actions and beliefs of individuals and institutions can bolster causal claims based on associations, even absent compelling estimates of the causal effects."

immediate recognition of actuarial gains or losses on the balance sheet in their comment letter submitted in response to the 2010 Exposure Draft that led to the introduction of IAS 19R, noting: “From a conceptual viewpoint, we are not convinced that highlighting short-term volatility provides any additional relevant information to the reader of financial statements and may in addition lead to inefficient investment decisions by entities (in order to avoid such volatility).” These expectations are echoed in audit firms’ publications. For example, Ernst & Young (2011, p. 3) states: “These changes will result in increased balance sheet volatility for those entities currently applying the corridor approach.”

Condition (2) states that firms also needed to be *concerned* about this effect to a sufficient extent for them to consider countermeasures. A first indication lies in the fact that treatment firms chose not to voluntarily adopt the OCI method before it became mandatory under IAS 19R. Consistent with this view, an increase in firms’ volatility of comprehensive income, equity and liabilities affects the perception of business risk by equity investors (Jin, Merton, & Bodie, 2006; Chava & Purnanandam, 2010) and debtholders (Bao, Billett, Smith, & Unlu, 2018). Another negative potential consequence is the impact on firms’ contractual arrangements. For example, volatility in the book value of equity increases the likelihood of violation of accounting-based debt covenants (Watts & Zimmerman, 1986). Higher volatility of comprehensive income also affects retained earnings, constraining firms that link dividend payouts to retained earnings.¹⁵

Consistent with these theoretical considerations, interviewed CAOs point out that equity volatility and depletion are severe concerns that are distinct from concerns about earnings volatility. Equity volatility is considered problematic due to debt covenants that vary with the book value of equity (e.g., debt-to-net worth), and because of capital-market perceptions of default risk. These concerns are corroborated by PIMCO’s global head of credit research, who notes that “it’s not just about the liability – it’s about the volatility of the liability” (Stracke, 2013). The immediate recognition of actuarial gains and losses that occurs under IAS 19R increases the volatility of pension liabilities, which “is a critical factor in credit analysis” (Stracke, 2013). Moreover, Stracke (2013) claims that

¹⁵ Whereas German corporate law restricts dividend payments to the amount of retained earnings calculated under German GAAP, shareholders may form expectations about dividends on the basis of published IFRS financial statements. Also, as indicated by one interviewee, corporate bylaws and charters occasionally make dividend distribution conditional on maintained minimum ratios of book value of equity to total assets.

information previously provided in the notes does not sufficiently enable credit analysts to properly assess pension liabilities and their volatilities, suggesting that IAS 19R will render pension-induced volatility more salient by elevating it from pre-IAS 19R notes disclosures to recognition in the financial statements.

Related to condition (3), there is a widespread perception among practitioners and academics that the pension asset investment strategy can affect financial statement volatility (Kiosse & Peasnell, 2009).¹⁶ For example Rauh (2009) shows that incentives to limit costly financial distress explain some of the variation in pension asset allocations. He finds firms decreasing the allocation to equities when they are close to financial distress. Amir and Benartzi (1999) find that firms shift pension assets from equity to fixed-income securities to reduce the risk of recognizing an additional pension liability. Interviewed CAOs also view “liability-driven investment” strategies for plan assets as a proper approach to mitigating the equity volatility concerns raised by IAS 19R. Specifically, they consider it favorable among other measures of “de-risking” pension plans, such as curtailments, settlements and shifts into cash-balance plans, which they deem more costly and feasible only in the long-term.

However, it is not obvious that firms can *de facto* influence asset allocations where pension plans are administered outside of the reporting entity. Asked directly, several CAOs report that asset management committees consisting of firm managers and independent pension plan trustees/directors decide on asset allocation strategies. This supports the notion that firms have *de-facto* opportunities to influence pension asset allocations in the expected way.

2.2.3.2 Empirical Predictions

Against this background, the first hypothesis predicts that IAS 19R affects pension asset allocations for firms applying the corridor method in the pre-IAS 19R period.¹⁷ These firms now adopt the OCI method, which requires immediate recognition of actuarial gains and losses in other comprehensive income. For these firms, actuarial gains and losses now fully affect balance sheet amounts (i.e., the net pension liability and – through OCI –

¹⁶ Alternative (and potentially costlier, and longer-term) ways of reducing the financial statement risks of pension plans include settlement payments, termination/freezing of existing pension plans, and risk transfers to insurance companies.

¹⁷ Again, refer to section 2.2.1 for a detailed comparison of the two methods of recognizing actuarial gains and losses, and Appendix B for a numerical example.

shareholders' equity), with ripple effects on financial ratios containing either amount, in the period in which they occur. We refer to this effect as the "OCI effect". Accordingly, we expect IAS 19R's elimination of the corridor method to increase firms' pension-induced equity volatility.

How would firms reallocate their pension assets to counteract this expected "OCI effect"? The pension-induced equity volatility caused by actuarial gains and losses flowing through OCI potentially stems from two sources: (1) fluctuations in the DBO (which are predominantly due to discount rate changes), and (2) fluctuations in plans assets. Therefore, firms have an incentive, first, to increase their investments in bonds, which are negatively correlated with interest rates (e.g., Amir & Benartzi 1999, Amir et al., 2010), and, second, to the extent that equities are more volatile than other asset classes held within plan assets (and ignoring diversification effects), reduce the percentage of equities. Taken together, we hypothesize that treatment firms mitigate the imminent increase in pension-induced equity volatility by decreasing (increasing) the percentage of equities (bonds) in their pension assets:

H₁: When adopting the OCI method under IAS 19R, treatment firms (which previously applied the corridor method) will, *on average*, reduce (increase) the portion of equities (bonds) in their pension assets, relative to control firms (which already apply the OCI method).

We further expect that this "OCI effect" predicted under H₁ varies in the cross-section with firms' defined benefit pension plan characteristics. Specifically, the volatility effect of IAS 19R is potentially more severe for firms with relatively large pension plans, as these firms are likely to have larger actuarial gains and losses, leading to higher pension-induced equity volatility. Furthermore, relatively larger plan assets provide larger scope for firms to counteract expected pension-induced equity volatility by decreasing the percentage of equities in their pension assets. For most firms, the magnitude of pension assets and pension obligations relative to book value of equity is considerable. Therefore, these firms could have stronger incentives to rebalance their pension assets as predicted under H₁.

However, shifting the relative weights of equities and bonds may be a blunt and weak instrument for managing expected equity volatility – especially where pension plans are large and funding levels are relatively low. In these cases, interviewees note that firms are likely to supplement other measures to counteract IAS 19R-induced equity volatility.

These include derivatives-based hedging (which the low granularity of pension asset disclosures prohibits us from observing), defined benefit plan curtailments, settlements, freezes, or closures (which are relatively costly and therefore less likely to occur within a relatively short window around the mandatory adoption of IAS 19R), and cash injections into plan assets. Therefore, we make the following unsigned prediction:

H₂: When adopting the OCI method under IAS 19R, treatment firms' relative reduction (increase) in the portion of equities (bonds) in pension assets will, *on average*, vary with firms' (a) exposure to pension plans and (b) level of funding deficits.

2.2.4 Institutional Setting

The within-Germany setting provides a sufficiently large number of public firms with substantial, but varying, exposure to defined-benefit pension plans. These firms' IFRS reporting is subject to a rigid enforcement mechanism (e.g., Hitz, Ernstberger, & Stich, 2012) and exhibits high data quality. As only a subset of firms is affected by IAS 19R's elimination of the corridor method, this setting facilitates a single-country difference-in-differences design.

In Germany, defined benefit pension plans are funded either internally (i.e., through the sponsoring firm's operating or financial assets), externally (i.e., through a separate funding agency that manages plan assets on the firm's behalf), or through a combination of both. In the case of external funding, funding agencies invest firms' contributions into various asset classes (e.g., equity instruments, bonds, real estate, or cash). Funding agencies include pension funds, contractual trust arrangements (CTAs), support funds, and insurance-like vehicles. Pension plan sponsors and funding agencies face numerous regulatory requirements, and the German setting is no exception. However, and importantly for this study, none of these requirements provide plausible explanations for mean shifts in the pension asset allocations of treatment firms relative to control firms in the context of IAS 19R adoption.¹⁸

¹⁸ In Appendix D, we further discuss the German regulatory environment in terms of three distinct institutional factors that prior studies have linked to variation in pension sponsors' plan asset allocations: (1) restrictions on funding agencies' investment strategies; (2) funding requirements and insurance; and (3) taxation. The purpose of that discussion is to show that these institutional factors are unlikely to explain the empirical patterns we observe in the context of IAS 19R adoption.

2.3 Research Design and Data

2.3.1 Identification Strategy and Regression Models

This section explains our approach to identifying the causal effect of IAS 19R on firms' pension plan asset allocations.

2.3.1.1 Modeling the Pension Asset Allocation

Following Amir et al. (2010), hypothesis tests rely on the following baseline regression to explain cross-sectional variation in the pension asset allocation:

$$\begin{aligned} ASSET_ALLOC_{it} = \alpha_0 &+ \alpha_1 Lev_{it} + \alpha_2 FF_{it} + \alpha_3 Size_{it} + \alpha_4 SDCF_{it} + \alpha_5 Fund_{it} \\ &+ \alpha_6 Horizon_{it} + \alpha_7 Exp_{it} + \sum_{k=8}^{18} \alpha_k Ind_{it} + \varepsilon_{it} \end{aligned} \quad (1)$$

The dependent construct, $ASSET_ALLOC_{it}$, reflects two alternative measures that characterize firms' pension asset allocations: $\%EQ_{it}$ ($\%BONDS_{it}$) is the percentage of pension assets invested in equity securities (bonds) of firm i at the end of fiscal year t .¹⁹ Prior literature identifies several determinants of firms' pension asset allocations, which are included in equation (1). First, firms with higher leverage ratios (Lev) are expected to be (on average) closer to violating their debt covenants, which creates incentives to decrease pension-induced equity volatility by investing more (less) pension assets in bonds (equities) (e.g., Mitra & Medova, 2010).

Second, the percentage of free float (FF) captures the presence of large blockholders. Findings in Faßhauer, Glaum, Keller, and Street (2011) suggest that firms with large shareholders are more effectively monitored, which could mitigate managers' compensation-related incentives to promote risk taking that manifests in the pension asset investment strategy (Anantharaman & Lee, 2014). We therefore expect a positive (negative) relation between FF and $\%EQ$ ($\%BONDS$).

Third, we control for firms' business risk by introducing firm size ($Size$) and the variability of operating cash flows ($SDCF$). To the extent firms' cash flows are positively correlated with stock returns (e.g., due to decreasing plan assets triggering cash funding requirements; Amir & Benartzi, 1999), firm risk increases in $\%EQ$. Hence, we predict a negative (positive) relation between $SDCF$ and $\%EQ$ ($\%BONDS$). Furthermore, as large

¹⁹ We suppress subscripts in the subsequent text. See Appendix A for detailed variable definitions.

firms are associated with lower business risk (e.g., Fama & French, 1993), we predict a positive (negative) relation between *Size* and *%EQ (%BONDS)*.

Fourth, prior literature also identifies pension plan funding levels as determinants of the pension asset allocation. Analytical research by Harrison and Sharpe (1983) suggests that firms should invest pension assets in equity securities if funding levels are low, increasing the value of the put option provided by a pension guarantee system. However, German legislation requires minimum funding of externally funded pension plans, which reduces the value of the put option. Moreover, in contrast to the theoretical prediction, Rauh (2009) and Anantharaman and Lee (2014) find that firms with higher funding levels allocate more pension assets to equity securities. We include the funding status (*Fund*; i.e., the fair value of plan assets scaled by the DBO), but due to conflicting findings in prior literature, we refrain from predicting a sign.²⁰

Fifth, we include the investment horizon of pension assets (*Horizon*). DBOs reflect estimated future payments and the discount rate. Whereas estimated future payments depend heavily on expected final salary levels, the discount rate reflects market yields of high-quality corporate bonds. Accordingly, DBOs for retirees are primarily affected by short-term interest rates, whereas DBOs for younger, active workforces are more strongly correlated with value changes in equities. Consistent with firms hedging against increases in DBOs caused by rising salaries (Sundaresan & Zapatero, 1997; Cocco et al., 2005), Bikker, Broeders, Hollanders, and Ponds (2012) find that older employees are associated with lower equity investments. Therefore, we predict a positive (negative) relation between *Horizon* and *%EQ (%BONDS)*.

Sixth, consistent with our reasoning in section 2.2.3.2, we control for the exposure of firms' book value of equity to the size of the pension plan (*Exp*), measured as the ratio of pension assets to book value of equity.²¹ We refrain from predicting a sign for this relation.

Finally, equation (1) is estimated including a set of 11 industry indicator variables (*Ind*).

²⁰ Alternatively, we test for a non-linear relation between *Fund* and *%EQ* as well *%BONDS* in section 4.4.4.

²¹ In section 2.4.2, we discuss results for an alternative measure of pension plan exposure.

2.3.1.2 Identifying the “IAS 19R Effect”

We adopt the difference-in-differences research design illustrated in Figure 1 to test our predictions. Specifically, we measure the effect of mandatory IAS 19R adoption on the pension asset allocation by comparing differences in pension asset allocations between a treatment group affected by IAS 19R and an unaffected control group across the pre- and post-IAS 19R periods. This design helps us isolate the causal “IAS 19R effect” by excluding time-invariant factors and time-series mean shifts affecting both groups.

Whereas treatment firms switch from the corridor method to the OCI method under IAS 19R, control firms already used the OCI method and are therefore unaffected. To quantify the effect of mandatory IAS 19R adoption on the pension asset allocation, we first measure the difference in the percentages of equities and bonds, $\%EQ$ and $\%BONDS$, between the two groups *before* the transition to IAS 19R (effect 1 in Figure 1). In a second step, we remeasure these differences *after* IAS 19R adoption (effect 2). To test H_1 , we calculate the difference between these pre- and post-IAS 19R differences (effect 3). This design controls for trends in pension asset allocations shared by both groups as well as observable and unobservable time-invariant firm characteristics; it thus mitigates potential selection bias (Lennox, Francis, & Wang, 2012). In addition, we use control variables to capture the effects of any observable time-variant firm characteristics that differ across the treatment and control groups.

Figure 1 also illustrates the pre- and post-treatment periods around the transition to IAS 19R. IAS 19R was issued by the IASB on June 16, 2011, obtained EU endorsement in June 2012, and became effective for fiscal years beginning on or after January 1, 2013. Importantly, the preceding 2010 exposure draft (IFRS Foundation, 2010) was already very much in line with the final IAS 19R, in that it proposed the OCI method as the only permitted approach to accounting for actuarial gains and losses. As affected firms required time to analyze the new requirements and evaluate their consequences, we assume any IAS 19R-induced change in pension asset allocations to start becoming visible in 2012. This assumption is consistent with prior literature using difference-in-differences research designs to examine the effect of changes in regulations and laws (e.g., Agrawal, 2013).

We structure our analysis over a four-year window centered on IAS 19R adoption. Specifically, we treat fiscal years 2010 and 2011 (2012 and 2013) as the pre-treatment (post-treatment) period. This choice of window length in the post-treatment period

reflects a trade-off between allowing sufficient time for firms to adjust their pension asset allocations and the risk of a longer window capturing confounding factors that might explain deviating levels of %EQ and %BONDS across the two groups (Roberts & Whited, 2013).²² To apply the difference-in-differences design, we extend equation (1) by the variables *TREAT* and *Post*. *TREAT* is the treatment assignment variable that equals 1 if a firm has applied the corridor method before the treatment, and 0 otherwise. *Post* is an indicator variable that equals 1 for post-treatment periods, and 0 otherwise. To compare changes in the pension asset allocation across the treatment and control firms before and after the treatment, we introduce the interaction term *Post* × *TREAT*. We test H₁ using the following regression:

$$ASSET_ALLOC_{it} = \beta_0 + \beta_1 TREAT_{it} + \beta_2 Post_{it} + \beta_3 Post \times TREAT_{it} + \sum_{k=4}^{21} \beta_k Controls_{it} + \varepsilon_{it} \quad (2)$$

In equation (2), *Controls* captures the control variables included in equation (1), *TREAT* captures pre-treatment differences across the treatment and control groups, and *Post* captures the treatment effect on the control group. The main coefficient of interest, β_3 on *Post* × *TREAT*, captures the incremental treatment effect on *ASSET_ALLOC* (i.e., %EQ and %BONDS, respectively) in the treatment group relative to the control group (i.e., the difference-in-differences). If treatment firms reduce (increase) their percentage of equities (bonds) more strongly than control firms (H₁), we predict β_3 to be negative (positive).

H₂ predicts that treatment firms' pension plan characteristics affect the "IAS 19R effect" on %EQ and %BONDS. To empirically test this prediction, we extend equation (2) by adding interactions between two different proxies for pension plan characteristics (*PP_CHAR*) and *Post* × *TREAT*, yielding the following regression:

$$ASSET_ALLOC_{it} = \gamma_0 + \gamma_1 TREAT_{it} + \gamma_2 TREAT \times PP_CHAR_{it} + \gamma_3 Post_{it} + \gamma_4 Post \times PP_CHAR_{it} + \gamma_5 Post \times TREAT_{it} + \gamma_6 Post \times TREAT_{it} \times PP_CHAR_{it} + \sum_{k=7}^{24} \gamma_k Controls_{it} + \varepsilon_{it} \quad (3)$$

PP_CHAR reflects either (1) *Exp*, the magnitude of the firm's pension plan, measured as the ratio of pension assets to the book value of equity, or (2) *Fund*, a measure

²² In section 2.4.4.1 we discuss robustness tests using alternative time windows.

of a firm's pension plan funded status.²³ We interact *PP_CHAR* with *TREAT*, *Post* and *Post* × *TREAT*, respectively, to test whether the “IAS 19R effect” (i.e., treatment firms' relatively larger change in the pension asset allocation compared to control firms) is more pronounced for firms with larger or more strongly underfunded pension plans.

In equation (3), *Post* × *TREAT* × *PP_CHAR* is the incremental pre- to post-treatment change in *ASSET_ALLOC* for treatment firms with high values of *PP_CHAR*, relative to those with low values. In line with the unsigned expression of H₂, we predict no direction for the coefficients on these interactions, γ₆. All models are estimated using pooled OLS regressions with standard errors clustered by firm and year.

2.3.1.3 Addressing Self-Selection Bias

Estimating causal effects of accounting standards poses the challenge that control samples often are either unavailable or non-randomly assigned, where the latter circumstance gives rise to the potential presence of correlated omitted variables. The German setting does provide the advantage of a set of control firms. However, these self-select into the control group by voluntarily adopting the OCI method – using an accounting choice offered under the original IAS 19 and eliminated by IAS 19R. In contrast, treatment firms switch to the OCI method only when forced to do so as IAS 19R becomes mandatory. To the degree that factors driving this accounting choice are correlated with firms' pension asset allocations (*%EQ* and *%BONDS*), coefficients on the independent variables could suffer from correlated omitted variable bias (Roberts & Whited, 2013), distorting inferences from the main test.

As our difference-in-differences design does not fully rule out these concerns, we construct the control sample through propensity-score matching based on firm characteristics that we expect to explain the choice between the corridor and the OCI methods. The matching procedure is intended to strengthen the key assumption of covariate balance across treatment and control firms, which mitigates the potential impact of correlated omitted variables (e.g., Rosenbaum, 2010). Collectively, this matching procedure and the difference-in-difference research design help us mitigate endogenous self-selection concerns, with the sole possible exception of unobserved time-variant firm

²³ Both measures capture (i) the sensitivity of firms' equity book values to pension-induced volatility and, simultaneously, (ii) the degree to which firms can mitigate that volatility by adjusting pension asset allocations.

characteristics that deviate across groups.²⁴ While we cannot rule out this possibility, we have no reason to suspect such factors in our setting.

We derive inputs for calculating the propensity scores by considering determinants of the choice of *TREAT*. Consistent with prior work (e.g., Glaum et al., 2018; Faßhauer et al., 2011; Morais, 2010), we model firms' choice of *TREAT* as a function of variables broadly capturing (1) the materiality of the pension plan; (2) expected exposure to pension-induced equity volatility; and (3) a firm's commitment to transparency and industry best practice. This leads to the following probit regression, which predicts firms' pre-IAS 19R choice of the corridor versus OCI methods (i.e., *TREAT*):

$$\begin{aligned}
 \text{Prob}(TREAT=1) = \delta_0 & + \delta_1 Lev_{it} + \delta_2 FF_{it} + \delta_3 Size_{it} + \delta_4 SDCF_{it} + \delta_5 Fund_{it} \\
 & + \delta_6 Horizon_{it} + \delta_7 Exp_{it} + \sum_{k=8}^{18} \delta_k Ind_{it} + \varepsilon_{it}
 \end{aligned} \tag{4}$$

As above, the indicator variable *TREAT* captures observations representing treatment firms that choose to apply the corridor method in the pre-IAS 19R adoption period (recall that only these firms are affected by mandatory IAS 19R adoption). Accordingly, *TREAT* assumes a value of 0 for control firm observations (i.e., representing firms that already applied the OCI method prescribed under IAS 19R before it was mandated).

The corridor method mitigates pension-induced volatility in income statement and balance sheet amounts. Accordingly, equation (4) mainly includes explanatory variables from equation (1). We expect exposure to material pension plans (*Exp*) to affect the choice, as the corridor method mitigates pension-induced equity volatility, which increases in exposure. Similarly, a firm is more sensitive to pension-induced equity volatility, making the choice of the corridor method more likely, if it has higher leverage (*Lev*), lower free float (*FF*), higher risk (*SDCF* and *Size*), a longer investment horizon (*Horizon*), and a lower funding ratio (*Fund*). Finally, we capture a firm's industry best practice by adding industry indicators.²⁵ We estimate equation (4) using data for 2011,

²⁴ Specifically, for results to be explained by an omitted variable, that variable would have to vary contemporaneously with IAS 19R adoption, and affect treatment and control firms differently.

²⁵ Data constraints preclude us from including cumulative unrecognized actuarial gains and losses, another likely factor of influence. This is due to cumulative actuarial gains and losses not arising under the OCI method. However, our interview suggests that cumulative actuarial gains and losses were an important determinant of the choice of corridor versus OCI method only for early adopters switching to the OCI method in or shortly after 2005. Further, comprehensive evidence in Glaum et al. (2018) documents that cumulative actuarial gains/losses explain firms' OCI adoption decisions in 2005 – but not between

i.e., one year before the treatment date, across all firms listed in the Prime Standard as of January 1, 2014, and which have available data according to the sample selection process outlined in section 2.3.2. This allows us to use pre-treatment characteristics when matching treatment and control firms. We use one-to-one (i.e., single nearest neighbor) matching without replacement.²⁶

2.3.2 Sample and Data

Table 1 illustrates the sample selection process. Sample firms are listed in Deutsche Börse Group's Prime Standard segment as of December 12, 2014.²⁷ We eliminate firms that do not sponsor externally funded defined benefit pension plans. We also drop firms that recognize actuarial gains and losses immediately in profit or loss (i.e., method 3 in section 2.2.1), as these firms should not expect IAS 19R to increase their equity volatility. Moreover, we exclude firms that invest pension assets solely in insurance contracts, as firm management cannot affect the investment strategy for these assets (violating assumption 3 in section 2.2.3.1). Finally, we eliminate firms with insufficient information on the pension asset allocation. We are left with 90 unique firms in the main analyses: 41 potential treatment firms using the corridor method, and 49 potential control firms using the OCI method.

The sample period spans four fiscal years, 2010 to 2013.²⁸ Our research design employs a balanced panel of treatment and control firms to enhance pre- and post-treatment comparability by eliminating effects of time-invariant factors. Therefore, we require firms to have observations and test variables in all of the four analysis periods. This procedure yields 37 treatment firms and 45 control firms. Observing these firms over a four-year period results in 328 firm-year observations. We subsequently match

2006 and 2013. We thus believe that omitting cumulative actuarial gains/losses from a selection model estimated in 2011 will not result in severe omitted variables problems.

²⁶ We also carry out robustness tests using caliper matching in section 2.4.4.3.

²⁷ The Prime Standard segment comprises 340 listings representing 319 unique firms. (Several firms have both common stock and preferred stock outstanding; these count as separate listings.) We select this particular market segment, as it imposes transparency standards that go beyond EU minimum requirements. Besides reporting under IFRS, these firms published quarterly reports in German and English during our analysis period. However, as firms usually do not disclose the pension asset allocation in their interim reports, observations are restricted to one per year. Furthermore, firms listed outside of this segment often lack significant pension plans and typically do not provide sufficient information on pension asset allocations.

²⁸ In robustness tests discussed in section 2.4.4.1, we vary the event window between 2010-2014 and 2009-2013.

treatment and control firms using the approach discussed in section 2.3.1.3, yielding a final sample of 216 firm-year observations (108 for treatment firms and 108 for control firms) used in the main analysis.

We obtain financial statement data and pension asset allocation information from Worldscope, ascertaining the quality of the latter by manually verifying Worldscope data with footnote disclosures in firms' annual reports accessed through Perfect Information database.²⁹ Finally, to identify treatment and control firms, we also hand-collect the method of recognizing actuarial gains and losses (refer to section 2.2.1). Finally, we conduct semi-structured interviews with Chief Accounting Officers of several sample firms during the first quarter of 2017; Appendix C provides related summary information.

2.4 Empirical Results

2.4.1 Descriptive Statistics

Panel A of Table 2 provides comparisons for the variables used in the main tests. Regarding the allocation of pension assets, treatment firms on average reduce amounts allocated to equities (*%EQ*) from 27.3% to 23.6% (a 14% reduction) between the pre- and post-treatment periods. In contrast, control firms' *%EQ* values remain relatively more stable, diminishing from 30.0% to 27.9% (a 7% reduction). Results for *%BONDS* are somewhat surprising, showing shrinking proportions allocated to bonds amidst falling interest rates. However, consistent with H₁, treatment firms' bond percentage falls by less (48.3% down to 46.5%, or 4%) than that of control firms (47.7% down to 42.9%, or 10%). The significance tests reported in Table 2 suggest that there are no significant differences in the covariates of interest after matching.

Figure 2 illustrates these differences-in-differences, indicating that *%EQ* and *%BONDS* values for the treatment and control groups exhibit a parallel trend in the pre-treatment period, distinctly drifting apart in the post-treatment period. Difference-in-differences research designs assume that the average change in the dependent variable would have been the same for the treatment and control groups absent the treatment

²⁹ Note that, during the analysis period, mandated disclosure requirements on the composition of plan assets were limited to a disaggregation of the percentages or amounts of "equity instruments, debt instruments, property, and all other assets" (IAS 19.120A (j)) and "amounts included in the fair value of plan assets for ... the entity's own financial instruments; and ... property occupied by, or other assets used by, the entity" (IAS 19.120A (k)). See Appendix E for examples of the various degrees of granularity in pension asset disclosures.

(Roberts & Whited, 2013). This parallel-trends assumption is more plausible if the dependent variable exhibits a similar trend for both groups during the pre-treatment period. Accordingly, we take Figure 2 as initial evidence supporting the parallel-trends assumption.³⁰

Two other notable insights emerge from Panel A of Table 2: First, treatment and control firms are relatively comparable in both the pre- and post-treatment periods, across all variables.³¹ Second, whereas most variables do not change significantly across the pre- and post-treatment periods, firms' exposure (*Exp*) increases by roughly three to five percentage points for the treatment and control group. Clearly, declining discount rates contribute to increased defined benefit obligations and low plan asset yields, increasing firms' exposures. However, constant funding levels indicate that the increasing exposure is caused by relative changes in the book value of equity, which lead to higher exposures for control firms.

Panel B of Table 2 presents correlations for the main variables of interest. Pearson (Spearman) correlations are shown above (below) the diagonal. All Spearman correlations between %*EQ* and the control variables (except for *Lev*) exhibit the expected signs; they are significant for *FF*, *Fund*, and *Horizon*. All Spearman correlations between %*BONDS* and the control variables (except for *Size*) exhibit the expected signs and are significant for *Lev*, *FF*, *Size*, *Fund*, *Horizon* and *Exp*. As expected, all asset allocation variables (%*EQ*, %*BONDS*, %*OTHER*, and %*PROPERTY*) are negatively correlated with each other, as they tend to be substitutes. Correlations among control variables are sufficiently low not to pose multicollinearity concerns, with variance inflation factors below 2.0 in the main tests.

³⁰ To formally test this assumption, we estimate a model where %*EQ* is the dependent variable, and the independent variables are those in equation (1). We include year dummies for the pre-treatment period (i.e., 2010) and the post-treatment periods (i.e., 2012 and 2013), and omit the dummy (i.e., 2011) for the year before the actual treatment date (i.e., 2012). In addition, we interact these year dummies with *TREAT*. Untabulated results reinforce the validity of the parallel-trends assumption, as the coefficient on the interaction term *TREAT* \times 2010 is statistically insignificant. We thank an anonymous reviewer for this suggestion.

³¹ Panel A of Table 2 is based on the matched sample. Note that matching eliminated previous significant covariate differences between the treatment and control firms. As Table 5 shows, significant pre-matching differences between the treatment and control firms (particularly in the pre-treatment period), propensity-score matching achieves its main objective of covariate balance between the treatment and control observations.

2.4.2 Main Results

Panel A of Table 3 presents univariate tests of differences in %EQ and %BONDS between the treatment and control groups as well as over time. Treatment firms exhibit a decline in %EQ by -3.73; this difference is not significant (p -value = 0.235). Control firms' %EQ declines by 2.19; again, this difference is not significant (p -value = 0.546). The difference-in-differences of interest, -1.54, is significant at the 10% level (p -value = 0.10). Similarly, whereas treatment and control firms' changes in %BONDS are not statistically significant, the difference-in-differences (3.03) is significant at the 5% level (p -value = 0.020). These findings provide initial support for H₁, which predicts that treatment firms decrease (increase) %EQ (%BONDS) relative to control firms after the mandatory adoption of IAS 19R.

Panel B of Table 3 reports multivariate results. Whereas columns (1) and (2) present baseline results for equation (1), columns (3) and (4) introduce the experimental variables *Post*, *TREAT*, and *Post x TREAT*, and present the results of the main test of H₁.³² Results for the base model in column (1) show that %EQ is significantly associated as predicted with ownership structure (*FF*; coefficient = 0.14; z -statistic = 2.13) and the funding levels of pension plans (*Fund*; coefficient = -0.30; z -statistic = -2.80). The adjusted R² of 31.5% is above findings in prior literature (e.g., Rauh, 2009; Anantharaman & Chuk, 2017). Turning to the results for %BONDS, column (2) displays the expected negative association with ownership structure (*FF*; coefficient = -0.26; z -statistic = -2.79), and an adjusted R² of 29.0%.

Column (3) presents the effect of the elimination of the corridor method on the percentage of equity securities in firms' pension plan assets (H₁). The main variable of interest – highlighted in bold – is *Post x TREAT*, which captures the change in %EQ after the introduction of IAS 19R that is unique to treatment firms (i.e., the difference-in-differences across the treatment and control firms). The coefficient on *Post x TREAT* is significant and negative, suggesting that, conditioning on the control variables, treatment firms *on average* reduce the percentage of equity investments by 2.46 percentage points

³² Table 3 reports difference-in-differences results based on the matched sample. Table 6 provides the results for the probit model used to match treatment and control firms. These results are robust to including %EQ (contemporaneous and lagged) in the probit model as an additional explanatory variable (untabulated). We thank the reviewer for this suggestion. Difference-in-differences results without matching (untabulated) lead to the same inferences as those reported in Table 3. However, note that covariate balance is limited in the unmatched sample.

(z -statistic = -3.35) more than control firms after IAS 19R adoption. This effect is economically significant given the pre-treatment level of 27.3%,³³ and supports H_1 . Turning to %*BONDS*, column (4) shows a coefficient on $Post \times TREAT$ that is statistically significant and positive as expected (coefficient = 4.61; z -statistic = 2.43); it is also economically significant relative to the pre-treatment level of 48.3%. Overall, results for both %*EQ* and %*BONDS* are consistent with treatment firms adjusting their pension asset allocations more strongly than control firms upon IAS 19R adoption. This is consistent with the “IAS 19R effect” of H_1 , which predicts that treatment firms attempt to counteract the increase in equity volatility expected under IAS 19R.

Panel C of Table 3 reports results for equation (3), testing H_2 . Recall H_2 predicts that pension plan magnitude (*Exp*) and funding (*Fund*) moderate the “IAS 19R effect” on %*EQ* and %*BONDS*. Accordingly, columns (1) and (3) present results for %*EQ*, whereas columns (2) and (4) focus on %*BONDS*. The main coefficient of interest in all columns – highlighted in bold – is that on the three-way interaction $Post \times TREAT \times PP_CHAR$ (where *PP_CHAR* is either *Exp* or *Fund*), which captures incremental changes in %*EQ* or %*BONDS* after IAS 19R adoption unique to treatment firms with higher levels of *Exp* (i.e., relatively larger pension plans) or *Fund* (i.e., relatively better funded pension plans), respectively.

Similar to the results in Table 3 Panel B, in column (1), the coefficient on $Post \times TREAT$ is negative and highly significant (coefficient = -6.70; z -statistic = -5.69). The coefficient on $Post \times TREAT \times Exp$ is significantly positive (coefficient = 0.16; z -statistic = 4.36), indicating that exposure to larger pension plans attenuates treatment firms’ tendency to shift pension assets out of equities. Column (2) displays results consistent with this insight. The significantly negative coefficient on $Post \times TREAT \times Exp$ with %*BONDS* as the dependent variable (coefficient = -0.17; z -statistic = -3.24) suggests that exposure to larger pension plans also dampens treatment firms’ proclivity to increase their bond investments relative to control firms upon IAS 19R adoption.³⁴ Overall, whereas these attenuation effects may not appear economically

³³ The pre-treatment difference between treatment and control firms is captured by *TREAT*, which is negative but not significantly different from zero (coefficient = -1.36; z -statistic = -0.43).

³⁴ These results also hold when we calculate *Exp* as defined benefit obligation (rather than by pension assets, as in the main analyses) divided by the book value of equity, to capture the exposure of firms’ book value of equity to the size of pension plans for firms with relatively low pension assets but – at the same time – relatively high pension obligations. Untabulated results are consistent with the findings reported in the main analysis.

massive, they reflect the change in the dependent variable associated with a *one-percentage-point change* in the independent variable. Results are similar when we consider *Fund* as a pension plan characteristic, as evidenced by a highly significant positive (negative) coefficient on $Post \times TREAT \times Fund$ for *%EQ* (*%BONDS*) as the dependent variable (*%EQ*: coefficient = 0.08; *z*-statistic = 3.49; *%BONDS*: coefficient = -0.14; *z*-statistic = -2.26).³⁵ The results on *FUND* is negatively significant whereas other control variables are not significant, consistent with the results reported by Anantharaman and Chuk (2017).^{36,37}

Taken together, the main tests support the prediction that firms adjust their pension asset allocations to mitigate pension-induced equity volatility when an accounting change (i.e., the mandatory adoption of IAS 19R) eliminates a previously available smoothing device (H_1). We obtain this result using a difference-in-differences research design, which benchmarks treatment firms' average response to trends exhibited by a group of control firms unaffected by that accounting change. We also find evidence for H_2 , under which we expect that pension plan characteristics – specifically magnitude (*Exp*) and funding status (*Fund*) – moderate the “IAS 19R effect” on the pension asset allocation. Interpreted in the light of our evidence from interviews and firms' public statements, results indicate that IAS 19R prompts firms to take action to mitigate IAS 19R-induced equity volatility. One instrument of choice for achieving this aim is to rebalance the pension asset allocation away from riskier assets. Firms with relatively larger and better funded pension plans exhibit this behavior to a lesser degree – presumably because they supplement, or even prioritize, other de-risking strategies (which are more difficult for us to observe),

³⁵ In addition to the Table 3 analyses, we implement the test of H_2 by estimating equation (3) after splitting the sample based on the median value of *PP_CHAR*, which is either *Exp* or *Fund*. Results reported in Table 7 are consistent with those reported in Table 3. Specifically, we find significantly negative (positive) coefficients on $POST \times TREAT$ for firms with below-median *PP_CHAR* where the dependent variable is *%EQ* (*%BONDS*). In contrast, coefficients on $POST \times TREAT$ are insignificant for firms with above-median *PP_CHAR* (except for $PP_CHAR = Fund$ in the *%BONDS* model).

³⁶ These results suggest that treatment and control firms are closely balanced along these variables.

³⁷ We repeated the analysis reported in Table 3 after including year fixed effects and industry-by-year fixed effects, and the results are qualitatively similar.

such as derivative hedging³⁸, settlements or curtailments, over the reallocation of pension assets out of equities and into bonds.³⁹

2.4.3 *Alternative Analyses: Disentangling the “IAS 19R effect”*

This section complements the main analysis of section 4.2 by exploring an alternative channel through which adoption of IAS 19R could affect treatment firms’ pension asset allocations. As explained in section 2.2.1, IAS 19R not only eliminates the corridor method in favor of the OCI method (the “OCI effect”), but it also changes the calculation of net periodic pension cost by requiring that the expected return on plan assets be based on the discount rate. This “ERR effect” could trigger pension asset rebalancing, e.g., through managers losing their incentive to invest in risky pension assets as a justification for inflated ERRs and higher earnings (e.g., Bergstresser et al., 2006; Anantharaman & Chuk, 2017).

However, such asset allocation shifting should only arise where it is of sufficient magnitude to matter, i.e., (1) where plan assets tend to be larger relative to DBOs (generating larger returns, *ceteris paribus*), and (2) where expected rate of return assumptions tend to deviate more from discount rate assumptions. Regarding (1), German firms traditionally employ *unfunded* defined benefit plans (i.e., plans with *no* plan assets) as well as funded defined benefit plans. Consequently, the pre-treatment median funded status (i.e., fair value of plan assets as a percentage of the DBO) of the German treatment group is 62.8% (Table 9), compared to 80.2% for Anantharaman and Chuk’s (their Panel A of Table 2) Canadian treatment group. Regarding (2), we have compared pre-treatment ERRs and discount rates for the German and Canadian treatment groups. (Recall that separate ERRs are no longer available under IAS 19R post-treatment.) Whereas German treatment firms’ median ERR is 5.21%, Anantharaman and Chuk’s (their Panel A of

³⁸ Due to lack of granularity in firms’ pension asset disclosures, we are unable to test explicitly whether treatment firms adjust their derivatives-based pension de-risking activities around the adoption of IAS 19R. Inspection of pension footnotes indicates that only a small portion of our sample discloses the proportion of pension assets representing derivatives. Even for those firms, the specific types of derivatives, their attributes, and whether they are intended for pension de-risking, are ultimately opaque.

³⁹ Overall, these findings are robust to including *SHIFT*, an indicator variable equal to one if firm *i* terminates or freezes existing defined benefit pension plans, or transfers risk to insurance companies, in year *t*, and zero otherwise, as an additional control variable, following Amir et al. (2010). However, the three-way interactions are insignificant when *PP_CHAR* is *Fund* (refer to section 4.4.4). The purpose of including *SHIFT* is to control for firms altering or closing their defined benefit pension plans as an alternative means of mitigating the increase in pension-induced equity volatility brought about by IAS 19R.

Table 2) Canadian treatment firms use a median ERR of 6.27%; at the same time, median discount rates are nearly equal (4.69 versus 4.50%). The higher median deviations between ERRs and discount rates for Canadian firms suggest that the expected ERR-induced earnings impact of IAS 19R is larger for Canadian firms. We view these structural differences (1) and (2) between Canadian and German pension plans as indicators that any “ERR effect” in Germany will differ from that documented by Anantharaman and Chuk (2017) for Canada.

To isolate the “ERR effect”, we use treatment firms that switch from the OCI method under IAS 19 (asset returns based on expected rate assumption) to that under IAS 19R (asset returns based on discount rate). This treatment group is provided by German IAS 19R adopters that had been voluntarily applying the OCI method under the original IAS 19 and now adopt IAS 19R (i.e., the previous control group in the main tests; see section 4.2). The control group here consists of U.S. firms reporting under SFAS 158; these firms apply a stable OCI method (with asset returns calculated using firms’ expected rate of return assumptions) throughout the analysis period. This test effectively isolates the “ERR effect” by holding firms’ application of the OCI method constant while varying the expected rate of return method. We select U.S. control observations by downloading data for U.S. firms sponsoring defined benefit pension plans between 2010 and 2013, i.e., the same time period used in the main analysis reported in Table 3. We then apply a propensity score matching procedure that mirrors the one used for the main analyses in section 4.2; it yields 164 treatment observations and an equal number of matched control observations.⁴⁰ Summary statistics indicate covariate balance in the pre-treatment period, the only exception being U.S. firms’ higher percentage of free float (*FF*). German and U.S. firms further differ in their pension asset allocations, with U.S. firms having significantly higher (lower) *%EQ* (*%BONDS*).^{41,42}

Multivariate regression results are reported in Table 4, which mirrors the layout of Table 3 Panel C. Regarding the pension asset allocation to equities (*%EQ*), column (1) indicates no significant effect of IAS 19R on treatment firms when the partitioning variable captures relative pension plan size (i.e., *PP_CHAR = Exp*). However, when

⁴⁰ For sample selection details, refer to Table 8.

⁴¹ Full summary statistics are reported in Table 9.

⁴² Untabulated results for H_1 suggest that $Post \times TREAT$ is insignificant in the *%EQ* model, whereas it is negatively significant in the *%BONDS* model.

$PP_CHAR = Fund$ in column (3), treatment firms with lower funded status significantly *increase* their $\%EQ$ relative to control firms after mandatory IAS 19R adoption (coefficient on $Post \times TREAT = 7.00$; z -statistic = 2.75). That effect is slightly attenuated for firms with high $Fund$, evidenced by a significantly negative coefficient on $Post \times TREAT \times Fund$ (-0.10; z -statistic = -2.90).

Turning to the pension asset allocation to bonds ($\%BONDS$), column (2) shows that treatment firms with small pension plans (i.e., low Exp) strongly and significantly *decrease* their $\%BONDS$ relative to control firms after mandatory IAS 19R adoption (coefficient on $Post \times TREAT = -11.01$; z -statistic = -7.01). That effect also is slightly attenuated for firms with high Exp (significantly positive coefficient on $Post \times TREAT \times Exp$ of 0.12; z -statistic = 3.32). In column (4), we find a similar relation for $Fund$ as the conditioning pension plan characteristic, with the coefficient on $Post \times TREAT$ negative and highly significant (-12.08; z -statistic = -5.59); however, no significant incremental effect of high funding is observed (insignificant coefficient on $Post \times TREAT \times Fund$).⁴³

Recall these alternative analyses repeat the main test for a setting in which only the calculation of pension expense changes (the “ERR effect”), with no corresponding change to the accounting for actuarial gains and losses (the “OCI effect”). In this setting, which isolates the “ERR effect”,⁴⁴ any significant rebalancing in pension asset allocations should not be due to the “OCI effect”. Indeed, the results described in this section show a pattern of pension asset rebalancing distinct from that found in the main tests. Specifically, the “ERR effect” documented here is consistent with treatment firms strongly shifting *out of* bonds relative to control firms. This contradicts H_1 and our main finding reported in section 2.4.2; it also contrasts with what Anantharaman and Chuk (2017) finds for Canadian firms. It is not obvious why these differences emerge. Our

⁴³ We repeated the analysis reported in Table 4 after including year fixed effects and industry-by-year fixed effects, and the results are qualitatively similar, with the exception of the coefficient on $Post \times TREAT$, which is positive and marginally significant in the $\%EQ$ model in column (1) when including industry-by-year fixed effects.

⁴⁴ Note this test is largely comparable with the main test in Anantharaman and Chuk (2017) – with one exception: Whereas our treatment group in this test consists solely of OCI method firms, Anantharaman and Chuk’s (2017) main test includes corridor firms in the treatment group, effectively mixing the “ERR and OCI effects”. Anantharaman and Chuk (2017) include an indicator variable, e.g., $CORRIDOR$, to control for the alternative options for recognizing actuarial gains or losses under IAS 19; they note that the $CORRIDOR$ indicator variable is insignificant, ‘suggesting that any balance sheet effects for firms using the corridor method for balance sheet recognition prior to IAS 19R are not substantial’ (p. 28).

discussion and descriptive evidence presented earlier in this section indicate that German and Canadian pension plans differ in terms of pre-IAS 19R funded status and ERR assumptions. In addition, in contrast to the study by Anantharaman and Chuk (2017) the spread between the ERR and the discount rate is much smaller German firms, which may partly explain the divergent findings. Additional factors underlying diverging German versus Canadian “ERR effects” could include different sample compositions and management incentives.⁴⁵

2.4.4 Robustness Tests

2.4.4.1 Alternative Measurement Windows

The main analyses use four fiscal years, two in the pre- (2010 and 2011) and two in post-treatment period (2012 and 2013), with the beginning of 2012 as the treatment date. We expect this window to be sufficiently long for firms to adjust their pension asset allocations, and simultaneously short enough to minimize the risk of capturing confounding factors that affect the treatment and control groups differently. In this section, we vary the measurement window in two ways to assess the robustness of our identification strategy. First, to account for the possibility that firms require more time to reallocate their pension assets, we increase the number of post-treatment periods to three, by including 2014. Second, we extend the pre-treatment period by one year, yielding the five-year window 2009-2013.

Panel A of Table 10 presents the results for the 2010-2014 window, whereas Panel B presents the results for the 2009-2013 window. In both panels, columns (1) and (2) report results for *%EQ* and *%BONDS* where *PP_CHAR = Exp*, and columns (3) and (4) repeat the analyses for *PP_CHAR = Fund*. When *%EQ* is the dependent variable, results are directionally consistent with, albeit somewhat weaker than, the main tests reported in section 2.4.2. Specifically, no significant effects obtain when *Fund* is the pension plan characteristic examined. These weaker results are to some extent expected, as lengthening the measurement windows around the treatment date decreases test power. When *%BONDS* is the dependent variable, results are consistent with the main tests, with coefficients on *Post × TREAT* positive and significant across all specifications. Also,

⁴⁵ Furthermore, Anantharaman and Chuk’s (2017) research design choices vary to some extent from ours, including in the choice of matching algorithm, measurement windows and control variables.

coefficients on $Post \times TREAT \times Exp$ are negatively significant, again consistent with the results reported in the main analysis, with the exception of results reported in column (2) of Panel B. Overall, these results suggest that firms are on average able to adjust their pension asset allocations within two years after the publication of IAS 19R.

2.4.4.2 Alternative Treatment Dates and Placebo Tests

As discussed in section 3.1.2, we expect the treatment date (beginning of 2012) to capture the point in time at which treatment firms start adjusting to the requirements of IAS 19R. To examine alternative treatment dates, we conduct the following two sets of additional tests. First, we shift the treatment date to the beginning of 2013 (IAS 19R's official effective date; see Figure 1), yielding a four-year window (2011-2014). We do this because firms' pension asset rebalancing might be a process still ongoing after 2013. Second, as a placebo test, we repeat the main tests for periods during which no treatment effect is expected. Finding no significantly negative coefficient on $Post \times TREAT$ in the period before mandatory IAS 19R adoption decreases the likelihood that the difference-in-differences is a chance finding, increasing our confidence in the parallel-trends assumption underlying the main tests. We therefore re-estimate the main analysis for the period 2007-2010 and falsely assume a treatment three years earlier, in 2009. Failing to find significant differences between the treatment and control groups would support the parallel trend assumption.⁴⁶

Results for 2013 as the treatment date are reported in Panel C of Table 10. Columns (1) and (3) report the results for $\%EQ$ and columns (2) and (4) report the results for $\%BONDS$. The coefficient on $Post \times TREAT$ is negatively significant in column (1), when Exp is the PP_CHAR examined; the $Post \times TREAT \times Exp$ coefficient is positively significant. These results are consistent with those reported in the main analysis. However, the variables of interest are insignificant when $Fund$ is the PP_CHAR in column (3). As expected and consistent with the results reported in the main analysis, the coefficient on $Post \times TREAT$ is positive and significant when $\%BONDS$ is the dependent variable in columns (2) and (4). However, $Post \times TREAT \times Exp$ and $Post \times TREAT \times Fund$ are statistically insignificant.

⁴⁶ In untabulated analyses, we conduct another robustness test, where, we define 2009-2010 as the pre-treatment period and 2013-2014 as the post-treatment period. Overall, the results are very similar (with coefficients slightly larger) to those reported in the main analysis when $PP_CHAR = Exp$. However, the coefficients of interest are only significant for $PP_CHAR = Fund$ in the $\%BONDS$ specification.

Panel D of Table 10 reports the results when assuming a placebo treatment date in 2009. Again, columns (1) and (2) report the results for %EQ and %BONDS when *Exp* is the *PP_CHAR* examined, while columns (3) and (4) report the results for %EQ and %BONDS when *Fund* is the *PP_CHAR* examined. The coefficients on $Post \times TREAT$, $Post \times TREAT \times PP_CHAR$ are insignificant when %EQ is the dependent variable and when *PP_CHAR* is *Exp* and *Fund*. This is expected, as there is no treatment that would cause %EQ to diverge between the treatment and control groups. Unexpectedly, the $Post \times TREAT$ coefficient is positively significant when %BONDS is the dependent variable in column (2), and $Post \times TREAT \times Exp$ is negatively significant. Overall, however, results of this falsification test support our inferences from the main analyses that the difference-in-differences in pension asset allocations observed in 2012 are likely caused by IAS 19R, rather than some alternative event occurring earlier.

2.4.4.3 Alternative Matching Procedures

In the main analysis, we used nearest-neighbor matching without replacement to match treatment and control firms. As a robustness test, we apply caliper matching without replacement. In this context, we follow prior literature and set the caliper equal to 20% of the standard deviation of the estimated propensity score (Cochran & Rubin, 1973; D'Agostino, 1998). This matching procedure reduces the sample size to 144 firm-year observations.

The results are reported in Table 11. Columns (1) and (2) report the results for %EQ and %BONDS when *Exp* is the *PP_CHAR* examined, while columns (3) and (4) report the results for %EQ and %BONDS when *Fund* is the *PP_CHAR* examined. When %EQ is the dependent variable, the $Post \times TREAT$ coefficient is negatively significant in columns (1) and (3) and the $Post \times TREAT \times Exp$ coefficient is positively significant in column (1), consistent with the results reported in the main analysis. However, the $Post \times TREAT \times Fund$ coefficient in column (3) is insignificant. When %BONDS is the dependent variable $Post \times TREAT$ is positively significant and $Post \times TREAT \times PP_CHAR$ is negatively significant across all specifications. Overall, these results suggest that the main findings are robust to this alternative matching procedure.

2.4.4.4 Additional Control Variables

In this section, we test whether the main findings are robust to additional control variables. Regarding additional control variables, we include the square of the funding ratio ($Fund^2$), the square of percentage of free float (FF^2), market returns (*Market Returns*), the payout ratio (*Payout Ratio*) and a variable capturing terminations and freezes of defined benefit plans as well as transfers of risk to insurance companies (*SHIFT*). $Fund^2$ captures a possible non-linear relation between $Fund$ and $\%EQ$. As described in section 2.3.1, this relation is suggested by theoretical research for firms with low levels of funding, as managers have incentive to increase $\%EQ$ to benefit from the increase in risk (Harrison & Sharpe, 1983; Rauh, 2009). Similarly, the square of FF controls for a non-linear relation between ownership structure and $\%EQ$. Prior research by Faßhauer et al. (2011) finds that very low and very high ownership concentrations explain the choice between the corridor and OCI methods. However, we do not include these variables in the main analysis because of potential multicollinearity issues.⁴⁷ Further, we include a proxy for stock market performance (*Market Returns*) as an additional control variable. Positive (negative) market returns increase (decrease) the value of equity investments. If firms do not rebalance their portfolios, $\%EQ$ varies with market returns. Consistent with Anantharaman and Chuk (2017), we measure market returns by the returns to the S&P Global Broad Market Index for equities, which measures global stock market performance. Over the sample period, *Market Returns* is positive for all years except 2011. Following Anantharaman and Chuk (2017), we include the dividend payout ratio, as firms which typically pay dividends have stronger incentives to minimize volatility in order to ensure that they will have sufficient cash flows to make dividend payments. Finally, we include *SHIFT*, following Amir et al. (2010).

Table 12 presents results of including these additional control variables. Columns (1) and (2) report the results for $\%EQ$ and $\%BONDS$ when Exp is the PP_CHAR examined, while columns (3) and (4) report the results for $\%EQ$ and $\%BONDS$ when $Fund$ is the PP_CHAR examined. The coefficient on $Post \times TREAT$ is significantly negative when $\%EQ$ is the dependent variable in column (1) and positive for $\%BONDS$ in columns (2) and (4), consistent with the results reported in the main analysis. The

⁴⁷ Pearson and Spearman correlation coefficients between $Fund$ and $Fund^2$ are significant and above 0.96 and those between FF and FF^2 are significant and above 0.99.

$Post \times TREAT \times Exp$ and $Post \times TREAT \times Fund$ coefficients for $\%EQ$ and $\%BONDS$ are significantly positive and negative respectively in columns (1) and (2).⁴⁸ Overall, the findings generally support results of the main analyses in Table 3.

2.4.4.5 Subsample Analyses

Finally, we analyze subsamples excluding firms with high proportions of ‘other (pension) assets’ to address concerns regarding the characteristics of the pension asset category of ‘other assets’ and in particular the opacity of this asset class. We find an increase in the median $\%OTHER$ from 15.2% in the pre-IAS 19R period to 18.1% in the post-IAS 19R period for the main sample. Föhrenbach, Glaum, and Keller (2015) raises the concern that the aggregation of ‘other assets’ into a residual category loses information needed to evaluate the risk characteristics and volatility of these assets. For example, ‘other assets’ includes both insurance contracts and shares in hedge funds, which we expect to have different risk properties. In fact, assuming that lower levels of pension assets invested into equities lead to lower levels of volatility depends on the volatility characteristics of other asset classes. To address the impact of the inclusion of ‘other assets’ in the main analysis, we carry out a robustness test excluding observations for which the category ‘other assets’ is 25% or greater.

The results are reported in Table 13. Columns (1) and (2) report the results for $\%EQ$ and $\%BONDS$ when Exp is the PP_CHAR examined, while columns (3) and (4) report the results for $\%EQ$ and $\%BONDS$ when $Fund$ is the PP_CHAR examined. The coefficient on $Post \times TREAT$ is significantly negative (positive) for $\%EQ$ and $\%BONDS$; the coefficient on $Post \times TREAT \times Exp$ ($Post \times TREAT \times Fund$) is positive (negative) when $\%EQ$ ($\%BONDS$) is the dependent variable, consistent with the results reported in the main analysis. Inferences are similar when we exclude observations for which the category ‘other assets’ is 20% or greater (untabulated). In particular, the coefficient on $POST \times TREAT$ is negative (positive) when the dependent variable is $\%EQ$ ($\%BONDS$); however, the coefficient on $POST \times TREAT \times PP_CHAR$ is statistically insignificant, possibly due to reduced sample size and hence lower test power. Overall, these results suggest that the findings of the main analysis are not driven by firms that invest pension

⁴⁸ However, the $Post \times TREAT$ and $Post \times TREAT \times Fund$ coefficients are insignificant in column (3) where PP_CHAR is $Fund$. The $Post \times TREAT \times Fund$ is also insignificant in column (4). Given the high correlation between $Fund$ and $Fund^2$, this regression specification suffers from multicollinearity.

assets in this opaque asset category; they indicate that there was no massive substitution effect in the asset allocation between equities and other assets.

2.5 Conclusion

This paper examines the ‘real’ effects of a change in accounting standards on a specific type of investment decision: firms’ allocation of pension assets into asset classes with different risk and return profiles. Extant literature identifies the elimination of the expected rate of return (Anantharaman & Chuk, 2017), the risk of recognizing an additional minimum pension liability (Amir & Benartzi, 1999), and the introduction of IAS 19 (Amir et al., 2010) as examples of accounting standards affecting pension asset allocations. We advance this stream of research by examining whether the elimination of the corridor method of recognizing actuarial pension gains and losses affects the allocation of firms’ pension assets.

To examine this research question, we use the mandatory change from IAS 19 to IAS 19R. The latter requires immediate recognition of actuarial gains and losses in other comprehensive income (OCI method), removing a previously available smoothing device. We apply a difference-in-differences research design that compares treatment firms affected by the accounting change to control firms that are unaffected. This test design allows us to approach identification of the causal effect of mandatory IAS 19R adoption on firms’ pension asset allocations to the extent feasible in an observational study.

We predict and find that treatment firms shift their pension assets from equities into bonds relative to matched control firms, consistent with firms rebalancing their pension asset allocations to mitigate a potential increase in pension-induced equity volatility. Further, we find that this rebalancing is attenuated for firms with larger pension plans and higher funding levels. Results are robust to alternative control groups, varying measurement periods and alternative model specifications.

We further undertake to disentangle two distinct and potentially contradicting effects of IAS 19R on firms’ pension asset allocations: the “OCI effect” and the “ERR effect”. Whereas the main tests inevitably mix both effects, they suggest – consistent with predictions – that the “OCI effect” is strong and driven by firms’ concerns about IAS 19R-induced equity volatility. In contrast, the additional analysis using German OCI firms and a U.S. control sample yields results that are inconsistent with our predictions and concurrent evidence from the Canadian setting (Anantharaman & Chuk, 2017).

Future research can exploit settings that allow clean isolation of the “OCI effect”. Such settings require holding the ERR method constant while varying the OCI method. One such setting consists of corridor-method firms adopting the “old” OCI method under IAS 19 in the pre-IAS 19R period. Control samples would be given by corridor-method or OCI-method firms staying with their respective methods throughout the analysis period. While we attempted such tests in our setting, data constraints (i.e., a small number of treatment firms) preclude them.

Our results are subject to the following limitations. First, the single-country results may not generalize to other countries. Second, we do not explicitly test implications of Anantharaman and Lee (2014), which suggests manager-specific incentives as further determinant of pension asset allocations. However, to the extent that these incentives are time-invariant, our difference-in-differences research design controls for them. Third, propensity score matching requires close matches, thus reducing the sample and the power of the tests. Fourth, the matched-sample difference-in-differences design addresses omitted variable bias to the extent feasible in the present setting; however, lingering self-selection concerns cannot be entirely ruled out. Finally, a lack of detailed disclosure requirements inhibits our ability to discern the asset classes (except bonds) that firms shift *into* when reducing their exposure to equities. Specifically, a large and opaque category ‘other assets’ (which can contain low-risk assets such as cash as well as high-risk ones such as hedge fund shares) likely captures some of these movements (see Föhrenbach et al., 2015). Finer disaggregation would render plan asset disclosures more useful for many purposes, including risk assessment and academic research.

This study complements prior literature on the determinants of pension asset allocations. In a broader context, we add to the literature on the ‘real’ effects of accounting by showing that managers alter their pension assets investment strategies in response to an accounting change that increases expected pension-induced equity volatility. These insights are relevant to financial reporting standard setters, as they elucidate the behavioral consequences of accounting standards – in particular, of those that narrow firms’ set of accounting choices and of those that increase expected financial statement volatility. Finally, our findings suggest that accounting for corporate pension plans affects the allocation of pension assets and thereby their riskiness. Such shifts may or may not be intended or desired by the standard setter. Future research could explore the consequences of these behavioral shifts for the firms’ stakeholders, and how these effects vary with the extent of home bias in firms’ asset allocation decisions.

2.6 Appendices

2.6.1 Appendix A: Variables Definitions

$\%EQ_{it}$	Percentage of equity investments, equal to pension assets allocated to equity securities of firm i for year t , divided by firm i 's total pension assets of year t , all measured at the end of fiscal year t (sources: hand-collection, Worldscope data item 18807).
$\%BONDS_{it}$	Percentage of bond investments, equal to pension assets allocated to fixed-income securities of firm i for year t , divided by firm i 's total pension assets of year t , all measured at the end of fiscal year t (sources: hand-collection, Worldscope data item 18807).
$\%OTHER_{it}$	Percentage of other investments, equal to pension assets allocated to other assets of firm i for year t , divided by firm i 's total pension assets of year t , all measured at the end of fiscal year t (sources: hand-collection, Worldscope data item 18807).
$\%PROPERTY_{it}$	Percentage of property investments, equal to pension assets allocated to real estate property of firm i for year t , divided by firm i 's total pension assets of year t , all measured at the end of fiscal year t (sources: hand-collection, Worldscope data item 18807).
$TREAT_i$	Indicator variable equal to 1 if firm i is a treatment firm, i.e., recognizes actuarial gains and losses under the corridor method in 2012, and 0 if firm i uses the OCI method in 2012 (source: hand-collection).
$Post_{it}$	Indicator variable equal to 1 for post-treatment periods, beginning in 2012, and 0 for pre-treatment periods.
Lev_{it}	Leverage ratio of firm i for year t , equal to total liabilities of firm i , divided by firm i 's total assets, both measured at the end of fiscal year t (source: Worldscope data items 03351, 02999).
FF_{it}	Percentage of free float of firm i for year t , equal to the number of shares in free float of firm i , divided by firm i 's total number of shares multiplied by 100, both measured at the end of fiscal year t (source: Worldscope data item noshff).
$Size_{it}$	Natural logarithm of the market value of equity of firm i , measured at the end of fiscal year t (source: Worldscope data item 08001).
$SDCF_{it}$	Standard deviation of operating cash flows of firm i for year t , equal to the natural logarithm of the standard deviation of operating cash flows over the past 4 years of firm i , divided by firm i 's book value of equity, all measured at the end of fiscal year t (source: Worldscope data items 04860, 03501).
$Fund_{it}$	Pension funding ratio of firm i for year t , equal to external pension assets of firm i , divided by firm i 's overall defined benefit obligations multiplied

	by 100, both measured at the end of fiscal year t (sources: hand-collection, Worldscope data items 18807, 18809).
$Horizon_{it}$	Investment horizon of pension assets, equal to the natural logarithm of the ratio of defined benefit obligations of firm i , divided by firm i 's current service cost, both measured at the end of fiscal year t (source: Worldscope data items 18809, 18811).
Exp_{it}	Exposure of firm i 's book value of equity to the size of a pension plan for year t , equal to pension assets of firm i , divided by firm i 's book value of equity multiplied by 100, both measured at the end of fiscal year t (source: Worldscope data items 18807, 03501).
Ind_{it}	Industry indicator variables (source: based on Worldscope data item 07021: SIC code). We specify the following industry indicators: (1) agriculture, forestry and fishing, (2) mining, (3) construction, (4) manufacturing, (5) transportation, communications, electric, gas, sanitary service, (6) wholesale trade, (7) retail trade, (8) finance, insurance and real estate, (9) services (10) public administration, (11) nonclassifiable.
$Market\ Returns_t$	Market returns for year t , measure by the 12 months returns of the S&P Global Broad Market Index for equities of year t (source: S&P website).
$Payout\ Ratio_{it}$	Common and preferred stock dividends paid by firm i in year t , divided by net income (source: Capital IQ).
$Shift_{it}$	Indicator variable equal to one if firm i terminates or freezes existing defined benefit pension plans, or transfers risk to insurance companies, in year t , and zero otherwise (source: hand-collection).

2.6.2 Appendix B: Impact of IAS 19R on equity volatility: The “OCI effect”

Panel A: The corridor method under IAS 19

The following numerical example illustrates the corridor method of recognizing actuarial gains and losses under IAS 19R’s predecessor standard, IAS 19 (all numbers are in € millions).

Assumptions		Recognition	
Plan assets (PA)	30	Actuarial losses	
Defined benefit obligation (DBO)	100	of current year	15.0
Remaining service years of employees	10	of previous years (cumulated)	40.0
Actuarial losses		Less corridor (10% of max [PA,DBO])	-10.0
- current year	15	Excess over corridor	= 45.0
- previous years (cumulated)	40	Minimum amount amortized into earnings and recognized in the net pension liability (excess over corridor spread over employees’ remaining service life)	4.5

The right-hand column of the table describes the calculation of the portion of actuarial gains and losses recognized under the corridor method. The corridor equals the greater of 10% of the defined benefit obligation and 10% of plan assets. Accumulated unrecognized actuarial gains or losses in excess of the corridor are recognized (at a maximum) over the remaining service life of employees. In the example, this procedure leads to an actuarial loss of 4.5 million that is amortized into profit or loss in the current year.

In contrast, the OCI method requires firms to immediately recognize any actuarial gain and loss in other comprehensive income during the current period. In the example, the recognized actuarial gain or loss would be 15 in the current year. Accordingly, for the OCI method, the recognized pension liability always corresponds to the difference between defined benefit obligations and plan assets (i.e., the plan’s funded status). Under the corridor method, in contrast, the recognized pension liability fails to reflect unrecognized cumulated actuarial gains and losses; in the example, losses of: $55.0 - 4.5 = 50.5$.

Panel B: Effect of adopting the OCI method under IAS 19R

Firms that used to apply the corridor method under IAS 19 have to adopt the OCI method under IAS 19R – with potentially significant one-time effects on the financial statements. The following example illustrates these effects for the firm in Panel A, which used to apply the corridor method (all numbers are in € millions). Numbers in italics represent the one-time effects of the transition to IAS 19R. To calculate the tax effects of the change, we assume a tax rate of 30%.

Reconciliation of pension liabilities under IAS 19 (corridor method)			
Funded status of the pension plan		Recognized pension liability	
Defined benefit obligation	100.0	Funded status (net obligation)	70.0
Plan assets	-30.0	thereof unrecognized (due to corridor method)	-50.5
Funded status (net obligation)	70.0	Recognized net pension liability	19.5
<hr/>			
Balance sheet under IAS 19 (corridor method)			
Assets		Liabilities and equity	
Assets	300.0	Equity	100.5
		Pension liability	19.5
		Other liabilities	180.0
Total assets	300.0	Total liabilities and equity	300.0
<hr/>			
Balance sheet under new IAS 19R (OCI method)			
Assets		Liabilities and equity	
Deferred tax assets	<i>15.2</i>	Equity (100.5 – 50.5 + 15.2)	<i>65.2</i>
Other assets	300.0	Pension liability (19.5 + 50.5)	<i>70.0</i>
		Other liabilities	180.0
Total assets	<i>315.2</i>	Total liabilities and equity	<i>315.2</i>

In this example, the change from the corridor method to the OCI method increases recognized pension liabilities by 50.5, as the unrecognized actuarial losses of prior periods are recognized immediately. Simultaneously, equity decreases by a net 35.3, i.e., the amount of previously unrecognized actuarial losses less a corresponding increase in deferred tax assets.

2.6.3 Appendix C: Summary information on semi-structured expert interviews

To collect field data that provides additional evidence to help develop our hypotheses related to the causal effect of IAS 19R on the allocation of pension assets, we sought systematic first-hand input from high-level practitioners experienced in pension accounting, plan asset investment, and especially the transition to IAS 19R. To this end, we conducted seven semi-structured phone interviews with participants from a group of firms selected to provide variation in terms of treatment and control firms, industry, and size.

Interviews had mean duration of about 30 minutes and were conducted (in German) during February and March of 2017. The median interview setup consisted of one of the authors (the interviewer) and up to three accounting and finance professionals from the participating firm, always including the Chief Accounting Officer or equivalent (the interviewees). Participating firms are large, publicly traded corporations representing a range of industries (consumer goods, energy, chemicals, real estate, automotive, medical equipment, and mechanical engineering).

The interview guide was structured to provide insights into the validity of the three assumptions underlying our hypotheses (refer to section 2.3.1 in the main paper). Recall our assumptions that treatment firms: (1) expect IAS 19R to increase equity volatility; (2) have incentives to avoid it; and (3) view plan asset reallocation as an effective, efficient (i.e., relatively low-cost), and de-facto feasible countermeasure. Specifically, we posed questions related to the following key themes:

- Voluntary adoption of the OCI method before IAS 19R (control firms)
- Expected effects of IAS 19R on the financial statements (treatment firms)
- Repercussions and management of equity volatility
- Management's de-facto influence on the pension asset allocation

All interviews allowed room for unstructured content and interviewees' topical preferences. In five cases, interviewees agreed to audiotaping; these tapes were the basis for analysis. In the remaining two cases, inferences are based on extensive notes taken during the interviews.

2.6.4 Appendix D: German regulatory environment for defined benefit plans

In this appendix, we further discuss the German regulatory environment in terms of three institutional factors that prior studies have linked to variation in pension sponsors' plan asset allocations: (1) restrictions on funding agencies' investment strategies; (2) funding requirements and insurance; and (3) taxation. The purpose of that discussion is to show that these institutional factors are unlikely to explain the empirical patterns we observe in the context of IAS 19R adoption.

Regarding restrictions on funding agencies' investment strategies, different funding agencies in Germany face different restrictions regarding their investment of plan assets. Whereas insurance-like funding agencies are discouraged from risk-taking, with the portion of equity securities limited to 35% of pension assets, pension funds, CTAs and support funds are unrestricted in the portion of pension assets invested in equities, as long as investments in individual firms do not exceed 5% of pension assets. Importantly, none of these restrictions have changed during our analysis period, which makes them unlikely to drive our results.

Regarding funding requirements and pension insurance, a statutory pension insurance fund (PSV) protects beneficiaries from bankruptcies of German pension plan sponsors. If a plan sponsor goes bankrupt, the PSV assumes its pension obligation and ensures payments to retirees, guaranteeing all benefits earned by employees for their service in the current and prior periods. Plan sponsors make yearly, mandatory contributions to the pension insurance fund that vary by kind of funding agency, but are independent of the funding agency's investment strategy.

Regarding taxation, investment returns are subject to deferred taxation for all kinds of funding agencies and plan assets throughout our analysis period. Specifically, plan contributions and investment returns are tax-exempt, whereas pension payments are income-taxed at the beneficiary level, according to a beneficiary's personal tax rate in the year in which he/she receives benefits. Contributions to pension plans lower the taxable income of firms. The upper limit of tax-deductible contributions depends on the kind of funding agency, but not on its asset allocation. This also applies for contributions required due to funding deficits and for internal funding.

2.6.5 Appendix E: Composition of pension plan assets and related disclosures

IAS 19 and IAS 19R require firms to disclose information on the allocation of pension assets that shall include, but is not limited to, equity securities, debt instruments, property and all other assets. Specifically, IAS 19.120A(j) requires disaggregation of the fair value of plan assets into “each major category of plan assets, which shall include, but is not limited to, equity instruments, debt instruments, property, and all other assets”. To comply with this requirement, firms could – and many did – provide the minimum required breakdown into the four asset classes explicitly mentioned, making ‘other asset’ a potentially material catch-all category.

Effective from 2013, IAS 19R.142 requires: “For example, and considering the level of disclosure discussed in paragraph 136, an entity could distinguish between: (a) cash and cash equivalents; (b) equity instruments (segregated by industry type, company size, geography etc.); (c) debt instruments (segregated by type of issuer, credit quality, geography etc.); (d) real estate (segregated by geography etc.); (e) derivatives (segregated by type of underlying risk in the contract, for example, interest rate contracts, foreign exchange contracts, equity contracts, credit contracts, longevity swaps, etc.); (f) investment funds (segregated by type of fund); (g) asset-backed securities; and (h) structured debt” (emphasis added). Note that the disaggregation into the asset classes (a) through (h) above is not mandatory, but merely represents a suggestion as to how the disclosure principle in IAS 19R.136 can be implemented, making finer disaggregation a de facto voluntary disclosure. Consequently, many firms carry over their previous, highly aggregated disaggregations into the IAS 19R regime.

This discretion in the disclosure requirements leads to considerable heterogeneity in the extent of information on the allocation of pension assets. The following table illustrates this variation.

Lufthansa AG	Dec. 31, 2013		Duerr AG	Dec. 31, 2013	
	<i>in €m</i>	<i>in %</i>		<i>in €m</i>	<i>in %</i>
Total assets	10,283	100.0%	Total assets	41.2	100.0%
Equities	3,293	32.0%	Pension liability insurance	30.8	74.7%
Europe	2,063	20.1%	Fixed-interest securities	9.2	22.4%
Other	1,230	12.0%	Shares	0.4	0.9%
Fixed-income securities	4,386	42.7%	Real estate	0.4	1.0%
Government bonds	1,871	18.2%	Other	0.4	1.0%
Corporate bonds	2,514	24.4%			
Share funds	63	0.6%			
Fixed-income funds	135	1.3%			
Mixed funds	124	1.2%			
Money market	550	5.3%			
Property	456	4.4%			
Direct investment	456	4.4%			
Indirect investment	0	0.0%			
Bank balances	268	2.6%			
Other investments	862	8.4%			

For this study, we classify pension assets according to the minimum level of aggregation mandated by the IASB. This classification leads to 32.6% (0.9%) equities, 44.0% (22.4%) bonds, 4.4% (1.0%) properties and to 19.0% (75.7%) other assets for Lufthansa AG (Duerr AG). The following graph shows the development of sample firms' asset classes for the sample period (2010-2013). Percentage allocations to equities are flat, those to bonds decrease slightly, while those to other assets increase. This increase of pension assets invested into other assets is also documented by Föhrenbach et al. (2015).

2.7 Figures

Figure 1: Difference-in-differences research design

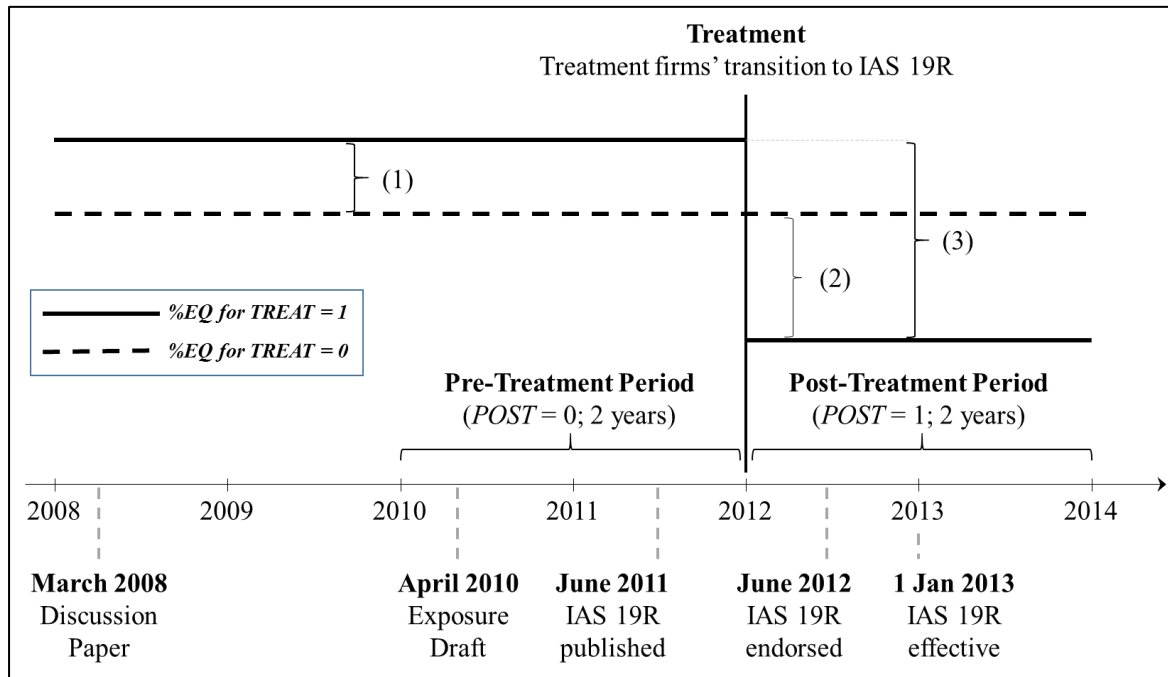


Figure 1 illustrates the difference-in-differences research design used in our main tests to identify the effect of IAS 19R on pension asset allocations. (Note that, whereas we observe two asset allocation characteristics, the percentage of equities, %EQ, and the percentage of bonds, %BONDS, the figure only depicts one of them: %EQ.) We observe %EQ and %BONDS for two groups of firms: a treatment group affected by mandatory IAS 19R adoption (solid line) and a control group not subject to this accounting change (dotted line). The Y axis of the graph depicts levels of %EQ, and the X axis represents a time line. Our research design measures differences in %EQ and %BONDS before (effect 1) and after (effect 2) the “treatment”: the transition to IAS 19R. This difference-in-differences (effect 3) represents the causal treatment effect of IAS 19R on %EQ under the appropriate assumptions (refer to section 3.1). We use 2012 as the treatment date, as the introduction and details of IAS 19R were known to firms in mid-2011 (when it was published), although it was effective only for fiscal years beginning on 1 January 2013 or after.

Figure 2: Equity and bond investments of firms over time

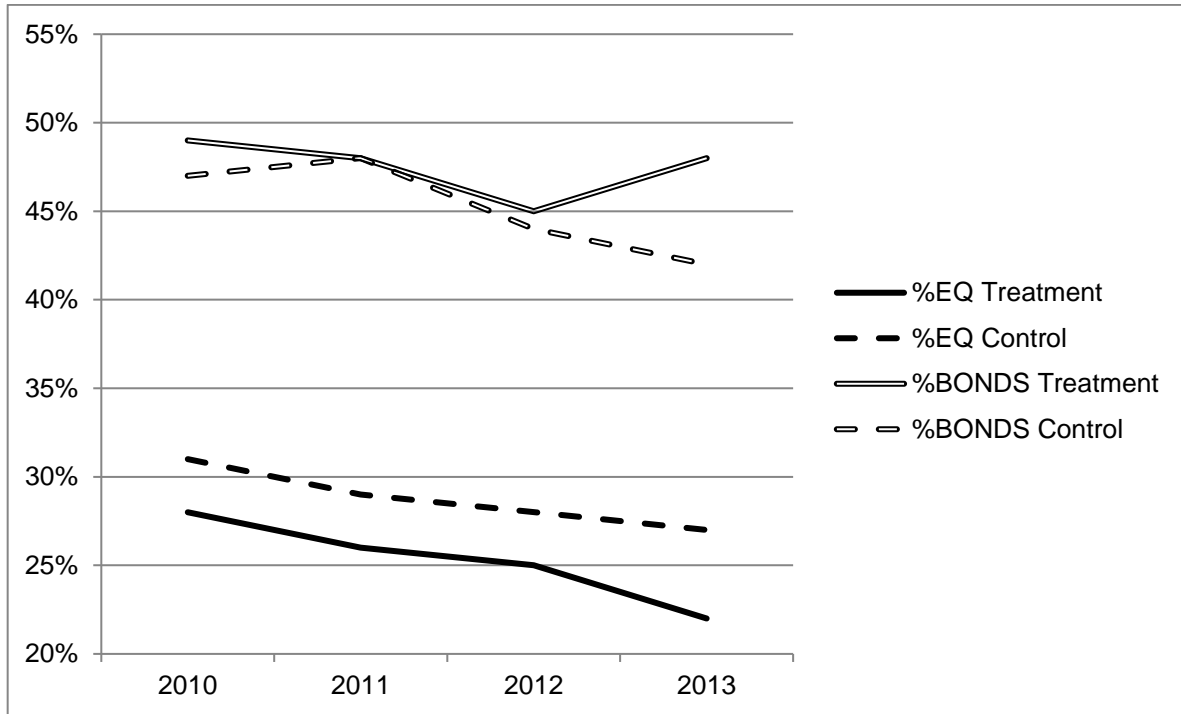


Figure 2 illustrates the two asset allocation characteristics, the percentage of equities (%EQ) and the percentage of bonds (%BONDS), for the treatment group affected by mandatory IAS 19R adoption (solid lines) and a control group not subject to this accounting change (dotted lines), around the “treatment”: mandatory adoption of IAS 19R. Both %EQ and %BONDS exhibit relatively parallel trends in the years leading up to IAS 19R adoption, and drift apart subsequently.

2.8 Tables

Table 1: Sample Selection

	Unique Firms	
Number of firms listed within the Prime Standard segment of Deutsche Börse Group, active as of December 12, 2014.	319	
Less firms		
without defined benefit pension (DB) plans	-102	
without externally funded DB plans	-45	
that apply neither the corridor method nor the OCI method prior to IAS 19R adoption	-17	
that fully fund pension plans with insurance contracts	-56	
that lack information on the pension asset allocation	-9	
	90	
	Corridor Method (Treatment Firms)	OCI Method (Control Firms)
	41	49
Less firms		
that lack information to calculate test variables	-1	0
that are not listed in each year of the sample period	-3	-4
Firm-year observations per period	37	45
Times four analysis periods (2010-2013)	x4	x4
Firm-year observations over total analysis period	148	180
Less observations dropped during matching process	-40	-72
Firm-year observations used in main analyses (Table 3)	108	108

Table 1 presents the sample selection process. The initial sample consists of all firms listed within the Prime Standard segment of Deutsche Börse Group as of December 12, 2014. We exclude firms: (1) without defined benefit pension plans; (2) without externally funded defined benefit pension plans; (3) that recognize actuarial gains and losses in profit or loss; and (4) that fully fund pension plans with insurance contracts only. The remaining 90 firms are classified into the treatment and control groups according to their method of recognizing actuarial gains and losses. We exclude firms that lack sufficient data or observations, resulting in 37 unique treatment firms and 45 unique control firms. We analyze treatment and control firms over four periods, resulting in 328 firm-year observations; the final sample used in the main empirical analysis in Table 3 after matching treatment and control firms using propensity score matching includes 108 firm-year observations for treatment and 108 firm-year observations for control firms.

Table 2: Summary Statistics

Panel A: Descriptive statistics

Pre-Treatment Period (aggregated over 2010 and 2011)							
Variable	treatment observations				control observations		
	N	mean	median	sd	mean	median	sd
<i>%EQ</i>	108	27.3	26.4	17.1	30.0	28.0	18.1
<i>%BOND</i>	108	48.3	47.0	19.2	47.7	47.7	24.2
<i>%OTHER</i>	108	17.2	15.2	14.5	17.1	9.0	19.5
<i>%PROPERTY</i>	108	7.2	4.2	7.9	5.1	2.0	* 9.0
<i>Lev</i>	108	63.9	66.3	18.6	63.3	61.5	18.6
<i>FF</i>	108	71.9	76.5	24.9	71.6	76.0	24.4
<i>Size</i>	108	7.6	7.1	1.7	7.9	7.9	1.5
<i>SDCF</i>	108	0.1	0.1	0.1	0.1	0.1	0.1
<i>Fund</i>	108	55.3	63.1	24.9	49.0	53.2	27.9
<i>Horizon</i>	108	3.9	3.8	1.0	3.8	3.8	0.6
<i>Exp</i>	108	21.0	15.1	22.5	25.1	8.8	37.9
Post-Treatment Period (aggregated over 2012 and 2013)							
Variable	treatment observations				control observations		
	N	mean	median	sd	mean	median	sd
<i>%EQ</i>	108	23.6	23.1	15.4	27.9	25.6	19.4
<i>%BOND</i>	108	46.5	45.7	21.7	42.9	44.4	24.4
<i>%OTHER</i>	108	24.2	18.1	22.0	23.8	17.0	25.4
<i>%PROPERTY</i>	108	5.6	2.7	7.2	5.3	1.7	10.1
<i>Lev</i>	108	62.5	63.5	18.3	62.3	62.0	20.5
<i>FF</i>	108	74.9	75.0	23.4	69.6	74.5	23.0
<i>Size</i>	108	7.9	7.5	1.7	8.2	8.1	1.4
<i>SDCF</i>	108	0.1	0.1	0.1	0.1	0.1	0.1
<i>Fund</i>	108	52.9	59.8	25.1	49.1	52.1	26.0
<i>Horizon</i>	108	3.9	3.9	1.1	3.8	3.9	0.6
<i>Exp</i>	108	24.0	17.3	31.2	29.8	9.6	44.1

Table 2: Summary Statistics (*cont'd*)

Panel B: Pearson and Spearman correlations

Variable	%EQ	%BOND	%OTHER	%PROPERTY	Lev
%EQ		-0.44 ***	-0.30 ***	-0.18 ***	0.06
%BOND	-0.45 ***		-0.65 ***	-0.11 *	0.21 ***
%OTHER	-0.24 ***	-0.57 ***		-0.13 **	-0.29 ***
%PROPERTY	-0.21 ***	0.07	-0.14 **		0.04
Lev	0.06	0.18 ***	-0.23 ***	0.10	
FF	0.15 **	-0.18 ***	0.08	-0.15 **	0.19 ***
Size	0.02	0.19 ***	-0.05	0.01	0.38 ***
SDCF	-0.06	0.08	-0.04	0.01	0.53 ***
Fund	-0.40 ***	0.25 ***	0.15 **	0.09	0.02
Horizon	0.21 ***	-0.14 **	-0.06	-0.04	0.22 ***
Exp	0.06	0.11 *	-0.10	0.22 ***	0.53 ***

Panel B: Pearson and Spearman correlations (*cont'd*)

Variable	FF	Size	SDCF	Fund	Horizon	Exp
%EQ	0.21 ***	-0.04	-0.01	-0.45 ***	0.27 ***	0.06
%BOND	-0.20 ***	0.19 ***	0.10	0.27 ***	-0.12 *	0.03
%OTHER	0.09	-0.12 *	-0.12 *	0.07	-0.07	-0.15 **
%PROPERTY	-0.14 **	-0.12 *	0.04	0.07	-0.09	0.17 ***
Lev	0.20 ***	0.39 ***	0.45 ***	0.03	0.13 *	0.41 ***
FF		0.03	0.08	0.05	0.25 ***	0.16 **
Size	-0.01		0.05	-0.05	-0.01	0.11 *
SDCF	0.16 **	0.10		0.11 *	0.19 ***	0.31 ***
Fund	0.13 **	-0.05	0.15 **		-0.26 ***	0.26 ***
Horizon	0.27 ***	0.00	0.34 ***	-0.19 ***		0.11 *
Exp	0.16 **	0.27 ***	0.38 ***	0.36 ***	0.25 ***	

Table 2 provides descriptive statistics for the variables used in the main analyses of Table 3. Panel A provides descriptive statistics for the main variables of interest, split between the treatment group and the matched control group as well as the pre- and post-treatment periods.

Panel B provides correlation coefficients between the variables used in the empirical analysis. The upper (lower) diagonal shows Pearson (Spearman) correlation coefficients. *%EQ* is the percentage of equity investments, *%BONDS* is the percentage of bond investments, *%OTHER* is the percentage of other investments and *%PROPERTY* is the percentage of property investments. *Lev* is the leverage ratio defined as total liabilities divided by total assets, *FF* is percentage of free float and is equal to the number of shares in free float divided by the total number of shares multiplied by 100, *Size* is the natural logarithm of the market value of equity, *SDCF* is the standard deviation of operating cash flows equal to the natural logarithm of the standard deviation of operating cash flows over the past 4 years divided by the book value of equity. *Fund* is the pension funding ratio defined as external pension assets divided defined benefit obligations and multiplied by 100. *Horizon* is the investment horizon of pension assets and is defined as the natural logarithm of the ratio of defined benefit obligations divided by the current service cost. *Exp* captures the exposure of a firm's book value of equity to the size of a pension plan and is defined as pension plan assets divided by the book value of equity multiplied by 100. All continuous variables have been winsorized at the 1% level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test).

Table 3: Effect of IAS 19R on the pension asset allocation
(main tests of H₁ and H₂)

Panel A: Univariate Analysis

	Pre-Treatment		Post-Treatment		Difference (Post-Pre)	
	<i>N</i>	Mean	<i>N</i>	Mean	Change	<i>p</i> -value
%EQ						
Treatment observations	54	27.33	54	23.60	-3.73	0.235
Control observations	54	30.04	54	27.85	-2.19	0.546
Difference					-1.54	0.100 *
	Pre-Treatment		Post-Treatment		Difference (Post-Pre)	
	<i>N</i>	Mean	<i>N</i>	Mean	Change	<i>p</i> -value
%BONDS						
Treatment observations	54	48.27	54	46.53	-1.74	0.658
Control observations	54	47.68	54	42.91	-4.77	0.310
Difference					3.03	0.020 **

Table 3: Effect of IAS 19R on the pension asset allocation (main tests of H₁ and H₂) (*cont'd*)Panel B: Multivariate analysis – base model and tests of H₁

Variable	Pred.	Base Model		Tests of H ₁	
		(1) DV = %EQ	(2) DV = %BONDS	(3) DV = %EQ	(4) DV = %BONDS
<i>Intercept</i>	?	9.80 (0.34)	66.61 (1.35)	10.11 (0.37)	67.42 (1.36)
<i>Lev</i>	- +	0.06 (0.37)	0.17 (0.77)	0.05 (0.30)	0.15 (0.68)
<i>FF</i>	+ -	0.14 (2.13) **	-0.26 (-2.79) ***	0.15 (2.16) **	-0.26 (-2.73) ***
<i>Size</i>	+ -	-0.33 (-0.25)	0.51 (0.32)	-0.21 (-0.16)	0.72 (0.44)
<i>SDCF</i>	- +	-2.58 (-0.88)	1.70 (0.47)	-2.95 (-1.01)	1.39 (0.36)
<i>Fund</i>	?	-0.30 (-2.80) ***	0.19 (1.45)	-0.30 (-2.87) ***	0.18 (1.28)
<i>Horizon</i>	+ -	2.62 (1.33)	-1.97 (-0.60)	2.94 (1.49)	-2.01 (-0.60)
<i>Exp</i>	?	0.09 (1.39)	-0.04 (-0.50)	0.10 (1.43)	-0.03 (-0.27)
<i>TREAT</i>	?			-1.36 (-0.43)	0.88 (0.22)
<i>Post</i>	- +			-2.84 (-2.82) ***	-4.94 (-3.53) ***
<i>Post×TREAT</i>	- +			-2.46 (-3.35) ***	4.61 (2.43) **
Industry Fixed Effects		Yes	Yes	Yes	Yes
Adjusted R ²		0.315	0.286	0.334	0.296
N		216	216	216	216

Table 3: Effect of IAS 19R on the pension asset allocation (main tests of H₁ and H₂) (*cont'd*)Panel C: Multivariate analysis – tests of H₂

Variable	Pred.	<i>PP_CHAR = Exp</i>		<i>PP_CHAR = Fund</i>	
		(1) DV = %EQ	(2) DV = %BONDS	(3) DV = %EQ	(4) DV = %BONDS
<i>Intercept</i>	?	9.49 (0.33)	67.10 (1.36)	10.43 (0.38)	71.97 (1.50)
<i>Lev</i>	- +	0.05 (0.29)	0.16 (0.71)	0.04 (0.29)	0.15 (0.69)
<i>FF</i>	+ -	0.15 (2.14) **	-0.27 (-2.71) ***	0.15 (2.15) **	-0.26 (-2.74) ***
<i>Size</i>	+ -	-0.24 (-0.18)	0.69 (0.40)	-0.23 (-0.17)	0.68 (0.41)
<i>SDCF</i>	- +	-2.89 (-1.00)	1.22 (0.32)	-3.09 (-1.06)	1.48 (0.38)
<i>Fund</i>	?	-0.30 (-2.89) ***	0.19 (1.33)	-0.31 (-2.82) ***	0.07 (0.49)
<i>Horizon</i>	+ -	2.92 (1.39)	-1.88 (-0.56)	2.98 (1.43)	-1.86 (-0.55)
<i>Exp</i>	?	0.15 (2.04) **	-0.11 (-0.97)	0.10 (1.51)	-0.02 (-0.23)
<i>TREAT</i>	?	0.09 (0.02)	-1.38 (-0.24)	-0.88 (-0.10)	-6.04 (-0.65)
<i>TREAT×PP_CHAR</i>	?	-0.06 (-0.61)	0.09 (0.76)	-0.01 (-0.05)	0.14 (0.82)
<i>Post</i>	- +	0.22 (0.18)	-8.86 (-4.12) ***	-2.20 (-0.80)	-12.16 (-5.93) ***
<i>Post×PP_CHAR</i>	?	-0.11 (-6.05) ***	0.14 (3.43) ***	-0.01 (-0.32)	0.15 (4.37) ***
<i>Post×TREAT</i>	- +	-6.70 (-5.69) ***	9.08 (3.33) ***	-6.73 (-4.90) ***	11.41 (5.19) ***
<i>Post×TREAT×PP_CHAR</i>	?	0.16 (4.36) ***	-0.17 (-3.24) ***	0.08 (3.49) ***	-0.14 (-2.26) **
Industry Fixed Effects		Yes	Yes	Yes	Yes
Adjusted R ²		0.344	0.304	0.336	0.301
N		216	216	216	216

Table 3 presents analyses examining the effect of the elimination of the corridor method brought about by IAS 19R on the allocation of pension assets. Panel A provides univariate tests of mean differences in %EQ and %BONDS across treatment and control firms.

Panel B presents regression results of estimating equations (1) and (2). Columns (1) and (2) present the results of estimating equation (1), the base model, for *ASSET_ALLOC*, where *ASSET_ALLOC* is %EQ and %BONDS, respectively. Columns (3) and (4) present the results of estimating equation (2) for *ASSET_ALLOC*, where *ASSET_ALLOC* is %EQ and %BONDS respectively.

Panel C presents regression results of estimating equation (3) for *ASSET_ALLOC*, where *ASSET_ALLOC* is %EQ and %BONDS for each pension plan characteristic (*PP_CHAR*), where *PP_CHAR* is either *Exp* or *Fund*.

The first (second) predicted sign refers to the predicted sign of *ASSET_ALLOC*, where *ASSET_ALLOC* is %EQ (%BONDS).

We provide z-statistics in parentheses below the coefficient estimates. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level.

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Table 4: Alternative analyses: Isolating the “ERR Effect” of IAS 19R

Variable	<i>PP_CHAR = Exp</i>		<i>PP_CHAR = Fund</i>	
	(1) DV = %EQ	(2) DV = %BONDS	(3) DV = %EQ	(4) DV = %BONDS
<i>Intercept</i>	44.54 (2.28) **	24.49 (0.93)	33.76 (1.81) *	40.08 (1.60)
<i>Lev</i>	0.13 (0.94)	-0.03 (-0.15)	0.09 (0.71)	-0.00 (-0.01)
<i>FF</i>	0.16 (2.20) **	-0.06 (-0.57)	0.17 (2.26) **	-0.08 (-0.79)
<i>Size</i>	-4.79 (-5.35) ***	3.52 (3.50) ***	-4.54 (-5.68) ***	3.39 (3.64) ***
<i>SDCF</i>	-2.66 (-0.94)	0.80 (0.27)	-2.05 (-0.91)	0.35 (0.13)
<i>Fund</i>	-0.05 (-0.55)	-0.07 (-0.60)	0.20 (1.51)	-0.33 (-2.16) **
<i>Horizon</i>	3.74 (1.02)	1.81 (0.40)	3.81 (1.07)	1.67 (0.42)
<i>Exp</i>	0.17 (2.38) **	-0.01 (-0.14)	0.05 (0.99)	0.03 (0.64)
<i>TREAT</i>	-14.46 (-3.37) ***	10.34 (1.82) *	9.92 (1.16)	-20.62 (-2.01) **
<i>TREAT×PP_CHAR</i>	-0.15 (-1.87) *	0.01 (0.09)	-0.46 (-3.61) ***	0.50 (3.29) ***
<i>Post</i>	0.79 (1.12)	1.16 (1.58)	-7.42 (-4.32) ***	7.83 (5.60) ***
<i>Post×PP_CHAR</i>	-0.05 (-1.50)	-0.01 (-0.52)	0.10 (4.64) ***	-0.10 (-7.61) ***
<i>Post×TREAT</i>	1.98 (1.54)	-11.01 (-7.01) ***	7.00 (2.75) ***	-12.08 (-5.59) ***
<i>Post×TREAT×PP_CHAR</i>	-0.03 (-1.36)	0.12 (3.32) ***	-0.10 (-2.90) ***	0.07 (1.39)
Industry Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R ²	0.471	0.154	0.522	0.229
N	328	328	328	328

Table 4 presents analyses designed to examine the “ERR effect” on the allocation of pension assets. It reports regression results of estimating equation (3) for *ASSET_ALLOC*, where *ASSET_ALLOC* is %EQ and %BONDS for each pension plan characteristic (*PP_CHAR*), where *PP_CHAR* is either *Exp* or *Fund*.

We provide z-statistics in parentheses below the coefficient estimates. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level.

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Table 5: Summary statistics for the sample before matching

Pre-Treatment Period (aggregated over 2010 and 2011)							
Variable	treatment observations			control observations			
	N	mean	median	sd	mean	median	Sd
<i>%EQ</i>	164	25.7	22.7	17.9	27.1	25.5	15.0
<i>%BOND</i>	164	44.3	45.3	23.7	51.7 **	55.4 **	20.5
<i>%OTHER</i>	164	22.0	15.6	22.1	15.9 **	11.9 **	16.2
<i>%PROPERTY</i>	164	8.0	4.2	9.1	5.3 **	3.0	8.0
<i>Lev</i>	164	64.6	63.6	17.9	63.1	62.4	15.8
<i>FF</i>	164	72.5	75.0	24.9	75.9	81.5	22.6
<i>Size</i>	164	7.2	6.9	1.8	8.5 ***	8.3 ***	1.6
<i>SDCF</i>	164	0.2	0.1	0.4	0.1 ***	0.1 ***	0.1
<i>Fund</i>	164	50.9	61.5	27.2	58.7 *	61.1 *	27.5
<i>Horizon</i>	164	3.9	3.8	1.0	3.9	3.9	0.5
<i>Exp</i>	164	22.2	13.4	26.0	28.8	13.4	32.7

Post-Treatment Period (aggregated over 2012 and 2013)							
Variable	treatment observations			control observations			
	N	mean	median	sd	mean	Median	sd
<i>%EQ</i>	164	22.1	20.8	16.6	25.8	25.0	15.8
<i>%BOND</i>	164	42.5	43.7	24.8	46.1	49.3	21.6
<i>%OTHER</i>	164	28.0	19.0	26.3	22.6	16.4	22.6
<i>%PROPERTY</i>	164	7.4	2.7	10.7	5.4	4.0	8.3
<i>Lev</i>	164	63.4	62.8	17.7	62.2	62.4	17.4
<i>FF</i>	164	74.1	75.0	23.9	72.1	75.0	23.7
<i>Size</i>	164	7.4	7.4	1.8	8.8 ***	8.6 ***	1.6
<i>SDCF</i>	164	0.2	0.1	0.5	0.1 **	0.0 ***	0.1
<i>Fund</i>	164	49.2	58.8	27.3	57.2 **	58.8 **	25.2
<i>Horizon</i>	164	3.9	3.8	1.0	3.9	3.9	0.5
<i>Exp</i>	164	25.9	15.5	35.5	32.0	15.1	36.9

Table 5 provides descriptive statistics for variables used in the main analyses of Table 3. Panel A provides descriptive statistics for the main variables of interest, split between the treatment group and the matched control group as well as the pre- and post-treatment periods.

All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level.

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test).

Table 6: Probit model to derive propensity scores for main tests

Variable	Pred.	DV = <i>TREAT</i>
<i>Intercept</i>	?	4.53 (2.38) **
<i>Lev</i>	+	-0.01 (-0.62)
<i>FF</i>	-	-0.00 (-0.56)
<i>Size</i>	-	-0.36 (-3.15) ***
<i>SDCF</i>	+	0.334 (1.26)
<i>Fund</i>	-	-0.01 (-0.99)
<i>Horizon</i>	+	-0.01 (-0.05)
<i>Exp</i>	+	0.00 (0.24)
Industry Fixed Effects		Yes
Pseudo R ²		0.233
N		78

Table 6 presents the results of estimating equation (4), the probit model to derive propensity scores and match treatment and control firms. The dependent variable is *TREAT*, which assumes value of 1 for firm observations applying the corridor method before IAS 19R, and 0 otherwise. For each firm-year observation in the treatment group derived in Table 1, we match a firm-year observation of the control group that has the closest propensity score (single nearest neighbor matching without replacement) using pre-treatment characteristics (i.e., we estimate the probit model using data from 2011, one year before the treatment date in 2012). Applying the propensity-score matching procedure results in two groups of firms that have similar characteristics but differ in that one applies the corridor method (treatment group) and the other applies the OCI method (control group) in the pre-IAS 19R period.

We provide z-statistics in parentheses below the coefficient estimates. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level.

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Table 7: Testing H₂ using separate subsamples based on the median value of *PP_CHAR*

Panel A: Multivariate regression results for *ASSET_ALLOC = %EQ*

Variable	Pred.	<i>Exp</i> < median <i>Exp</i>	<i>Exp</i> ≥ median <i>Exp</i>	<i>Fund</i> < median <i>Fund</i>	<i>Fund</i> ≥ median <i>Fund</i>
<i>Intercept</i>	?	23.19 (0.49)	7.49 (0.20)	13.91 (0.33)	-2.32 (-0.12)
<i>Lev</i>	-	-0.19 (-0.66)	0.19 (0.79)	0.03 (0.08)	0.31 (1.78) *
<i>FF</i>	+	0.17 (1.58)	0.08 (0.69)	0.28 (1.63) *	0.05 (0.92)
<i>Size</i>	+	0.10 (0.04)	-1.36 (-1.06)	-0.21 (-0.12)	1.02 (0.73)
<i>SDCF</i>	-	1.47 (0.33)	-1.01 (-0.40)	0.77 (0.16)	-6.15 (-3.34) ***
<i>Fund</i>	?	-0.42 (-2.58) ***	-0.23 (-1.26)	-0.46 (-1.60)	-0.39 (-2.11) **
<i>Horizon</i>	+	2.76 (0.96)	4.46 (0.72)	3.02 (1.13)	0.54 (0.14)
<i>Exp</i>	?	-0.19 (-0.20)	-0.03 (-0.34)	0.20 (0.83)	-0.02 (-0.19)
<i>TREAT</i>	?	0.47 (0.07)	-1.44 (-0.34)	-2.81 (-0.42)	-4.95 (-1.42)
<i>Post</i>	-	-0.84 (-0.31)	-3.40 (-1.88) *	-3.47 (-1.10)	-3.21 (-1.70) *
<i>Post</i>×<i>TREAT</i>	?	-5.91 (-4.80) ***	0.83 (0.52)	-3.35 (-2.63) ***	0.16 (0.22)
Industry Fixed Effects		Yes	Yes	Yes	Yes
Adjusted R ²		0.461	0.430	0.321	0.515
N		108	108	108	108
<i>Test of the equality of the coefficients</i>					
<i>Diff</i>			-6.74		-3.51
<i>p-value</i>			(0.00)		(0.02)

Panel B: Multivariate regression results for $ASSET_ALLOC = \%BONDS$

Variable	Pred.	Exp < median Exp	Exp ≥ median Exp	Fund < median Fund	Fund ≥ median Fund
<i>Intercept</i>	?	40.31 (0.55)	82.24 (1.50)	79.83 (1.15)	32.92 (0.72)
<i>Lev</i>	+	0.21 (0.55)	0.31 (0.76)	0.29 (0.86)	-0.08 (-0.27)
<i>FF</i>	-	-0.36 (-2.09) **	-0.16 (-1.11)	-0.49 (-2.77) ***	-0.14 (-1.36)
<i>Size</i>	-	2.18 (0.49)	0.08 (0.06)	-0.18 (-0.05)	1.29 (0.68)
<i>SDCF</i>	+	-2.88 (-0.58)	4.05 (1.47)	-4.53 (-1.42)	3.42 (1.20)
<i>Fund</i>	?	0.16 (0.57)	0.33 (1.28)	0.07 (0.19)	0.55 (2.70) ***
<i>Horizon</i>	-	2.37 (0.50)	-15.14 (-2.32) **	-1.74 (-0.56)	-1.32 (-0.27)
<i>Exp</i>	?	-0.65 (-0.45)	-0.05 (-0.34)	0.04 (0.21)	0.15 (3.49) ***
<i>TREAT</i>	?	2.25 (0.33)	5.88 (1.02)	3.38 (0.74)	9.11 (1.47)
<i>Post</i>	+	-11.82 (-4.81) ***	2.82 (0.77)	-12.18 (-2.74) ***	4.35 (6.29) ***
<i>Post×TREAT</i>	?	9.60 (3.14) ***	-0.78 (-0.59)	11.86 (3.27) ***	-6.71 (-2.38) **
Industry Fixed Effects		Yes	Yes	Yes	Yes
Adjusted R ²		0.483	0.390	0.385	0.514
N		108	108	108	108
<i>Test of the equality of the coefficients</i>					
<i>Diff</i>		10.38		18.57	
<i>p-value</i>		(0.00)		(0.00)	

Table 7 presents analyses examining the effect of the elimination of the corridor method on the allocation of pension assets after splitting the sample based on the median value of PP_CHAR (Exp and $Fund$). Panel A presents results of estimating equation (3) for $ASSET_ALLOC$, where $ASSET_ALLOC$ is $\%EQ$ and Panel B for $\%BONDS$.

The first (second) predicted sign refers to the predicted sign of $ASSET_ALLOC$, where $ASSET_ALLOC$ is $\%EQ$ ($\%BONDS$)

We provide z-statistics in parentheses below the coefficient estimates. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Table 8: Sample selection for alternative analyses (“ERR effect”)

	Firm-year observations
Number of firm-year non-missing observations for main variables used in the analysis from WRDS Compustat and the German sample	3,396
<i>Less firm-year observations</i>	
that have missing free float data (CIQ)	330
that are not listed in each year of the sample period	22
Firm-year observations over total analysis period	3,044
Less observations dropped during matching process	2,716
Firm-year observations used in analyses (Table 4)	328

Table 8 presents the sample selection process for the alternative analyses in Table 4. The initial sample consists of all US firm-year non-missing observations for the main variables used in the empirical analysis available in WRDS Compustat and firm-year observations of German firms using the OCI method. We then merge this sample with Free Float data (*FF*) available from Capital IQ for U.S. firms. We subsequently exclude firm-year observations with missing free float data or that are not listed in each year of the sample period. The final sample used in the main empirical analysis in Table 4 in the main paper after matching treatment and control firms using propensity score matching includes 164 firm-year observations for treatment and 164 firm-year observations for control

Table 9: Summary statistics for alternative analyses (“ERR effect”)

Pre-Treatment Period (aggregated over 2010 and 2011)							
Variable	treatment observations				control observations		
	N	mean	Median	sd	mean	median	sd
<i>%EQ</i>	164	26.8	25.4	15.2	48.6 ***	53.0 ***	19.7
<i>%BOND</i>	164	51.3	55.4	21.3	39.8 ***	38.7 ***	17.2
<i>Lev</i>	164	62.3	61.8	16.0	61.6	62.8	13.3
<i>FF</i>	164	74.7	80.0	22.8	88.5 ***	97.8 ***	16.6
<i>Size</i>	164	8.5	8.3	1.7	8.3	8.2	1.7
<i>SDCF</i>	164	0.1	0.1	0.1	0.1	0.1	0.1
<i>Fund</i>	164	62.2	62.8	25.8	61.8	67.9	20.7
<i>Horizon</i>	164	3.9	3.9	0.5	3.8	3.8	0.6
<i>Exp</i>	164	30.4	13.4	33.8	27.8	18.7	31.8

Post-Treatment Period (aggregated over 2012 and 2013)							
Variable	treatment observations				control observations		
	N	mean	median	sd	mean	median	sd
<i>%EQ</i>	164	25.7	25.0	15.7	48.3 ***	52.6 ***	20.8
<i>%BOND</i>	164	46.0	49.0	21.8	40.9	36.3 **	19.5
<i>Lev</i>	164	61.2	61.2	17.5	62.6	63.9	12.5
<i>FF</i>	164	71.1	75.0	23.9	89.5 ***	98.0 ***	15.8
<i>Size</i>	164	8.7	8.6	1.6	8.4	8.3	1.7
<i>SDCF</i>	164	0.1	0.1	0.1	0.1	0.1	0.1
<i>Fund</i>	164	60.6	61.5	23.4	64.5	70.3	21.5
<i>Horizon</i>	164	3.9	3.9	0.6	3.9	3.8	0.7
<i>Exp</i>	164	32.6	17.8	37.5	31.2	19.0	34.1

Table 9 provides descriptive statistics for the variables used in the analyses of Table 4, split between the treatment group and the matched control group as well as the pre- and post-treatment periods.

All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level.

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test).

Table 10: Robustness tests: Alternative measurement windows

Panel A: Alternative measurement periods – window: 2010-2014

Variable	Pred.	<i>PP_CHAR = Exp</i>		<i>PP_CHAR = Fund</i>	
		(1)	(2)	(3)	(4)
		DV = %EQ	DV = %BONDS	DV = %EQ	DV = %BONDS
<i>Post</i> × <i>TREAT</i>	- +	-6.99 (-6.03) ***	12.61 (6.01) ***	-0.16 (-0.06)	12.14 (3.53) ***
<i>Post</i> × <i>TREAT</i> × <i>PP_CHAR</i>	?	0.16 (3.29) ***	-0.18 (-2.24) **	-0.05 (-0.74)	-0.11 (-1.71) *
Industry Fixed Effects		Yes	Yes	Yes	Yes
Adjusted R ²		0.297	0.285	0.296	0.272
N		250	250	250	250

Panel B: Alternative measurement periods – window: 2009-2013

Variable	Pred.	<i>PP_CHAR = Exp</i>		<i>PP_CHAR = Fund</i>	
		(1)	(2)	(3)	(4)
		DV = %EQ	DV = %BONDS	DV = %EQ	DV = %BONDS
<i>Post</i> × <i>TREAT</i>	- +	-5.83 (-2.77) ***	10.20 (1.65) *	-4.17 (-1.61)	14.45 (1.96) **
<i>Post</i> × <i>TREAT</i> × <i>PP_CHAR</i>	?	0.14 (2.84) ***	-0.14 (-1.39)	-0.05 (-0.98)	-0.16 (-1.73) *
Industry Fixed Effects		Yes	Yes	Yes	Yes
Adjusted R ²		0.416	0.334	0.416	0.334
N		210	210	210	210

Table 10: Robustness tests: Alternative measurement windows (*cont'd*)

Panel C: Alternative treatment date – 2013 (window: 2011-2014)

Variable	Pred.	<i>PP_CHAR = Exp</i>		<i>PP_CHAR = Fund</i>	
		(1)	(2)	(3)	(4)
		<i>DV = %EQ</i>	<i>DV = %BONDS</i>	<i>DV = %EQ</i>	<i>DV = %BONDS</i>
<i>Post×TREAT</i>	- +	-5.06 (-2.22) **	11.08 (4.59) ***	3.42 (0.84)	11.58 (2.12) **
<i>Post×TREAT×PP_CHAR</i>	?	0.13 (1.64) *	-0.17 (-1.52)	-0.10 (-0.89)	-0.10 (-0.95)
Industry Fixed Effects		Yes	Yes	Yes	Yes
Adjusted R ²		0.321	0.262	0.339	0.254
N		192	192	192	192

Panel D: Alternative “placebo” treatment date – 2009 (window: 2007-2010)

Variable	Pred.	<i>PP_CHAR = Exp</i>		<i>PP_CHAR = Fund</i>	
		(1)	(2)	(3)	(4)
		<i>DV = %EQ</i>	<i>DV = %BONDS</i>	<i>DV = %EQ</i>	<i>DV = %BONDS</i>
<i>Post×TREAT</i>	- +	-2.80 (-0.16)	39.41 (4.39) ***	17.79 (0.63)	24.50 (1.47)
<i>Post×TREAT×PP_CHAR</i>	?	0.28 (0.45)	-1.66 (-3.11) ***	-0.23 (-0.56)	-0.30 (-1.30)
Industry Fixed Effects		Yes	Yes	Yes	Yes
Adjusted R ²		0.516	0.673	0.533	0.670
N		64	64	64	64

Table 10 presents analyses examining the effect of the elimination of the corridor method on the allocation of pension assets using alternative measurement windows. Panel A presents the results for the 2010-2014 period. Panel B presents the results for the 2009-2013 period. Panel C presents the results for the 2011-2014 period when the treatment date is in 2013. Panel D presents the results of a placebo test for the 2011 to 2014 period when the treatment date is in 2009.

All panels present results of estimating equation (3) for *ASSET_ALLOC*, where *ASSET_ALLOC* is *%EQ* and *%BONDS* for each pension plan characteristic (*PP_CHAR*), where *PP_CHAR*, is either *Exp* or *Fund*.

The first (second) predicted sign refers to the predicted sign of *ASSET_ALLOC*, where *ASSET_ALLOC* is *%EQ* (*%BONDS*).

We provide *z*-statistics in parentheses below the coefficient estimates.

All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level.

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Table 11: Alternative matching procedure

Variable	Pred.	<i>PP_CHAR = Exp</i>		<i>PP_CHAR = Fund</i>	
		(1)	(2)	(3)	(4)
		DV = %EQ	DV= %BONDS	DV = %EQ	DV = %BONDS
<i>Intercept</i>	?	22.39 (0.58)	60.19 (1.18)	21.77 (0.63)	56.84 (1.22)
<i>Lev</i>	- +	0.20 (0.80)	0.11 (0.31)	0.23 (0.96)	0.13 (0.36)
<i>FF</i>	+ -	0.20 (2.15) ***	-0.44 (-3.36) ***	0.19 (2.13) **	-0.44 (-3.73) ***
<i>Size</i>	+ -	-2.23 (-1.18)	2.00 (0.94)	-2.34 (-1.30)	2.23 (1.10)
<i>SDCF</i>	- +	-0.54 (-0.11)	2.15 (0.37)	-0.76 (-0.16)	1.98 (0.36)
<i>Fund</i>	?	-0.28 (-1.74) *	0.18 (0.92)	-0.30 (-2.07) **	0.14 (0.76)
<i>Horizon</i>	+ -	-0.40 (-0.09)	0.70 (0.13)	-0.28 (-0.06)	1.34 (0.26)
<i>Exp</i>	?	0.19 (1.46)	-0.15 (-1.01)	0.14 (1.56)	-0.12 (-0.91)
<i>TREAT</i>	?	3.72 (0.57)	-5.01 (-0.59)	-0.56 (-0.04)	-6.87 (-0.45)
<i>TREAT</i> × <i>PP_CHAR</i>	?	-0.06 (-0.46)	0.07 (0.48)	0.06 (0.27)	0.07 (0.27)
<i>Post</i>	- +	-0.10 (-0.06)	-11.68 (-5.49) ***	-1.09 (-0.33)	-18.72 (-5.40) ***
<i>Post</i> × <i>PP_CHAR</i>	?	-0.07 (-1.72) *	0.13 (3.67) ***	-0.02 (-0.19)	0.22 (2.69) ***
<i>Post</i> × <i>TREAT</i>	- +	-5.10 (-3.50) ***	18.04 (6.15) ***	-6.31 (-2.37) **	28.33 (6.51) ***
<i>Post</i> × <i>TREAT</i> × <i>PP_CHAR</i>	?	0.07 (2.35) **	-0.21 (-4.02) ***	0.05 (0.70)	-0.32 (-1.83) *
Industry Fixed Effects		Yes	Yes	Yes	Yes
Adjusted R ²		0.392	0.377	0.391	0.379
N		144	144	144	144

Table 11 presents the results of equation (3), for *ASSET_ALLOC*, where *ASSET_ALLOC* is %EQ and %BONDS for each pension plan characteristic (*PP_CHAR*), where *PP_CHAR* is either *Exp* or *Fund*, using an alternative matching procedure, *caliper matching*, to test the robustness of the main findings reported in Table 3 in the main paper. We set the caliper equal to 20% of the standard deviation of the estimated propensity score (Cochran & Rubin, 1973; D'Agostino, 1998).

The first (second) predicted sign refers to the predicted sign of *ASSET_ALLOC*, where *ASSET_ALLOC* is %EQ (%BONDS).

We provide *z*-statistics in parentheses below the coefficient estimates. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level.

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Table 12: Additional control variables

Variable	Pred.	<i>PP_CHAR = Exp</i>		<i>PP_CHAR = Fund</i>	
		(1)	(2)	(3)	(4)
		DV = %EQ	DV = %BONDS	DV = %EQ	DV = %BONDS
<i>Intercept</i>	?	17.60 (0.54)	88.01 (1.77) *	12.25 (0.41)	90.23 (1.62)
<i>Lev</i>	- +	0.11 (0.58)	0.11 (0.46)	0.12 (0.67)	0.11 (0.46)
<i>FF</i>	+ -	-0.48 (-0.69)	-0.73 (-0.66)	-0.54 (-0.82)	-0.79 (-0.71)
<i>FF²</i>	?	0.01 (0.92)	0.00 (0.40)	0.01 (1.10)	0.00 (0.46)
<i>Size</i>	+ -	0.54 (0.25)	2.22 (0.85)	1.02 (0.46)	2.43 (0.92)
<i>SDCF</i>	- +	-1.30 (-0.30)	1.70 (0.49)	-1.35 (-0.33)	1.62 (0.52)
<i>Payout ratio</i>	?	-0.08 (-0.75)	0.03 (0.31)	-0.06 (-0.64)	0.02 (0.21)
<i>Shift</i>	?	8.43 (2.81) ***	1.16 (0.25)	8.61 (4.05) ***	-0.19 (-0.04)
<i>Fund</i>	?	-0.55 (-1.15)	-0.33 (-0.71)	-0.72 (-1.56)	-0.41 (-0.85)
<i>Fund²</i>		0.00 (0.83)	0.00 (0.85)	0.00 (0.94)	0.00 (0.80)
<i>Horizon</i>	+ -	1.90 (0.57)	-3.21 (-1.10)	3.49 (0.91)	-3.24 (-0.77)
<i>Market Returns</i>	+	0.02 (0.31)	-0.04 (-0.26)	0.02 (0.26)	-0.08 (-0.61)
<i>Exp</i>	?	0.07 (0.73)	0.04 (0.35)	0.03 (0.26)	0.15 (1.31)
<i>TREAT</i>	?	4.42 (0.76)	2.60 (0.43)	-10.38 (-0.88)	-0.08 (-0.01)
<i>TREAT×PP_CHAR</i>	?	-0.14 (-0.60)	0.13 (0.53)	0.24 (1.19)	0.11 (0.51)
<i>Post</i>	- +	-0.27 (-0.16)	-11.49 (-3.13) ***	-9.69 (-2.51) ***	-11.6 (-1.65) *
<i>Post×PP_CHAR</i>	?	-0.10 (-1.93) **	0.21 (1.80) *	0.12 (1.50)	0.12 (0.96)
<i>Post×TREAT</i>	- +	-8.89 (-4.77) ***	13.70 (3.66) ***	0.93 (0.39)	17.27 (2.04) **
<i>Post×TREAT×PP_CHAR</i>	?	0.38 (3.78) ***	-0.26 (-2.11) **	-0.04 (-0.43)	-0.20 (-1.30)
Industry Fixed Effects		Yes	Yes	Yes	Yes
Adjusted R ²		0.309	0.377	0.322	0.366
N		144	144	144	144

Table 12 presents the results of equation (3), for *ASSET_ALLOC*, where *ASSET_ALLOC* is *%EQ* and *%BONDS* for each pension plan characteristic (*PP_CHAR*), where *PP_CHAR* is either *Exp* or *Fund* after including additional control variables to test the robustness of the main findings reported in Table 3 in the main paper.

The first (second) predicted sign refers to the predicted sign of *ASSET_ALLOC*, where *ASSET_ALLOC* is *%EQ* (*%BONDS*).

We provide *z*-statistics in parentheses below the coefficient estimates. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level.

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Table 13: Subsample analyses excluding observations
where %OTHER is 25% or greater

Variable	Pred.	<i>PP_CHAR = Exp</i>		<i>PP_CHAR = Fund</i>	
		(1)	(2)	(3)	(4)
		DV = %EQ	DV = %BONDS	DV = %EQ	DV = %BONDS
<i>Intercept</i>	?	71.48 (1.90) *	76.73 (1.76) *	61.23 (2.16) **	89.50 (2.52) ***
<i>Lev</i>	- +	0.01 (0.03)	-0.12 (-0.30)	0.08 (0.28)	-0.21 (-0.58)
<i>FF</i>	+ -	0.19 (1.67) *	-0.19 (-1.38)	0.21 (1.68) *	-0.20 (-1.44)
<i>Size</i>	+ -	-1.49 (-0.50)	0.41 (0.12)	-1.89 (-0.84)	0.85 (0.27)
<i>SDCF</i>	- +	3.94 (1.11)	2.32 (0.47)	2.39 (0.69)	4.15 (0.83)
<i>Fund</i>	?	-0.32 (-1.93) **	0.31 (1.75) *	-0.39 (-3.64) ***	0.33 (2.81) ***
<i>Horizon</i>	+ -	-0.54 (-0.16)	-4.45 (-1.14)	1.61 (0.49)	-6.79 (-1.98) **
<i>Exp</i>	?	-0.01 (-0.05)	-0.20 (-1.01)	-0.08 (-0.94)	-0.06 (-0.45)
<i>TREAT</i>	?	4.83 (0.54)	-6.91 (-0.81)	-17.46 (-1.21)	15.94 (1.07)
<i>TREAT×PP_CHAR</i>	?	-0.09 (-0.45)	0.15 (0.78)	0.36 (1.65) *	-0.33 (-1.59)
<i>Post</i>	- +	3.94 (2.16) **	-7.16 (-4.85) ***	5.28 (1.73) **	-8.64 (-3.35) ***
<i>Post×PP_CHAR</i>	?	-0.09 (-2.19) **	0.18 (3.58) ***	-0.09 (-2.14) **	0.14 (3.74) ***
<i>Post×TREAT</i>	- +	-9.55 (-4.75) ***	14.25 (4.91) ***	-8.98 (-2.56) ***	14.19 (2.43) **
<i>Post×TREAT×PP_CHAR</i>	?	0.14 (2.30) **	-0.23 (-2.99) ***	0.10 (1.73) *	-0.17 (-1.84) *
Industry Fixed Effects		Yes	Yes	Yes	Yes
Adjusted R ²		0.403	0.367	0.458	0.405
N		112	112	112	112

Table 13 presents the results of equation (3), for *ASSET_ALLOC*, where *ASSET_ALLOC* is %OTHER for each pension plan characteristic (*PP_CHAR*), where *PP_CHAR* is either *Exp* or *Fund* after excluding observations where *other pension assets* is equal or greater to 25% to test the robustness of the main findings reported in Table 3 in the main paper.

The first (second) predicted sign refers to the predicted sign of *ASSET_ALLOC*, where *ASSET_ALLOC* is %EQ (%BONDS). We provide *z*-statistics in parentheses below the coefficient estimates. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level.

*, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

3 MARKET REACTIONS TO THE ELIMINATION OF PENSION SMOOTHING MECHANISM⁴⁹

3.1 Introduction

This study investigates whether the introduction of IAS 19R alters the assessment of firm value by equity investors. Specifically, I examine the effect of three major changes in the accounting for corporate pension plans that likely affect firm valuation. These distinct changes are the elimination of the corridor method, the replacement of the expected rate of return of plan assets and changes of disclosure requirements.

The corridor method as well as the expected rate of return are two mechanisms that smooth financial statement volatility caused by corporate pension plans. Actuarial gains and losses that are affected by yearly fluctuations of actuarial assumptions are smoothed with the help of the corridor method. Fluctuations of yearly returns of pension plan assets are smoothed with the help of the expected rate of return. However, these mechanisms lead, on various levels, to discussions on complex practical and conceptual issues of pension accounting.

People in favor of smoothing mechanisms argue that firms are not able to measure pension obligations as reliable as other financial statement items. Changes of assumptions to calculate pension obligations are inherent and often reverse over time. Accordingly, an immediate recognition of such changes induces volatility in financial statements which does not reflect a faithful representation of underlying economics. Moreover, opponents argue that these period-to-period changes are not relevant to users of financial statements as they base their decisions on the longer-term prospects of the entity. In contrast, proponents of the elimination of smoothing methods emphasize that the accounting for such methods is complex and makes it difficult for many users of financial statements to understand it. Furthermore, the smoothing of changes in the value of pension plans lead to financial statement items that do not reflect the funded status of a pension plan. The corridor method

⁴⁹ Chapter 3 represents an unpublished working paper (Barthelme, 2022a). This version of the unpublished working paper was solely written by Christian Barthelme with helpful comments of my dissertation advisor Thorsten Sellhorn. Based on this unpublished working paper, a further developed version of this paper was submitted as published working paper to the website *SSRN* by authors Christian Barthelme, Vicky Kiosse and Thorsten Sellhorn Equity in December 2022.

does not require firms to recognize economic costs of providing corporate pension plans when they occur. Thus, important information is buried in the notes and decreases the comparability of financial statements across firms. The paper investigates the question how investors react to events regarding the elimination of the smoothing mechanism and to the amendment of disclosure requirements that should enable investors to better assess the risk and cash flow characteristics of corporate pension plans.

I investigate this question in a German setting that allows comparing a wide range of firms in a critical sample size that are differently affected by the changes of IAS 19R. In Germany, the corridor method is widely used by firms that vary in their characteristics, such as size or industry. Moreover, the design of the German pension system in general leads to characteristics of firms that are merely found in other countries. These are firms that do fund pension obligations internally without external pension assets and also to a number of firms that do not offer defined benefit pension plans to their employees at all. These two characteristics of the German setting – firms without plan assets or without defined benefit obligation – help to identify the channels, or more precisely, the specific changes of IAS 19R that affects the stock price of firms. Second, another aspect speaking for the German setting is the variation across firms regarding the exposure to defined benefit pension plans and their risks. Again, this variation is possible and observable because of the German regulation of corporate pension plans that do not require to fully fund defined benefit obligations with external assets. Hence the legislative setting allows for high levels of underfunding of pension plans that is commonly seen as risk factor for firms and investors. Third, the single country setting allows to exclude effects that differently affects stock prices of firms from different countries.

Based on prior literature and theory, the study tests four predictions. The first three predictions relate to each single major accounting change of IAS 19R. First, the elimination of the corridor method is expected to influence firm valuation. It positively affects the transparency and comparability of firms but also negatively affects estimation risk and contractual arrangements by an increase of pension induced financial statement volatility. Accordingly, the first hypothesis predicts that investors, on average, price the elimination of the corridor method as value negative. The second hypothesis examines the reaction of investors to the replacement of the expected rate of return by the discount rate of defined

benefit. Prior literature suggests that the replacement should lead to negative direct as well as indirect effects on stock prices. Direct effects include the recognition of, on average, lower return expectation in the profit and loss statement and indirect effects comprise de-risking of pension asset allocations leading to higher cash flow needs to fund pension plans, as firms lose incentives to bias pension asset allocation to equities upwards. However, these negative direct and indirect effects could be outweighed by lower estimation risk as future cash flows are better predictable. Also, a positive effect could be caused by less earnings management as the discretion of setting expected rate of returns to high, which was repeatedly documented by prior literature, is also eliminated. IAS 19R comes along with new disclosure requirements that should enable investors to better assess the risk return profile and cash flow consequences of corporate pension plans. Whether these adjustments lead to stock price reactions or a net costly or net beneficial is subject to the third hypothesis. The fourth prediction tests cross-sectional variation in the stock price movements depending on firms' relative exposure to the risk of their pension plans.

Overall, the main tests support the hypotheses regarding firm value effects of events leading to the introduction of IAS 19R. While, I do not find a general reaction of the stock market to the events, I do find significant differences of stock price movement across firms that are differently affected by the amended accounting standard. Accordingly, I find stock prices of firms that used to apply the corridor method react more negatively to events that increase the likelihood of the elimination of this smoothing mechanism than control firms. This effect is even more pronounced for firms that have a higher exposure to the risk of pension plans. These findings suggest that negative consequences of higher pension induced financial statement volatility on estimation risk of investors and on contractual arrangements of firms decrease firm values. Moreover, also firms that are affected by the elimination of the use of the expected rate of return show a significant and positive reaction in comparison to firms that are not affected by this change, suggesting positive effects of the withdrawal of incentives to increase the risk of pension assets or to manipulate earnings by the expected rate of return. Finally, findings advocate that the introduction of new disclosures requirements are perceived by investors as net costly as firms, which are affected to this change react more negatively than their peers.

These findings are robust to alternative explanations, confounding events and research design choices. For example, supplemental analyses point out that interest rate changes of the ECB, that heavily affects the value of defined benefit obligations, do not explain findings of the study. Regarding confounding events, placebo tests that repeat main test 1,000 times with varying event dates exhibit results that are inconsistent to those obtained in the main analyses. Moreover, additional analyses show a parallel trend across firms used for testing hypotheses that minimizes the risk of other underlying drivers of test results. Various sensitivity analyses include additional control variables, test alternative sets of events and research design choices such as event or estimation periods. All in all, these additional analyses are in line with findings derived by main analyses. Noteworthy, are findings regarding additional control variables and tests regarding pension asset allocation that do not alter main findings.

Thus, the contribution of this paper is twofold. First, current research examines the consequences of the introduction of IAS 19R on firms' pension asset allocation. Barthelme, Kiosse and Sellhorn (2019) show that after the elimination of the corridor method, which is an effective smoothing device of pension-induced volatility, firms change their investment behavior regarding pension assets. They find that firms reallocate pension assets to less volatile assets in order to mitigate potential negative effects of an expected increase in volatility. Similar, Anantharaman and Chuck (2018) show that firms used the allocation of pension assets to justify high levels of expected rate of returns that directly affected net income. After the replacement of the expected rate of return by the discount rate of pension obligations that is unrelated to pension asset allocation, firms alter their investment behavior by decreasing the risk of pension assets. While relying on different changes due to IAS 19R, both papers show that firms react to the introduction of IAS 19R and take real actions by changing their investment behavior. Though, while these studies shed light on the reaction of firms to changes of IAS 19R, little is known how investors assess these changes. This question is especially important against the background that firms alter the allocation of pension assets and thus changing the actual risk-return and cash flow profiles of defined benefit pension plans that ultimately affect firm valuation.

Second, this study contributes to the stream of literature on the value relevance of pension accounting. Prior research shows that investors incorporate information of defined

benefit pension plans in their stock price valuation. This is true for balance sheet related information on defined benefit obligations and plan assets (e.g., Barth, 1991) as well as for income statement related information such as the expected rate of return (Bergstresser, Desai and Rauh, 2006). Consistently, studies also find variation in the value relevance of pension information, attributing this finding to differences between recognition and disclosure of pension information (Hann, Hefflin and Subramanayam, 2007), to differences in the degree of professional investors that are expected to better understand and deal with accounting information (Yu, 2013) and to differences in the incentive to manipulate earnings (Bergstresser, Desai and Rauh, 2006). This study complements prior literature by applying a more direct test of the various channels that are expected by prior literature to affect the valuation of equity investors compared to long-term value relevance studies.

Section 3.2 outlines the major milestones in the transition to IAS 19R and provides information on the accounting for defined benefit pension plans as well as on the amendments of IAS 19R. Section 3.3 summarizes prior literature and develops empirical predictions. Section 3.4 describes the identification strategy and research design. Section 3.5 to 3.7 provides descriptive statistics, empirical results and sensitivity analyses. Section 3.8 concludes.

3.2 Background

3.2.1 Institutional Setting

The accounting for defined benefit pension plans is subject to the reporting standard IAS 19 that is the same across jurisdictions. However, pension agreements are based on a high degree of trust between employees and employers. To additionally protect employees, for example, from expropriation by firms, national legislators have passed several regulations that differ across countries. Prior research highlights the importance of regulatory environment and finds cross-country differences, e.g., in the use of pension accounting choices (Morais, 2010). Accordingly, examining the effect of IAS 19R on stock prices suggests a single-country setting that prevent conclusions that are triggered by different country-specific regulations.

Studying the effect of IAS 19R on stock prices in a German setting offers several advantages that are inherent in German legislation. In contrast to the vast majority of developed countries, Germany exhibits a legislation that does not require to fund defined

benefit pension plans by legally separate, external funding vehicles. German firms are able to fund defined benefit pension plans either internally (i.e., through the sponsoring firm's operating or financial assets), externally (i.e., through a separate funding agency that manages plan assets on the sponsor's behalf), or through a combination of both. Funding defined benefit obligations externally by legally separated assets usually qualifies firms to offset plan assets from pension obligations and to recognize only the difference as pension liability on the balance sheet (IAS 19.54). In contrast, internal assets used to fund pension obligations are by definition not legally separate from the firm and obligations automatically result in pension liabilities. The flexibility of funding defined benefit obligations either externally or internally results in a high variation of funding levels of plan sponsors, which was found by prior literature as a significant driver of accounting choices and other firm-level decisions related to corporate pension plans (Morais, 2010). This study uses this unique characteristic of German legislation regarding funding of pension plans and exploits the variation in funding levels in cross-sectional analyses.⁵⁰

In the case of external funding, sponsoring firms use legally separate funding agencies that invest firms' contribution to pension plans. Funding agencies in Germany are either pension funds, contractual trust arrangements (CTAs), support funds or insurance-like funding agencies. These agencies invest into various asset classes such as equity instruments, bonds, real estate, or cash. However, depending on the kind of funding agency, German regulation describes various investment restrictions that aim to regulate the level of risk-taking.⁵¹ Accordingly, the variation in asset classes used to fund pension obligations is very high, which is reflected in a high range of expected returns. This characteristic of the German setting also has a beneficial effect in studying the impact of IAS 19R on firm valuation as the expected rate of return was a key measure for recognizing pension related effects on the profit and loss statement under IAS 19 and was removed by IAS 19R. The accounting for and use

⁵⁰ Regarding pension insurance, in Germany, comparable to most other developed countries, a statutory pension insurance fund protects beneficiaries from bankruptcies of pension plan sponsors.

⁵¹ Insurance-like funding agencies are discouraged from risk-taking, with the portion of equity securities limited to 35% of pension assets. In contrast, pension funds, CTAs and support funds are unrestricted in the portion of pension assets invested in equities, as long as investments in individual firms do not exceed 5% of pension assets. These restrictions have not changed during the period of interest of this study.

of the expected rate of return under both standards is described in more detail in section 3.2.3.2 and in section 3.3.

Changes in the expected rate of return as well as changes in other demographic or financial assumptions that are used in the context of accounting for pension plans are recognized as so-called actuarial gains and losses. Under IAS 19, firms can choose among three methods of recognizing actuarial gains and losses in financial statements that are described in detail in section 3.2.3.1. In contrast to firms in most other countries applying IFRS, the number of German firms that use different methods of recognizing actuarial gains and losses is sufficiently high. I exploit this variation in the empirical sections of this paper as the removal of two methods of recognizing actuarial gains and losses in the course of the introduction of IAS 19R is expected to affect stock prices, which is outlined in section 3.3.

Regarding tax treatment, since 2005, the basic tax treatment of a deferred taxation is identical for all kinds of pension plans. According to this principle, plan contributions and investment returns are tax-exempt, whereas pension payments are taxed at the level of beneficiaries. Regular contributions to pension plans by firms are tax-exempt up to a level that depends on the kind of funding agency, but not on the kind of investment done by the funding agency (e.g., bonds or equity securities). This principle also applies for contributions that are required because of shortfalls of pension plans and for internal funding. While contributions to pension plans and investment returns are tax-exempt, benefits paid to retirees are subject to taxation by beneficiaries.

Taken together, the use of the German setting combines several advantages regarding high variations in funding levels, investment strategies and related expected rates of return and the use of methods or recognizing actuarial gains and losses. All these features are affected by the introduction of IAS 19R and are expected to impact the firm valuation by equity holders. Moreover, these advantages come along with identical tax treatment and insurance guarantees for all kinds of pension plans, which are constant over time making these characteristics unlikely to affect test results of this study.

3.2.2 Major Milestones in the transition to IAS 19R

In 2006, the IASB added a project to its technical agenda with the objective to fundamentally review all aspects of pension accounting. The project was separated into two phases, of which

the first phase resulted in the publication of IAS 19R in 2011. The second phase, which focuses on the measurement of post-employment benefits, e.g., asset returns, is currently reactivated as IASB research project.

The first event expected to affect the likelihood of the elimination of the corridor method and the expected rate of return is the discussion of the IASB Board members of a proposal of the staff on May 24, 2006. The staff suggested consulting the IASC Foundation Trustees and the SAC for adding a project on the technical agenda that addresses the elimination of different deferral and smoothing mechanisms in accounting for post-employment benefits. Eight weeks after the proposal of the staff, on July 18, 2006, the Board decided to add the post-employment benefits project to its agenda to consider the elimination of smoothing mechanism in pension accounting. The decision to add the project to the agenda is interpreted as increasing the likelihood for eliminating the corridor method and the expected rate of return.

Over the next 19 months the IASB had several meetings discussing whether changes in post-employment benefits and plan assets should be recognized in the profit or loss statement or in other comprehensive income. Both options are synonymous with the elimination of the corridor method; hence most events in this period are characterized as increase in likelihood. On July 19, 2007 the IASB Board expressed explicitly the will to abandon the use of the expected rate of return on plan assets and to only use a single discount rate on post-employment benefits.

On March 27, 2008, the IASB released the discussion paper *Preliminary Views on Amendments to IAS 19* (IFRS Foundation, 2008) with the call for comments on the proposed amendments until September 2008. The discussion paper proposed several changes to the recognition, presentation and disclosure of corporate pension plans. Regarding the recognition of actuarial gains and losses, the IASB decided to reduce the number of recognition methods from three to one method. This change should enhance the transparency of the standard and comparability across firms. By suggesting an immediate recognition of these items in profit and loss, the IASB intended to remove the OCI method and the corridor method. Accordingly, the event is marked as increase of the likelihood of elimination of the corridor method.

After receiving and analyzing feedback on the discussion paper, the IASB staff gave a high-level summary of comments on November 19, 2008. The proposal of eliminating the corridor method caused a lot of concerns and criticisms expressed in the comment letters on the discussion paper. Various interest groups argued that the immediate recognition would lead to an increase in volatility that is (in part) not necessary because of future offsets. With respect to the concerns raised by some respondents, I expect this event to decrease the likelihood of the elimination of the corridor method.

The Board of the IASB met again on January 23, 2009, to discuss the scope of an exposure draft based on the discussion paper and the received comments. In the meeting the Board decided to maintain the proposal made in the discussion paper and to immediately recognize all changes in the value of pension plans in profit and loss. Over the next months, the IASB made several decisions concerning the design of the proposed standard. On April 22, 2009, the Board made the tentative decision to maintain all previous decision – also concerning the recognition of actuarial gains and losses in profit and loss.

On April 29, 2009, the IASB issued the Exposure Draft *Defined Benefit Plans – Proposed Amendments to IAS 19*. In contrast to previous decisions, the Exposure draft did no longer require an immediate recognition of actuarial gains and losses in profit and loss. Instead, the immediate recognition of actuarial gains and losses in other comprehensive income is the only method permitted. However, this change would result in an elimination of the corridor method as method of recognition actuarial gains and losses again.

Also, the Exposure Draft led to further controversies, expressed in over 200 comment letters presented to the Board of the IASB on September 16, 2010. The overall criticisms against the proposals focused on behavioral implications and the cost and benefits of the proposals. Especially, many respondents expressed support for retaining the corridor method, decreasing the likelihood of its elimination.

After considering the concerns expressed in the comment letter, the Board of the IASB discussed again the recognition of actuarial gains and losses on October 20, 2010. At the end of the meeting most of the Board voted in favor of removing the corridor method and to require the immediate recognition of actuarial gains and losses in the OCI. View months later, the Board reconfirmed all their previous decisions in a meeting on March 17, 2011. After the publication of a Near-final draft on June 6, 2011, the IASB finally published

IAS 19R on June 16, 2011. The amended standard confirmed the elimination of the corridor method of recognizing actuarial gains and losses and requires firms to use the OCI method. Accordingly, firms no longer have the possibility to defer the recognition of actuarial gains and losses. In the basis of conclusion of IAS 19R, the IASB explains this change with the objective to provide more relevant information for financial statement users and to increase faithful representation of underlying economics. The reduction from three to one method of recognizing actuarial gains and losses should also improve the comparability of financial statements between firms (IAS 19.BC70-72). The final standard also removed the calculation of the expected returns on pension assets with the help of a separate assumption and instead requires the use of the discount rate assumption.

3.2.3 Accounting for Defined Benefit Pension plans and changes of interest

The events outlined above lead to three major changes between IAS 19R and its predecessor. The accounting for defined benefit pension plans is outlined along these changes, which serve as basis for developing hypotheses regarding stock price reactions in section 3.3.

3.2.3.1 Elimination of the corridor method

The accounting for defined benefit pension plans heavily depends on assumptions regarding future pension payments. If these actuarial and financial assumptions change, firms recognize resulting differences in the pension plan measures as so-called actuarial gains or losses. IAS 19 provides three methods of recognizing actuarial gains and losses, which are the immediate recognition in other comprehensive income (OCI method), the immediate recognition in profit and loss and the deferred recognition in profit and loss (corridor method).

Under the corridor method, firms recognize actuarial gains and losses only (in part) if these gains and losses cumulate in excess of a certain threshold, commonly referred to as corridor. Consequently, the recognized pension liability on the balance sheet does not represent the difference between defined benefit obligations and plan assets. Chapter 2.6.2 Panel A illustrates the corridor method of recognizing actuarial gains and losses with the help

of a numerical example.⁵² The table describes the calculation of the portion of actuarial gains and losses that have to be recognized for firms using the corridor method. The corridor corresponds to the greater of 10% of defined benefit obligations, or 10% of plan assets. The accumulative unrecognized actuarial gains or losses in excess of the corridor has to be recognized (at the longest) over the remaining life of employees. In the numerical example, this procedure leads to an actuarial loss of 1.1 million that has to be recognized in profit and loss of the current year.

In contrast, the OCI method requires firms to immediately recognize any actuarial gain and loss in other comprehensive income. In the example this would be 5 million in the current year. Accordingly, for the OCI method, the recognized pension liability corresponds to the difference between defined benefit obligations and plan assets.

Under IAS 19R firms have to recognize all remeasurements in other comprehensive income in the period in which they occur. Accordingly, the IASB eliminated both, the corridor method and the immediate recognition in profit and loss. Firms that used to apply one of these methods have to change the way of accounting for actuarial gains and losses. This change leads to onetime effects on financial statements. Chapter 2.6.2 Panel B illustrates these effects for a firm that used to apply the corridor method. In the example, the change from the corridor method to the OCI method leads to an increase of 20 million of recognized pension liabilities, since the unrecognized actuarial gains and losses of prior periods have to be recognized immediately under the OCI method. Simultaneously, equity decreases by the amount of previously unrecognized actuarial gains and losses less the portion of deferred tax assets, which are 14 million (assuming a tax rate of 30%).

Beside these onetime effects, the switch from the corridor method to the OCI method will have permanent consequences on firms that used to apply this method. The change will affect financial statements though an increase in volatility of comprehensive income, equity and pension liabilities, since the recognition of actuarial gains and losses are no longer deferred over time.

⁵² This section refers to the Appendix in chapter 2 of the first paper of this thesis as both papers are based on the same underlying principles and changes in the accounting for defined benefit obligations.

3.2.3.2 Elimination of the expected rate of return

IAS 19R profoundly changes the principle of calculating pension expenses. Under IAS 19 pension expenses was composed by the service cost of pension plans, the interest cost of defined benefit obligations and the expected return of plan assets. The interest cost was calculated by multiplying the defined benefit obligation times the discount rate and the expected return of plan assets was calculated by multiplying pension assets times the expected rate of return of pension assets. The use of the expected rate of return instead of the actual return of plan assets, resulted in lower volatility of pension costs as actual returns are affected by yearly fluctuations.

IAS 19R alters the considerations of defined benefit obligations and plan assets in the calculation of pension expenses. Under the new regime the difference between defined benefit obligation and plan assets is multiplied by the discount rate used to measure the defined benefit obligation. In other words, the new standard multiplies both, defined benefit obligations and plan assets, with the same rate. Accordingly, this so-called net interest expense (income) does not reflect the asset allocation of pension assets anymore.

When the discount rate is lower (higher) than the previously used expected rate of return, pension costs increase (decrease) under IAS 19R. The difference between the discount rate based expected return on plan assets and the actual return of plan assets is recognized as actuarial gain or loss through other comprehensive income as described in section 3.2.3.1. See Appendix B Panel A for an illustrative example of the calculation under IAS 19 in comparison to the calculation under IAS 19R.

3.2.3.3 Change of disclosure requirements

Changes of IAS 19R also include a considerable increase of disclosure requirements in comparison to IAS 19. These requirements can be distinguished between disclosures of defined benefit plan characteristics and disclosures that describe the amount, timing and uncertainty of future cash flows. Appendix B Panel B depicts several disclosure requirements mentioned below.

Disclosures of defined benefit plan characteristics changed in several ways. First, the entity's exposure to risk should be explained by a narrative description with focus on entity-specific, unusual and concentration risks (see Example 1 of Appendix B Panel B). Second,

entities are now required to separate the impact of financial and actuarial assumptions. Changes of these assumptions usually result in actuarial gains or losses that affect the total amount of defined benefit obligations. Among the actuarial assumptions are estimates such as mortality rates, fluctuation in staff or early retirements. Financial assumptions usually include information on discount rates and benefits level. Moreover, IAS 19R now requires also extended disclosures on these assumptions, e.g., information on mortality tables (see Example 2 of Appendix B Panel B). Third, new plan asset disaggregation disclosures are set by IAS 19R that aim at providing more meaningful information on plan assets. Accordingly, IAS 19R is following the guiding principle of disaggregating “the fair value of plan assets into classes that distinguish the nature and risks of those assets”, while also providing an extended list of assets as example of the disaggregation. Under IAS 19, the standard only required firms to disaggregate their pension assets in minimum four asset categories that are “equity instruments”, “debt instruments”, “property” and “other assets”. This differentiation was neglecting potential risks, e.g., if major portions of pension assets were categorized as “other assets” without any information on the risk content of this position (see Example 3 of Appendix B Panel B).

Regarding the disclosures on the amount, timing and uncertainty of future cash flows, the standard setter focused on disclosures of sensitivity analyses. These include the sensitivity to actuarial assumptions, future funding requirements and asset-liability matching. In doing so, IAS 19R follows IAS 1 that requires information relating to estimation uncertainty for financial statement users (see Example 4 of Appendix B Panel B).

3.3 Prior Literature and Hypotheses

The outlined changes of IAS 19R might affect firm valuation by equity investors, leading to hypotheses outlined below. These hypotheses rely on the assumptions that (1) equity investors incorporate information on defined benefit pension plans in their stock price evaluation and (2) changes in the course of the introduction of IAS 19R affect the stock market evaluation of firms.

Regarding the first assumption a vast literature in accounting, economics and finance provide substantial empirical evidence that information about defined benefit pension plans affect the valuation of firms. Among these papers are early studies by Oldfield (1977) as well

as Feldstein and Seligman (1981) but also more recent papers such as Yu (2013) and Jin, Merton and Bodie (2006). See also Glaum (2009) for an extensive summary of research on the value relevance of pension accounting information. Regarding the second assumptions, changes in the accounting for defined benefit pension plans under IAS 19R are expected to affect the market valuation of firms. Models that derive market valuation of firms usually rely on expected future cash flows and a rate that discounts these future cash flows to derive a present value of a firm (Fama, 1977). The discount rate reflects the time value and risk of future cash flows (Sharpe, 1964). Accordingly, changes of IAS 19R should affect stock market valuation if changes of the amendment affect future cash flows or the perceived risk of cash flows manifested in the discount rate, or both.

Based on these two assumptions, the first hypothesis predicts that the introduction of IAS 19R affects the valuation of firms that apply the corridor method of recognizing actuarial gains or losses. Regarding the perceived risk of cashflows that are incorporated in the discount rate, research by Jin, Merton and Bodie (2006) shows that risk of defined benefit pension plans is reflected in the evaluation of business risk by stockholders. Accordingly, the elimination of the corridor method could affect the perceived risk in two ways. First, recognized pension liabilities of firms that used the corridor method were biased by the amount of actuarial gains and losses that were accounted separately within the corridor. Only manual calculations with the help of disclosures revealed the true nature of the pension liability. In this context, Yu (2013) finds that recognized pension liabilities are more value relevant than disclosed liabilities in the notes, suggesting that investors discount disclosed pension information versus recognized pension information. This finding supports prior research by Davis-Friday, Liu and Mittelstaedt (2004), who find that investors perceive disclosed post-retirement benefits as less reliable than recognized post-retirement benefits. Following this line of literature, I would expect a positive value effect for firms that used the corridor method as investor benefit from lower estimation risk, as more transparency is ensured.

On the contrary, the removal of the corridor method also eliminates an effective smoothing mechanism of pension-induced volatility. Volatility directly affects the estimation risk of investors that is reflected in the discount rate (Hodder, Hopkins and Wahlen, 2006).

Accordingly, higher pension-induced volatility of comprehensive income, equity, liability and respective leverage ratios could have negative effects on firm values.

Alongside effects on the discount rate, the elimination of the corridor approach also affects firm value by its implications on future cash flows. Future cash flows are affected by contractual arrangements that directly and indirectly rely on financial statement information, which are affected by the volatility of pension liabilities. Indirect effects are observed by higher cost of credit of firms with higher volatility of OCI, as debtholders want to be compensated for business risk associated with volatility (Bao, Billett, Smith and Unlu, 2020). Direct effects of financial statement volatility on contractual arrangements are more and stricter debt covenants as well as an increased risk of breaking them (Chava, Kumar and Warga, 2009). Both, literature on direct and indirect effects of financial statement volatility on contractual arrangements suggest that higher pension induced volatility by the elimination of the corridor method negatively affect firm value by higher contracting cost.

Pension induced volatility might also affect dividends of shareholders, as dividends are often communicated and linked to financial statement ratios, especially levels of equity measured by retained earnings. Accordingly, higher fluctuations of retained earnings increase the risk of not achieving hurdle rates for paying dividends to equity investors.

Taken together, prior literature shows that pension induced volatility affects firm valuations by affecting both, discount rates and future cash flows of firms. However, while the elimination of the corridor method leads to an increase in transparency suggesting positive effects on firm values, the elimination of the corridor method should also lead to negative valuation effects as pension induced volatility increases estimation risk and might lead to negative cash flow consequences as contractual arrangements or dividend payout policies are affected. Overall, I expect investors, on average, weight the opposing implications of the elimination of the corridor method as value negative leading to the following prediction:

H₁: On average, the removal of the corridor method by the introduction of IAS 19R will negatively affect the value of firms that used to apply this method.

I further expect that the introduction of IAS 19R affects firm value by the elimination of the expected rate of return. As described above, the expected rate of return is no longer applied

to estimate the profitability of pension plan assets. Instead, the discount rate is (implicitly) used for this estimation, which might lead to direct as well as indirect effects on firm value.

Direct effects arise from the relative differences between the expected rate of return and the discount rate. When the discount rate is lower (higher) than the previously used expected rate of return, pension costs increase (decrease) under IAS 19R and affect net income of firms accordingly. While actual returns and thus cash flows are per se not affected by this change, prior literature suggests that investors might not see the transitory nature of the income on pension assets reported in the profit and loss statement (Bergstresser, Desai and Rauh, 2006).

Indirect effects arise from the different accounting treatment of expected rates of returns and actual returns of plan assets. Under IAS 19, actual returns were not (for firms using the OCI method) or only in part (for firms using the corridor method) recognized in the profit and loss statement. Though, the expected rate of return directly affects net income of firms. Research findings show that firms used the incentive to inflate the expected rate of return by increasing the risk of pension assets to increase earnings (e.g., Rauh, 2008). These findings are in accordance with observations of pension asset allocations that bear too much risk as explained by finance theory (Gold, 2005). However, by the removal of the expected rate of return, managers do no longer have the incentive to increase the risk of pension assets to justify high return assumptions. Accordingly, Anantharaman and Chuck (2018) find that firms rebalance the pension asset allocation by decreasing the portion of riskier assets after the introduction of IAS 19R. This indirect effect of reallocating pension assets might affect firm value in two ways. First, it should decrease the assessment of risk by investors, reflected in the rate they use to discount future cash flows. The lower level of risk of pension assets should lead to lower levels cash flow volatility, as fluctuation of pension assets and potential shortfalls in pension plans are less likely. Second, the rebalancing of pension assets affects actual returns of plan assets and thus free cash flows of firms. Lower risk of pension assets on average manifests in lower returns and hence in higher capital contribution of firms to fund pension obligations.

Prior literature suggests that both, direct and indirect effects of the elimination of the corridor method likely affects the perception of investors. Regularly, the discount rate used for pension plan calculations is lower than the average expected rate of return, leading to

potentially negative effects on stock prices. Also, lower future cash flows of pension assets in the course of rebalancing pension assets should have a negative effect on firm values. Yet, eliminating the option to manage earnings with the help of inflated expected rate of returns together with lower levels of cash flow volatility that is achieved by a less risky asset allocation should all be reflected in lower rates to discount future cash flows and thus should lead positive firm value effect. Both, negative and positive effects lead to the second unsigned prediction.

H₂: On average, the removal of the expected rate of return by the introduction of IAS 19R will affect the value of firms with plan assets.

The introduction of IAS 19R comes along with more comprehensive disclosure requirements than IAS 19 that likely affects both, firms cash flows and cost of capital. Costs of the new disclosure rules arise for firms as preparer of these information and for shareholders as users of these information. Providing additional disclosures is net costly for firms, as additional information has to be prepared and even information that are already available within firms are costlier, because information that are externally disclosed require more documentations and internal controls. Moreover, gathering additional information on corporate pension plans often involves external pension advisors or actuaries that also cause additional costs. Concerns about higher costs were also raised during the consultations of the IASB and are outlined in the basis for conclusion of the new standard. Overall, more extensive disclosure requirements of IAS 19R result in higher costs and lower net income leading to a negative effect on cash flows of firms. In contrast, the new disclosure requirements of IAS 19R should only sparsely affect the costs of equity shareholders, as the nature of corporate pension plans and respective disclosure requirements were already very complex and require much effort to analyze.

Beside the costs, also benefits arise from new disclosures requirement of IAS 19R that should benefit especially investors by positive effects on the cost of capital. The new standard eliminates accounting choices of firms that increase the comparability of disclosures and finally comparability of firms. Most prominently was the reduction of methods of recognizing actuarial gains on losses from three options to one. Under the old standard, financial statement users were required to analyze and manually adjust financial numbers in

the P&L, the OCI and balance sheet based on information in the notes to compare firms that used different methods. Prior research indicates that financial statement users were (in part) not fully able to understand or able to process all available information leading to differences in the valuation of disclosed and recognized information on pension plans (Yu, 2013). By reducing the number of accounting and disclosure choices, the IASB harmonized provided information across firms. Accordingly, information quality differences between firms should be mitigated thus facilitating flows of capital and its cost (e.g., Armstrong, Barth, Jagolinzer and Riedl, 2010; Diamond and Verrecchia, 1991).

Beside the reduction of accounting and disclosure choices and thus the harmonization of information, the new standard also requires additional disclosures. Among these additional requirements are information on plan characteristics and on the amount, timing and uncertainty of future cash flows. This information should help investors to better assess the risk of pension plans on financial statement numbers, leverage ratios and on future cash flow needs. Moreover, the old standard was criticized for providing information that were not relevant, leading the IASB to withdraw disclosures that were regarded as not useful, e.g., the disaggregation of plan curtailments, settlements and amendments that have similar economically rationale and same reporting outcome. Taken together, new disclosure requirements under IAS 19R should help investors to better judge the risk, return and cash flow consequences of pension plans leading to lower estimation risk and finally to lower cost of capital (Barry and Brown, 1985; Lambert, Leuz and Verrecchia, 2007).

Overall, I expect investors, on average, to value the changes of pension disclosure requirements as net costly leading to a decrease of firm values. Given the already detailed information provided by IAS 19R that enables investors to evaluate the risk and opportunities of corporate pension plans, I expect that an additional benefit from new disclosure requirements do not outweigh the cost of providing these information, leading to the following hypothesis:

H₃: On average, new disclosure requirements of IAS 19R will negatively affect the value of firms with defined benefit pension plans.

Finally, I expect that the effect of the introduction of IAS 19R on firm value experiences cross-sectional variation. The major accounting changes of IAS 19R comprise the

elimination of the corridor method, the replacement of the expected rate of return and the change of disclosure requirements. Each of these changes are more relevant for investors of firms with large defined benefit pension plans. In more detail, the elimination of the corridor method is also an elimination of an effective smoothing mechanism of pension-induced volatility that is caused by actuarial gains and losses. Firms with large pension plans relative to other financial statements items experience higher levels of pension-induced volatility that more heavily affects the assessment of investors. Similar, the effect of the replacement of the expected rate of return is also more severe for firms with large pension plans. The expected rate of return affected the net income of firms by applying the return expectation on the plan assets of firms. Firms with relatively high levels of plan assets were better able to boost income by increasing the expected rate of return with the help of pension asset allocation than firms with lower levels of plan assets. Finally, investors of firms with material pension plans also depend more on useful disclosures than investor of firms with lower levels of pension plans. The estimation and pricing of pension-related returns, risks and cash flows of pension plans are more important for investors of firms with large pension plans.

Taken together, the changes in the accounting for defined benefit pension plans under IAS 19R should be more relevant for the price assessment of investors of firms with relatively large pension plans, leading to the following hypothesis:

H4: On average, the introduction of IAS 19R will affect the value of firms depending on the relative size of firms' defined benefit pension plans.

3.4 Research design

3.4.1 Identification Strategy

The main contribution of this study lies not in the investigation of the overall effect of the introduction of IAS 19R on stock prices, but in examining different channels that allow to pin down the overall effect to the effect of distinct accounting characteristics such as different smoothing mechanisms. The isolation of effects requires a careful identification of events and firms to ensure a precise attribution to each effect tested in the outlined hypotheses.

Regarding the identification of events, I base my identification strategy on methods of prior literature (e.g., Joos and Leung, 2012) and use two approaches to identify events that

potentially affect the likelihood of the introduction of IAS 19R that comes along with the accounting changes described above. These are the search on the IFRS Foundation website for announcements and project news and a keyword search on LexisNexis and ABI ProQuest for news related to IAS 19R. The search keywords comprise varying combinations of the terms “IAS 19”, “IAS 19R”, “corridor method”, “OCI method”, “pension smoothing”, “expected rate of return”, “deferred recognition” and “IASB”.

Overall, this leads to the identification of 16 events ranging from May 2006 to June 2011. I characterize all events according to their influence on the likelihood of (i) the elimination of the corridor method and (ii) the removal of the expected rate of return. Studying the protocols of IASB meetings as well as the media coverage of the introduction of IAS 19R leads not to the identification of events that decreases the likelihood of the general introduction of the amended standard. Concerning the elimination of the corridor method, I identify twelve events as increasing the likelihood of the elimination of the corridor method and three events as decreasing the likelihood.⁵³ Moreover, out of the 16 events, I mark eleven events as increasing and one events as decreasing the likelihood of eliminating of the expected rate of return.⁵⁴ Table 1 gives an overview of all events and their influence on the likelihood of the elimination of the corridor method and the expected rate of return (increasing/decreasing). Unfortunately, public information provided by the IFRS Foundation on events regarding Board meetings does not allow to clearly identify events that increase or decrease the likelihood of the introduction of specific disclosure requirements. Consequently, I do not distinguish events for this hypothesis but use the general direction of the event concerning the likelihood of the introduction of IAS 19R.

Regarding the identification of firms attributable to distinct accounting effects on stock prices, I use information provided by firms’ annual reports and split the sample into four groups. Appendix C summarizes the grouping of firms (Panel A) and the use of each group in hypothesis tests in (Panel B). Group I comprises firms that do not offer defined benefit pension plans to their employees. These firms do not have any defined benefit obligations or

⁵³ One out of 16 events are not marked as affecting the likelihood of eliminating the corridor method, as the event affects the removal of the expected rate of return, only.

⁵⁴ Five out of 16 events are not marked as affecting the likelihood of removing the expected rate of return, as this topic was not addressed by the event.

plan assets and consequently are not affected by the introduction of IAS 19R. Group II includes firms that do offer defined benefit pension plans but fund defined benefit pension obligations with internal assets only and thus do not have any external plan assets. Group III contains firms that do offer defined benefit obligations, fund these obligations by external pension plan assets and use the OCI method for recognizing actuarial gains or losses. Group IV consists of firms that do offer defined benefit obligations, fund these obligations by external pension plan assets and use the corridor method for recognizing actuarial gains or losses.

The disaggregation of sample firms allows to test each hypothesis as not all firms are affected by each accounting change. Hypothesis 1 examines the effect of the elimination of the corridor method on stock prices. Accordingly, I test the stock market reactions of firms that use the corridor method (group IV) and compare the results with the results of firms that already use the OCI method (group III). Both groups are affected by other changes introduced by IAS 19R in the same way but set themselves apart from each other by using different methods of recognizing actuarial gains or losses. Hypotheses 2 investigates the effect the removal of the expected rate of return on stock prices. Firms without plan assets (group II) are not affected by the elimination of the expected rate of return. These firms either do not externally fund pension obligations in general or use internal funds that do not qualify as plan assets. I test the stock market reaction of these firms against the reaction of firms in group (III). Hypotheses 3 examines the effect of new disclosure requirements under IAS 19R on firm values. I use firms without defined benefit pension obligations (group I) and compare the average stock price reaction of this group with firms of group II that are affected by new disclosure requirements but not by the elimination of the expected rate of return or the removal of the corridor method. Hypothesis 4 concentrates on cross-sectional analysis by testing the effect of differences between the relative size of firms' defined benefit pension plans on stock price reactions in the course of the introduction of IAS 19R. For this analysis, I include firms of group II, III and IV and test cross-sectional differences by including interaction terms in the estimations used to test Hypotheses 1 and 2 as explained in the section below.

3.4.2 Models for testing hypotheses

3.4.2.1 Measuring abnormal returns

Hypotheses 1 to 3 predict that firm value effects of the introduction of IAS 19R differ on average across firms depending on the proposed accounting change. To test these hypotheses, I examine stock price reaction of sample firms of different groups around 16 events that are expected to affect the likelihood of the elimination of the corridor method (H₁), the removal of the expected rate of return (H₂) and the introduction of new disclosure requirements (H₄). Similar to prior literature (e.g., Schipper and Thompson, 1983 or Andreicovici et al., 2018), I apply the event study methodology and base my estimation of the average stock market reaction and abnormal returns of firms on the following regression model:

$$Ret_{it} = \alpha_i + \beta_i Mkt_Ret_t + \gamma_i Event_t + \varepsilon_{it} \quad (1)$$

The dependent variable Ret_{it} is the stock return of firm i on day t .⁵⁵ Mkt_Ret is the daily return of the market portfolio, proxied by the index *Prime All Share* of Deutsche Börse Group that covers all shares listed in the prime standard market segment. $Event$ is a signed dummy variable for each of the 16 events. The variable is equal to one (minus one) during the event window for events increasing (decreasing) the likelihood of the elimination of the corridor method, and zero otherwise. The event window comprises three trading days that are the day of the event and one trading day before and after the event. See Appendix A for detailed definitions of all variables.

The intercept α reflects firms expected average abnormal stock returns for days outside the event window. Coefficient β represents firms' returns that are equal to the movement of the returns of the market portfolio on non-event trading days. My primary measure of examining effects on firm value is the coefficient γ . The coefficient measures abnormal returns of firms during the 16 event windows. Accordingly, a positive (negative) value of γ reflects the perception of investors on the introduction of changes of IAS 19R, by showing positive (negative) changes on firms' market values.

⁵⁵ Hereafter, I drop the explanation of the subscripts for variable descriptions.

Cross-sectional correlation might affect the validity of test results, as potential abnormal returns could be caused by identical event dates for all firms or by a common economic underlying (Bernard 1987, Moulton 1990). Therefore, I cluster standard errors by date, which assumes returns to not being autocorrelated which is consistent with random walk assumption of stock price movements (Fama, 1995). Similar to the assumption of a random walk, I also assume that the process of revising IAS 19 does not lead to reallocation of market capitalization between sample firms (Binder, 1985), basing my tests on investigating average abnormal returns across firms rather than testing returns of all firms.

Events likely affecting the perception of stock market participants of IAS 19R range from May 2006 to June 2011. Consistent with prior literature (e.g., Beatty, Chamberlain and Magliolo, 1996 or Andreicovici et al., 2018) the estimation period includes all trading days between January 1, 2006 and September 30, 2011, except for days that fall in event windows.⁵⁶

3.4.2.2 Cross-sectional analyses

Hypotheses of this paper predicts that the introduction of IAS 19R affects the perception of investors differently, depending on the design of firms' corporate pension plans and the relative exposure of firms to the implied of risk of defined benefit pension plans. Examining these predictions requires the estimation of firms' abnormal returns as described in equation (1) as a function of their belonging to a respective group, leading to the following cross-sectional model:

$$\gamma_i = \delta_0 + \delta_1 Treat_i + \delta_2 Controls_i + \delta_i \quad (2)$$

The dependent variable γ_i is derived by equation (1) and reflects the coefficient on abnormal returns (*Abn_Ret*) for aggregated events (*Agg_Events*) for each firm. In other words, it reflects the average abnormal return of firm *i* over all event days. The first independent variable *TREAT* is a dummy variable that proxies for the belonging of a firm to

⁵⁶ For example, Andreicovici et al. (2018) use an estimation period from June 1, 2010 to December 31, 2015, while events took place between December 15, 2010 and December 11, 2015. I test an alternative approach for the estimation period in section 3.7.4 on sensitivity analyses.

a specific group. Accordingly, this variable changes for testing hypotheses. For examining H_1 , abnormal returns of firms of group IV are compared to those of group III (please refer to Panel B of Appendix C for an overview). In doing so, abnormal returns of group III and IV are used in the cross-sectional analyses as described by equation (2), whereas in this case $TREAT$ is a dummy variable equal to 1 for firms that belong to group IV. Coefficients on $TREAT$ are the main variable of interest, as the coefficient captures the incremental effect on abnormal returns of group IV relative to the control group that is group III. If investors of firms in group IV react differently to events affecting the likelihood of the elimination of the corridor method, the coefficient on $TREAT$ should be significantly different from zero. Similar, $TREAT$ proxies for firms of group III for testing H_2 that includes abnormal returns of all firms of groups II and III. For examining H_3 that compares abnormal returns of firms in groups I and II, $TREAT$ proxies for firms of group II.

The variable *Controls* comprises a set of firm characteristics that likely affect stock price reaction to the introduction of IAS 19R. First, as outlined in the section on hypotheses development above, I include the independent variable Exp that is a proxy of firms' exposure to their corporate pension plan, measured as the ratio of defined benefit obligations relative to book value of equity.⁵⁷ Prior literature finds Exp to be a significant determinant in affecting the allocation of pension assets to different asset classes and also for changing this allocation in the course of the elimination of the corridor method. This behavior is likely triggered by the risk and negative consequences of pension induced financial statement volatility (Barthelme, Kiosse and Sellhorn, 2019). I expect these risks and potentially negative consequences to be relevant for investors as well, leading to the inclusion of this measure as control variable. Moreover, as outlined above, I also expect that investors react differently to the introduction of IAS 19R according to firms' variation in their exposure to the risk of corporate pension plans (H_4). For this reason, I additionally re-estimate equation (2) including an interaction term between the group indicator variable $TREAT$ and the exposure Exp ($TREAT \times Exp$) to test whether effects from the elimination of the corridor method or the elimination of the use of the expected rate of return is more pronounced for firms with higher

⁵⁷ In section 3.7 on sensitivity analyses, I repeat analyses with an alternative measure for Exp .

exposure to firms pension plans.⁵⁸ Second, I add the size of firms (*Size*) by including the natural logarithm of the market value of equity. Prior literature regularly uses this control as proxy for the information environment of firms, relying on the notion that larger firms are covered by more information intermediaries and exhibit higher information quality (e.g., Riedl and Serafeim, 2011, Yu, 2013). Positive coefficients on this variable would indicate that investors of larger firms react more positive to changes introduced by IAS 19R. Third, I include a proxy for the leverage of firms (*Lev*) as additional control variable. I expect firms with high leverage ratios to be more affected by IAS 19R as higher pension-induced equity volatility (at least for firms previously using the corridor method) leads to an increased risk of breaking contractual arrangements that are linked to leverage KPIs such as debt covenants. Fourth, I control for the percentage of free float of each firm (*FF*) is additionally included as control variable. Firms with low levels of free float usually have one or a limited number of large equity holders. In the literature this proxy is often used to account for differences in the level of corporate governance of firms (e.g., Song, Thomas and Yi, 2010). Fifth, I also control for the level of funding defined benefit obligations (*Fund*). Funding levels were found by prior literature (Rauh, 2008, Anantharaman and Lee, 2014) as significant in determining managerial risk-taking in corporate pension decisions. Similar, levels of funding affect shareholders, as they affect their estimation of future cash flows. Considerable cash flow risks could arise, for example, by shortfalls caused by negative returns of pension assets. Finally, I control for the standard deviation of operating cash flows (*SDCF*). This variable proxies for the business risk of firms as well as risks associated with pension plans. Firms with higher levels of operating cash flow volatility may face difficulties in funding corporate pension plans or payouts of pension entitlements if obligations are funded internally. Again, as in equation (1), I cluster standard errors by date to avoid distorted standard errors for the cross-sectional analysis that could occur because of the same periods of time used to estimate the model.

⁵⁸ Testing the effect of new disclosure requirements is done with the help of group I that includes firms without defined benefit pension plans. Therefore, I do not test the effect of firms' variance of pension exposure for H₃.

3.5 Sample and descriptive statistics

3.5.1 *Sample Selection and Data*

Panel A of Table 2 illustrates the sample selection process. Sample firms were initially identified from the Prime Standard for shares of Deutsche Börse Group in the period ranging from January 1, 2006 to September 20, 2011.⁵⁹ I exclude firms that are not publicly listed during the sample period to reduce the possibility of distorted results by differences in the composition of the sample over time. Moreover, I do not consider firms that miss data for calculating variables or test statistics. These requirements lead to 193 unique sample firms and 282,552 daily observations (1,464 trading days).

I obtain share price data, pension asset allocation information and financial statement data from Worldscope. I hand-collected information on the method of recognizing actuarial gains and losses from annual reports provided by Perfect Information database to identify firms using the corridor or the OCI method. As described in section 3.2.3, firms differ in the way they are affected by the change in the accounting regulation of IAS 19R. Accordingly, Panel B of Table 2 disaggregates overall daily observations according to the method of recognizing actuarial gains and losses and additionally shows the number of daily observations for firms that do not have plan assets or defined benefit plans at all.

3.5.2 *Summary statistics*

Panel A of Table 3 gives an overview of summary statistics of main variables for all sample firms (highlighted in bold) and for groups of firms used in hypotheses testing, respectively. The average market return over the sample period is 0.01% and the average abnormal return during event windows is 0.03%. For groups II and IV the average abnormal returns are comparable with each other and with market returns. However, abnormal returns of firms without defined benefit pension plans (group I) and firms with plan assets that use the OCI

⁵⁹ I include all trading days between January 1, 2006 to September 30, 2011 in the estimation period, except trading days falling in event periods. This span covers all events as described in section 3.2.2 and is consistent with prior literature that employs similar estimation periods around examined events (e.g., Beatty, Chamberlain and Magliolo, 1996).

method (group III) are on average higher. Though, this finding does not hold when comparing the median of returns for which all groups of firms are on a comparable level around -0.05%.

Regarding variables used for cross-sectional analyses, two characteristics stand out. First, firms with high exposures of defined benefit obligations relative to book value of equity (*Exp*) regularly use external plan assets to fund their pension plans, which is shown by high values for *Exp* for group III and IV in comparison to group II that do not use external funding at all. Also, these firms are somewhat larger (*Size*) than firms that without plan assets (group II) or defined benefit obligations (group I). This finding is consistent with the notion that corporate pension plans are complex to provide and very costly, which could be carried by larger firms more easily. Second, the level of funding by plan assets (*Fund*) is comparatively low with average levels of 55% (46%) for firms using the OCI (corridor) method of recognizing actuarial gains or losses. The low levels of funding are caused by decreased interest rates and yields on bonds during the sample period. Low yields on bonds increase the recognized amount of defined benefit obligations by decreasing the rate used for discounting future pension payments. Furthermore, low yields on bonds also negatively affect the returns of fixed-income plan assets that are used to pay pension payments or that are reinvested to increase the level of plan assets. Furthermore, German regulation does not require firms to fully fund their pension plans.

Panel B of Table 3 provides information on Pearson (above) and Spearman (below) correlation coefficients. Spearman correlation supports the relation between the exposure of firms and the level of funding as described above with a coefficient of 0.72 between *Exp* and *Fund*. For the overall sample the coefficients show no significant correlation between variables used in cross-sectional tests and abnormal returns of sample firms, suggesting that these variables do not affect the perception of investors regarding the value effect of the introduction of IAS 19R on an overall level. Repeating the analysis for individual groups used for testing hypotheses show significant Pearson correlations of the dependent variable with *Fund* for group III (at the 5% level) and for group IV (at the 10% level).

3.6 Empirical results

The first finding documents the average market reaction of firms on event dates. Panel A of Table 4 shows results of estimating equation (1) for all sample firms in column (1) and for

firms affected by the introduction of IAS 19R that include all groups except group I in column (2). Instead of individually measuring events, I include *Agg_Events* that reflects a pooled event dummy over all events (*Event*). The coefficient on the indicator variable for all events (*Agg_Events*) is positive but not significant different from zero for both columns. This finding indicates that on average, there is no significant positive or negative stock market reaction to events leading the publication of IAS 19R. While this finding is in line with expectations that an amendment of the accounting for corporate pension plans does not affect stock markets in general, hypotheses of this paper concern the cross-sectional analyses of stock market reactions.⁶⁰ To this end, I test whether stock market reactions across firms that are differently affected by the amended accounting standard are significantly different from each other.

Univariate tests of the difference in abnormal returns between groups used for testing hypothesis 1 to 3 are depicted in Panel B of Table 4. Column (1) focus on cumulative abnormal returns, whereas column (2) concentrates on average abnormal returns within event windows, reflecting the abnormal returns presented in summary statistics in Panel A of Table 3. Again, all groups show positive returns during event windows, whereas group III exhibits the largest abnormal returns. Test statistics show that the difference in abnormal returns between group III and IV (H_1) is significant at the 5% level in both columns. Similar, also the difference in abnormal returns between group II and III (H_2) is significant at the 5% level. However, differences between group II and group I are not significantly different from each other. These findings of univariate tests provide initial support for hypotheses 1 and 2 that predict different stock market reactions caused by the elimination of the corridor method (H_1) and by the elimination of the use of the expected rate of returns (H_2). Yet, univariate tests do not support H_3 that predicts different stock market reaction caused by the introduction of new disclosure requirements. To further assess the validity of initial univariate findings, I next consider cross-sectional differences between firms and include control variables in the estimation of abnormal returns as outlined in equation (2).

⁶⁰ In the section on sensitivity analyses, I also test for stock market reactions for individual events (section 3.7.3). Coefficients on the market return (*Mkt_Ret*) show similar returns for the overall sample as well as for firms affected by IAS 19R. This finding regarding the general market trend and those for individual groups are analyzed in more depth in section 3.7.1.

Panel C of Table 4 presents multivariate results of testing hypotheses 1 to 4. Columns (1) and (2) present tests of H_1 , whereas *TREAT* is a measure for firms of group IV that used to apply the corridor method under IAS 19. Similar, columns (3) and (4) present tests of H_2 , but now, *TREAT* is a measure for firms of group III that are affected by the elimination of the expected rate of return and new disclosure requirements, but not by the elimination of the corridor method. Finally, column (5) presents coefficients testing the firm value consequences of new disclosure requirements, whereas *TREAT* reflects firms of group II that are only affected by these amendments. Multivariate tests also include tests of H_4 , which predicts that cross-sectional differences in abnormal returns are affected by the exposure of firms to the risk of corporate pension plans, proxied by the interaction variable *TREAT* \times *Exp*. Results of this test that relates to both, H_1 and to H_2 , are shown in column (2) and column (4).

Regarding market reactions to the elimination of the corridor method (H_1), the coefficient on *TREAT* in column (1) that proxies for firms of group IV is significant at the 1% level and negative (coefficient = -0.2651; *t*-statistic = -4.14). Also, column (2) exhibits a significantly negative coefficient, suggesting that investors perceive the elimination of the corridor method negative for affected firms in comparison to firms that use the OCI method. Moreover, the negative reaction to events leading to the elimination of the corridor method is even stronger for firms that have higher exposures to the risk of pension plans, documented by a significantly negative coefficient on *TREAT* \times *Exp* in column (2). This finding supports H_4 for firms and events related to the use and elimination of the corridor method.

Regarding H_2 that investigates stock price reaction to events leading to the elimination of the use of the expected rate of return, the coefficients on *TREAT* in columns (3) and (4) are significantly positive and about the same magnitude of 0.38% and 0.32%, respectively. The coefficient on *TREAT* \times *Exp* is also positive but slightly fails to be significant (coefficient = 0.4777; *t*-statistic = 1.63). These findings indicate a positive firm value effect of the elimination of the expected rate of return, whereas this effect does not significantly depend on firms' exposure to the risk of their pension plans.

Findings, regarding the firm value effects of new disclosure requirements are presented in column (5). The coefficient on *TREAT* is significantly negative, indicating a negative effect of IAS 19R for firms that do have defined benefit obligations but no plan assets (group II) in

comparison to firms that do not have defined benefit obligations at all. Control variables in these multivariate tests are partly significant, too. Coefficients on *Fund* are consistently significant and negative across all specifications in columns (1) to (4). Consequently, the level of funding increases the negative effect of the elimination of the corridor method but moderates the positive effect of the elimination the expected rate of return. Coefficients on *Size* are significant in testing the effect of the elimination of the corridor method, but not in testing H_2 and H_3 . Finally, *Exp* is significant and positive for all specifications, except for column (4), supporting the finding that the exposure of firms to pension risk is not a factor in investors evaluation of the elimination of the expected rate of return.

Overall, the main tests presented in Table 4 support the hypotheses regarding firm value effects of events leading to the introduction of IAS 19R. While, I do not find a general reaction of the stock market to the events, I do find significant differences of stock price movement across firms that are differently affected by the amended accounting standard. Accordingly, I find stock prices of firms that used to apply the corridor method react more negatively to events that increase the likelihood of the elimination of this smoothing mechanism than control firms. This effect is even more pronounced for firms that have a higher exposure to the risk of pension plans. These findings support the notion that positive effects of higher transparency are outweighed by negative consequences of the elimination of the corridor method that are higher pension induced financial statement volatility and potential negative consequences on contracts or dividends. Moreover, firms that are affected by the elimination of the use of the expected rate of return show a significant and positive reaction in comparison to firms that are not affected by this change, suggesting that investors positively value the elimination of an incentive to either manipulate earnings or the incentive to increase the risk of pension plans through the allocation of asset. Finally, findings support the view that investors perceive the introduction of new disclosures requirements as net costly for firms, as firms affected to this change react more negatively than their peers.

3.7 Sensitivity analyses

3.7.1 *Alternative explanation, parallel trend and placebo analysis*

In this section, I examine alternative explanations for the results obtained in the main analyses to mitigate concerns that results are driven by confounding events, for example, a general trend in the stock market.

Concerns regarding an underlying market trend driving test results could be mitigated by the identification strategy of this study. A general underlying market trend would affect all sample firms equally. However, findings of this study are derived by comparing groups that differ from each other by their pension plan designs. Accordingly, an underlying trend that affect test results would have to occur only for firms assigned to a specific group. The effectiveness of the identification strategy is shown in Panel C of Appendix C, that gives an overview the development of average share price movements of firms in each group over the sample period. The development shows a parallel trend over the sample period for all groups. This trend starts with a positive development of share prices between 2006 and 2007. Stock prices of firms of all groups began to decline with the beginning of the so-called financial crises in late 2007. The share price lows in 2009 mark a turning point for stock prices that began to rise again until the end of the sample period in 2011. Compounded monthly growth rates over the sample period are virtually the same across groups, ranging from 0.56% (Group II) to 0.68% (Group III).

Moreover, the identification strategy also controls for determinants on firm level that might affect firms of groups differently, depending on their pension plan design by including variables in the analyses that were found to be significant drivers by the literature. Albeit the identification strategy of this paper already mitigates concerns, I further minimize the probability of confounding events by (a) include interest rate changes by the ECB and (b) compare test results with results of performing a placebo analysis.

First, I test the influence of interest rate changes by the European Central Bank. Results of the main test indicate that the stock price reactions to the events leading to the amendment of IAS 19 are sensitive regarding the risk of defined benefit pension plans for firms. The risk was defined as ratio of defined benefit obligations to book equity. The size of defined benefit obligations heavily depends on the discount factor that is used to estimate the present value

of future payouts to retirees. According to IAS 19.76, the discount rate has to reflect market yields of high-quality corporate bonds, whereas the currency and term of the bonds have to approximately reflect the characteristics of the benefit obligations.

Usually, each firm or actuary is able to individually choose the basket of corporate bonds they use to derive a propriate discount rate. However, a good proxy for the yield of high-quality corporate bonds are the interest rates set by the European Central Bank (ECB), illustrated in Figure 1. Interest rates of the ECB are a reference point for the cost of credit and affect the yield of corporate bonds that are traded with a spread to compensate for additional firm-specific risk.

To examine whether findings of main analyses are determined by the interest rate policy of the ECB, that affect the size of firm's defined benefit obligations, I include a dummy variable (*Int*) indicating interest rate changes by the ECB in estimating abnormal returns during event windows. Figure 1 shows that in the sample period, 17 interest rate changes occurred over time, whereas 9 of them were interest rate cuts. These cuts mainly occurred during the period of the financial crises from 2008 to 2009 and the European sovereign debt crises in 2011.

Rerunning analyses with abnormal returns that reflect interest rate changes by the ECB (presented in Table 5) result in virtually the same empirical results as main results (presented in Table 4). Still, stock prices of firms that used to apply the corridor fall in the course of the publication of IAS 19R, for both kind of firms – with and without high exposure to pension risk (coefficient on $TREAT \times Exp = -0.3996$; t -statistic = 1.74). Also, the elimination of the expected rate of return is seen positive by investors for firm with and without high exposure to their pension plans, indicated by significant coefficients on test variables *TREAT* and $TREAT \times Exp$. Results of testing hypothesis 3, the influence of new disclosure requirements, are unchanged in comparison to the main test.

Second, I perform a placebo analysis and compare test results with those obtained for the main analyses. The placebo analysis randomly assigns non-event dates in the sample period as event dates and reruns the estimation of the main tests for a thousand times. The procedure of falsely drawing event dates follow the same routine as in main test, namely the number of events in total and the year over year distribution of events have to be equal to the original event dates characteristics. Results of this placebo test contradict confounding events

such as a general market trend, if simulated results do not closely mirror results of the main test.

Figure 2 gives an overview of the distributions of the coefficients used for testing hypotheses obtained from the placebo test (marked by blue bars) and shows the original values obtained in the main test (marked as red line). The distribution of simulated coefficients shows a high deviation from the originally obtained values for each of the coefficients of *Group IV*, *Group III* and *Group II*. For each coefficient, original values lie in the 5th percentile of the simulated distribution, resulting in the conclusion that original values significantly deviate from simulation results obtained from randomly assigned event dates.

Overall, concerns regarding confounding events could be mitigated by the identification strategy of empirical tests as well as additional tests performed in this section. These tests show that the development of average stock prices of each group follow a parallel trend over time. Moreover, findings of the main analysis are not driven by interest rate changes of the ECB as an alternative explanation of test results. Also, the likelihood of obtaining results of the main test by chance or by capturing an underlying market trend could be addressed by showing that randomly selected event dates in the placebo analysis do not result in similar findings as using the original ones.

3.7.2 Sensitivity of results to additional control variables

In this section, I test the robustness of main results to the inclusion of additional control variables. The tests are clustered in two parts testing various specifications of including the percentage of pension assets allocated to different asset classes in the first part and testing additional control variables used in the literature in the second part.

Regarding the inclusion of the percentage of pension assets allocated to different asset classes, I consider the allocation of assets to equity and bond investments as well as the interaction of these variables with main test variables *TREAT* and *TREAT x Exp*. Barthelme, Kiosse and Sellhorn (2019) shows that firms which are affected by the elimination of the corridor method reduce the perceived risk of pension plans by shifting pension assets from equity to bond securities. However, the shift from equity to bond investments in the allocation of pension assets does not only affect the risk of pension assets in terms of volatility characteristics, but also expected returns and the need of additional cash flows to fund defined

benefit obligations. To the extent investors expect firms to react to changes in the regulations of IAS 19R by reducing the risk of pension plans, it remains an empirical question whether they perceive these real consequences and an adjusted risk-return profile of pension assets as value enhancing or not.

Table 6 presents findings of testing hypotheses H₁, H₂ and H₄, controlling for the percentage of equity investments in the pension asset allocation of firms (*%EQ*). Firms used to test Hypothesis H₃ do not exhibit pension assets and are not shown in this analysis. The restriction of using information on the allocation of pension assets leads to the elimination of firms from the test sample, resulting in 59 (45) firms for testing H₁ (H₂) and H₄, respectively. Columns (1) to (4) show that inferences from the main tests are unchanged in the case of controlling for the percentage of equity investments. The variable *TREAT* remains significantly negative for firms affected by the elimination of the corridor method (columns (1) and (2)) and significantly positive for firms affected by the elimination of the expected rate of return (columns (3) and (4)). Moreover, when controlling for *%EQ*, the exposure of firms to the risk of pension plans does affect the stock price reaction to the elimination of the corridor method (column 2) and also stock market reactions to the elimination of the expected rate of return (column 4) as shown by significant a coefficient on *TREAT x Exp* (coefficient = -1.5802; *t*-statistic = -2.12). In contrast to prior (not significant) findings, the coefficient is negative, suggesting that shareholders evaluate the elimination of the corridor method more negative for firms with high exposure to pension risk in terms of underfunding. The coefficients on *%EQ* are positive for all specifications and significant for specifications in columns (1) to (3), suggesting that the percentage of equity investments in pension assets is a significant determinant for investors in evaluating firm values around event dates. Repeating the placebo analysis of section 3.7.1 for this variable shows, that the coefficients ranging from 0.0003 to 0.0037 are in the very center of the distribution of the coefficients on *%EQ*. Untabulated results show that replacing the coefficient *%EQ* by the percentage of bonds in the allocation of pension assets does not affect inferences from the main analysis and the analysis above. Still, all coefficients on *TREAT* are significant and exhibit the same sign, supporting hypotheses H₁ and H₂. In contrast to previous findings, the coefficient on *TREAT x Exp* is not significant when testing the effect of the elimination of the corridor method (coefficient = -0.3676; *t*-statistic = -1.49) but in the case of testing the elimination of

the expected rate of return (coefficient = -1.5261; t -statistic = -2.08). Further (untabulated) analyses show that findings of the main test presented in Table 4 are not sensitive to the interaction of treatment variables with the percentage of pension assets invested in equity or bond investments. Again, coefficients on *TREAT* are significant and exhibit the same sign, supporting hypotheses H₁ and H₂. Coefficients on interactions between *TREAT* and %*EQ* (or %*Bond*) and on three-way interactions with *TREAT* \times *Exp* and %*EQ* (or %*Bond*) are not significant.

Regarding additional control variables used in prior literature, I test the robustness of main findings by including the following variables in equation (2). I include the square of the funding ratio (*Fund*²), which reflects a potential relation between the funding status of firms and stock price returns that is non-linear. Including this variable is based on the rationale that very low levels of funded defined benefit obligations create incentives for managers to increase the risk of pension assets to avoid additional funding by cash flows (Rauh, 2008). I also control for the square of free float (*FF*²), as prior literature shows that ownership structure could be correlated with the pension plan designs (Faßhauer, Glaum, Keller, and Street, 2011). Further, I include a proxy for the investment horizon of the firms' pension assets (*Horizon*). Prior literature finds that depending on the investment horizon, firms invest higher percentages of pension assets in equities or bonds (Bikker, Broeders, Hollanders and Ponds, 2012). However, the allocation of pension assets between equities and bonds affects the risk-return profile of pension assets and finally of the firm, which might affect firm valuations of investors. Finally, I also include the dividend payout ratio (*Payout Ratio*), as cash flows of investors are affected by the dividends of their investments. The elimination of smoothing mechanisms of pension induced financial statement volatility, such as the corridor method or the expected rate of return, might affect firms' ability to pay dividends to investors as these dividends are regularly tied to financial statement measures (see, for example, Anantharaman and Chuk, 2018).

Table 7 shows results of re-calculating equation (2) including these additional control variables. Again, columns (1) and (2) show results for group IV as *TREAT* testing H₁ and columns (3) and (4) show results for group III as *TREAT* for testing hypotheses 2. Hypotheses 3 is tested in column (5) by using group II as *TREAT*. Inferences regarding variable *TREAT* remain unchanged for each specification, as all coefficients are significant and exhibit the

same sign as in main test. The same is true for cross-sectional analysis that show that the coefficient on *TREAT x Exp* is only significant in column (2) when testing the effect of the elimination of the corridor method (coefficient = -0.4147; *t*-statistic = -1.67).

Overall, additional analysis show that main findings are robust to the inclusion of additional control variables as shown in Table 7. Moreover, testing the effect of pension asset allocation in more detail shows that the assessments of the elimination of the corridor method or the expected rate of return by shareholders are not affected by firms' allocation of pension assets (see Table 6).

3.7.3 Sensitivity of results to alternative event selections

In this section, I assess the sensitivity of results of main tests to the selection of events by testing three different approaches that rely on alternative set of events. First, I only use events that are related to publication activities of the IASB such as publications of the Exposure Draft and events that decrease the likelihood of the elimination of the corridor method or the use of the expected rate of return. In other words, I exclude events that do not alter the general tendency of the elimination of the smoothing factors and events that are not associated with the publication of documents regarding IAS 19R. This approach addresses concerns that the original event selection includes events that are only of minor significance for investors in terms of attention or publicity which include regular board meetings of the IASB. Excluding these kinds of events lead to a reduction from 16 to 8 events. The remaining events include events 1, 2, 4, 6, 11, 13, 15 and 16, as described in Table 1.⁶¹

Results of repeating main analyses with this subset of events are reported in Table 8. Findings of the analysis support the conclusions drawn by main analysis. Hypotheses 1 is supported by the significant coefficient on *TREAT* in column (1), but not by coefficients in column (2). Results regarding H₂ and H₃ are also confirmed by the same significance and magnitude of coefficients on *TREAT* in column (3) to (5). The re-estimation of the main

⁶¹ In a further analysis, I also include events 7 and 12. These events proxy for the evaluation of proposed changes by different stakeholder, as the IASB publicizes and discusses comment letters to the Discussion Paper and Exposure Draft in these events. However, the inclusion of these two events do not alter the results of the sensitivity analysis.

analyses with a subset of events fail to find support for H_4 , as coefficients on $TREAT \times Exp$ fail to be significant.

Additionally, I follow prior literature on event studies and test an alternative set of events that comprises only events with abnormal returns in individual event windows (e.g., Zhang, 2007). Panel A of Table 9 gives an overview of abnormal returns in the test of the average stock market reaction. Results show that returns of 4 out of 16 events are significantly different from the average market return on event windows. These events are event 4, which marks the only event with a decreasing likelihood of elimination of both, the corridor method and the expected rate of return as the IASB tentatively decides to change its preliminary view on the elimination of smoothing mechanisms. The release of the discussion paper on March 27 in 2008 (Event 6) turns out to be significant as well. Moreover, events 14 and 16 exhibit also abnormal returns reflecting final steps in the publication of IAS 19R, namely the confirmation of all previous decision (event 14) and the publication of the amended standard (event 16). Column (3) shows the return of the aggregation of all events that shows not to be significant (coefficient = 0.05; t -statistic = -0.48), suggesting that the events are not significant for each group of firms, which supports the approach to perform cross-sectional and subsample analyses. Panel B of Table 9 shows test results of re-estimating main analyses with significant events only. These events are derived by the test of the average stock market reaction to individual events as described in Panel A. Findings support H_2 that tests the reaction to the elimination of the expected rate of return. Comparable to main findings in Table 4, stock market participants evaluate the elimination of the expected rate of return positive (coefficient on $TREAT$ in column (3) = 0.2112; t -statistic = 1.68), especially for firms with high exposure to risk of corporate pension plans (coefficient on $TREAT \times Exp$ in column (3) = 0.7630; t -statistic = 2.05). However, the re-estimation fails to find support for hypotheses H_1 and H_3 . These findings suggest that not single significant events, but the aggregation of events cause the negative effect of the elimination of the corridor method as shown in the main test and previous sensitivity analysis.

Finally, I also analyze the sensitivity to the selection of events by repeating main analyses with various samples of events that exclude one event at a time. By eliminating each of the overall events once, I repeat the main analyses for the first hypotheses 15 times with 14 events each, for the second hypotheses 12 times with 11 events each and for the third

hypotheses 16 times with 15 events each. Table 10 gives an overview of results on coefficients *TREAT* and *TREAT x Exp* used to test hypotheses for the different selections of events. Overall, findings are in line with conclusions drawn from the main analysis. Regarding the reaction to the elimination of the corridor method outlined in columns (1) and (2), only in two out of 15 specifications of events, the coefficients on *TREAT* or *TREAT x Exp* are not significant. These two specifications exclude events 8 and 11. Though, findings mainly support the hypothesis for firms with high exposure to pension risks (column 2). In contrast, results show that reactions to the elimination of the expected rate of return are not depending on the exposure to pension risk, as each specification tested in the analyses shows significant results on the coefficient *TREAT* for Group III on testing H_2 in column (3) thus strongly supporting hypotheses 2. Regarding alternative sets of events for testing H_3 , results are mixed finding 9 significant coefficients on *TREAT* out of 16 tested specifications.

3.7.4 Sensitivity of results to alternative research design choices

In this section, I examine the robustness of main findings to various alternative research design choices. First, I alter the time span of the estimation period. Studying the consequences of changes in the pension accounting standard IAS 19 requires looking at a considerable long horizon of time, spanning from mid-2006 to the mid of 2011. Analyses regarding the significance of individual events show that especially at the beginning and at the end of this time span, events marked to be significant for investors. Accordingly, alter the estimation period to a narrower time window before the actual events (-60 to -30 days before each event) and thus eliminate phases in which no events occur for a long time. Results (untabulated) of re-estimating equation (2) support findings of the main analyses by showing virtually the same significance, sign and magnitude of each specification of *TREAT* and *TREAT x Exp* as in Table 4.

Second, I test whether conclusions of the main tests depend on the length of the event window that is set to 3 days in the main tests. On the one hand I shorten the event window to the actual event date (1-day event window) to decrease the risk of noise in test variables. On the other hand, I address potential concerns that market participants need more time to evaluate the consequences of events increasing or decreasing the likelihood of the elimination of pension smoothing mechanisms on firm values and increase the event window by one day

to a 4-day event window. Untabulated results for both alternative specifications support findings that firm value is affected negatively for firms using the corridor method (H_1) and the elimination of the expected rate of return is seen as value enhancing (H_2). However, I do not find support for cross-sectional differences in the exposure to risk of pension plans or for value effects of new disclosure requirements.

Finally, I use alternative measures for the calculation of the market return and the proxy of exposure to pension risk (Exp). In untabulated sensitivity analyses, I substitute market returns proxied by returns of the Prime All Share Index with returns measured with the help of the CDAX Index. The latter has a broader approach by adding the stocks of the General Standard to those of the Prime Standard that are included in the Prime All Share Index. Furthermore, I change the calculation of Exp , by using the ratio of pension assets to book equity instead of defined benefit obligations to book equity. This proxy of pension risk ensures a more aligned measure regarding the examination of the consequences of the elimination of the expected rate of return, as this smoothing mechanism relies on the existence and size of firms' pension assets. Yet, inferences from main analyses are not sensitive to alternative measures of market returns. Using exposure to pension risk measured by pension assets does not alter inferences on the elimination of the corridor method but slightly on the elimination of the expected rate of return. Coefficients on $TREAT$ are significant at the 1%-level but the re-estimation fails to find a significant coefficient on $TREAT \times Exp$, suggesting that value effects do not depend on the exposure of firms to pension risk.

3.8 Conclusion

This paper examines the effects of changes in the accounting for corporate pension plans on stock prices. The amendments that come along with the introduction of IAS 19R are changes in the disclosure requirements and the elimination of pension smoothing devices, namely the corridor method for recognizing actuarial gains and losses and the use of the expected return of plan assets. Current research shows that the elimination of these two pensions smoothing mechanisms lead to a change of investment behavior of firms regarding the allocation of pension assets. This study complements this finding about firm-level effects by shedding light on stock market effects of the introduction of IAS 19R.

To pin down stock market reaction to distinct changes of IAS 19R, I use a German setting that allows to differentiate firms regarding their exposure to each of the changes. More precisely, I compare stock market reactions of (I) firms with and without defined benefit pension plans, (II) firms that differ in terms of using plan assets for funding defined benefit plans and (III) firms that differ in terms of using various methods of recognizing actuarial gains or losses. These distinct groups are differently affected by the changes of IAS 19R, allowing to identify possible channels, the magnitude and size of how changes in pension accounting affect firm valuation.

Based on prior literature, I predict and find that shareholder adjust their pricing of firms in the course of the introduction of IAS 19R, suggesting that information on defined benefit pension plans is priced by equity holders of firms. Differentiating between the three major changes of IAS 19R results shows that each individual change affects stock prices differently. The elimination of the corridor method comes along with stock market declines for firms who applied this method, supporting the notion that investors judge the increase in pension induced financial statement volatility as value negative. Also, the introduction of new disclosure requirements is seen as net costly to investors. In contrast, the elimination of the expected rate of return is seen as value positive, indicating that investors are in favor of eliminating incentives to increase the risk of pension assets or use the discretion in using such a measure as expected returns. Additional tests show that the reaction is in part more pronounced for firms with higher exposure to defined benefit pension plans.

Although sensitivity analyses could mitigate concerns regarding confounding events, alternative explanations and research design issues, findings of this study or subject to several limitations. First, the intention to provide more transparent disclosures, e.g., on pension asset allocation was the goal to increase the usefulness of information for assessing the amount, timing and uncertainty of future cash flows related to defined benefit pension plans (IAS 19, BC 282). However, a stock market reaction will only be observed if the benefits of the new disclosure requirements significantly outweigh the cost of providing these information (or vice versa). If the benefits and cost of information are comparable to each other, there should not be a stock market reaction. In this study, I test the hypothesis on the effect of new disclosure requirements with the help of firms that exhibit defined benefit obligations vs. firms without plan assets. Though, some of the new disclosure requirements concern the

allocation of pension assets. Due to the overlap with the elimination of the use of the expected rate of return, firms with plan assets were not included in testing the effect of new disclosure requirements. Therefore, findings regarding the new disclosures are limited to disclosures regarding defined benefit obligations and do not effectively catch the effect for those on pension assets. Second, the single country setting of this study may impair the generalizability of the results to other countries or jurisdictions.

Overall, findings of this study complement prior research on the effects of IAS 19R and the assessment of pension smoothing mechanisms. Accordingly, this study shows that not only managers of firms are concerned about pension-induced financial statement volatility, but also shareholder of firms. This finding suggest that equity investors do not value technical accounting methods that might impair the transparency and comparability between firms, which should be a help for financial reporting standard setters in upcoming deliberations, especially in complex fields of accounting that foster such mechanisms.

3.9 Appendices

3.9.1 Appendix A: Variable Definitions

Panel A: Measuring abnormal returns for cross-sectional analyses

Ret_{it}	Stock return for firm i on day t (source: Worldscope data items 06001, Price).
Mkt_Ret_t	Equal-weighted return on day t of index Prime All Share (source: Worldscope data items 06001, Price).
$Event_t$	Indicator variable equal to 1 if day t falls in the event window (i.e., event date as well as the trading day prior and after this date) of event number m and equal to 0 otherwise, with m ranging from 1 to 16.
Agg_Events_t	Indicator variable equal to 1 (-1) if day t falls in the event window (i.e., event date as well as the trading day prior and after this date) of an event expected to increase (decrease) the likelihood of (i) the elimination of the corridor method for testing hypothesis 1, (ii) the removal of the expected rate of return for testing hypothesis 2 and (iii) the introduction of IAS 19R for testing hypotheses 3 and 4.
Abn_Ret_i	Abnormal stock return for firm i during days within in the event window, as measured by estimated from equation (1).

Panel B: Measuring cross-sections determinants of abnormal returns

$TREAT_i$	Indicator variable equal to one if firm i is (i) included in group IV for testing H_1 , (ii) included in group III for testing H_2 or (iii) included in group II for testing H_3 and zero otherwise. For an overview of groups see Appendix C (source: hand-collection).
Exp_{it}	Exposure of firms' book value of equity to defined benefit obligations of firm i for year t , equal to defined benefit obligations that are assigned to be funded by plan assets (external funding) of firm i , divided by firm i 's book value of equity, both measured at the end of fiscal year t (source: Worldscope data items 18809, 03501).
$Size_{it}$	Natural logarithm of the market value of equity of firm i , measured at the end of fiscal year t (source: Worldscope data item 08001).
Lev_{it}	Leverage ratio of firm i for year t , equal to total liabilities of firm i , divided by firm i 's total assets, both measured at the end of fiscal year t (source: Worldscope data items 03351, 02999).

FF_{it}	Percentage of free float of firm i for year t , equal to the number of shares in free float of firm i , divided by firm i 's total number of shares multiplied by 100, both measured at the end of fiscal year t (source: Worldscope data item noshff).
$Fund_{it}$	Pension funding ratio of firm i for year t , equal to external pension assets of firm i , divided by firm i 's overall defined benefit obligations multiplied by 100, both measured at the end of fiscal year t (sources: hand-collection, Worldscope data items 18807, 18809).
$SDCF_{it}$	Standard deviation of operating cash flows of firm i for year t , equal to the natural logarithm of the standard deviation of operating cash flows over the past 4 years of firm i , divided by firm i 's book value of equity, all measured at the end of fiscal year t (source: Worldscope data items 04860, 03501).

Panel C: Sensitivity Analyses

$\%EQ_{it}$	Percentage of equity investments, equal to pension assets allocated to equity securities of firm i for year t , divided by firm i 's total pension assets of year t , all measured at the end of fiscal year t (sources: hand-collection, Worldscope data item 18807).
FF_2_{it}	The square of percentage of free float of firm i for year t , equal to the square of the number of shares in free float of firm i , divided by firm i 's total number of shares multiplied by 100, both measured at the end of fiscal year t (source: Worldscope data item noshff).
$Fund_2_{it}$	The square of pension funding ratio of firm i for year t , equal to the square of external pension assets of firm i , divided by firm i 's overall defined benefit obligations multiplied by 100, both measured at the end of fiscal year t (sources: hand-collection, Worldscope data items 18807, 18809).
$rDiv_{it}$	Dividend payout ratio of firm i for year t , equal to common and preferred stock dividends divided by net income, both measured at the end of fiscal year t (source: Worldscope data items 04551, 01551).
$Horizon_{it}$	Investment horizon of pension assets of firm i for year t , equal to the natural logarithm of the ratio of defined benefit obligations of firm i , divided by firm i 's current service cost, both measured at the end of fiscal year t (source: Worldscope data items 18809, 18811).

3.9.2 Appendix B: Illustration of examined changes of IAS 19R

Panel A: Illustration of the replacement of the expected rate of return on plan assets

This overview shows a simplified illustration of the replacement of the expected rate of return on plan assets by the discount rates used to calculate the defined benefit obligations.

Assumptions:

<u>Financial Positions</u>		<u>Rates</u>	
Defined Benefit Obligations	100	Discount rate	2%
Plan Assets	60	Expected rate of return	5%
<hr/> Pension Liability	<hr/> 40		

Calculation of pension cost under IAS 19 and IAS 19R:

<u>IAS 19</u>		<u>IAS 19R</u>	
Service cost	-2	Service cost (unchanged)	-2
Interest cost (100 * 2%)	-2	Net interest expense (40 * 2%)	-0,8
Expected return (60 * 5%)	+3		
<hr/> Pension cost	<hr/> -1	<hr/> Pension cost	<hr/> -2.8

Under IAS 19 the interest cost is derived by multiplying the defined benefit obligations of 100 times the discount rate of 2%. The expected return is derived by multiplying plan assets of 60 times the expected rate of return of 5%. The net interest expense under IAS 19R is derived by multiplying pension liability of 40 times the discount rate of 2%. By using the net interest expense, pension costs rise in this example by 1.8 as the discount rate is lower than the formerly used expected rate or return.

Panel B: Illustration of disclosure changes under IAS 19R

Example 1: Disclosure on exposure to risk:

A significant exposure to risk exhibit, for example, a pension plan that has invested 75% of plan assets in equity securities that are attributed to a specific sector such mobile payment. Materiality considerations are laid out in IAS 1.

Example 2: Separation of the impact of financial and actuarial assumptions

<u>IAS 19</u>	(in Mio. EUR)	<u>2018</u>	<u>2017</u>
Actuarial Gain or Loss		-15	-10
 <u>IAS 19R</u>			
Actuarial Gain or Loss		<u>-15</u>	<u>-10</u>
<i>Demographic Assumptions</i>		-2	-2
<i>Financial Assumptions</i>		-13	-8

Example 3: Disclosure on the disaggregation of plan assets

IAS 19:

<u>Plan Assets</u>	(in Mio. EUR)	
Equity instruments	10	“Other assets” as biggest portion of pension assets with uncertain risk characteristics
Debt instruments	8	
Property	2	
Other Assets	50	
Sum	70	

IAS 19R:

<u>Plan Assets</u>	(in Mio. EUR)	
Equity instruments	<u>10</u>	Risk characteristics of “Equity instruments” and “Other assets” are clearer, as additional information on the nature of assets are disclosed
<i>Mobile Payment</i>	9	
<i>Media</i>	1	
Debt instruments	<u>8</u>	
Property	<u>2</u>	
Other Assets	<u>50</u>	
<i>Insurance Contracts</i>	5	
<i>Hedge Fund Investment</i>	45	
Sum	70	

Example 4: Disclosure on amount, timing and uncertainty of future cash flowsSensitivity Analysis under IAS 19R:

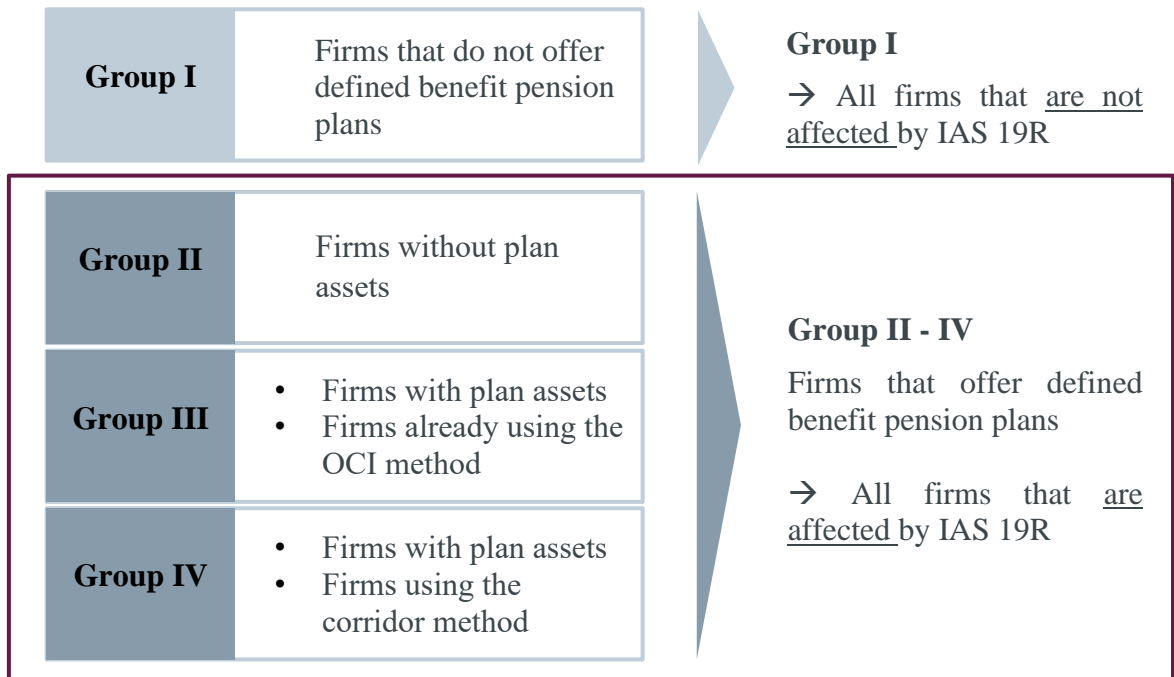
The impact of a reasonable possible change of a specific actuarial assumption on the defined benefit obligation (holding all else equal) is illustrated in the following table:

<u>Actuarial Assumption</u>	<u>reasonable change</u>	<u>Defined Benefit Obligation (in Mio. EUR)</u>	
		Increase	Decrease
Discount Rate	+/- 1.0%	-40	+42
Growth in salaries	+/- 1.0%	+3	-3
Increase in inflation	+/- 1.0%	+2	-2

3.9.3 Appendix C: Groups of firms to identify distinct “IAS 19R effect”

Panel A: Allocation of firms to distinct groups

The following overview shows the allocation of firms to distinct groups that are differently affected by the introduction of IAS 19R.

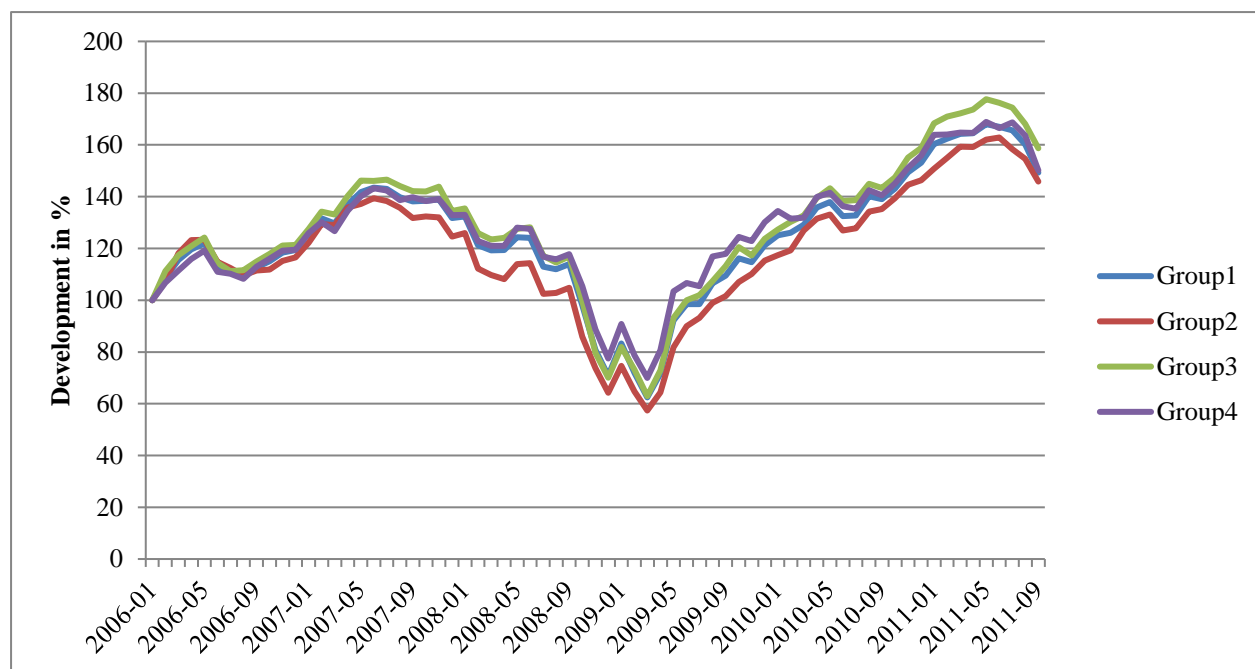


Panel B: Overview of groups used for testing hypotheses

For testing hypotheses, I compare stock price reactions between groups to identify channels through which IAS 19R affects firm value. The following table summarizes the use of groups in testing each hypothesis derived in section 3.3.

Hypothesis	Groups used to test hypothesis	Equation (2): $TREAT = 1$ for
Hypothesis 1	Group IV vs. Group III	Group IV
Hypothesis 2	Group III vs. Group II	Group III
Hypothesis 3	Group II vs. Group I	Group II
Hypothesis 4	Cross-sectional test of firms allocated to Group II, III and IV	

Panel C: Share price development of clustered firms in each group over sample period



The illustration shows the share price development of firms allocated to individual groups over the sample period, starting January 2006 by 100%. The compounded monthly growth rates (in percent) for each group account for:

- Group I: 0.59%
- Group II: 0.56%
- Group III: 0.68%
- Group IV: 0.60%

All four groups show a parallel trend of stock price changes over the sample period, exhibiting virtually the same compounded monthly growth rates.

3.10 Figures

Figure 1: Overview of ECB interest rate and corporate bond yields

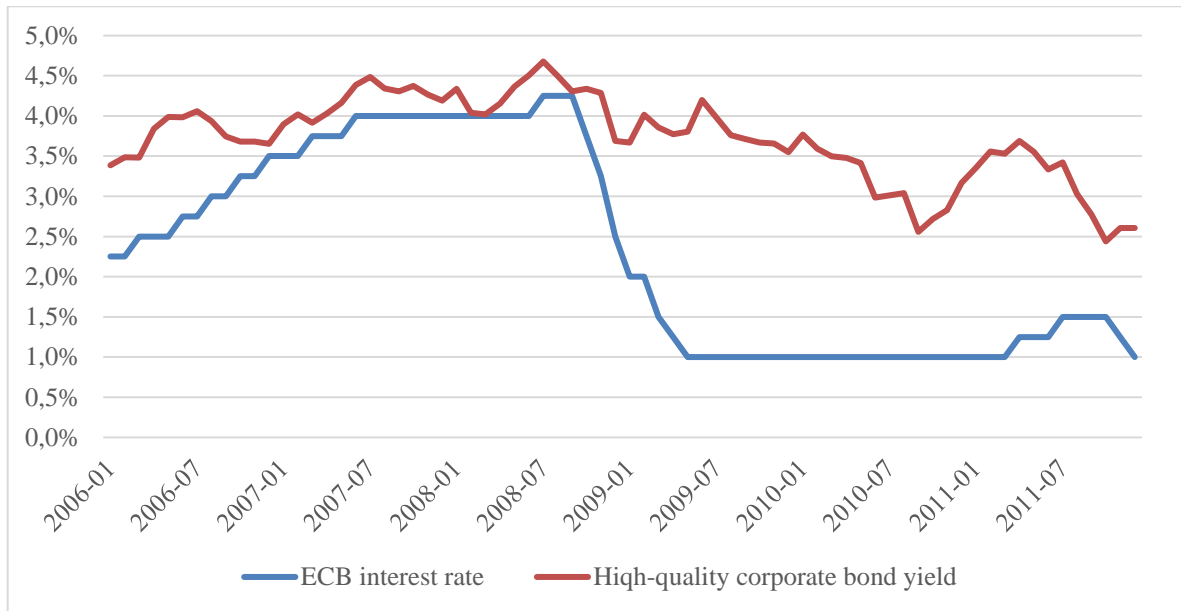


Figure 1 illustrates the interest rate of the ECB (marked in blue) and the yield of high-quality corporate bonds (marked in red). The latter comprises European firms with a maturity of 10 years. Both data were retrieved from the website of the European Central Bank.

Figure 2: Distribution of Coefficients derived by Monte Carlo Simulation

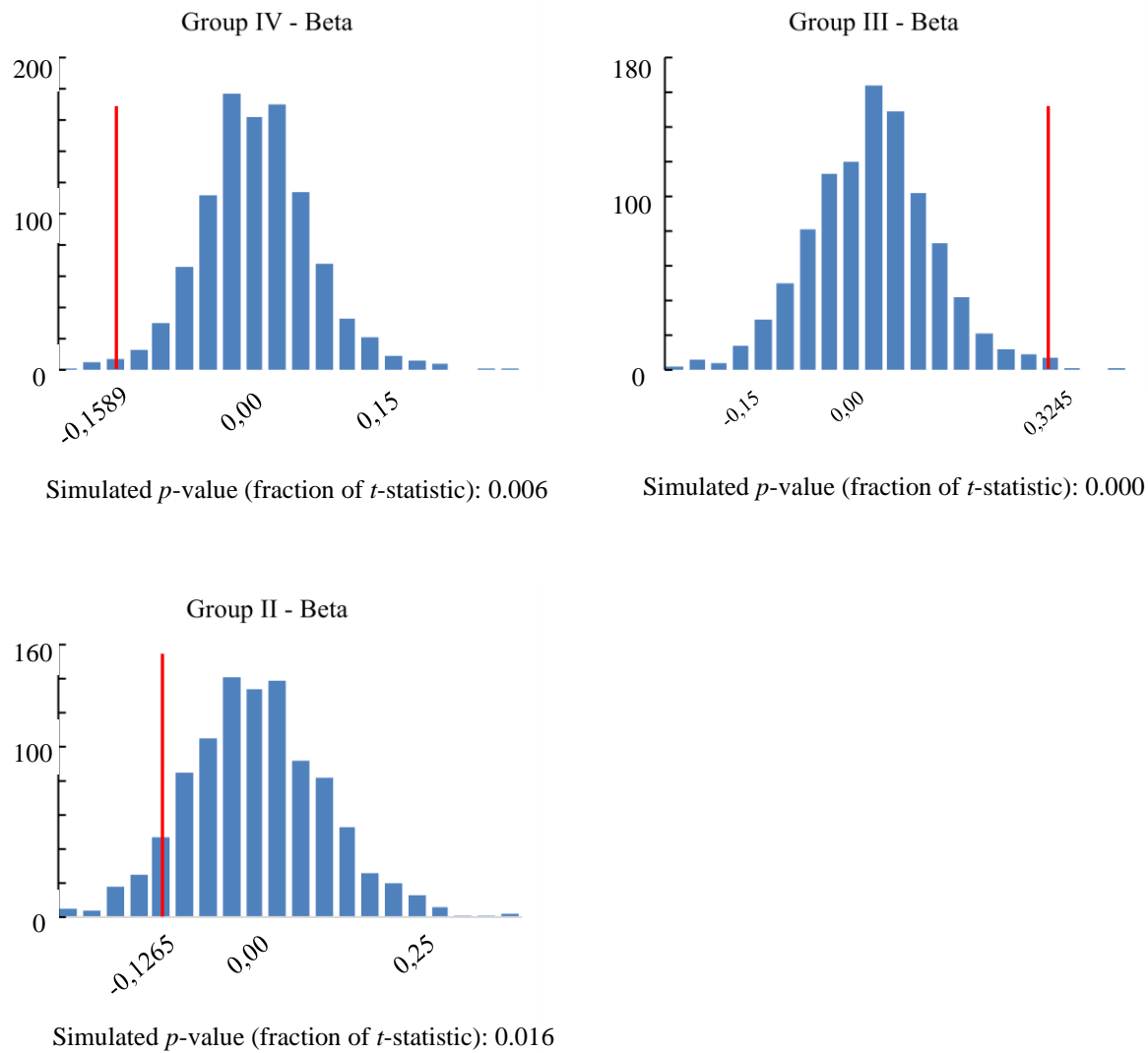


Figure 2 shows over statistics of a placebo analysis. For each main determinant of testing Hypotheses, I present the distribution of results derived by simulating 1,000 placebo regressions, marked in blue. The placebo regressions used 16 random events out of the non-event dates for each placebo regression, mirroring the distribution of events over years. The results of the main tests for the coefficients of Groups II to IV are marked with a red line. The number of t -statistics resulting from placebo regressions that exceed the t -statistics from main analysis are shown by the simulated p -value below each histogram.

3.11 Tables

Table 1: Overview and description of events

No.	Date	Description	Corridor method elimination - Likelihood	ERR elimination - Likelihood
1	May 24, 2006	IASB discusses a proposal from the staff on adding a project on post-employment benefits to its technical agenda. The proposal of the staff includes suggestions of revising various smoothing and deferral mechanisms in IAS 19.	Increasing	Increasing
2	Jul 18, 2006	The post-employment benefits project is added to the agenda. IASB plans to focus on removing the ‘add-ons’ to the basic pension model, in particular the smoothing and deferral mechanisms, such as the corridor, the assumed rate of return on plan assets, and the recognition of actuarial gains and losses.	Increasing	Increasing
3	Nov 17, 2006	As a preliminary view, the majority of IASB board members indicate that all components of pension costs should be recognized directly in profit and loss when they arise.	Increasing	Increasing
4	Mar 20, 2007	IASB tentatively decides to change its preliminary view to require all changes in the post-employment benefit obligation and in the value of plan assets to be recognized in comprehensive income in the period in which they occur.	Decreasing	Decreasing
5	Jul 19, 2007	Many IASB board members state in a meeting that they want to eliminate the use of expected returns on plan assets.	-	Increasing
6	Mar 27, 2008	The IASB releases a discussion paper proposing to reduce the method of recognizing actuarial gains and losses from three to one. According to the discussion paper firms have to recognize actuarial gains and loss immediately in profit and loss.	Increasing	Increasing
7	Nov 19, 2008	The IASB staff introduces a high-level summary of comments it had received on the IAS 19 discussion paper including concerns regarding the elimination of the corridor method by many respondents.	Decreasing	-
8	Jan 23, 2009	The IASB discusses at length whether all components of pension cost should be recognized in profit or loss. The chairman takes a vote, and the IASB Board agrees that all components should be recognized in profit or loss.	Increasing	-
9	Apr 22, 2009	The IASB concludes to maintain the previous decision concerning the recognition of actuarial gains and losses in profit and loss.	Increasing	-

10	Nov 17, 2009	The IASB decides to propose that pension remeasurements should be presented in other comprehensive income section of the statement of comprehensive income.	Increasing	-
11	Apr 29, 2010	Publication of Exposure Draft IAS 19R.	Increasing	Increasing
12	Sep 16, 2010	Respondents to the Exposure Draft raise massive concerns on the removal of the corridor method.	Decreasing	Increasing
13	Oct 20, 2010	After discussing the responses to the Exposure Draft, the IASB decides to eliminate corridor method and the profit and loss method of recognizing actuarial gains and losses.	Increasing	Increasing
14	Mar 17, 2011	The IASB reconfirms all their previous decisions in a board meeting.	Increasing	Increasing
15	Jun 2, 2011	Release of the near final draft of IAS 19R to subscribers of the IASB website.	Increasing	Increasing
16	Jun 16, 2011	Publication of IAS 19R.	Increasing	Increasing

This table summarizes events regarding the process of releasing IAS 19R. The first column shows the number of events incorporated in the main test. The respective dates are shown in the second column. The third column provides a description of the respective event. The fourth and fifth columns indicate the direction into which the event is supposed to affect the likelihood of eliminating the corridor method and the expected rate of return, respectively.

Table 2: Sample Selection

Panel A: Identification of firms used for testing hypotheses

	Unique Firms	Daily Observations	Group
Number of firms listed within the Prime Standard segment of Deutsche Börse Group, between January 1, 2006 and September 30, 2011.	248		
Less firms with missing data/trading days for all events	-55		
Firms used for testing hypotheses	193	282,552	

Panel B: Allocation of sample firms to distinct groups

Firms used for testing hypotheses,	193	282,552	
thereof			
Firms without defined benefit pension plans	49	71,736	Group I
Firms without plan assets	59	86,376	Group II
Firms with plan assets using non-corridor method	47	68,808	Group III
Firms with plan assets using the corridor method	38	55,632	Group IV

This table presents the sample selection process. Panel A shows the initial sample consisting of all firms listed within the Prime Standard segment of Deutsche Börse Group as of September 2011. I exclude firms: (1) with missing observations for calculating returns across all event and firms with missing data for calculating variables. Sample firms are multiplied by the number of trading days (1.464) in the estimation period between January 1, 2006 and September 30, 2011, resulting in 282.552 daily observations. Panel B shows the number of firms and daily observations for each distinct group that is used for testing hypotheses. Groups are defined and described in section 3.4.1.

Table 3: Summary Statistics

Panel A: Descriptive Statistics

Variable	N	mean	sd	p25	p50	p75
<u>Average stock market reaction</u>						
<i>Mkt_Ret (in %)</i>	193	0.01	1.51	-0.67	0.05	0.70
<i>Abn_Ret (in %)</i>	193	0.03	3.00	-1.40	-0.05	1.38
Group I	49	0.07	3.41	-1.46	-0.05	1.49
Group II	59	0.02	3.13	-1.46	-0.06	1.42
Group III	47	0.21	2.25	-1.15	-0.03	1.25
Group IV	38	0.03	2.75	-1.39	-0.04	1.33
<u>Cross-sectional analyses</u>						
<i>Exp</i>	144	0.13	0.23	0.00	0.01	0.13
Group I	0	0.00	0.00	0.00	0.00	0.00
Group II	59	0.06	0.15	0.00	0.00	0.03
Group III	47	0.25	0.29	0.03	0.11	0.40
Group IV	38	0.24	0.28	0.04	0.16	0.32
<i>Size</i>	193	6.12	2.18	4.37	5.89	7.55
Group I	49	4.36	1.26	3.43	4.08	5.23
Group II	59	5.56	1.47	4.37	5.53	6.75
Group III	47	7.94	2.11	6.53	8.00	9.63
Group IV	38	7.00	1.96	5.49	6.81	8.78
<i>Lev</i>	193	0.36	0.20	0.23	0.32	0.44
Group I	49	0.32	0.20	0.17	0.29	0.43
Group II	59	0.37	0.18	0.26	0.33	0.43
Group III	47	0.37	0.20	0.23	0.31	0.44
Group IV	38	0.40	0.23	0.26	0.35	0.44
<i>FF</i>	193	65.16	25.45	45.00	67.00	89.00
Group I	49	64.25	22.66	48.00	64.00	83.00
Group II	59	62.66	25.63	41.00	63.00	89.00
Group III	47	68.73	26.55	52.00	72.00	94.00
Group IV	38	65.82	26.63	44.00	69.00	92.00
<i>Fund</i>	85	0,23	0,33	0,00	0,00	0,45
Group I	0	0,00	0,00	0,00	0,00	0,00
Group II	0	0,00	0,00	0,00	0,00	0,00
Group III	47	0,55	0,32	0,28	0,56	0,83
Group IV	38	0,46	0,33	0,14	0,45	0,72
<i>SDCF</i>	193	-2,42	0,89	-2,99	-2,48	-1,84
Group I	49	-2,19	0,92	-2,81	-2,20	-1,57
Group II	59	-2,41	0,96	-2,98	-2,46	-1,84
Group III	47	-2,65	0,85	-3,17	-2,71	-2,17
Group IV	38	-2,45	0,72	-2,91	-2,48	-1,92

Table 3: Summary Statistics (cont'd)

Panel B: Pearson and Spearman correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) <i>Abn_Ret (in %)</i>		0.0053	-0.0170	-0.0023	-0.0166	-0.0211	0.0078
(2) <i>Exp</i>	0.0020		0.4599	0.1319	0.2159	0.4790	0.0019
(3) <i>Size</i>	0.0014	0.5632		0.1986	0.2050	0.5060	-0.1893
(4) <i>Lev</i>	0.0109	0.2030	0.2060		0.0600	0.0716	0.3925
(5) <i>FF</i>	-0.0125	0.1817	0.1956	0.0959		0.1616	-0.0028
(6) <i>Fund</i>	-0.0046	0.7160	0.5522	0.0677	0.1438		-0.1141
(7) <i>SDCF</i>	0.0002	-0.0939	0.1893	0.3504	0.0032	-0.1416	

This table provides descriptive statistics for the variables used in the empirical analyses. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level.

Panel A provides descriptive statistics of the main variables of interest. The overview shows summary statistics for the full sample of 193 firms marked in bold and for groups I to IV.

Panel B provides correlation coefficients between the variables used in the main analysis. The upper (lower) diagonal shows Pearson (Spearman) correlation coefficients. Bold coefficients indicate significance at the 0.05 level.

Table 4: Firm value effects of IAS 19R

Panel A: Dependent Variable

Variable	<i>All firms</i>		<i>All firms affected by IAS 19R</i>	
	(1)		(2)	
<i>Mkt_Ret (in %)</i>	0.7240	***	0.7764	***
	(22.59)		(25.95)	
<i>Agg_Events</i>	0.0473		0.0344	
	(0.48)		(0.37)	
<i>Const</i>	0.0289	*	0.0268	
	(1.68)		(1.58)	
Adjusted R ²	0.133		0.172	
N	282.552		210.816	
# Clusters (Date)	1,464		1,464	
# Firms	193		144	

Panel B: Univariate Results

Variable	N	Cumulative Abnormal Returns		Abnormal Returns	
		(1)		(2)	
		mean	p-value	Mean	p-value
<u>Hypothesis 1</u>					
Group III	47	6,95		0,21	
Group IV	38	1,17		0,03	
Difference		5,78	0,0159 **	0,18	0,0184 **
<u>Hypothesis 2</u>					
Group III	59	0,93		0,02	
Group IV	47	6,95		0,21	
Difference		-6,02	0,0150 **	-0,19	0,0168 **
<u>Hypothesis 3</u>					
Group I	49	3,35		0,07	
Group II	59	0,93		0,02	
Difference		2,42	0,2309	0,05	0,2891

Table 4: Firm value effects of IAS 19R (*cont'd*)

Panel C: Multivariate Results

Variable	H ₁ : Elimination Corridor		H ₂ : Elimination ERR		H ₃ : Disclosure
	(1)	(2)	(3)	(4)	(5)
<i>TREAT x Exp</i>		-0.3993 *		0.4777	
		(-1.76)		(1.63)	
<i>TREAT</i>	-0.2651 ***	-0.1589 *	0.3813 ***	0.3245 ***	-0.1265 *
	(-4.14)	(-1.82)	(3.87)	(3.13)	(-1.69)
<i>Exp</i>	0.2746 **	0.4457 ***	0.3281 **	0.0096	
	(2.08)	(2.74)	(2.39)	(0.04)	
<i>Size</i>	-0.0522 ***	-0.0488 ***	-0.0213	-0.0214	0.0353
	(-2.84)	(-2.68)	(-1.18)	(-1.20)	(1.34)
<i>Lev</i>	0.1680	0.1765	0.0354	0.0171	-0.1984
	(1.02)	(1.08)	(0.20)	(0.10)	(-0.93)
<i>FF</i>	0.0005	0.0003	-0.0005	-0.0008	-0.0015
	(0.37)	(0.24)	(-0.43)	(-0.71)	(-1.06)
<i>Fund</i>	-0.2795 **	-0.2671 **	-0.3901 **	-0.3831 **	
	(-2.64)	(-2.55)	(-2.52)	(-2.50)	
<i>SDCF</i>	-0.0492	-0.0463	0.0221	0.0361	0.0356
	(-1.17)	(-1.11)	(0.62)	(0.99)	(0.90)
<i>Const</i>	0.4455 ***	0.3903 **	0.1486	0.2264	0.1662
	(2.78)	(2.42)	(1.02)	(1.49)	(0.92)
Adjusted R ²	0.201	0.222	0.170	0.184	0.001
# Firms	84	84	106	106	108

This table presents analyses examining the effect of events leading to the publication of IAS 19R on stock prices. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Panel A shows the calculation of the dependent variable *Abn_Ret* during the event windows that are used for cross-sectional analyses. The variable *Agg_Events* reflects the return during the event windows over all events (*Event_{it}*) as described in Table 1. Column (1) presents results for all sample firms. Column (2) presents results for all firms affected by the introduction of IAS 19R, that are group II, III and IV. The number of observations represent the daily returns of firms in each group between January 1, 2006 and September 30, 2011

Panel B shows univariate tests of mean differences in abnormal returns across firms of group I to IV.

Panel C provides estimates of the cross-sectional determinants of firms' abnormal returns.

Columns (1) and (2) present results regarding H₁ and H₄, whereas *TREAT* is a measure for firms of group IV that used to apply the corridor method under IAS 19.

Columns (3) and (4) present results regarding H₂ and H₄, whereas *TREAT* is a measure for firms of group III that proxy for firms applying the expected rate of return, but not affected by the elimination of the corridor method.

Column (5) presents results regarding H₃, whereas *TREAT* is a measure for firms of group II that proxy for firms with defined benefit pension plans.

Table 5: Sensitivity Analysis – ECB interest rate changes

Variable	H ₁ : Elimination Corridor		H ₂ : Elimination ERR		H ₃ : Disclosure
	(1)	(2) H ₄	(3)	(4) H ₄	(5)
<i>TREAT x Exp</i>		-0.3996 * (-1.74)		0.4715 (1.59)	
<i>TREAT</i>	-0.2648 *** (-4.10)	-0.1586 * (-1.80)	0.3802 *** (3.83)	0.3242 *** (3.10)	-0.1261 * (-1.68)
<i>Exp</i>	0.2754 ** (2.07)	0.4467 *** (2.72)	0.3299 ** (2.39)	0.0155 (0.06)	
<i>Size</i>	-0.0515 *** (-2.79)	-0.0482 ** (-2.63)	-0.0202 (-1.12)	-0.0203 (-1.13)	0.0364 (1.38)
<i>Lev</i>	0.1596 (0.96)	0.1681 (1.02)	0.0322 (0.18)	0.0141 (0.08)	-0.2036 (-0.95)
<i>FF</i>	0.0006 (0.38)	0.0004 (0.25)	-0.0005 (-0.43)	-0.0008 (-0.70)	-0.0015 (-1.07)
<i>Fund</i>	-0.2764 ** (-2.59)	-0.2640 ** (-2.50)	-0.3896 ** (-2.50)	-0.3827 ** (-2.48)	
<i>SDCF</i>	-0.0482 (-1.13)	-0.0453 (-1.08)	0.0230 (0.64)	0.0368 (1.00)	0.0354 (0.89)
<i>Const</i>	0.4469 *** (2.77)	0.3917 ** (2.41)	0.1466 (1.00)	0.2235 (1.46)	0.1636 (0.90)
Adjusted R ²	0.196	0.217	0.169	0.182	0.001
# Firms	84	84	104	104	101

This table provides estimates of the cross-sectional determinants of firms' abnormal returns that were adjusted by a dummy for interest rate changes of the ECB. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Columns (1) and (2) present results regarding H₁ and H₄, whereas *TREAT* is a measure for firms of group IV that used to apply the corridor method under IAS 19.

Columns (3) and (4) present results regarding H₂ and H₄, whereas *TREAT* is a measure for firms of group III that proxy for firms applying the expected rate of return, but not affected by the elimination of the corridor method.

Column (5) presents results regarding H₃, whereas *TREAT* is a measure for firms of group II that proxy for firms with defined benefit pension plans.

Table 6: Sensitivity Analysis – %EQ as additional control variable

Variable	H ₁ : Elimination Corridor		H ₂ : Elimination ERR	
	(1)	(2) H ₄	(3)	(4) H ₄
<i>TREAT x Exp</i>		-0.4417 * (-1.87)		-1.5802 ** (-2.12)
<i>TREAT</i>	-0.2890 *** (-4.14)	-0.1640 * (-1.72)	0.3695 ** (2.51)	0.5094 *** (3.28)
<i>%EQ</i>	0.0033 ** (2.05)	0.0037 ** (2.33)	0.0007 (0.32)	0.0003 (0.13)
<i>Exp</i>	0.3974 *** (2.92)	0.5930 *** (3.51)	0.6911 *** (3.84)	2.1458 *** (3.04)
<i>Size</i>	-0.0642 *** (-3.21)	-0.0637 *** (-3.27)	-0.0521 ** (-2.09)	-0.0552 ** (-2.32)
<i>Lev</i>	-0.2166 (-1.06)	-0.1694 (-0.84)	0.0506 (0.16)	0.0955 (0.32)
<i>FF</i>	-0.0006 (-0.34)	-0.0010 (-0.61)	-0.0022 (-1.10)	-0.0008 (-0.41)
<i>Fund</i>	-0.1821 (-1.61)	-0.1626 (-1.46)	-0.2663 (-1.53)	-0.2910 * (-1.75)
<i>SDCF</i>	0.0253 (0.49)	0.0202 (0.40)	-0.0126 (-0.18)	-0.0165 (-0.24)
<i>Const</i>	0.7470 *** (4.03)	0.6735 *** (3.64)	0.2440 (0.97)	0.0736 (0.29)
Adjusted R ²	0.319	0.351	0.323	0.383
# Firms	59	59	45	45

This table provides estimates of the cross-sectional determinants of firms' abnormal returns including the allocation of pension assets to equity investments (*%EQ*) as additional control variable to test the robustness of the main findings presented in Panel B of Table 4. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Columns (1) and (2) present results regarding H₁ and H₄, whereas *TREAT* is a measure for firms of group IV that used to apply the corridor method under IAS 19.

Columns (3) and (4) present results regarding H₂ and H₄, whereas *TREAT* is a measure for firms of group III that proxy for firms applying the expected rate of return, but not affected by the elimination of the corridor method.

Table 7: Sensitivity Analysis – Additional control variables

Variable	H ₁ : Elimination Corridor		H ₂ : Elimination ERR		H ₃ : Disclosure
	(1)	(2) H ₄	(3)	(4) H ₄	(5)
<i>TREAT x Exp</i>		-0.4147 * (-1.67)		6.9296 (0.67)	
<i>TREAT</i>	-0.2923 *** (-4.07)	-0.1739 * (-1.74)	0.7344 *** (4.39)	0.6309 ** (2.75)	-0.1325 * (-1.71)
<i>%EQ</i>	0.0032 * (1.78)	0.0036 ** (2.02)	-0.0026 (-1.35)	-0.0018 (-0.78)	
<i>Exp</i>	0.3921 ** (2.67)	0.5880 *** (3.16)	0.4955 *** (3.26)	-6.3925 (-0.62)	
<i>Size</i>	-0.0668 *** (-3.16)	-0.0679 *** (-3.27)	-0.0447 ** (-2.17)	-0.0485 ** (-2.24)	0.0327 (1.22)
<i>Lev</i>	-0.1478 (-0.67)	-0.1140 (-0.52)	0.4771 * (1.76)	0.4364 (1.55)	-0.1742 (-0.80)
<i>FF</i>	0.0099 (1.22)	0.0085 (1.07)	0.0105 (1.52)	0.0091 (1.25)	-0.0043 (-0.55)
<i>FF_2</i>	-0.0001 (-1.32)	-0.0001 (-1.21)	-0.0001 (-1.46)	-0.0001 (-1.28)	0.0000 (0.36)
<i>Fund</i>	-0.2085 (-0.46)	-0.1186 (-0.26)	0.5926 (1.23)	0.5155 (1.03)	
<i>Fund_2</i>	0.0179 (0.04)	-0.0630 (-0.14)	-0.9306 * (-1.92)	-0.8265 (-1.61)	
<i>SDCF</i>	0.0106 (0.20)	0.0083 (0.16)	-0.0139 (-0.25)	-0.0217 (-0.38)	0.0357 (0.90)
<i>Horizon</i>	-0.0209 (-0.53)	-0.0266 (-0.69)	-0.0796 * (-2.01)	-0.0922 ** (-2.08)	
<i>Payout Ratio</i>	0.0721 (0.72)	0.0410 (0.41)	0.2124 ** (2.07)	0.2024 * (1.93)	0.0312 (0.75)
<i>Const</i>	0.5184 * (1.71)	0.5020 * (1.69)	-0.4722 (-1.46)	-0.2804 (-0.64)	0.2436 (0.89)
Adjusted R ²	0.297	0.323	0.631	0.622	-0.012
# Firms	59	59	36	36	101

This table provides estimates of the cross-sectional determinants of firms' abnormal returns including additional control variables to test the robustness of the main findings presented in Panel B of Table 4. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Columns (1) and (2) present results regarding H₁ and H₄, whereas *TREAT* is a measure for firms of group IV that used to apply the corridor method under IAS 19.

Columns (3) and (4) present results regarding H₂ and H₄, whereas *TREAT* is a measure for firms of group III that proxy for firms applying the expected rate of return, but not affected by the elimination of the corridor method.

Column (5) presents results regarding H₃, whereas *TREAT* is a measure for firms of group II that proxy for firms with defined benefit pension plans.

Table 8: Sensitivity Analysis – Alternative event selection

Variable	H₁: Elimination Corridor		H₂: Elimination ERR		H₃: Disclosure
	(1)	(2) H ₄	(3)	(4) H ₄	(5)
<i>TREAT x Exp</i>		-0.3296 (-1.03)		0.0207 (0.05)	
<i>TREAT</i>	-0.1648 * (-1.85)	-0.0772 (-0.63)	0.2675 * (1.95)	0.2650 * (1.81)	-0.1722 * (-1.70)
<i>Exp</i>	0.3570 * (1.94)	0.4983 ** (2.17)	0.6787 *** (3.55)	0.6649 * (1.97)	
<i>Size</i>	-0.0117 (-0.46)	-0.0089 (-0.35)	0.0203 (0.81)	0.0203 (0.81)	0.0558 (1.57)
<i>Lev</i>	0.2325 (1.01)	0.2395 (1.04)	0.1984 (0.81)	0.1976 (0.80)	-0.2046 (-0.71)
<i>FF</i>	0.0026 (1.30)	0.0024 (1.21)	-0.0014 (-0.82)	-0.0014 (-0.81)	-0.0030 (-1.61)
<i>Fund</i>	-0.2880 * (-1.95)	-0.2778 * (-1.88)	-0.5105 ** (-2.37)	-0.5102 ** (-2.35)	
<i>SDCF</i>	-0.0397 *** (-0.67)	-0.0373 (-0.63)	0.1191 ** (2.38)	0.1197 ** (2.32)	0.1706 *** (3.19)
<i>Const</i>	0.0082 *** (0.04)	-0.0374 (-0.16)	0.1526 (0.75)	0.1560 (0.73)	0.5329 ** (2.17)
Adjusted R ²	0.111	0.112	0.231	0.223	0.124
# Firms	84	84	104	104	101

This table provides estimates of the cross-sectional determinants of firms' abnormal returns for a subset of events that are associated with publication activities of the IASB and events that decrease the likelihood of the elimination of the corridor method or expected rate of return. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Columns (1) and (2) present results regarding H₁ and H₄, whereas *TREAT* is a measure for firms of group IV that used to apply the corridor method under IAS 19.

Columns (3) and (4) present results regarding H₂ and H₄, whereas *TREAT* is a measure for firms of group III that proxy for firms applying the expected rate of return, but not affected by the elimination of the corridor method.

Column (5) presents results regarding H₃, whereas *TREAT* is a measure for firms of group II that proxy for firms with defined benefit pension plans.

Table 9: Sensitivity Analysis – Abnormal returns of significant events only

Panel A: Significance of events					
Variable	Corridor method elimination	ERR elimination	Base model	Full model with individual events	Full model with aggregated events
	Likelihood	Likelihood	(1)	(2)	(3)
<i>Market_Ret</i>			0.7239 *** (22.59)	0.7233 *** (22.33)	0.7240 *** (22.59)
<i>Event₁</i>	Increase	Increase		0.0039 (0.66)	
<i>Event₂</i>	Increase	Increase		-0.0048 (-1.60)	
<i>Event₃</i>	Increase	Increase		-0.0008 (-0.89)	
<i>Event₄</i>	Decrease	Decrease		0.0032 ** (2.54)	
<i>Event₅</i>	-	Increase		0.0018 (1.31)	
<i>Event₆</i>	Increase	Increase		0.0038 *** (12.28)	
<i>Event₇</i>	Decrease	-		-0.0016 (-0.41)	
<i>Event₈</i>	Increase	-		-0.0069 (-1.28)	
<i>Event₉</i>	Increase	-		0.0027 (0.87)	
<i>Event₁₀</i>	Increase	-		0.0012 (1.23)	
<i>Event₁₁</i>	Increase	Increase		-0.0021 (-0.53)	
<i>Event₁₂</i>	Decrease	Increase		0.0013 (0.80)	
<i>Event₁₃</i>	Increase	Increase		-0.0021 (-1.53)	
<i>Event₁₄</i>	Increase	Increase		0.0105 *** (5.17)	
<i>Event₁₅</i>	Increase	Increase		0.0016 (0.32)	
<i>Event₁₆</i>	Increase	Increase		-0.0042 *** (-3.61)	
<i>Agg_Events</i>	Increase	Increase			0.0005 (0.48)
<i>Constant</i>			0.0003 * (1.80)	0.0003 * (1.69)	0.0003 * (1.68)
Adjusted R ²			0.133	0.133	0.133
N			282552	282552	282552

Table 9: Sensitivity Analysis – Abnormal returns of significant events only (*cont'd*)

Panel B: Multivariate Results for significant events only

Variable	H ₁ : Elimination Corridor		H ₂ : Elimination ERR		H ₃ : Disclosure
	(1)	(2)	(3)	(4)	(5)
<i>TREAT x Exp</i>		-0.4026 (-1.08)		0.7630 ** (2.05)	
<i>TREAT</i>	-0.0593 (-0.57)	0.0478 (0.33)	0.2112 * (1.68)	0.1206 (0.92)	-0.0342 (-0.26)
<i>Exp</i>	0.0637 (0.30)	0.2362 (0.88)	-0.0391 (-0.22)	-0.5479 * (-1.81)	
<i>Size</i>	-0.0232 (-0.78)	-0.0199 (-0.66)	-0.0760 *** (-3.32)	-0.0762 *** (-3.38)	-0.0049 (-0.11)
<i>Lev</i>	0.5298 * (1.98)	0.5384 ** (2.01)	0.0333 (0.15)	0.0040 (0.02)	0.2321 (0.62)
<i>FF</i>	0.0001 (0.05)	-0.0001 (-0.03)	0.0006 (0.41)	0.0001 (0.06)	-0.0007 (-0.28)
<i>Fund</i>	-0.3684 ** (-2.14)	-0.3559 ** (-2.07)	-0.1643 (-0.83)	-0.1532 (-0.79)	
<i>SDCF</i>	-0.0662 (-0.97)	-0.0632 (-0.92)	-0.0057 (-0.12)	0.0167 (0.36)	0.0342 (0.50)
<i>Const</i>	0.0500 (0.19)	-0.0056 (-0.02)	0.5581 *** (3.00)	0.6824 *** (3.54)	0.4680 (1.48)
Adjusted R ²	0.017	0.019	0.055	0.086	-0.032
# Firms	84	84	104	104	101

This table presents analyses examining the effect of restricting event selection to significant events, only. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Panel A shows the average stock market reaction to individual events as described in Table 1. Across all regressions in columns (1) to (3) the dependent variable is the stock return for firm i on day t (Ret_{it}). Column (1) presents the base model that proxies for the market return on day t . Column (2) adds to the market return a dummy for each event (ranging from 1 to 16) equal to 1 if day t fall in one of the 16 event windows and 0 otherwise. Column (3) adds to the market return an indicator variable for aggregated events over time.

Panel B provides estimates of the cross-sectional determinants of firms' abnormal returns for events that showed to be significant in the estimation of the average stock market reaction to each event and for each group.

Columns (1) and (2) present results regarding H₁ and H₄, whereas *TREAT* is a measure for firms of group IV that used to apply the corridor method under IAS 19.

Columns (3) and (4) present results regarding H₂ and H₄, whereas *TREAT* is a measure for firms of group III that proxy for firms applying the expected rate of return, but not affected by the elimination of the corridor method.

Column (5) presents results regarding H₃, whereas *TREAT* is a measure for firms of group II that proxy for firms with defined benefit pension plans.

Table 10: Sensitivity to event selection – Eliminating one event at a time

Event that is excluded	H₁:		H₂:		H₃:
	Elimination Corridor		Elimination ERR		Disclosure
	(1)	(2)	(3)	(4)	(5)
	<i>TREAT</i>	<i>TREAT x Exp</i>	<i>TREAT</i>	<i>TREAT x Exp</i>	<i>TREAT</i>
<i>Event₁</i>	-0.0658 (-1.13)	-0.3445 * (-1.67)	0.1667 * (1.66)	-0.3879 (-1.29)	-0.0849 (-1.07)
<i>Event₂</i>	-0.0683 (-1.05)	-0.4091 * (-1.77)	0.2563 ** (2.33)	0.4605 (1.40)	-0.1351 * (-1.75)
<i>Event₃</i>	-0.0938 (-1.41)	-0.4417 * (-1.88)	0.2595 ** (2.34)	0.3880 (1.17)	-0.1207 (-1.52)
<i>Event₄</i>	-0.0556 (-0.87)	-0.3768 * (-1.66)	0.1909 * (1.76)	0.4364 (1.34)	-0.1344 * (-1.70)
<i>Event₅</i>			0.2315 ** (2.15)	0.4814 (1.50)	-0.1182 (-1.49)
<i>Event₆</i>	-0.1245 * (-1.87)	-0.4426 * (-1.88)	0.2143 * (1.96)	0.4206 (1.29)	-0.1385 * (-1.73)
<i>Event₇</i>	-0.0746 (-1.14)	-0.4697 ** (-2.03)			-0.1215 (-1.54)
<i>Event₈</i>	-0.0697 (-1.04)	-0.2394 (-0.99)			-0.1692 ** (-2.20)
<i>Event₉</i>	-0.0940 (-1.62)	-0.3544 * (-1.72)			-0.1376 ** (-1.90)
<i>Event₁₀</i>	-0.1016 (-1.54)	-0.4287 * (-1.83)			-0.1060 (-1.40)
<i>Event₁₁</i>	-0.0896 (-1.44)	-0.3219 (-1.44)	0.2442 ** (2.43)	0.4620 (1.54)	-0.1324 * (-1.71)
<i>Event₁₂</i>	-0.0946 (-1.42)	-0.4341 * (-1.84)	0.2282 ** (2.12)	0.3620 (1.12)	-0.1373 * (-1.78)
<i>Event₁₃</i>	-0.0773 (-1.17)	-0.4315 * (-1.85)	0.2292 ** (2.20)	0.5096 * (1.64)	-0.1045 (-1.31)
<i>Event₁₄</i>	-0.1193 * (-1.82)	-0.3862 * (-1.65)	0.2245 ** (2.10)	0.1094 (0.34)	-0.1308 * (-1.76)
<i>Event₁₅</i>	-0.0925 (-1.44)	-0.4218 * (-1.85)	0.2364 ** (2.19)	0.4373 (1.35)	-0.1032 (-1.32)
<i>Event₁₆</i>	-0.0674 (-1.02)	-0.4795 ** (-2.05)	0.2608 ** (2.39)	0.4060 (1.24)	-0.1573 ** (-1.98)
Sum of significant coefficients	2	13	12	1	9

Table 10: Sensitivity to event selection – Eliminating one event at a time (*cont'd*)

Notes:

This table presents analyses examining the effect of using alternative selections of events by re-estimating main tests eliminating one event at a time for each of the sample events. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Columns (1) and (2) present results regarding H_1 and H_4 , whereas column (1) presents coefficients on *TREAT* and column (2) presents coefficients on *TREAT x Exp*. For each column, *TREAT* is a measure for firms of group IV that used to apply the corridor method under IAS 19.

Columns (2) and (3) present results regarding H_2 and H_4 , whereas column (3) presents coefficients on *TREAT* and column (4) presents coefficients on *TREAT x Exp*. For each column, *TREAT* is a measure for firms of group III that proxy for firms applying the expected rate of return, but not affected by the elimination of the corridor method.

Column (5) presents results regarding H_3 , whereas *TREAT* is a measure for firms of group II that proxy for firms with defined benefit pension plans.

The rows show results for the coefficients and *t*-statistics for variables shown in columns (1) to (5) with each event being excluded once at a time.

4 THE IMPACT OF INFORMATION PROCESSING AND ECONOMIC DIFFERENCES ON THE MARKET PRICING OF CORPORATE PENSION PLANS⁶²

4.1 Introduction

This paper examines pricing differences between alternative ways of funding corporate pension plans. Ways of funding corporate pension plans can be distinguished between plans, for which firms set aside assets either by themselves (internal funding) or by legally separate parties on their behalf (external funding).⁶³

One role of accounting for pension is to measure and recognize corporate pension plans in a set of firms' financial statements (Maines and Wahlen, 2006). The measurement of expected future pension payments – the so-called defined benefit obligation (DBO) – that arise from corporate pension plans is independent from the way of funding. For a given pension plan, the same calculation method and the same actuarial and financial assumptions have to be applied to determine the DBO. However, the accounting for corporate pension plans comprises a major difference between funding alternatives, which is the recognition of pension obligations on the balance sheets of sponsoring firms. To determine the pension obligation that has to be recognized on the balance sheet (pension liability), accounting standards allow the offsetting of pension assets against pension obligations for external funding. Accordingly, for external funding, only the difference between pension obligations and related pension assets has to be recognized as pension liability on the balance sheet. Though, this method of offsetting is not permitted for internal funding. Hence, internally funded pension obligations are always recognized on the balance sheet. Therefore, by looking at the pension liability on the balance sheet, financial statement users can't distinguish between pension liabilities that are internally funded and pension liabilities that are externally funded but lack sufficient assets to cover all related obligations (unfunded pension

⁶² Chapter 3 represents an unpublished working paper (Barthelme, 2022b).

⁶³ This distinction only refers to defined benefit pension plans. According to International Financial Reporting Standards (IFRS), corporate pension plans are either defined benefit plans or defined contribution plans. Beside regular payments to funding agencies no further liability arises for firms that offer defined contribution plans. Therefore, the focus of this paper is on defined benefit plans. Throughout this paper, I use the term corporate pension plan for defined benefit pension plans only. Please see section 4.2, for a detailed description of defined benefit plans and defined contribution plans.

obligations). Yet, according to IAS 19 firms have to disclose the portion of internal funding in the notes.

A substantial literature examines whether and how corporate pension plans affect firm valuation. Theoretical and empirical research shows that assets and liabilities, which arise from corporate pension plans, are perceived by investors as part of a firm, even if they are not recognized on the balance sheet. Among others, studies by Feldstein and Seligman (1981), Feldstein and Morck (1983) and Bulow et al. (1987) provide strong empirical evidence that market participants also consider the funding status of pension plans, which is the difference between pension plan obligations and its assets, in assessing the market value of a firm. However, prior research also documents that the valuation of pension assets and pension obligations is different from the valuation of other items of the balance sheet (Landsman, 1986). Representative papers by Wiedman and Wier (2004) and by Kiosse et al. (2007) show that the pricing of pension obligations and its assets is affected by the funding status of corporate pension plans. These results support prior findings by Barth et al. (1998), who show that the relative importance of earnings versus balance sheet information depends on the financial health of a firm. As mentioned above, internally funded pension obligations are recognized on the balance sheet in the same way as unfunded pension obligations. Hence, a recognized pension liability does not automatically imply an underfunded pension plan. Though, so far, the literature provides no analysis whether the way of funding corporate pension plans affect their market valuation. Therefore, this paper extends prior literature by distinguishing between internal and external funding in analyzing the valuation of corporate pension plans.

As primary setting, I use German firms over 1999-2012, which offers several advantages. First, the within-country design avoids cross-country variations, which might influence the valuation of corporate pension plans. Institutional features, regulatory aspects as well as statutory and corporate pension systems differ between countries. The single-country setting holds constant these factors and helps to identify the pricing of internal funding in a more unbiased way. Second, corporate pension plans in general and in particular internal funding are economically significant for German firms. Although, Germany's pension system ensures statutory pension payments for retirees, corporate pension payments traditionally play an important role for retirees and sponsoring firms. Accordingly, pension

obligations for sample firms represent 35% of their total equity. Finally, this setting provides a maximum of variation in the way of funding corporate pension plans. Regulation in other countries requires a minimum or full funding of pension obligations by external funds. In contrast, German firms are permitted to fully fund their pension plans just with the help of internal funding, external funding or a combination of both alternatives. Therefore, German firms are able to use potential advantages of both funding alternatives in an unlimited way. I exploit this variation in analyzing the question whether the market valuation differs between internal and external funding of corporate pension plans.

To examine this question, I use a value relevance research design, which analyzes the association of accounting information with equity market values (Barth et al., 2001). Furthermore, I use the framework for the usefulness of accounting information for firm valuation by Maines and Wahlen (2006) to develop and test two hypotheses. First, I test whether internally funded and unfunded pension plans are priced differently by investors. These alternatives are subject to economic differences, which include different risk characteristics. However, prior research indicates that financial statement users have problems to incorporate information on the economics of pension plans into firm valuation (Franzoni and Marín, 2006; Picconi, 2006). Building on this literature, I expect no pricing differences between internal and external funding. Second, I conduct cross-sectional analysis to examine if differences in the underlying economics of firms (e.g., differences in risk characteristics such as financial gearing) and differences in the information processing of investors (e.g., differences in the costs of investors to process information) explain the results of my first analysis. Regarding the role of economic differences, research by Barth et al. (1998) shows that the valuation of balance sheet information is affected by the financial health of firms. Cash flow consequences of funding alternatives differently affect the overall risk of firms, especially for financially constraint firms. Jin et al. (2006) provide evidence that the risk arising from pension plans is incorporated in firm valuation. Accordingly, I expect valuation multiples to differ between funding alternatives for firms that are subject to higher risk. Differences in the information processing of financial statement users are an alternative explanation for the valuation of funding alternatives. According to Yu (2013), information intermediaries mitigate problems of investors, who are subject to high information processing cost or lack knowledge about the incorporation of information on

underlying economics. Therefore, I expect that economic differences across funding alternatives find their way into firm valuation for firms, which have a high percentage of information intermediaries.

Results of this paper reveal that, without considering cross-sectional differences, the market valuation of internal funding does not differ from the market valuation of unfunded pension obligations. This is consistent with the view that investors do not discriminate between funding alternatives, even in the presence of economic differences. Though, after taking into account cross-sectional differences, I find that the valuation of funding alternatives depends on the information environment of a company and on differences in underlying economics. Notably, for firms with a high percentage of institutional investors, or a high number of analysts covering a stock, the valuation multiple on internal funding is the same as the valuation multiple on external funding. This finding is also true for companies with high levels of leverage or high exposures to pension plans. These findings support the explanation that financial statement users might have problems in processing pension information disclosed in the notes and that information intermediaries are able to mitigate these problems.

I perform several sensitivity analyses to ensure the results of my main tests. My findings are robust to various model specifications, alternative measures of variables and subsample analysis. I test alternative model specifications to mitigate potential multicollinearity concerns and potential omitted variable concerns. Alternative model specifications include the test of a change model and alternative scale factors. Moreover, I use alternative measures of the dependent and key independent variables. Sensitivity analyses also include the examination of several subsamples to address the effects of foreign investors and different recognition methods of actuarial gains and losses. Overall, I conclude that the results of my main analyses appear to be robust and additional analyses support all hypotheses.

This paper contributes to the literature in the following ways. First, the findings of this study make an important contribution to the understanding of the nature and valuation of corporate pension plans. I combine literature on funding of pension plans with the literature on accounting for pension plans, by investigating the valuation of internal funding that is recognized on the balance sheet like unfunded external pension plans. Findings of this paper

cannot be derived by prior literature, because so far, studies neglect the possibility of internal funding and do not differentiate between funding alternatives in analyzing recognized pension liabilities. Yet, prior studies differentiate implications of pension plans according to the funding status and outline the significant role of pension liabilities in their analyses (e.g., Carroll and Niehaus, 1998). Therefore, the question whether internally funded and unfunded pension plans are priced differently from each other is important for the assessment of the risk of firms and their valuation.

Second, more generally, this study emphasizes information processing-related aspects as important factor in analyzing the value relevance of accounting information (Barth et al., 2001; Maines and Wahlen, 2006). Given the complex nature of pension accounting and given that important information, such as the level of internal funding, is buried in the notes, financial statement user might have problems in processing all available information for the valuation of a firm (Glaum, 2009). The primary goal of this study is to investigate the pricing of internal funding. Cross-sectional analyses show that the pricing of funding alternative is affected by varying levels of institutional investors. These results support the suggestion of Yu (2013) that the value relevance of pensions depends on the information environment of firms. Differences in the information processing by investors may shed light on inconclusive findings of prior literature regarding the incorporation of disclosed pension information into firm values (Barth, 1991; Franzoni and Marín, 2006).

Finally, investigating the valuation of corporate pension funding in a setting different from the U.S. adds to prior literature in two ways. First, this study enhances our understanding of how corporate finance and accounting factors work in different market structures. Existing knowledge on the pricing of corporate pension plans is primarily based on U.S. evidence (e.g., Rauh, 2006; Franzoni and Marín, 2006). However, prior literature also indicates that the valuation of corporate pension plans might depend on its level of funding (Barth et al., 1998; Fasshauer and Glaum, 2008). By using a German setting that allows for unfunded pension plans, I am able to exploit a maximum of variation of funding levels in the analysis of the pricing of corporate pension plans. Thus, this study complements prior literature, by investigating the pricing of corporate pension plans in a setting with a markedly different market structure than the U.S. (Laboul and Yermo, 2006). Second, this paper also contributes to the deliberation of standard setters on the development of the

accounting for corporate pension plans. Despite recent changes, standard setter plan to revise pension accounting to increase the economic representation of pension plans in financial statements. Among other issues, standard setters want to discuss if the actual way of recognizing net pension liabilities (offsetting permitted) reflects the underlying economics of pension plans in a better way than recognizing all pension assets and liabilities (offsetting not permitted) on the balance sheet (Bachan et al., 2008). Though, the discrimination between internal and external pension plans in the application of the netting approach raised a lot of critique by managers and actuaries. According to them, the violation of the netting approach for internal funding leads distorted reported pension liabilities (Zielke, 2009). This study relates to this debate by examining how financial statement users perceive internal funding.

The results of this paper are subject to several limitations. First, the number of firms in the empirical analysis is relatively small. The focus of this paper is the way of internal funding corporate pension plans. Germany provides a unique setting for this study, because of the regulation that allows firms to internally fund pension plans without quantitative limitation. Therefore, results of this study may not generalize to firms in different institutional settings without limitations. Second, findings of this paper document that the valuation of internal funding differs across the level of institutional ownership and across different levels of underlying economics. However, my research design does not allow answering the question if investors do not use disclosed information on differences in economics of firms between pension plans, or if these differences are not high enough to affect firm valuation. These are interesting question for further research.

Section 4.2 provides background on the accounting for corporate pension plans according to IAS 19. Section 4.3 describes the institutional background. Section 4.4 reviews prior literature and section 4.5 provides the hypothesis development. Section 4.6 describes the research design, while section 4.7 discusses the sample selection and descriptive statistics. Empirical results are presented in section 4.8 and section 4.9 discusses additional analysis. Section 4.10 concludes.

4.2 Accounting for corporate pension plans

4.2.1 Classification and funding of corporate pension plans

According to IAS 19, corporate pension plans can be distinguished between defined contribution and defined benefit plans. The funding of defined contribution plans is achieved through regular payments by plan sponsors to funding agencies. Since the employees bear investment risks, there are no further legal or financial implications in addition to these regular contribution payments. In contrast, for defined benefit plans, firms guarantee the amount of pension payments to retirees. Therefore, firms are exposed to uncertainty that is due to actuarial risk (that total costs for pension plans differ from estimates) and investment risk (that invested funds do not perform as expected). Because of this uncertainty, the present value of expected future pension payments – the so-called defined benefit obligation (DBO) – has to be estimated. To finance future pension payments, sponsoring firms set aside assets in two different ways that are illustrated in Figure 1. One way is to set aside assets within the firm (internal funding), another way is to set aside assets outside the firm with the help of funding agencies, which are legally separate third parties (external funding).

4.2.2 Economics of internal and external pension plans

4.2.2.1 Measurement of defined benefit obligations

The calculation of defined benefit obligations is independent from the way of funding and is achieved by using an actuarial calculation method, the so-called projected unit credit method (IAS 19.64).⁶⁴ According to this method, a benefit entitlement arises for each period in which an employee has rendered service in return. Each year of service is separately measured, and the present value of their sum yields the total obligation of the firm. Thus, the defined benefit obligation is determined in three steps that are summarized in Figure 2.

⁶⁴ In Germany, the calculation of defined benefit obligations for tax purposes is done by the so-called entry-age normal method. This method is similar to the described projected unit credit method, except for the method of allocating the present value of benefit obligations to current and prior years of service. The projected unit credit method is based on an increasing yearly amount, because of the assumption of increasing salaries over time. In contrast, the entry-age normal method allocates a constant amount of benefit obligations per year of service. I do not expect this difference to bias the results of this study.

First, future payments to beneficiaries have to be estimated. The final costs of defined benefit plans for firms usually depend on the one hand on contractual details of pension plans (e.g., annual pension payments that equal a certain percentage of the final salary), on the other hand on several uncertain factors (e.g., development of the salary). Because of such uncertain factors, firms have to make so-called actuarial assumptions to estimate the total costs of their defined benefit plans. Actuarial assumptions shall be unbiased and mutually compatible (IAS 19.72). They deal with demographic variables (e.g., mortality) and with financial variables that depend on market expectations such as future increases in salaries and changes in medical costs (IAS 19.73).

Second, estimated future payments are discounted to determine the present value of pension obligations. The discount rate has to reflect market yields of high-quality corporate bonds. The currency and term of the bonds have to approximately reflect the characteristics of the benefit obligations (IAS 19.76). Hence, discount rates usually do not reflect the risk of the sponsoring firm or the risk of their pension plans such as unexpected changes of actuarial assumptions or investment risk.

Third, the present value of pension obligations is allocated to current and prior periods of service of employees (IAS 19.68).

In sum, the measurement of defined benefit obligations mainly depends on contractual agreements on pension payments, the time of service and on actuarial assumptions. The way of funding pension obligations does not influence the calculation of the pension obligation.

4.2.2.2 Funding and cash flow consequences

To ensure future pension payments to retirees, firms have to accumulate sufficient funds before these payments are due – either within the firm (internal funding) or outside the firm (external funding).

Regarding internally funded pension plans, firms accumulate funds within the company and do the actual pension payments to beneficiaries on their own when these payments fall due. Thus, firms commit to pension payments today, but defer actual cash outflows to the future. In the time between the commitment and the actual payments, firms are provided with additional liquidity. This liquidity is used to invest in the business of the firm with the intention to use resulting cash flows to pay pension promises when they are due. If firms are

not able to pay them with the help of operating cash flows, they are obliged to use other financing sources.

Regarding externally funded pension plans, future pension payments are made by external funding agencies on behalf of sponsoring firms. To enable funding agencies to pay out pension promises, plan sponsors provide them with sufficient assets – the so-called plan assets – before payments are due. To qualify as plan assets, assets have to be legally separated from the reporting firm and have to be used for funding future pension payments only (IAS 19.7). According to their investment strategy, funding agencies invest into various kinds of asset classes (e.g., equity or debt instruments, derivatives, investment funds, real estate or cash) with different risk and liquidity characteristics. Figure 3 depicts the cash flow consequences of internal and external pension plans for plan sponsors graphically.⁶⁵ The figure illustrates the difference in the timing of cash outflows between internally and externally funded pension plans. External pension plans require cash outflows to provide funding agencies with sufficient funds before payments during the retirement of the beneficiaries fall due. The amount of cash outflows is increasing over time as the projected credit unit method assumes increasing salaries over time. Firms offering internal pension plans recognize constant cash outflows during a later period of time, beginning with the retirement of beneficiaries. The difference in the timing of cash outflows is increased by the risk of shortfalls of plan assets. Shortfalls can be caused by negative returns of invested assets or by unexpected increases of benefit obligations as a result of actuarial changes. As external pension plans require pre-funding and regulators passed minimum funding requirements, shortfalls have to be covered before claims fall due. Firms offering internal pension plans do not need to cover the shortfalls before payments are due and do not face the potential risk of short-term financing constraints.⁶⁶

4.2.2.3 Risk characteristics

Internally and externally funded pension plans do not only differ in terms of cash flows, but also in terms of investment strategy and risk. Risk associated with each kind of funding can

⁶⁵ To facilitate the understanding of fundamental cash flow consequences of funding alternatives, I refrain from illustrating the impact of remeasurements on cash flows.

⁶⁶ Section 4.3 describes the institutional setting and regulatory funding requirements in detail.

be separated into actuarial risk and investment risk (IAS 19.25). While actuarial risk is associated with the measurement of defined benefit obligations, investment risk refers to assets in which funds are invested in.

Actuarial risk describes the risk of changes in demographic or financial assumptions, which both are required to calculate defined benefit obligations (IAS 19.73). As described above, the ultimate costs of future pension payments are not observable today and variables for calculating pension benefits, e.g., mortality and final salary, have to be estimated. These demographic and financial variables, as well as the discount rate to calculate the present value of the pension payments, are subject to ongoing changes over time. Due to the long-term nature of pension obligations even small changes can have a big impact on the present value of pension obligations. If changes in demographic or financial assumptions lead to higher defined benefit obligations, the increase has to be covered by additional funds. Nevertheless, since the calculation of defined benefit obligations is the same for internally and externally funded pension plans, there are no differences in actuarial risk for funding alternatives.

Investment risk describes the risk that invested funds are insufficient to pay pension promises (IAS 19.25). In contrast to actuarial risk, investment risk is associated with the funding of defined benefit obligations. In a defined benefit plan a firm guarantees the level of payments to beneficiaries, hence bears the risk that invested funds are too low to meet expected benefits (IAS 19.49). In addition to legal requirements or the willingness to ascertain sufficient funds, the risk of having insufficient funds mainly depends on the risk of invested assets. This risk can be expressed by the volatility of invested assets.⁶⁷ Since investments in assets differ between internally and externally funded pension plans, also the volatility in pension assets differs among funding alternatives. Internally funded pension plans invest funds within the company. Therefore, funds are invested in the operating business of the firm and the volatility of pension assets equals the volatility of the business of the firm. In contrast, externally funded pension plans require firms to invest funds outside the company. On behalf of the sponsoring firm, funding agencies invest funds into different asset classes such as cash, real estate, derivatives, equity instruments and debt instruments.

⁶⁷ In 4.11.3, I formally derive the relation between investment risk and volatility in the context of structural models of credit risk.

Volatilities among and within asset classes are expected to differ from each other and also from assets of sponsoring firms (Jin et al., 2006). How these differences may affect firm valuation is discussed in section 4.5 on hypotheses development in section.

4.2.3 Accounting representation

IAS 19 requires firms to compare the fair value of plan assets with the carrying amount of defined benefit obligations and to recognize the difference as pension liability (asset) on the balance sheet. However, the offsetting of pension assets against defined benefit obligation is only permitted for qualified plan assets (IAS 19.54). As outlined above, funds only qualify as plan assets if they are legally separated from the sponsoring firm and only if they are used for funding pension obligations. Assets of the firm funded by internal pension plans are by definition not legally separate from the firm and automatically result in pension liabilities. In contrast, funds invested by external funding agencies usually meet the criteria of qualified plan assets and are offset against pension obligations (Napier, 2009). Because of the different treatment of internal and external pension plans, a pension liability recognized on the balance sheet can have two reasons. Either the pension liability is internally funded, or the pension liability is externally funded, but lacks sufficient plan assets to cover all pension obligations.

In addition to the difference in offsetting pension assets against pension obligations, there are also differences in the accounting for remeasurements between funding alternatives. Remeasurements – so-called actuarial gains and losses – are changes in the measurement of pension obligations or pension assets that are caused by changes or experienced adjustments of demographic or financial assumptions. While the accounting for remeasurements of defined benefit obligations, like their general measurement, is the same for each funding alternative, the accounting for remeasurements of pension assets does differ. Firms that internally fund pension plans set aside assets by themselves and usually invest funds into the operating business of the firm. The performance of these assets directly affects the profit or loss, thereby the equity of the firm in the respective reporting period. In contrast, IAS 19 permits three methods to account for actuarial gains and losses of externally funded plan assets. First, according to IAS 19.92, firms have the possibility to use the so-called corridor approach. According to this approach firms recognize the portion of the net cumulative actuarial gains and losses that exceed the greater of (i) 10% of the present value of the defined

benefit obligation (before deducting plan assets); and (ii) 10% of the fair value of any plan assets. The amount of actuarial gains and losses that has to be recognized is the excess that fell outside the 10% corridor at the end of the previous reporting period, divided by the expected average remaining working lives of the employees participating in that plan. The second method permits firms to immediately recognize any actuarial gain or loss in profit or loss, which equals the treatment for internally funded pension assets. The third option is to immediately recognize actuarial gains and losses in other comprehensive income (IAS 19.93). Especially the first method may lead to biased amounts in the balance sheet, as this method smoothes the impact of actuarial gains and losses over several periods. To be able to compare companies with each other and to adjust balance sheet amounts, firms have to make disclosures that show the amount of actuarial gains and losses not yet recognized.⁶⁸

Firms also have to make disclosures that shall explain the characteristics of defined pension plans, the amounts recognized on the balance sheet and the amount, timing and uncertainty of future cash flows (IAS 19.120). In this sense, firms have to distinguish between pension plans that materially differ in risk and also have to disaggregate plans according to funding arrangements, e.g., internally or externally funded pension plans (IAS 19.120A). Thus, financial statement users have to look into the notes of the annual report to see which portion of the recognized pension liability is caused by internal and external funding of pension plans. Additional to disclosures about the funding of pension plans, firms have to disclose assumptions used to calculate the defined benefit obligations as well as the composition of pension costs and plan assets. According to IAS 19.120A firms have to disaggregate plan assets into asset classes such as cash, real estate, derivatives, debt instruments and equity instruments. This aggregation should help financial statement users to assess the investment risk associated with externally funded pension plans. There are no equivalent disclosures that describe assets in which internally funded pension plans are invested in.

⁶⁸ The IASB published amendments to IAS 19 in 2011. The amendments are effective for annual periods beginning on or after 1 January 2013. Earlier application is permitted. Among others, the IASB changed the accounting for actuarial gains or losses of qualified plan assets. According to the amended standard, firms are only allowed to recognize actuarial gains or losses (remeasurements) within other comprehensive income (IAS 19.122). In section 4.9, I test whether the results of the main test are sensitive to the method of recognizing actuarial gains and losses.

4.2.4 Corporate pension plans and credit ratings

To finance the business of the firm with the help of debt instruments, such as bonds, managers ask credit rating agencies for an assessment of their creditworthiness. The three major rating agencies in Germany are Fitch Ratings, Standard & Poor's (S&P) and Moody's (Buschmeier, 2011). All of these companies follow a similar approach in incorporating pension information into credit ratings, except for information on the type of funding pension plans.

In the calculation of firm debt and financial ratios, above listed rating agencies do not consider pension obligations that are covered by external pension assets. This net approach is in contrast to the gross approach that takes into account externally funded pension obligations. Pension liabilities caused by underfunded external pension plans are treated as debt-like (Neuhaus, 2009). Though, the treatment of pension liabilities caused by internal pension plans does differ among rating agencies. For comparability reasons and for the assessment of creditworthiness of firms, rating agencies convert internally funded pension plans into external ones. In their adjustments, Moody's and Fitch Ratings assume that firms would finance the funding of external funding agencies with a composition of debt and equity. In their method the composition of debt and equity equals the current debt-to-equity ratio of firms, without the consideration of pension liabilities (Moody's, 2006; Fitch Ratings, 2006). In contrast, S&P adjust for internal pension plans by assuming firms to entirely fund external plan assets with the help of debt (Standard & Poor's, 2006). Hence, S&P does not differentiate between the unfunded and internally funded part of the pension liability and treats the latter as conventional debt. The described approach by Standard & Poor's was introduced in 2003. As a result, credit ratings of several firms were downgraded by Standard & Poor's, while the ratings by Fitch and Moody's did not change.

4.2.5 Summary

The way of funding pension plans does not affect the measurement of defined benefit obligations and both ways of funding are subject to the same actuarial risk. However, there are three major differences between funding alternatives.

First, the accounting representation of internal and external pension plans differs from each other. For the calculation of pension liabilities recognized on the balance sheet, assets

of external plans are offset against pension obligations. This approach is not allowed for internal plans. Thus, pension liabilities can have two reasons, namely internal funding, or insufficient external funds. Financial statement users have to look into the notes to distinguish between these possibilities.

Second, the cash flow characteristics of each kind of pension plan do differ from each other. While cash outflows for internal funding occur when claims fall due, external funding requires cash outflows before that point in time. Externally funded pension plans do also suffer from the risk of unexpected cash outflows caused by the requirement to cover shortfall of pension plans.

Third, internal and external pension plans are subject to different investment risk. Pension plans invest funds into various kinds of assets with differing returns. Investment returns can easily be expressed in asset volatilities, which determine the risk associated with each kind of asset and pension plan.

In addition, minor differences are the treatment of actuarial gains and losses and the varying treatment in the calculation of credit ratings. In section 4.5, I discuss whether these differences are likely to result in valuation differences.

4.3 Institutional background

The aim of this study is to examine the pricing of internally funded pension plans and to further investigate whether the pricing differs in the cross-section and from externally funded pension plans. To understand the market perception of funding alternatives and to evaluate the results of this study in the context of the literature, the institutional setting and its specific characteristics must be properly understood.

4.3.1 Pension funding in an international context

Despite comparable accounting rules for pension plans under International Financial Reporting Standards (IFRS) and United States Generally Accepted Accounting Principles (U.S.-GAAP), funding practices and requirements differ across countries (Fenge et al., 2003). The implementation and significance of occupational pension schemes within a country depends on the historic development of statutory pension schemes. Accordingly,

countries can be divided into two groups, depending on the relative importance of statutory pension plans for the total level of income of retirees during retirement (OECD, 2020).

The first group consists of countries in which statutory pension plans only provide a basic level of income during retirement such as the United Kingdom, the United States, the Netherlands or Switzerland. Because of the importance of corporate pension schemes for the retirement income of pensioners, governments established guarantee funds as providers of insurance for workers. Additionally, they passed laws that require companies to externally fund defined benefit obligations up to a certain level. Especially the latter regulation influences companies in their decision to fund pension schemes by internal or external funds and hinder an unbiased view on internally funded pension plans. The second group consists of countries that provide high statutory pension payments and in which corporate pension plans are often not prevalent or at least not significant for firms. France, Italy and Spain are considered to belong to this group of countries (OECD, 2020).

Germany is usually allocated to the second Group of countries, as statutory pension payments do provide a high level of pension income for retirees. Nevertheless, Germany differs from other countries of that group, because occupational pension schemes do also provide a high level of pension income and corporate pension plans are also significant for the financial development of firms (Franzen, 2010). Germany also differs from countries of the first group because no minimum or full funding of defined benefit obligations by external funds is required by law. Allowing companies to use possible advantages of both external and internally funded pension plans in an unrestricted way, provides an unbiased view on internally funded pension plans and offers a unique setting to examine the market valuation of funding alternatives.

4.3.2 Pension funding in Germany

German firms are allowed to internally fund pension plans without quantitative restrictions because of the historical role of pension plans as financing opportunity for firms. After the Second World War, German firms were in need of funds to rebuild productions capacities and to invest into the expansion of operating business (Gerke et al., 2006). Internal funding of pension plans offers the advantage to commit to pension payments today, but to defer pension payments and cash outflows until promises are due. This financing effect is increased

by lower tax payments. The commitment to pension payments is considered as cost of the current fiscal year, which reduces the taxable income of firms. As most pension plans were newly set up after the Second World War, most employees have had to render many more years of service before pension payments were due. Therefore, internally funded pension plans have a financing effect and provided firms with additional liquidity until actual payments to retirees fall due (Becker, 2012).

To allow firms to alternatively invest pension obligation outside the firm and to protect retirees against bankruptcy of plan sponsors, legislators passed several laws that introduced various ways of funding pension plans externally. In the decades after the Second World War, the first priority of externally funded pension plans was the safety of investments, which led to regulations that prevent funding agencies from investing in risky assets. Pursuing the goal of aligning German pension regulation to international standards, the German Pension Reform of 2002 introduced the possibility of funding pension plans with the help of pension funds, which increased the flexibility of externally funded corporate pension plans. Pension funds are funding agencies that are independent and legally separated from plan sponsors (Franzen, 2010). They face less legal investment restrictions, which, in comparison to alternative ways of external funding, allow funding agencies to take more risk in terms of asset allocation. Section 4.7.2 discusses the distribution of internally and externally funded pension plans of sample firms over the sample period.

4.3.3 Pension regulation in Germany

4.3.3.1 Supervision

Before 2002, financial regulation in Germany was separated into three institutions. The Federal Securities Supervisory Office (BaWe) regulated securities, the Federal Banking Supervisory Office (BaKred) oversaw of the banking industry and the Federal Insurance Supervisory Office (BAV) was in charge of the insurance industry. In 2002, the government replaced these institutions by the Financial Supervisory Authority (BaFin), which acts as an integrated financial supervision institution. Its primary objective is to guarantee the proper functioning, stability, and integrity of the German financial system (BaFin, 2014). The BaFin is also responsible for the supervision of all pension funding agencies that are required by

law to guarantee for pension entitlements. In this context, the BaFin especially monitors the compliance of funding agencies with funding and investment requirements.

4.3.3.2 Funding requirements

Pension agreements are based on a high degree of trust between employees and employers. To additionally protect employees from expropriation by firms, legislators have passed several regulations that outline funding requirements of pension plans. As described above, the BaFin is responsible for the supervision of funding agencies that have to guarantee for pension entitlements by law. These include all types of external funding agencies, except those that qualify as support funds (so-called “pauschaldotierte Unterstützungskasse”), which account for 7% of total corporate pension plans (Schwind, 2013). All other types of external funding agencies are monitored by the BaFin and subject to funding requirements based on the Insurance Supervision Act. According to this regulation, German pension plans have to comply with funding rules that are conditional on the type of investment strategy. Funding agencies that are equivalent to life insurance companies have to be constantly funded at a level of 104.5% of pension obligations. Funding agencies, which do not primarily invest in life insurances, e.g., pension funds are not allowed to have a funding level below 90% of pension obligations. In both cases if funding level fall below the thresholds, a detailed recovery plan has to be prepared and the shortfall has to be reduced within 3 years.⁶⁹ In contrast, support funds that are also summarized within external funding do require specific levels of fundings.

By definition, there are no funding requirements for internally funded pension plans. Cash outflows occur when pension payments to retirees fall due. Therefore, funding of internal pension plans is always assured by the assets of the firm. This principle is also valid for a contractual trust arrangement (CTA). A CTA is a legally separate funding agency that does not change the legal character of an internal pension plan but offers the possibility to invest funds outside the company, e.g., in bonds. Usually, the assets of a CTA meet the criteria of qualified plan assets according to IAS 19 and are offset against pension obligations. There are also no quantitative or qualitative funding requirements, as the

⁶⁹ Section 115 (2) Insurance Supervision Act and Section 4 (3) Minimum Allocation Regulation.

establishment of CTAs is voluntary. Pension obligations that are not covered by assets of a CTA are accounted for as pension liability in the balance sheet.

4.3.3.3 Investment requirements

In addition to the establishment of an adequate level of funding, a major priority of German pension regulation is the safety of investments. Like the regulation of funding of external pension plans, the investing requirements also differ between the various types of funding agencies.

Insurance-like funding agencies, e.g., direct insurances are discouraged from taking high risks. Assets under management of funding agencies have to yield a positive rate of return, have to be liquid and have to observe the principles of good business practice.⁷⁰ Apart from these qualitative investment requirements, they also have to comply with quantitative investment rules. The legislator prescribes asset classes in which funding agencies are allowed to invest in. Moreover, the legislator also defines limits for investments into a single asset class in terms of percentages. In general, investments into a single asset are restricted to 5% of total assets.⁷¹

Fund managers and other market participants criticized such strict investment rules. According to their argumentation, these rules prevent funding agencies from investing in market innovations, such as hedge funds, and prevent funding agencies also from diversifying assets in an unrestricted way (Andresen, 2001). As a consequence of increasing critique, German legislation introduced in 2002 pension funds as new opportunity to externally fund pension plans. Although pension funds are supervised by the BaFin, they are not subject to conservative investment rules that became effective for insurance-like funding agencies. Accordingly, pension funds do not face as strict quantitative investment restrictions as other funding vehicles.⁷² By allowing, for example, to invest 30% of total assets into bond investments, pension funds are better able to diversify investments compared to alternative funding vehicles. These advantages of pension funds are only shared by support funds, which

⁷⁰ Section 54 Insurance Supervision Act (VAG) and Section 1 Investment Regulation (AnlV).

⁷¹ Section 3 Investment Regulation (AnlV).

⁷² Section 3 Pension Fund Investment Regulation (PFKapAV).

are not subject to the supervision by the BaFin. Accordingly, support funds are able to invest without quantitative restrictions, but are also subject to higher costs in terms of payments to the statutory pension insurance fund.

Similar to the funding rules for defined benefit obligations, there are also no legal investment requirements for internally funded pension plans. In contrast to external funding, firms that internally fund their pension plans do not face cash outflows before the payments to retirees fall due. Hence, pension funds are usually invested in the assets of the firm.

4.3.3.4 Statutory pension insurance fund

German legislation established a statutory pension insurance fund (PSVaG) that protects beneficiaries from bankruptcies of pension plans. If plan sponsors are bankrupt, the PSVaG becomes the debtor of the respective pension obligation and ensures the actual payments to retirees. The insurance fund covers all vesting benefits that employees have earned in return for their service in the current and prior periods.⁷³ It is funded by yearly, mandatory contributions of pension plan sponsors. However, not all kinds of pension plans are protected by the PSVaG and subject to contribution payments. Insurance-like funding agencies that are under supervision of the BaFin, such as direct insurances, are not protected by the fund, because they face stricter funding and investment rules.

4.3.3.5 Taxation

Since 2005, the general tax treatment of a deferred taxation is identical for all kinds of pension plans.⁷⁴ According to this principle, plan contributions and investment returns are tax-exempt, whereas pension payments are taxed.

Regular contributions to pension plans by firms are tax-exempt up to a level that depends on the way of funding.⁷⁵ This principle also applies for contributions that are required because of shortfalls of pension plans. Employees are able to yearly defer compensation up to € 1,800 additional to 4% of the social security contribution threshold.⁷⁶

⁷³ Sections 7 (1) and (2) Occupational Pension Act (BetrAVG).

⁷⁴ Section 22 (5) German Income Tax Act (EStG).

⁷⁵ Section 4b to 4e German Income Tax Act (EStG).

⁷⁶ Section 3 (63) German Income Tax Act (EStG).

One of the few exemptions refers to support funds. These funds do not face investment rules. To restrict these funds from lending money back to sponsoring firms, tax-exempt contributions are lower for such pension plans. Hence, support funds are often underfunded until actual payments to retirees are due. The unfavorable tax treatment can be changed if support funds fully commit to re-insurance contracts. The general principle of deferred taxation also applies for internal funding. Funds that are allocated to book reserves are also tax-exempt and lower the taxable income of the firm.

While contributions to pension plans and investment returns are tax-exempt, benefits paid to retirees are subject to taxation. The taxation of pension income is independent from the way of funding. Beneficiaries have to pay taxes on their pension income according to personal tax rate in the year in which they receive the benefits.

4.3.3.6 Comparison to the United States

To assess the results of this study in the context of previous literature, I briefly describe the setting of the United States (U.S.) in which most of the studies were conducted. The U.S. have a long tradition of corporate pension plans, as statutory pension plans only provide minimal pension incomes. The basis of today's pension regulation in the U.S. was established in 1974 by the Employment Retirement Income Security Act (ERISA). ERISA includes laws for funding, investment, securitization and taxation of corporate pension plans, which were updated by the Pension Protection Act of 2006. According to U.S. laws, internally funded pension plans do not meet the criteria of qualified pension plans, which receive a favorable tax treatment (Sections 401 (a) and (f) Internal Revenue Code). To avoid tax disadvantages, corporate pension plans are externally funded in the U.S. While German legislation explicitly defines different types of funding vehicles, there is no differentiation in the US. Therefore, almost all pension plans are funded by pension funds.

By passing ERISA, the U.S. government requires firms to immediately address underfunding of their pension plans. The Pension Protection Act tightened funding rules even more and increased the minimum funding level of pension plans from 90% up to 100% of respective pension obligations. If pension assets do not cover all benefit obligations, firms have to transfer additional assets to pension funds within seven years for single-employer

pension plans and within 15 years for multiemployer pension plans.⁷⁷ They also have to provide a plan with detailed information about the actions they take to increase funding levels. Firms do also have to pay a penalty in terms of a premium additional to mandatory contributions to the benefit insurance company.

In contrast to detailed funding rules, U.S. legislation has not passed strict investment requirements, providing pension funds with a high degree of investment flexibility. Pension funds only have to comply with qualitative but not with quantitative investment rules. The former consists of a prudent person rule that requires fund managers to do their duties with care and prudence (Russel, 2002). According to this rule fund managers have to invest, for example, in a diversified portfolio of assets. Legislation that allows for a maximum of flexibility in investment strategies, led to a high percentage of stocks and other equity instruments in the portfolio of U.S. pension funds. Because of this of asset allocation, funding levels of pension funds strongly depend on the development of global stock markets.

To protect beneficiaries from negative developments and bankruptcies of pension plans, the U.S. government established the Pension Benefit Guarantee Corporation (PBGC) in 1974. The PBGC is a benefit insurance company that is under the behalf of the U.S. government. It guarantees benefits up to a yearly adjusted maximum for participants of corporate pension plans. However, some types of benefits, e.g., health and welfare benefits do not fall under the protection of the PBGC. The insurance company is funded by all pension plans, which pay a flat fee per participant and per year of \$19. If a pension fund is underfunded, the fee increases by \$9 for every \$1,000 of unfunded benefits.

The taxation of pension plans in the U.S. is similar to the rules in Germany. Contributions to pension funds are tax-deductible and investment returns of plan assets are tax-exempt. Pension payments are also taxed as personal income by the beneficiaries.

In summary, with respect to the funding of corporate pension plans, pension regulation in the U.S. is comparable to the German one. Compared to German firms, U.S. companies do also face strict funding rules for externally funded pension plans. While German legislation allows for a funding deficit up to 10%, U.S. firms are required to fully fund their

⁷⁷ Before passing the Pension Protection Act in 2006 the amortization period for shortfalls in pension plans was up to 30 years.

pension plans. Apart from differences in the amounts of contributions, which are tax-exempt per year, there are no differences in the taxation of corporate pension plans. Similar to Germany, the U.S. government also established a pension guarantee fund that protects beneficiaries against plan sponsors' bankruptcies. In contrast to German pension plans, pension funds in the U.S. do not face quantitative investment rules, which allow them to invest pension asset more flexible. However, for this study, the most important difference between the two systems is the taxation of internal funding. In contrast to German firms, U.S. firms face an unfavorable taxation of internally funded pension plans, which make this type of funding de facto not existing in the U.S.

4.4 Prior literature

This study contributes to two streams of literature. The first examines the value relevance of corporate pension plans and the second relates to papers that study the influence of information processing on firm valuation.

4.4.1 Value relevance of corporate pension plans

The first stream of literature consists of papers examining the nature and valuation of corporate pension plans. Early papers of this line of research concentrate on the question whether and how corporate pension plans are priced by investors. These papers are primarily based on U.S. firms. However, different market structures across countries and limits of the U.S. setting, such as low variation in the funding status, foster research on the value relevance of corporate pension plans in settings different from the U.S. This paper adds to both lines within the literature on the value relevance of corporate pension plans.

4.4.1.1 U.S. evidence

Regarding the first line of literature, which is mainly based on U.S. evidence, prior research theoretically and empirically investigates *whether* and *how* corporate pension plans affect firm value.

Early theoretical research focuses on the question *whether* corporate pension plans and their funding levels are relevant for firm valuation at all. According to Modigliani and Miller (1958), pension asset allocation as well as the level of funding of pension obligations are

irrelevant for the value of the firm in the absence of market imperfections. This notion is supported by Sharpe (1976), who theoretically shows the irrelevance of pensions funding for the value of the firm in the presence of guarantee funds for pension claims. He concludes that guarantee funds work in a manner of put options that increase in value if companies' equity is at stake. Based on this view, Sharpe (1976) argues that employees bidding up wages to levels that compensate for potential declines in the value of pension-related compensation. However, this is unlikely to be observable in practice, because of the lack of bargaining power of current employees and because former employees cannot bid on wages anymore (Laboul and Yermo, 2006).

Due to this kind of observations, which are in contrast to the view of Modigliani and Miller (1958) and the work of Sharpe (1976), a number of theoretical studies explicitly examine the funding of corporate pension plans in the presence of market imperfections, e.g., in labor or financial markets or by introducing taxes. Arnott and Gersovitz (1980) and Ippolito (1985a, b) concentrate on labor market frictions and investigate the influence of the level of pension funding on wage claims of current employees. These studies conclude that underfunded pension plans enable employers to mitigate wage demands of current employees. The sharing of pension risk between employers and employees as well as lower wage demands, positively affect the value of the firm. Considering taxes, Bicksler and Chen (1985) document limitations of the marginal value of the tax shield at different levels of funding, which influences the overall value of the firm. A more recent study by Cooper and Ross (2002) builds on the research of Tepper and Affleck (1974) and investigate how access to financial markets affects pension funding levels and firm value. The authors find that financial market imperfections, such as the lack of internal funds, low returns of pension assets or borrowing restrictions, affect the value maximizing level of pension funding. The influence of financial market imperfections is also supported by research of Menzefricke and Smieliauskas (2012). Their results emphasize the importance of plan assets' rate of return in determining the optimal level of pension funding. Overall, theoretical research suggests that in the presence of market imperfections, e.g., in financial and labor markets, funding of pension plans affects firm valuation.

Empirical research builds on this theoretical literature and investigates the relation between funding levels of corporate pension plans and firm values. One of the first studies

examining this relation is Feldstein and Seligman (1981). For a sample of 200 U.S. firms they show that pension plan deficits are incorporated into share prices, suggesting that pension liabilities are treated as corporate debt. Moreover, the authors find that an increase in pension liabilities is associated with a negative development of equity market values. Subsequent studies by Feldstein and Morck (1983), Bulow et al. (1987) and Bodie and Papke (1991) confirm the result that the market takes into account unfunded pension liabilities and that findings are not caused by measurement biases or by different financial and actuarial assumptions. This finding persists, despite several changes of pension accounting standards (e.g., Yu, 2013). Other studies provide evidence that the level of pension assets and liabilities do not only affect equity prices, but also credit spreads and ratings of corporate bonds. According to Carroll and Niehaus (1998), the funding of pension plans is significantly associated with bond ratings of sponsoring firms and with their firm value. Using credit spread as dependent variable, findings by Cardinale (2007) support the notion of pension information as credit relevant. Taken together, these findings provide vast empirical evidence that the level of funding is relevant for investors to assess the market value of a firm.

Prior literature does not only addresses the valuation of unfunded pension plans, which is recorded in large parts on the balance sheet, it does also address the question *whether* pension assets and liabilities that are recognized off the balance sheet are relevant for firm valuation as well.

Concerning this question, two contrasting theoretical views have evolved over time: the legal view and the economic substance view.⁷⁸ The legal view argues that there is a legal separation between sponsoring firms and pension funding vehicles. Therefore, pension fund managers should act in the best interest of beneficiaries and without considering the financial interests of sponsoring firms. By being legally separate from sponsoring firms, externally funded pension plans should not matter for firm valuation (Gallagher and McKillop, 2010). In contrast, the economic substance view asserts that pension assets and liabilities are financial assets and liabilities of the firms, despite legal segregation. The performance of pension assets and changes of pension obligations affect the cash flows of sponsoring firms.

⁷⁸ See, for example, Bodie et al. (1987) for a summary of the two opposing views.

Together with the fact that employees still have a claim on firms' assets, externally funded pension plan should be relevant for firm valuation despite its legal separation (Black, 2006).

Empirical literature provides evidence in favor of the economic substance view and suggests that pension assets and liabilities are perceived by equity investors as assets and liabilities of the sponsoring firms. One of the first empirical studies that addressed this question was conducted by Barth (1991). The author investigates the association between equity market values and the accounting measures of off-balance sheet pension information. Barth finds a significant association along several dimensions of measurement methods, suggesting that investors incorporate information on the extent of the pension plan into firm value. Other papers using a similar research design support these findings (e.g., Barth et al., 1993; Hann et al., 2007). A different research method is used by Jin et al. (2006). The authors analyze whether the risk of off-balance sheet pension assets and liabilities is reflected in the overall risk and in equity returns of firms. By finding a significant association, their findings also suggest that investors seem to process disclosed information about the extent of corporate pension plans. The rich theoretical and empirical literature on the valuation of corporate pension plans generally finds that corporate pension plans are relevant for firm valuation, independent from its recognition on or off the balance sheet.

However, by examining *how* corporate pension are priced by investors, prior research documents that the valuation of pension assets and pension obligations is different from the valuation of other items of the balance sheet (Barth et al., 2001). In general, the pricing multiples of off-balance sheet pension assets and liabilities tend to be lower than other recognized assets and liabilities (Glaum, 2009). For example, Landsman (1986) obtains that externally funded pension plans are perceived as assets and liabilities of the firm. Though, he also finds for his sample of U.S. firms in the period from 1979 to 1981 that the coefficients on pension assets and liabilities are significantly lower than theoretically derived values of +1 and -1, respectively. Further studies, which came to the same results, suggest that these findings are attributable to measurement errors or to lower reliability as for recognized amounts. Davis-Friday et al. (2004) investigate the relative pricing of on-balance sheet versus off-balance sheet pension information. They find lower valuation multiples for off-balance sheet pension obligations that are only disclosed in the notes. The authors suggest that this finding is due to differences in the quality of information on recognized obligation and

disclosed pension information, which are caused by the application of different regulations. Also, other empirical studies by Barth (1991) and Choi et al. (1997), which compare different measures of pension obligations, come to the conclusion that noisy information on pension obligations impair their reliability and affect their market valuation. An alternative explanation is provided by Yu (2013). He addresses the notion of differences in the reliability between disclosed and recognized pension obligation by using a mandatory accounting change. The new accounting rules include the recognition of previously disclosed off-balance sheet pension obligations. In his study, Yu compares the value relevance of this item before and after the accounting rules changed. The author finds that the value relevance of off-balance sheet information only increases after the introduction of the new recognition rules for firms with lower levels of institutional ownership and less analysts following. Firms with high level institutional ownership and a high number of analysts following do not experience a change in the value relevance of pension information. These results suggest that the different pricing of recognized and disclosed pension information might be due to information processing differences.⁷⁹

With respect to the valuation of recognized pension liabilities, prior literature documents inconclusive results. Papers examining the risk of corporate pension plans suggest that pension liabilities are perceived as ordinary liabilities. Dhaliwal (1986) and Jin et al. (2006) develop models that allow examining how the risk of pension liabilities affects the overall risk of firms. Both papers find that betas of firms behave as suggested by finance theory and that investors correctly assess the risk of pension liabilities. However, past literature also documents an asymmetric pattern in the valuation of changes in pension deficits and surpluses. While an increase in pension deficits by one dollar lowers the market value of firm in the same amount, a decrease of pension deficits by one dollar does not raise the market value of the firm in the same amount (e.g., Wiedman and Wier, 2004; Kiosse et al., 2007; Carroll and Niehaus, 1998). This finding suggests that investors treat pension deficits as liabilities of the firm, but do not consider pension surpluses as corporate assets. This is in accordance with the view that pension surpluses could not be transferred back to

⁷⁹ I will address the influence of these two explanations – differential reliability and differential information processing costs – on the valuation of internal funding in the section on the hypotheses development.

the company, once these assets were transferred to legally separate funding agencies. Most of prior studies do expect the value relevance of pension liabilities to be the same across all firms and do not consider cross-sectional differences. However, studies by Barth et al. (1998) and Yu (2013) indicate that the pricing of recognized pension liabilities is affected by the information environment or the financial health of firms.

4.4.1.2 International evidence

Integrated worldwide economic and capital markets foster the convergence of financial reporting standards (Ball, 2006). Standard setters, such as the IASB and FASB, pursue the goal of making international accounting more similar. This convergence process led to an alignment of the accounting for corporate pension plans between U.S.-GAAP and IFRS.

In the previous section, I identified funding practices as major difference between German and U.S. pension regulation. As a consequence, pension plans in Germany are often internally funded and show large pension deficits (e.g., Fasshauer and Glaum, 2008), while U.S. firms experienced several decades with overfunded pension plans (e.g., Coronado and Sharpe, 2003). Such differences in the level of funding might influence the assessment of pension plans and related research (Glaum, 2009). Nevertheless, most of our knowledge about the accounting and valuation of corporate pension plans is based on U.S. evidence.

An exception is the paper by Fasshauer and Glaum (2008), who investigate whether investors concentrate more on pension information recognized in the balance sheet or in the income statement. Prior U.S. literature only provides inconclusive results on this question, suggesting that the relative importance of balance sheet versus income information might depend on the level of funding (e.g., Barth et al., 1993; Coronado and Sharpe, 2003). Fasshauer and Glaum examine this question in a German setting, where the average funding level of pension plans is significantly lower than in the U.S. The authors apply a similar research design as previous studies and find balance sheet information to be more important for the value of the firm than income statement information. This finding sheds light on the inconclusive findings of prior literature and supports the notion that the level of funding is an important driver of capital market perception of pension plans.

Further evidence for this argument is provided by research that examines the relation between the level of funding and debt markets in a cross-country context. Cardinale (2007)

explores the relation between the funding of U.S. pension plans and plan sponsors' credit spreads. In the section on additional analysis, the author investigates Japanese and U.K. firms and compares the results with the main findings from the U.S. setting. While debt investors of U.S. firms price on-balance sheet pension obligations three times higher than ordinary leverage, this pattern was not found for Japanese and U.K. firms. In these countries, pension obligations are priced like ordinary leverage. Findings by Gallagher and McKillop (2010) support these results by explicitly investigating an international setting of mainly U.S. and European firms. The authors separate pension plans into funded and unfunded pension obligations and compare the valuation of each item across countries. While obtaining similar results for off-balance sheet obligations across countries, they also find differences in the pricing of recognized pension liabilities across countries. Consistent with Cardinale (2007) pension liabilities of U.S. firms are priced more aggressively than ordinary leverage. They also find this pattern for German firms, in part for U.K. firms, but not in countries like France or the Netherlands. Gallagher and McKillop attribute these findings to differences in the information processing costs of investors across countries.

In summary, papers investigating different country settings provide further evidence consistent with prior U.S. literature, which suggests that the pricing of pension liabilities might depend on the financial health of firms (Barth et al., 1998). Moreover, international studies show that the pricing of on-balance sheet pension liabilities varies across countries and are priced more aggressively in the markets of Germany and the U.S.

4.4.2 Information processing

The second stream of literature investigates the influence of information processing-related factors on market prices. Results of prior research suggest that investors might have problems in processing available information into stock prices. Among these potential problems is the lack of sufficient knowledge about incorporating information on underlying economics of a firm into predictions about future cash flows (Dearman and Shields, 2005). Prior literature also identifies cognitive biases (Hobson and Kachelmeier, 2005) and insufficient attention as potential problems in assessing firm values. Especially for the accounting for corporate pension plans, there are several reasons to suspect that investors might not be fully able to process available information. The accounting for corporate pension plan is complicated and

opaque (e.g., Jin et al., 2006). Due to the long-term nature of pension plans many assumptions have to be made and investors could not easily replicate the calculation of pension obligations. Moreover, the majority of information on corporate pension plans is recognized off the balance sheet or is buried in the notes.

Several papers investigate if financial statement users are able to process information on corporate pension plans into stock prices. To identify potential mispricing, these papers concentrate on value relevance of additional information on the funding status, which is disclosed in the notes. Coronado and Sharpe (2003) investigate a sample of U.S. firms between 1993 and 2001. The authors find that firms with underfunded pension plans are overvalued on average. They attribute these findings to the fixation of investors on earnings and argue that investors do not process information on the funding of corporate pension plans, which are disclosed in the notes. A study by the same authors, conducted five years later, finds the same results, despite of an increased interest in the funding status by investors and analysts (Coronado et al., 2008). Franzoni and Marín (2006) apply a different research method and analyze the influence of pension information on risk-adjusted stock returns. They also find that investors overvalue firms with underfunded pension plans. According to the authors market participants do not fully process available information on the level of funding and therefore do not anticipate negative consequences of the current underfunding on future cash flows and earnings. This interpretation is supported by a study of Picconi (2006), who examines 15,553 firm-year observations between 1988 and 2001. The author finds a significant association between future stock returns and off-balance sheet components of the funding level of pension plans. However, Picconi does not find this association for information recognized on the balance sheet. He interprets this finding as the failure of investors to process information on the funding status that are disclosed in the notes.

Taken together, quite a bit of evidence suggests that investors seem to have problems in processing pension related information. Therefore, several authors (e.g., Barth et al., 2001; Maines and Wahlen, 2006) outline the importance to take into account information-processing related factors in assessing the value relevance of accounting information. However, most of prior studies do expect the value relevance of pension obligations to be the same across firms and do not consider cross-sectional differences. An exception is the already mentioned study by Yu (2013). In his paper he documents that institutional ownership and

the number of analysts following influence the relevance of pension information for firm valuation. Yu uses a mandatory accounting change that obliges firms to recognize previously disclosed information on the funding of pension obligations on the balance sheet. The author finds that the accounting change increases the value relevance for firms with a bad information environment more than for firms with a good information environment. This result suggests that professional market participants, like institutional investors and analysts, have lower information processing costs and influence the pricing of accounting information.

My study contributes to this literature by investigating whether the value relevance of disclosed pension information, namely internal funding, varies with the level of institutional ownership.

4.5 Hypotheses development

4.5.1 Does the pricing of pension information differ from each other?

My first hypothesis examines *whether* the pricing of internally funded and unfunded pension plans differ from each other. Assets of internal pension plans are set aside within sponsoring firms and accordingly do not meet the criteria of plan assets as defined by IAS 19. As a consequence, internally funded pension obligations are recognized in the same way as unfunded pension obligations. Standard setting bodies argue that pension obligations need to be legally separate from sponsoring firms to be protected against consequences of their potential bankruptcies (IAS 19.7). Only those assets can be taken into account in assessing the funding status of plan sponsors. However, actuaries and managers argue that this approach of recognizing internal pension plans leads to reported pension liabilities that do not reflect economic pension liabilities (Zielke, 2009). They consider internal funding as just another way of funding pension obligations, independent from its legal status. In contrast to unfunded pension obligations, internally funded pension obligations do not require cash outflows before actual payments to beneficiaries are due. No additional funding of internally funded pension obligations is required because funds are invested into assets of sponsoring firms. According to this kind of view, internal pension plans have to be considered as funded

pension plans in assessing the overall funding status of firms' pension plans.⁸⁰ Given valuation differences between funded and unfunded pension obligations, documented by previous literature, an answer to the question whether internally funded pension plans are priced like unfunded pension plans sheds light on the above discussion.

In order to make predictions about the valuation of internally funded pension plans, it is important to reflect on how investors price firms, namely through assumptions about cash flows and the discount rate. In discounted cash flow valuation models, firm value V is calculated by

$$V = \sum_{t=1}^T \frac{CF_t}{(1+r)^t}, \quad (1)$$

where T is the life of the asset, CF_t is the estimated cash flow in period t and r is the discount rate reflecting the riskiness of the estimated cash flows. Investors will discriminate between types of funding by adjusting cash flows CF_t if they expect different future cash flow realizations. They will also adjust the discount rate r if they perceive differences in risk between each type of funding.

To derive a hypothesis about the valuation of different pension information, I use the framework for the usefulness of accounting information for firm valuation provided by Maines and Wahlen (2006).⁸¹ In their paper, the authors distinguish three factors that influence accounting information usefulness. First, an economic factor that reflects past, current and future underlying economics of firms such as commercial transactions and events. Second, a reliability factor that displays the underlying economics of a firm in terms of accounting information. Third, an information processing factor, which includes the ability of financial statement users to appropriately use accounting information for firm valuation.

⁸⁰ For example, in a conference on managing pension risks in 2014, managers of E.ON SE and MAN SE treat internal funding as one of five ways of funding corporate pension plans in Germany. Moreover, managers consider specific costs and benefits of external and internal funding for deriving a company-wide pension plan strategy.

⁸¹ Maines and Wahlen (2006) refer to decision usefulness of accounting information in the context of (better) predicting future cash flows. They characterize future cash flows by their amount, timing and uncertainty. In this study, according to equation (1), I do not consider uncertainty of future cash flows in the calculation of future cash flows CF_t but in the calculation of the discount rate r .

4.5.1.1 Economic factor

According to the framework of Maines and Wahlen (2006), the underlying economics of a firm are the first factor that influences the pricing of a firm. Underlying economics determine the amount, timing and uncertainty of future cash flows, which are represented in equation (1) by CF , t and r , respectively.

Internally funded and unfunded pension obligations differ in the timing (t) and amount of cash flows (CF) because of their contrasting funding characteristics. While external pension plans require cash outflows to funding agencies before actual payments to retirees are due, internal pension plans require cash outflows at the moment when the actual payments to retirees fall due. This contrast yields differences in the timing of cash outflows for each type of pension plan. Also, the amount of cash outflows differs across funding alternatives. While internal funding leads to constant cash outflows during the retirement of beneficiaries, cash outflows for external funding varies, due to regulatory requirements, contractual details and calculation methods.⁸² However, incorporating information on the timing and amount of cash flows into equation (1) does not yield pricing differences, as the present values of cash flows are the same for funding alternatives if the discount rate (r) does not differ.

Internally funded and unfunded pension obligations do also differ in terms of riskiness of cash flows (r). The main approach to analyze the risk of debt is the structural model, established by Merton (1974). The structural approach derives the risk of debt by characterizing corporate liabilities as contingent claims on the assets of a firm (Giesecke, 2004; Blake, 2008). In such models, debt investors evaluate the risk of debt by assessing its probability of default. The probability of default is determined by three factors (Sundaresan, 2013).⁸³

First, it is determined by the capital structure of the firm. The calculation of defined benefit obligations is the same for both funding alternatives and all kinds of pension

⁸² See section 4.2 for a detailed description of the cash flow consequences of funding alternatives.

⁸³ See 4.11.3 for a detailed description of the Merton Model (1974) in the context of pension accounting.

obligations are considered in the analysis of firm value, which equals the gross approach.⁸⁴ Therefore, the capital structure does not differ between funding alternatives.

Second, the probability of default is determined by the volatility of related assets, commonly referred to as business risk (Sundaresan, 2013). This factor does not differ between internally funded and unfunded pension plans, because funds are invested in the assets of the firm for each alternative. However, this is different for externally funded pension plans. While internally funded pension plans invest in assets of the firm, externally funded pension plans invest in several asset classes such as bonds or real estate. These asset classes, as well as assets of the firms are all subject to different inherent asset volatilities. As volatility is a major determinant of the probability of default, the risk associated with each kind of funding also differs.

Third, the probability of default is also characterized by the maturity of debt. For internal funding, cash outflows occur when actual payments of pension benefits fall due. The principle of external funding as well as pension regulations require pre-funding of external pension plans. If external pension plans are not funded with sufficient pension assets, firms are required to cover the shortfall with additional funds before claims fall due. Therefore, the maturity of debt for unfunded pension obligations is much shorter than for internally funded pension obligations.⁸⁵ However, the maturity of debt does not differ between internally funded and externally funded pension plans. The actual payments to retirees are independent from the way of funding, hence the maturity of debt for internally and externally funded pension obligations is also the same. Figure 4 summarizes the determinants of the probability of default according to the type of funding of pension obligations.

Differences in risk lead to adjustments of the discount rate r in equation (1) by both, debt and equity investors. For example, if the risk of one funding alternative is higher, the cost of capital will increase accordingly, as debt investors will adjust credit spreads upwards (Cardinale, 2007) and equity investors will demand a higher rate of return to be compensated for bearing higher risk (Gwangheon and Sarkar, 2007; Chava and Purnanandam, 2010).

⁸⁴ The difference between the net approach and the gross approach is also outlined in section 4.2 in the description of the incorporation of corporate pension plans into credit ratings.

⁸⁵ See section 4.2 for a detailed description of funding requirements, cash flow consequences and risk characteristics of internal and external pension plans.

In summary, the economic factor might lead to differences between internally funded and unfunded pension obligations. While differences in the amount and timing of cash flows do not affect valuation, differences in risk might affect valuation through adjusted discount rates. I expect discount rates on average to be lower for internally funded pension obligations, because the maturity of debt is usually longer for internal funding than for unfunded pension obligations.

4.5.1.2 Reliability factor

The second factor that influences the usefulness of accounting information for firm valuation is the reliability factor, which represents the underlying economics in a set of financial statements. One component of this factor is the recognition of relevant economic constructs in the set of financial statement. As described in section 4.2, there are no differences between internally funded and unfunded pension plans, because both are recognized as pension liabilities on the balance sheet. Another component is the reliability of the recognized accounting information on which the valuation is based on. In their paper, Maines and Wahlen (2006, p. 403) define reliability as:

Reliability is the degree to which a piece of accounting information (1) uses an accounting construct that objectively represents the underlying economic construct it purports to represent, and (2) measures that construct without bias or error using the measurement attribute it purports to use.

The authors emphasize reliability as an inherent characteristic of the accounting information and separate it from the use of the accounting information. As the final costs of each type of pension plan are uncertain, investors have to assess the reliability of the disclosures that reveal potential differences between internal and external funding of pension obligations. However, reliability of information can be impaired by measurement errors inherent in pension information and by management-induced bias (Maines and Wahlen, 2006).

Measurement error refers to the subjective nature of pension measures caused by the quantity of unobservable valuation inputs. These inputs make pension information susceptible to measurement error and to a noisy measure of underlying economics (Barr, 2009; Napier, 2009; Blankley, 2010). As outlined in section 4.2, assumptions used as

valuation inputs, such as life expectancy or inflation, change over time. Due to the long-term nature of pension obligations even small changes of actuarial assumptions can result in high adjustments of the pension obligation. If measurement error is expected to differ systematically across internal and external funding, investor will adjust the weight they put on the information in the calculation of firm valuation.

Regarding management-induced bias, the reliability of information is expected to be linked with the reliability of the source of the information (Song et al., 2010). As described in the section 4.4 on prior literature, managers are prone to use pension information in a non-neutral fashion that arises from various managers' incentives. If information about economic differences between funding alternatives is unreliable due to management-induced bias, users will adjust their valuation of the disclosure, or will reduce the weight of it, which would result in non-significant association.

However, as outlined in section 4.2, the basis of the calculation of defined benefit obligations is independent from the way of funding. Any measurement error or management-induced bias in the calculation of defined benefit obligations affect both ways of funding in the same manner. Thus, I do not expect valuation differences caused by differences in the second factor of the framework provided by Maines and Wahlen (2006).

4.5.1.3 Information processing factor

The information processing factor is the third factor in the framework of Maines and Wahlen (2006). The usefulness of accounting information for company valuation depends on the possibility to predict future cash flows (CF) and to assess their risk (r) with the help of current financial statements. Hence, the information processing factor represents on the one hand the predictive relation of current accounting information and future cash flows, on the other hand the ability of investors to process current accounting information and to form expectations about future cash flows.

According to Maines and Wahlen (2006), a weak predictive relation between current-period accounting information and future cash flows could be caused by factors such as low reliability of accounting amounts or random realizations of future cash flows. As the calculation of pension obligations as well as future realizations of payments to retirees are independent from the way of funding, there are no differences in the reliability or realization

of cash flows. Therefore, I do not expect differences in the predictive relation of current-period accounting information and future cash flows between the types of funding.

Regarding the ability of investors to process available information, several papers find problems of investors to properly incorporate information into firm value. As outlined in the section on prior literature, investors may lack knowledge about the incorporation of accounting information on underlying economics into predictions about future cash flows (Dearman and Shields, 2005). Investors may also make random errors, face cognitive biases (Hobson and Kachelmeier, 2005), or assign not enough attention to disclosures to process all available information (Hirshleifer and Teoh, 2003).

4.5.1.4 *Synthesis*

I consider these three factors for developing my first hypothesis examining *whether* the pricing of internally funded and unfunded pension plans differ from each other.

For the reliability factor that includes the representation of underlying economics in a set of financial statements, I do not expect pricing differences between internal and external pension plans, as both plans are subject to the same calculation methods, potential measurement errors and management-induced biases. In contrast, the economic factor is expected to yield pricing differences between internal and external pension plans. The maturity of debt is lower for unfunded obligations than for internal ones. Because of this difference, investors will discriminate between funding statuses of pension plans by adjusting the discount rate r in equation (1). If the difference in the maturity of pension obligations between funding alternatives is high enough, internal funding should lead to lower valuation multiples. However, the predictive factor and the establishment of a statutory pension insurance fund provide tension against the pricing of economic differences between internal and external funding.

The ability of investors to process available information and to form expectations of future cash flows is crucial for pricing differences in underlying economics. If investors fail to incorporate the information about the differences of internal and external funding or face higher costs in processing available information, valuation multiples of unfunded and internally funded obligations are expected to be the same. The latter argument is supported by studies of Franzoni and Marín (2006) and Picconi (2006), who find problems of financial

statement users to incorporate pension information that are disclosed in the footnotes. Also, the introduction of a statutory pension insurance fund may interfere the pricing of economic differences of pension plans. Pension promises are paid by the insurance fund if the plan sponsors have become insolvent and the pension funding agency is not able to cover all claims.⁸⁶ Hence, the risk of a pension plan is in part transferred to the insurance fund (Blake et al., 2007) and might not be fully priced by equity investors of sponsoring firms. Thus, my first hypothesis is:

H₁: The valuation of internally funded pension obligations does not differ from the valuation of unfunded pension obligation.

4.5.2 Does the pricing of pension information differ across firms?

Most of prior studies expect the value relevance of pension liabilities to be the same across all firms and do not consider cross-sectional differences. However, findings by Barth et al. (1998) and Yu (2013) indicate that the pricing of pension obligations is affected by the financial health of the firm and by information processing-related factors, respectively.⁸⁷ Therefore, I examine in my second set of hypotheses *how* the valuation of internal and external funding of pension obligations differs across the information processing factor and the economic factor.

4.5.2.1 Differences in the information processing factor

Consistent with my discussion on reasons why investors are unlikely to adjust the valuation of internally funded and unfunded pension obligations, I test whether the value relevance of these alternatives varies across differences in the information processing factor. In the development of my first hypotheses, I discuss potential information processing problems that may influence the pricing of the differences between internal funding and unfunded pensions. According to Maines and Wahlen (2006) investors do not adjust for differences in accounting information when they lack knowledge about the underlying economic construct or face high

⁸⁶ See section 4.3 for a more detailed description of the statutory pension insurance fund in Germany.

⁸⁷ As outlined in the derivation of hypothesis 1, I do not expect differences in the reliability of information between information on internal and external funding. Therefore, I do not test how the valuation of funding alternatives differs across the reliability factor.

cognitive costs of adjusting information. Recent research suggests that these information processing problems are less pronounced among institutional investors, who face lower information processing costs due to higher competence and attention. For example, Yu (2013) uses an accounting change that requires companies to recognize previously disclosed off-balance-sheet pension liabilities as component of other comprehensive income to examine the influence of institutional investors on the value relevance of accounting information. The author shows that the value relevance of previously disclosed pension liabilities increases more pronounced for firms with a lower portion of institutional investors. In addition, evidence by Müller et al. (2015) suggest that information processing costs complement the factor of reliability as explanation of pricing differences between accounting amounts. Consistent with this argumentation, I expect:

H_{2A}: The valuation of internally funded pension obligations does differ from the valuation of unfunded pension obligations for firms with a higher level of investors that are subject to lower information processing costs.

4.5.2.2 Differences in economic factor

Regarding the economic factor, I expect that higher levels of risk will cause pricing differences between internally funded and unfunded pension obligations. In particular, I assume the pricing multiple of unfunded pension obligations to be greater for firms facing higher levels of risk. At the same time, I expect the pricing multiple of internally funded pension plans to be similar across different levels of risk.

In the development of the first hypothesis, I describe the capital structure of firms as a major determinant of the assessment of risk by equity investors. Prior research finds a non-linear function between risk and firm value (Merton, 1992) and documents that the valuation of balance sheet accounting information is affected by the financial health of the firm (Beaver, 2002). For example, Barth et al. (1998) show that information on balance sheet amounts become more value relevant for firms that are in financial distress. The authors argue that the role of the balance sheet to provide information on debt becomes more prevalent for firms that face financial problems. Results of Collins et al. (1999) support the notion of financial health as important factor in assessing the value relevance of accounting information. The authors complement the argumentation of Barth et al. (1998) by suggesting

that for firms that make losses, investors evaluate balance sheet information as better proxy for future earnings than current income statement information.

However, varying capital structures differently affect the valuation of unfunded and internally funded pension obligations because of their maturity. Internal pension plans require cash outflows, when the actual payments to retirees fall due. In contrast, unfunded pension obligations are subject to regulations that require firms to externally set aside assets within a short period of time. The required cash outflows will affect firms more negatively if they face higher levels of leverage and especially liquidity problems. For those firms, additional cash outflows cause additional costs, e.g., in terms of underinvestment (e.g., Chen and Merville, 1999) or deteriorating costs of capital (e.g., Altman and Hotchkiss, 2005). Findings by Jin et al. (2006) and McKillop and Pogue (2009) show that investors take into account the risk that arises from pension plans when valuing firms. Thus, I hypothesize:

H_{2B}: The valuation of internally funded pension obligations does differ from the valuation of unfunded pension obligations for firms that are subject to higher financial risk.

4.6 Research design

The choice of a valuation model to study the relation between accounting information and equity values depends on the underlying research question and econometrical considerations. According to Barth et al. (2001), papers that investigate the timeliness of the incorporation of accounting information into market values should choose a price change (return model). Though, studies interested in the question, which information is reflected in firm value should consider a valuation model examining price levels. As this study analyzes whether internal funding is priced like unfunded pension plans and further tests cross-sectional valuation differences, a price levels approach is more suitable for the underlying research question.⁸⁸

⁸⁸ Kothari and Zimmerman (1995) show that return models have more biased slope coefficients compared to price models, as the latter is economically better specified. However, econometrically, in comparison to return models, price level models may suffer from a reduced explanatory power due to omitted variables. To mitigate the problem of omitted variables, I estimate a price changes model in the section of additional analysis.

4.6.1 Levels model without considering cross-sectional differences

As outlined in the section on prior literature, pension assets and liabilities are perceived by investors as value-relevant but tend to have pricing multiples that differ from theoretical values (Barth, 2001). I build on this research by examining whether pension liability components are priced differently from each other and how economic and information processing differences influence this pricing.

Consistent with prior literature (Hann et al., 2007; Yu, 2013), I estimate the following base regression to test my first hypothesis:⁸⁹

$$\begin{aligned} MVE_{it} = & \alpha_0 + \alpha_1 Assets_{it} + \alpha_2 NPTL_{it} \\ & + \alpha_3 DBO_unf_{it} + \alpha_4 DBO_int_{it} + \alpha_5 DBO_ext_{it} \\ & + \alpha_6 NI - PX_{it} + \alpha_7 PX_{it} + \alpha_8 MTB_{it} + \varepsilon_{it}. \end{aligned} \quad (2)$$

See 3.9 for detailed definitions of all variables. The dependent variable MVE_{it} is the market value of equity of firm i three months after fiscal year of year t (hereafter I drop the explanation of the subscripts). The independent variables consist of $NPTL$ that are non-pension total liabilities and of $Assets$, which are total assets of a firm including its pension assets. This procedure equals the gross approach of recognizing externally funded pension assets and obligations on the balance sheet. This approach offers the advantage of allowing multiples on various liability items to vary and, for this study, it allows to compare internal funding with both, externally funded and unfunded pension obligations, at the same time. Accordingly, I decompose defined benefit obligations of each firm into three components, of which DBO_ext is the portion of defined benefit obligations that is funded by plan assets, DBO_int is the portion of defined benefit obligations that is funded internally and DBO_unf , which is the portion of defined benefit obligation that is neither funded by plan assets nor by internal funds. To examine the effect of pension costs on the market value of equity, I also decompose net income of a firm into net income before pension costs and pension costs, which are $NI-PX$ and PX , respectively. Moreover, I also include the market-to-book ratio MTB to control for information on growth opportunities not reflected in financial statements.

⁸⁹ See 4.11.2 for an illustration of the decomposition of book value of equity into balance sheet variables used to test my hypotheses.

Consistent with Yu (2013), I deflate all variables except *MTB* by current-year sales. Considering the panel structure of the data, residuals could be correlated across time and across firms (Petersen, 2009). Therefore, I use clustered standard errors along these two dimensions, since Gow et al. (2010) show that clustered standard errors by firm and time produce less biased estimates.

If internally funded and unfunded pension obligations do have explanatory power for market prices but are priced differently from each other, *DBO_unf* and *DBO_int* should be negative, significantly different from zero and significantly different from each other.

4.6.2 Levels model considering cross-sectional differences

The second set of hypotheses examines how differences in information processing costs of investors and differences in the underlying economics of firms affect the pricing of internally funded and unfunded pension obligations. To test these differences, I introduce variables *INF* as proxy for information processing costs and *ECO* as proxy for economic differences.

Based on prior research (e.g., Yu, 2013), I introduce the proportion of institutional shareholders as proxy for information processing costs (*INF*). Institutional investors usually have more experience in analyzing accounting information than private investors and also have strong incentives to build up expertise (Callen et al., 2005). Research by Ayers and Freeman (2003) and Bartov et al. (2000) show that institutional investors also have advantages in gathering and processing information. Overall, literature suggests that institutional investors are more sophisticated investors; hence, face lower information processing costs.

I further expect the pricing of funding alternatives to differ for firms that face different underlying economic risk (Barth et al., 1998). That is, for firms with higher financial risk, unfunded pension obligations imply higher risk than internally funded pension obligations. In contrast to internal funding, firms with unfunded pension plans suffer from the risk of additional cash outflows, especially if they are financially constraint. Barthelme, Kiosse and Sellhorn (2019) outline the importance of pension induced financial statement volatility as risk factor that affects management pension asset allocation decisions. Additionally, the second paper of this theses shows the respective effect on investors (Barthelme, 2022). Consistently, I expect this risk factor that captures the short-term risk of pensions, e.g., in

breaking debt covenants, to be value relevant for investors in the long run as well. Therefore, I introduce the exposure of firms' book value of equity to the size of the pension plan (*Exp*), measured as the ratio of DBO to book value of equity as proxy for *ECO* to measure the short-term aspects of financial risk. Moreover, I use the leverage of firms (*LEV*) as second proxy for *ECO* to measure the long-term aspects of financial risk, as a large body of literature documents increasing leverage as reason for higher financial risk (e.g., Andrade and Kaplan, 1998; Molina, 2005).⁹⁰

Turning to H_{2A} and H_{2B} , I extend the base model to test whether information processing costs and economic differences affect the valuation of funding alternatives.

$$\begin{aligned}
 MVE_{it} = & \beta_0 + \beta_1 Assets_{it} + \beta_2 NPTL_{it} \\
 & + \beta_3 DBO_unf_{it} + \beta_4 DBO_unf_{it} \times TREAT_{it} \\
 & + \beta_5 DBO_int_{it} + \beta_6 DBO_int_{it} \times TREAT_{it} \\
 & + \beta_7 DBO_ext_{it} + \beta_8 DBO_ext_{it} \times TREAT_{it} \\
 & + \beta_9 NI - PX_{it} + \beta_{10} PX_{it} + \beta_{11} MTB_{it} + \varepsilon_{it}.
 \end{aligned} \tag{3}$$

Equation (3) is basically the same as equation (2) with the exception of the introduction of the interaction term *TREAT* as indicator variables for proxies *INF* and *ECO*. The following paragraph describes the calculation of the interaction terms *INF* and *ECO* in the context of equation (3).

Consistent with prior literature, I use a categorical classification for information processing costs to test for a non-linear relation with the dependent variable (e.g., Yu, 2013). Specifically, I differentiate information processing costs into five groups (ranging from 0 to 4), depending on the percentage of shares held by institutional investors. Group 0 (4) accounts for the group with the lowest (highest) percentage of institutional shareholders. Afterwards, I scale the group numbers by 4 leading to scaled ranks, ranging between 0 and 1. This procedure enhances the power of the tests (Collins et al., 2003) and allows for an easier interpretation of the findings. All other variables in the model are defined as in equation (2). The same procedure is applied for variables *EXP* and *LEV* used as proxy for economic differences (*ECO*), where the rank of 0 (1) indicates low (high) financial risk.

⁹⁰ In the sensitivity analysis I test alternative proxies for the financial risk of firms.

To analyze H_{2A} and H_{2B} , the coefficients β_3 , β_4 , β_5 and β_6 are of particular importance. Coefficient β_3 accounts for the value relevance of unfunded pension obligations for firms with the lowest percentage of institutional investors ($INF = 0$). Coefficient β_4 measures the incremental effect of INF on the change of the value relevance of unfunded pension obligations. Accordingly, the coefficient β_5 can be interpreted as the value relevance of internally funded pension obligations for firms with the lowest percentage of institutional investors and coefficient β_6 as the incremental effect of INF on the change of the value relevance of internally funded pension obligations. I calculated the scaled rank of INF that varies between 0 and 1. Therefore, the sum of the coefficients β_3 and β_4 equals the value relevance of unfunded pension obligations for firms with the highest percentage of institutional investors ($INF = 1$). Accordingly, the sum of the coefficients β_5 and β_6 measures the value relevance of internally funded pension obligations for firms with the highest percentage of institutional investors ($INF = 1$). The same rational applies for the interactions with economic differences measured as financial risk (ECO).

If financial statement users have problems of processing information about the underlying economics of pension liabilities, I expect the valuation of internally funded and unfunded pension obligations to differ from each other for firms with the highest INF rank. Hence, the sum of β_3 and β_4 should be different from the sum of β_5 and β_6 . Regarding the effect of economic differences across firms (ECO) on the value relevance of internally funded and unfunded pension obligations, I assume the valuation of unfunded pension obligations to differ for firms with the higher levels of financial risk ($ECO = 1$). In contrast, I predict no (or only small) effects of financial risk on the valuation of internally funded pension obligations.

4.7 Sample selection and descriptive statistics

4.7.1 Sample selection

Panel A of Table 1 delineates the sample selection process. The sample firms were initially identified from the Prime Standard for shares of Deutsche Börse Group. The Prime Standard comprises 340 shares and requires compliance with transparency standards that go beyond the minimum requirements set by the European Union. These transparency standards include, for example, the implementation of international accounting standards and the publication of

quarterly reports in German and English. I obtain stock price information and financial statement data from Worldscope. Furthermore, I hand-collected information on the funding of defined benefit pension plans from annual reports, provided by Perfect Information database. Due to data availability, the sample period spans 22 fiscal years from 1999 to 2020. I eliminate firm-year observations in which firms do not report information on defined benefit pension plans, internal funding of pension obligations, plan assets and in which firms are not publicly traded. To be consistent with prior literature on the value relevance of pension information (e.g., Yu, 2013; Picconi, 2006), I also exclude financial firms with two-digit SIC codes ranging from 60 to 69. Furthermore, I also delete firm-year observations for firms that miss data to calculate test variables and for firms that do not report under IFRS. In the main analyses, I use a balanced sample over time by excluding firms with less than 10 years to minimize distortions caused by a fluctuation of firms. This procedure yields a final sample of 905 firm-year observations derived from 58 unique firms.

Panel B of Table 1 provides an overview of firm-year observations per year of the sample period. The illustration shows that from 1999 to 2012 the number of firms providing information on internally funded defined benefit obligations is rising. However, beginning in 2013 the number is declining to a total of 72 firms in 2022. The sharp decrease in 2013 could be attributable to the introduction of IAS 19R that required firms to revisit their pension plan disclosures to meet the requirements of the new standard. The amended standard does not provide concrete guidance to the disclosures of internally funded defined benefit obligations. Given the long-term nature of pension plans, it seems obvious that some of the sample firms discontinue to provide information on this type of funding.

4.7.2 Descriptive statistics

Panel A of Table 2 presents descriptive statistics of main variables. The median of internal funding (*DBO_int*) of defined benefit obligations is 89 million of Euros. In comparison, external funding (*DBO_ext*) accounts for a median of 157 million of Euros, suggesting that firms on average choose external funding over internal funding in absolute terms. The median of the unfunded portion of defined benefit obligations (*DBO_unf*) is 27 million of Euros. The relation between internal funding and unfunded DBO shows that internal funding is about 3 times the number of unfunded pension obligations. This observation is true for the Q25 and

Q75 as well. Hence, the main part of recognized pension liability is not caused by underfunded pension plans, but by internally funded pension obligations. Therefore, the question whether both components of the pension liability are priced differently from each other has important implications for the overall assessment of firms.

An untabulated time series analyses of the median of test variables confirms this observation ($DBO_{int} > DBO_{unf}$) over time. The overview across time also outlines the impact of economic crises in years 2008, 2012 and 2020 by showing a decrease in the market value of equity of firms. This observation is addressed in more detail the section on sensitivity analyses by analyzing different subsamples and by examining the effect of specific years on test results. Until 2005, the portion of internal funding exceeds the portion of external funding. Afterwards, the level of internal funding decreased slowly to 26% of external funding in 2020.

The economic significance of pension obligations for sample firms is demonstrated by comparing the total DBO of firms (equaling the sum of DBO_{ext} , DBO_{int} and DBO_{unf}) to their non-pension liabilities (median: 14% of $NPTL$) or their market value of equity (median: 13% of MVE). These numbers are even higher for the average numbers of variables presented in the first column of the overview, summing up to 24% of $NPTL$ and 41% of MVE , respectively. The higher numbers for the averages indicated a skewed distribution of variables across the sample, highlighting the importance of outlier treatment and subsample analyses that are addressed in the remainder of the paper.

Panel B of Table 2 provides the correlation matrix for the main variables. Spearman (Pearson) correlations are shown above (below) the diagonal. The market value of equity (MVE) is significantly correlated with $Assets$ and $NPTL$, suggesting the existence of a scale effect and the importance of controlling for other accounting items. The correlation between market value of equity and pension variables is significant at the 1%-level, but not as high as for $Assets$ and $NPTL$. The correlation between DBO_{int} and DBO_{unf} is significantly positive, but smaller in magnitude ($r_{Spearman} = 0.44$; $r_{Pearson} = 0.30$). Also, the correlation between DBO_{int} and DBO_{ext} is significantly positive and high in magnitude. These findings outline the importance of internal funding as alternative way of funding corporate pension plans. The Pearson correlations (except for DBO_{unf} and $NI-PX$) are generally smaller compared to the corresponding Spearman correlations. Pearson correlations assume

that the relation between two variables is linear, while Spearman correlations accommodate a non-linear relation. This finding suggests that there are cross-sectional differences between test variables (Yu, 2013). I address potential non-linear relations in my second set of hypotheses, by analyzing valuation differences across different levels of institutional ownership and across economic differences.

4.8 Empirical results

4.8.1 Value relevance of pension liability components

The first hypothesis tests whether the pricing of internally funded and unfunded pension plans differ from each other. Panel A of Table 3 presents results of the regression of *MVE* on pension variables. Column (1) of Panel A shows the basis regression of prior literature, which does not distinguish between different components of pension liabilities. The coefficient on *PL* is significantly negative and with a value of -2.53 (*t*-statistic = 6.00). This finding is consistent with prior literature (Fasshauer and Glaum, 2008), suggesting that pension liabilities are priced more aggressively than ordinary debt. The coefficient on *DBO_ext* is negative and significantly different from zero (coefficient = -1.93, *t*-statistic = 4.71), corroborating that off-balance sheet pension obligations are perceived by investors as assets of the firm. Also, in line with prior literature, the pricing multiple of off-balance pension obligations differs from recognized pension liabilities and tends to be the same as the multiple on recognized liabilities (*NPTL* coefficient = -2.03, *t*-statistic = 7.07). Consistent with predictions, all other variables are also significant and have the expected sign, except for the net income less pension costs (*NI-PX*). The coefficient on *PX* is significant and high in magnitude (coefficient = -7.26, *t*-statistic = 1.71), which is similar to prior findings for German settings (Fasshauer and Glaum 2008).

Column (2) of Panel A presents the estimation results for equation (2), which is the primary test of H_1 . The main coefficients of interest are *DBO_unf* and *DBO_int*, which represent the two components of the pension liability. The coefficient on *DBO_unf* is negative and significantly different from zero (coefficient = -2.03, *t*-statistic = 1.86). Similarly, the coefficient on *DBO_int* is significantly negative (coefficient = -2.65, *t*-statistic = 6.74). Both components of the pension liability are associated with market values. The coefficient on internal funding of -2.65 suggests that internally funded pension obligations

are priced similar to unfunded pension obligations and that both components are priced similar to the aggregate measure *PL*. This finding is not in contrast to the valuation of externally funded pension obligations. The coefficient on *DBO_ext* is also significantly negative and the pricing multiple is similar (coefficient = -2.06, *t*-statistic = 4.78). Consistent with results in column (1), the coefficient on *DBO_ext* suggests that externally funded pension obligations are valued similar to *NPTL* and with a discount to pension liability components. The coefficients on the other variables of the DBO model in column (2) are broadly in line with results of the liability model in column (1). The coefficients on *Assets*, and *MTB* are significantly positive (*t*-statistics = 8.16 and 10.76, respectively). The coefficients on P&L variables *NI-PX* and *PX* are not significantly different from zero.

Panel B of Table 3 presents findings on whether pension information is priced different from each other and different from non-pension information. Column (1) of Panel B shows that the coefficient on *PL* is not significantly different from the coefficient on *NPTL* (*p*-value = 0.158) and not significantly different from externally funded pension obligations (*p*-value = 0.165). This result shows that the higher coefficient of *PL* in the estimation presented in column (1) of Panel A is not significantly different than off-balance sheet pension liabilities and ordinary debt. Similar, the coefficient on *DBO_ext* is not significantly different from the coefficient on *NPTL* (untabulated F-statistic = 0.15, *p*-value = 0.700). Column (2) of Panel B shows that the coefficients on *DBO_unf* and *DBO_int* are not significantly different from each other (*p*-value = 0.489). Furthermore, *DBO_unf* and *DBO_int* are both priced not significantly different from *DBO_ext* (*p*-value = 0.979 and 0.190, respectively).

These results support initial finding of the regression analysis that both components of the pension liability are not priced differently from each other showing no support for the first hypotheses, that on average internal funding is priced differently than unfunded DBO. Also, both variables do not significantly differ from externally funded pension obligations, supporting the finding of prior literature that externally funded defined benefit obligations are considered as part of the firm by investors.

4.8.2 *The effect of cross-sectional differences*

The second set of hypotheses examines whether the findings on the value relevance of pension information documented in of Table 3 are affected by information processing or economic factors.

4.8.2.1 *Information processing factor*

Table 4 presents cross-sectional results for the information processing factor in column (1) of Panel A, which is the primary test of H_{2A}. Column (1) in Panel B presents coefficient comparisons across pension variables for the lowest and highest rank of institutional ownership (*INF*). The main coefficients of interest are *DBO_int* and *DBO_unf* as well as the interactions of these variables with *INF*.

Regarding the pricing of the pension liability components, Panel A reveals that the coefficient on *DBO_int* is significantly negative (coefficient = -1.84, *t*-statistic = 3.54), providing evidence of the value relevance of internal funding for firms with the lowest rank of institutional ownership. The incremental effect of institutional investors on internal funding *DBO_int* × *INF* is significantly positive (coefficient = 1.25, *t*-statistic = 1.89), suggesting that internal funding is priced less aggressive for firms with more institutional investors. These results are in contrast to the influence of institutional investors on the pricing of unfunded pension obligations. The coefficient on *DBO_unf* is not significantly differently to zero (coefficient = 0.46, *t*-statistic = 0.38), indicating a different pricing to internal funding for firms with the lowest *INF* rank. Also, in contrast to internal funding, the coefficient on the interaction *DBO_unf* × *INF* is significant but negative (coefficient = -4.48, *t*-statistic = 2.34), revealing that unfunded pension obligations are priced more negative for firms with higher levels of institutional ownership. Panel B provides additional analyses, comparing the value relevance of pension information for firms with the lowest and with highest portion of institutional ownership. Results reveal that the pricing of internally funded and unfunded pension obligations differ from each other for firms with the lowest *INF* rank (test statistic = 4.70, *p*-value = 0.030) and the highest *INF* rank (test statistic = 4.34, *p*-value = 0.037). These findings support the second hypothesis (H_{2A}) and show the importance of considering the information environment of firms in the analysis of pension information.

Regarding externally funded pension obligations, results indicate that the valuation of externally funded pension obligations also depends on information processing factors. The coefficient on *DBO_ext* is significant and negative (coefficient = -3.12, *t*-statistic = 3.81), showing that externally funded pension obligations are value relevant for firms with the lowest *INF* rank. Similar to the incremental effect of institutional ownership on internal funding, the coefficient on *DBO_ext* × *INF* is also significantly positive (coefficient = 1.63, *t*-statistic = 2.34), suggesting that an increasing level of institutional investors mitigates the negative valuation multiple on externally funded pension obligations. Panel B reveals that for firms with the lowest and highest *INF* rank, the valuation of externally funded pension obligations is not different to the valuation of internal funding but does differ to the valuation of unfunded pension obligations.

Overall, results in Table 4 indicate that the information processing factor plays a significant role in the pricing of pension obligations. Results in Table 3 show that, on average, internal funding is priced like unfunded pension obligations. However, cross-sectional estimations suggest that this finding is attributable to the failure to account for differences in the information processing factors of investors. Prior literature shows that investors face problems in incorporating disclosed pension information into share prices (Franzoni and Marín, 2006; Picconi, 2006). If institutional investors are a proxy for lower information processing costs of investors, results reveal that market values of firms with more institutional investors are more likely to reflect the underlying economics of corporate pension plans described in section 4.2.

4.8.2.2 *Economic factor*

Regarding the economic factor, Panel A of Table 4 presents estimation results for equation (3), which is the primary test of H_{2B}. Panel B presents coefficient comparisons across pension variables for the lowest and highest rank of economic differences (*ECO*). The main coefficients of interest are *DBO_int* and *DBO_unf* as well as the interactions of these variables with *ECO*.

Column (2) of Panel A presents the regression results for the interaction with firms' exposure to defined benefit pension plans (*EXP*). The coefficient on *DBO_int* is significantly negative (coefficient = -3.21, *t*-statistic = 2.97), while the coefficient on the interaction term

$DBO_{int} \times ECO$ is not significant (coefficient = 1.13, t -statistic = 1.06). These results suggest that investors take into account internal funding for firms with the lowest exposure and that the pricing of internal funding does not differ for firms with higher levels of exposure. Turning to DBO_{unf} , results reveal that unfunded pension obligations are value relevant for firms with the lowest rank of EXP (coefficient = 6.45, t -statistic = 2.28). The coefficient on $DBO_{unf} \times ECO$ is significantly negative (coefficient = -9.39, t -statistic = 2.85), showing that investors evaluate unfunded pension obligations more negative for firms with higher levels of exposure. The coefficients on DBO_{ext} and on the incremental effect of higher exposures on externally funded pension obligations $DBO_{ext} \times ECO$ are both not significant.

Column (2) of Panel B shows again the difference in pricing of pension variables against each other. Results for the lowest level of exposure show no differences in the pricing of each funding variable. However, I do find differences for firms with the highest rank of exposure. For these firms, pricing of internally funded pension obligations differs to the pricing unfunded but not to externally funded pension obligations. Moreover, the pricing of internal and external funding is not significantly different from each other. These results give initial support for H_{2B} that economic differences affect the various components of pension obligations in different ways.

Column (3) of Panel A presents the regression results for the interaction with firms' long-term leverage (LEV). Findings for this proxy are in some respects different as findings for EXP . For example, the interaction $DBO_{int} \times ECO$ is significant and positive (coefficient = 0.94, t -statistic = 2.02). In contrast to findings in column (2), the coefficients on DBO_{unf} and $DBO_{unf} \times ECO$ exhibit different signs but are also significant. Moreover, findings for external funding are now both significant and negative for the lowest rank (DBO_{ext}) and the incremental effect ($DBO_{ext} \times ECO$). The tests of differences in the pricing across pension coefficients in column (3) of Panel B show slightly different results for firms with the lowest rank of long-term leverage. For firms with the lowest level of leverage, the pricing of internal funding does not differ to the pricing of unfunded DBO. In contrast, it differs to the pricing of external funding. For firms with the highest level of leverage the findings are virtually the same as for columns (1) and (2).

Overall, results in Table 4 suggest that the pricing of internal funding and pension information in general is affected by the economic characteristics of firms. For firms with high levels of exposure to defined benefit pension plans or high levels of leverage, the pricing of different ways of funding differs significantly as shown in Panel B, providing support for H_{2B}. That is, differences in the underlying economics of firms differently affect the pricing of pension obligations. This result is consistent with different risk characteristics of funding alternatives described in section 4.2. Finding increasing valuation multiples on unfunded pension obligations but not for firms with higher financial risk, is consistent with negative consequences caused by the requirement to set aside additional assets. This rationale is also applicable to externally funded pension obligations that are also subject to the risk of additional cash outflows, in the event of decreasing values of pension assets. However, this risk of potential cash outflow for externally funded pension obligations is not as severe as the actual cash outflows, which are necessary for unfunded pension obligations. Accordingly, results reveal a lower incremental effect on externally funded pension obligation than on unfunded pension obligations and also a difference in the statistical comparison across each other in Panel B. Consistent with the cash flow characteristics of internal funding, the valuation of this alternative is significantly positively affected by changes of financial risk.

4.9 Sensitivity analysis

In this section, I perform several robustness tests and additional analyses to mitigate potential biases and to consider alternative explanations for my primary test results.

4.9.1 Alternative analyses on information processing factor

4.9.1.1 Foreign investors

In the main tests, I introduce the percentage of institutional investors as proxy for information processing costs (*INF*) in equation (2) to test whether this factor has an influence on the pricing of ways of funding defined benefit obligations. Institutional investors usually are more experienced in analyzing financial statements and do also have advantages in gathering information (Callen et al., 2005; Freeman, 2003). Therefore, differences in the level of institutional ownership should proxy for differences in the costs of investors to process information. Results in Table 4 reveal that the valuation of pension obligation is affected by

the portion of institutional ownership. That is, higher levels of institutional ownership positively (negatively) affect the valuation multiple on internal (unfunded) pension obligations.

The proxy of institutional investors is composed of national and foreign institutional investors. In section 4.2, I describe the recognition rules for internal and external funding of corporate pension plans. Without reading the notes, investors are not able to distinguish internal funding from unfunded pension obligations as components of recognized pension liabilities. However, in other countries, national regulation does not allow firms to internally fund corporate pension plans. Therefore, foreign investors might lack experience and knowledge of analyzing the funding status of corporate pension plans and to assess the consequences of funding alternatives for German firms. To test whether results in Table 4 are affected by foreign investors, I re-estimate equation (2) with *FOREIGN* as proxy for information processing costs (*INF*) that is the portion of foreign institutional investors. If results of the main tests are not driven by foreign investors, coefficients on pension measures should be constant.

Findings presented in Panel A of Table 5 show different results than in the main analyses for the internal funding of pension obligations. Both, *DBO_int* and the incremental effect (*DBO_unf*×*INF*) are not significant in the regression estimation. Unfunded pension obligations are significantly negative associated to the market value of equity for the lowest rank and the incremental effect of higher levels of foreign investors. However, comparing the coefficients on internal funding to unfunded DBO in Panel B of Table 5 shows significant differences across these variables for the lowest and the highest rank of foreign investors. Also, no differences are attributed between internal and external funding of DBO for each level of foreign investors, suggesting that these investors do not affect the overall findings in Table 4.

4.9.1.2 Analysts following

The way accounting information affect share prices is not only influenced by investors, who trade on this information. Another important factor is the overall information environment of a firm. Unsophisticated investors might be able to reduce the informational disadvantage by either investing in financial knowledge or by hiring services of sophisticated investors

(Bhushan, 1989). Therefore, information intermediaries play an important role for firm valuation, as they foster the disseminating of available information (Hong et al., 2000). Prior literature shows that especially analysts have an impact on the pricing of accounting information. For example, findings by Barth and Hutton (2000) show that market values of firms with a higher number of analysts following reflect information on accruals and cash flows faster than firms with viewer analysts following. Another paper by Lang and Lundholm (1993) documents a positive correlation between the number of analysts following and the quality of accounting disclosures. Consistent with prior literature (e.g., Müller et al., 2014; Yu, 2013), I introduce the number of analysts of a firm as alternative measure for (*INF*). If the number of analysts following proxies for the dissemination of information, hence for lower information processing costs, I expect that a higher number of analysts following will lead to pricing differences across funding alternatives.

I calculate the scaled rank of the number of analysts following (*ANALYSTS*) as measure of *INF* in the same way as for previous tests. Column (2) in Table 5 presents the results of the influence of the number of analysts following on the pricing of pension obligations. Consistent with Table 4, I find support for H_{2A}. While the coefficient on *DBO_int* is not significant, the opposite is true for the incremental effect of more analysts following a firm (coefficient = 2.35, *t*-statistic = 2.21), suggesting that internally funded pension obligations are priced less negative for firms with a high number of analysts following.⁹¹ This finding is supported by results of Panel B that show no valuation difference across pension information for low levels, but differences for high levels of analysts covering firms. For the latter findings are virtually the same as presented in previous analyses. The incremental effect of analysts following on the pricing of unfunded pension obligations is significantly negative (coefficient = -7.17, *t*-statistic = 3.23), supporting the findings in Table 4. The coefficient on *DBO_ext* is significantly negative (coefficient = -2.22, *t*-statistic = 3.96) and the coefficient on *DBO_ext* × *INF* is significant and positive (coefficient = 2.43, *t*-statistic = 1.90). These results suggest that an increasing number of analysts following decrease the pricing multiple on externally funded pension obligations.

⁹¹ Due to data availability for the number of analysts following, the sample size of this test is lower than for previous analyses.

Overall, findings suggest that analysts help investors to understand the economic implications of pension information and facilitates the pricing of this information in firm value evaluations.

4.9.2 *Alternative measurements on economic differences*

In the primary test of the influence of economic differences (*ECO*) on the valuation of pension obligations across firms, I use differences in the exposure to DBO (*EXP*) and differences in capital structure risk (*LEV*) as proxy for *ECO*, respectively. These two types of risk should measure the short term and long-term component of financial risk of firms (Lundholm and Sloan, 2007, p. 107-108). However, there is no consensus in literature about the best way to measure financial risk of firms, resulting in various constructs used in empirical research (e.g., Yu, 2013; Jin et al., 2006).

Therefore, I use alternative measures of *EXP* and *LEV* to ensure the robustness of the main results in Table 4. Regression results for the estimation of equation (3), using these alternative measures, are presented in columns (3) and (4) of Table 5. As alternative proxy for *EXP*, exposure to defined benefit obligations is now measured by the relative size of pension assets. As alternative proxies for capital structure risk, *LEV* is now measured with the help of firms' total debt.

Consistent with prior findings, analyses presented in columns (3) and (4) using alternative measures provide support for H_{2B} by showing that the economic factor differently affects the pricing of internally funded and unfunded pension obligations. In both specifications, the coefficients on *DBO_int* are significant and negative and mitigated by the incremental effect $DBO_int \times LEV$. Coefficient comparisons for firms with the lowest and highest rank of *ECO* reveal that unfunded pension obligations are priced significantly different from internal funding for the highest rank but not for the lowest rank. Findings on the pricing of externally funded pension obligations also remain constant for all alternative measures of *ECO*. Results for other non-pension variables remain the same in magnitude and sign across all regression specifications.

Overall, results of using alternative measurement of test variables for *ECO* show that findings of the main analyses are robust in that regard.

4.9.3 *Alternative model specifications*

4.9.3.1 *Dependent variable*

Regarding the dependent variable, I use market value of equity of firm i , measured three months after the end of firm i 's fiscal year t across all tests. Using three months for the measurement procedure is consistent with prior research (e.g., Yu, 2013; Davis-Friday et al., 2004) and should account for the time that investors need for understanding and incorporating all available information into stock prices (Ohlson, 1980). Especially for the incorporation of information on pension liability components that is disclosed in the notes of financial statements, investors need to wait until financial reports are released by firms. However, to ascertain results of this study are not driven by the period of three month, I re-estimate equations (2) and (3), using market value of equity four months and two months after fiscal year end, respectively.

Results in Table 6 show that using four months after fiscal year end for the measurement of market value of equity does not change the results of primary analysis. In the DBO model in column (1) all coefficients have the same sign and magnitude as in the main test presented in Table 3. Coefficient comparisons show once more that internal funding is not priced different from unfunded pension obligations without considering cross-sectional differences. In columns (2) to (4), I test the second set of hypotheses.

Regarding the analysis of cross-sectional differences in the information environment of firms in column (2), findings confirm prior results as all coefficients are virtually the same as in Table 4 in terms of sign and significance. Likewise, column (2) of Panel B reveals no differences. Regarding the analyses of the influence of *ECO*, presented in columns (3) and (4), results of Table 4 are again not affected by the measurement of *MVE*, except for the incremental effect of internal funding. $DBO_{int} \times EXP$ shows the same sign and magnitude but is significant for this specification (F-statistic = 1.77, p -value = 1.95). On the contrary, $DBO_{int} \times LEV$ is not significant anymore. Findings on the coefficient comparisons across pension variables in Panel B stay the same in comparison to findings of Panel B of Table 4.

Overall, results for all hypotheses are robust to alternative measurements of the dependent variable.

For measuring the market value of equity two months after fiscal year reveal, I find untabulated results to be consistent for variables with the lowest rank of differences in *INF* and *ECO*, but less significant results for the incremental effects. Although, these findings are not surprising given the discussion above that much information to assess the impact of defined benefit obligations are provided in the notes of financial statements that are usually not available two months after a new fiscal year begun.

4.9.3.2 Ranking procedure

In my second set of hypotheses, I test how the valuation of internally funded and unfunded pension obligations differs across the information processing factor and the economic factor. I test differences along these two dimensions by ranking differences in information processing costs (*INF*) and economic differences (*ECO*) into quintiles. The use of ranks facilitates the interpretation of results and enhances the statistical power of multivariate analysis (Collins et al., 2003) and is also in line with prior literature (e.g., Yu, 2013). However, results of my main test may be caused by the lowest or highest quintile. Therefore, I re-estimate equation (3) using quartiles as basis of the ranking procedure. Untabulated results are consistent with results in Table 4 in terms of sign and significance, except for the interaction of internal funding with institutional investors ($DBO_{int} \times INF$) that is not significant using quartiles instead of quantiles.

4.9.4 Subsample analysis and tests of hypotheses over time

4.9.4.1 The introduction of IAS 19R

In section 4.7.2, I discuss the relative importance of internal versus external funding over time and noted that, the portion of internal funding exceeds the portion of external funding until 2005. However, the relative importance of internal funding versus external funding declined afterwards. In 2020, the amount of DBO funded externally was about 4 times the amount of internal funding. Nevertheless, internal funding is still economic significant. The DBO recognized as pension liability on the balance sheet is caused by unfunded DBO and internally funded DBO. Whereas internal fundings accounts for 90% in year 2000 and for 68% in 2020 showing its significance over time.

During the sample period, in 2013, a major revision in pension accounting from IAS 19 to IAS 19R was endorsed. The revised standard includes changes like the elimination of the corridor method of recognizing actuarial gains and losses, the replacement of the expected rate of return of plan assets and changes of disclosure requirements. The latter caused a revision and adjustments of firms to their note on pension obligations. IAS 19R did not require firms to change their disclosures regarding the internal funding of defined benefit obligations. However, I experience a couple of firms that change the disclosures on internal funding in the course of revised notes. Accordingly, the number of firms disclosing internal funding decreased with the introduction of IAS 19R, which is graphically illustrated in Panel B of Table 1. To test, whether the introduction of IAS 19R affected the pricing of pension information, I re-estimated estimations for the sample of firms before and after the introduction of IAS 19 R in 2013.

Table 7 presents the results of re-running main analyses for the periods pre and post IAS 19R, respectively. The DBO model depicted in columns (1) and (2) of Panel A and B shows no difference to findings of main analyses and still shows on average no significant pricing differences across funding alternatives for both, pre and post IAS 19R.

Generally, differentiating between pre and post IAS 19R periods does not show inconsistent findings for major test variables, indicating that results of the main analyses are not driven by the introduction of IAS 19R. For all model specification of Table 7, internal funding (*DBO_int*) is significant and negative. The interaction with *INF* shows no difference between pre and post periods. However, for the interaction with *ECO* shown in Panel C, pre and post periods show opposite effects. While the interaction between *DBO_int* \times *EXP* is significant for post periods, *DBO_int* \times *LEV* is found significant in pre periods. Testing the pricing of pension variables against each other for the lowest and highest rank in Panel D of Table 7 shows also different results for pre and post periods for the cross-sectional analyses of *LEV*. Accordingly, post periods seem to have a higher influence on the pricing of pension information when taking the leverage of firms into account. Generally, for all test of pension coefficient, post periods show higher levels of significant differences across pension variables indicating that investors are now more differentiating the provided information on the kind of funding of DBO in their evaluation of firm value.

4.9.4.2 Year of financial crises

My primary sample is comprised of publicly listed German firm over a period of 14 fiscal years, ranging from 1999 to 2012. Like firms of other countries, German firms were affected by the global financial crises, which appeared in 2007. During the financial crises, the role of accounting was criticized for the creation of additional asset volatility caused by fair value accounting (Kothari et al., 2010) and for the failure to account for risk (Magnan and Markarian, 2011). Although, most of the debate concentrated on the role of accounting for financial institutions, this discussion might also affect investors' assessment of the relevance and reliability of accounting information in general (Laux and Leuz, 2009).

As discussed in the section on descriptive statistics, a time-series analyses of test variables (untabulated) shows that in 2008, sample firms suffered from the economic downturn caused by the global financial crisis, resulting in a vast drop in the market value of equity. As a consequence, plan assets decreased in value as well and led to an increase in unfunded pension obligation. The sovereign debt crises, taking place in 2011, did also hit the financials of sample firms, but not as severe as the financial crises. The third economic downturn happened in 2020 with the global outbreak of Covid-19, leading to the same observations for pension variables as in 2008.

My primary research design includes year fixed effects in regression analysis, which should account for the effects of the financial crises. However, to additionally assess the robustness of my findings, I re-estimate equations (2) and (3) without firm-year observations for the fiscal years 2008, 2012 and 2020. Results presented in Table 8 show that findings are consistent with those of the main analysis. In line with H_1 , column (1) of Panel B reports coefficients on *DBO_int* and *DBO_unf* that are not significantly different from each other (untabulated F-statistic = 1.82, p -value = 0.178) and not significantly different from externally funded pension obligations (untabulated F-statistic = 1.94, p -value = 0.164). Results in column (2) provide evidence in favor of H_{2A} by showing the contrasting influence of higher levels of institutional ownership, leading to higher valuation multiples on unfunded pension obligations (coefficient = -4.55, t -statistic = 1.96) and lower valuation multiples on internally funded pension obligations (coefficient = 1.41, t -statistic = 2.02). Columns (3) and (4) in each Panel of Table 8 presents results equal to prior findings and consistent with

H_{2B} that predicts a differing effect of higher financial risk on the pricing of pension liability components, for both proxies *EXP* and *LEV*.

Overall, results from estimating equations (2) and (3) without firm-year observations for years of financial crises remain consistent with primary analysis.

4.9.4.3 *Methods of recognizing actuarial gains and losses*

Findings of this paper suggest that higher numbers of institutional investors and analysts following a firm have an effect on the pricing of funding alternatives. As outlined above, given the complex nature of pension accounting and given that important information, such as the level of internal funding, is buried in the notes, financial statement user might have problems in processing all available information for the valuation of a firm and rely on the advice and signaling of information intermediaries. This could be especially true for choices provided by the accounting standard that adds to the general complexity of pension accounting. For example, before the introduction of IAS 19 R in 2013, the recognition of actuarial gains and losses could be accounted for by using the corridor method or the OCI method as described above.⁹² To analyze, whether the method of recognizing actuarial gains and losses affected the valuation of pension information and the findings of the main analyses presented in Table 3 and 4, I re-estimate regression estimation while differentiation between firms using the OCI method and the corridor method for sample periods before the introduction of IAS 19R in Table 9.

Findings in Panel A and Panel C of Table 9 show lower numbers of significant coefficients for a couple of variables. This finding could be attributable to the decreased sample size caused by the empirical restriction of this sub-sample analysis. Pension information are more often significantly associated with market value of firms for firms using the corridor method. Firms using the OCI method show a significant relation to internal funding only for testing pricing differences across the level of leverage.

Test of pricing differences across pension variables in Panels B and D are consistent with major findings by showing that internal funding is priced different to unfunded pension

⁹² Due to the low number of firms that directly recognized actuarial gains and losses in the P&L in the year in which they occur, I did not separately test this effect.

plans for interactions with test variables *ECO* and *INF* for the highest rank, except for firms using the OCI method.

4.10 Conclusion

This study examines pricing differences between alternative ways of funding corporate pension plans and whether the pricing is affected by cross-sectional differences in information processing costs and underlying economics. Especially, I focus my analysis on the pricing of the two components of pension liabilities – internally funded and unfunded pension obligations.

Prior literature documents that pension liabilities are priced similar to ordinary debt (e.g., Feldstein and Seligman, 1981; Feldstein and Morck, 1983). In contrast, externally funded pension obligations are priced with a discount to ordinary debt (e.g., Landsman, 1986; Barth, 1991). However, prior literature does not distinguish between the two components of pension liabilities, which might be due to its accounting treatment. Accounting standards discriminate in the recognition rules for pension liabilities between internal and external funding. That is, in determine pension liabilities, offsetting of pension assets against pension obligations is only allowed for external funding, but not for internal funding. This treatment leads to pension liabilities that are caused either by internally funded pension plans, or by externally funded pension plans that lack sufficient plan assets to cover all pension obligations. This treatment is caused by legal aspects, but might also mislead investors, because internally funded und unfunded pension obligations usually have inherently different risk characteristics and different cash flow consequences. Based on prior literature, I examine the pricing of pension liabilities by explicitly differentiating internally funded and unfunded pension obligations.

The setting of this study is Germany, because of several unique advantages. Most importantly, in contrast to other countries, German regulators allow firms to use the possibility of internal funding without any quantitative restrictions. Therefore, I am able to exploit a maximum of variation between internal and external funding in my research design. In addition, corporate pension plans are economically significant for German firms and the single-country setting offers the advantage of constant institutional and regulatory factors.

I use the framework for the usefulness of accounting information for firm valuation by Maines and Wahlen (2006) to derive and test two hypotheses. First, I predict and find that on average, the two components of pension liabilities are not priced differently from each other. The second set of hypotheses examines whether this finding is affected by cross-sectional differences in information processing costs of investors and underlying economics of firms. Regarding the former, I use the percentage of institutional ownership as proxy for information processing costs. For firms with low levels of institutional ownership there are no pricing differences across the different kinds of pension obligations. However, consistent with predictions, I find a contrary effect of lower information processing costs on the pricing of internally funded and unfunded pension obligations. Notably, the valuation multiple on internal funding for firms with a high percentage of institutional investors is the same as the valuation multiple on externally funded pension obligations. This finding supports the view that financial statement users might have problems in processing pension information disclosed in the notes and that information intermediaries are able to mitigate these problems. Regarding the economic factor, I assess differences with the help of leverage ratios and firms' exposure to defined benefit pension plans. I predict and find that higher levels of risk will cause the pricing multiple on unfunded pension obligations to become more negative, while the negative pricing multiple on internal funding is mitigated across different levels of risk.

These findings contribute to the literature in several ways. First, this study sheds light on the pricing of different components of pension liabilities. Prior literature distinguishes implications of corporate pension plans for firm valuation conditional on the funding status (e.g., Carroll and Niehaus, 1998). However, results of this paper suggest that the pricing of pension liabilities is not homogeneous across its components. Moreover, this paper highlights the importance to take into account cross-sectional differences in the economics of firms and information processing costs of investors in assessing corporate pension plans. Second, more general, this study also contributes to the debate whether internal pension plans should be accounted for as funded or unfunded pension obligations. Standard setters are in favor of the latter interpretation and argue that internally funded pension assets are not protected in case of plan sponsor's bankruptcy. In contrast, actuaries and managers outline that the recognition of internally funded pension obligations as pension liabilities do not reflect their underlying

economics. Results of this paper indicate that professional investors treat internal funding as funded pension obligations, which supports the view of corporate managers.

Finally, I note that results of this study are subject to several limitations. First, findings from this setting may not generalize to countries in which internal funding is economically less relevant. However, sensitivity analyses show that foreign investor price pension components in a similar way as national investors. Second, my research design is not able to distinguish if investors do not use all information on differences between underlying economics or if these differences are not high enough to have implications for valuation.

4.11 Appendices

4.11.1 Appendix A: Variable Definitions

Panel A: Main Analyses

MVE_{it}	Market value of equity of firm i , measured three months after the end of firm i 's fiscal year t , divided by firm i 's sales of year t , measured at the end of fiscal year t (source: Worldscope data items 05350, 050XX, 05301, 01001).
$Assets_{it}$	Assets of firm i for year t , equal to firm i 's total assets plus firm i 's plan assets, divided by firm i 's sales, all measured at the end of fiscal year t (source: Worldscope data items 02999, 18807, 01001).
$NPTL_{it}$	Non-pension total liabilities of firm i for year t , equal to firm i 's total liabilities minus firm i 's pension liabilities, divided by firm i 's sales, all measured at the end of fiscal year t (source: Worldscope data items 03351, 18821, 01001).
$DBO_{unf_{it}}$	Unfunded portion of defined benefit obligations of firm i for year t , equal to firm i 's pension liabilities minus firm i 's portion of defined benefit obligations funded by internal funds, divided by firm i 's sales, all measured at the end of fiscal year t (sources: hand-collection, Worldscope data items 18821, 01001).
$DBO_{int_{it}}$	Portion of defined benefit obligations funded by internal funds of firm i , divided by firm i 's sales, both measured at the end of fiscal year t (sources: hand-collection, Worldscope data item 01001).
$DBO_{ext_{it}}$	Portion of defined benefit obligations funded by plan assets of firm i for year t , equal to firm i 's plan assets, divided by firm i 's sales, both measured at the end of fiscal year t (source: Worldscope data items 18807, 01001).
$NI-PX_{it}$	Net income before extraordinary items and net periodic pension income or cost of firm i for year t , equal to firm i 's net income before extraordinary items minus firm i 's pension income or cost adjusted for taxes, divided by firm i 's sales, all measured at the end of fiscal year t (source: Worldscope data items 01551, 18801, 01451, 01001).
PX_{it}	Net periodic pension income or cost of firm i for year t , equal to firm i 's pension income or cost, divided by firm i 's sales, both measured at the end of fiscal year t (source: Worldscope data items 18801, 01001).

MTB_{it}	Market-to-book ratio of firm i for year t , equal to market value of equity of firm i , measured three months after the end of firm i 's fiscal year t , divided by book value of equity of firm i , measured at the end of fiscal year t (source: Worldscope data items 05350, 050XX, 05301, 03501).
Exp_{it}	Exposure of firm i 's book value of equity to the size of a pension plan for year t , equal to defined benefit obligations of firm i , divided by firm i 's book value of equity multiplied by 100, both measured at the end of fiscal year t (source: Worldscope data items 18809, 03501).
LIQ_{it}	Liquidity ratio of firm i for year t , equal to cash and equivalents of firm i , divided by firm i 's current liabilities, both measured at the end of fiscal year t (source: Worldscope data items 02001, 03101).
LEV_{it}	Leverage ratio of firm i for year t , equal to long-term debt of firm i , divided by firm i 's total assets, both measured at the end of fiscal year t (source: Worldscope data items 03251, 02999).
PL_{it}	Pension liability of firm i for year t , measured at the end of fiscal year t (source: Worldscope data item 18821).
INF_{it}	The percentage of the proportion of institutional investors for each firm i for year t , measured at the end of fiscal year t (sources: hand-collection; Worldscope data item noshic).
ECO_{it}	Indicator variable of the scaled rank of EXP_{it} and LEV_{it} for each firm i for year t , respectively. Calculated by ranking variables into five groups ranging from 0 to 4 and then scaled by 4.
$TREAT_i$	Indicator variable equal to INF_{it} or ECO_{it} for the respective regression calculation and presentation of results in tables presented in chapter 4.13.

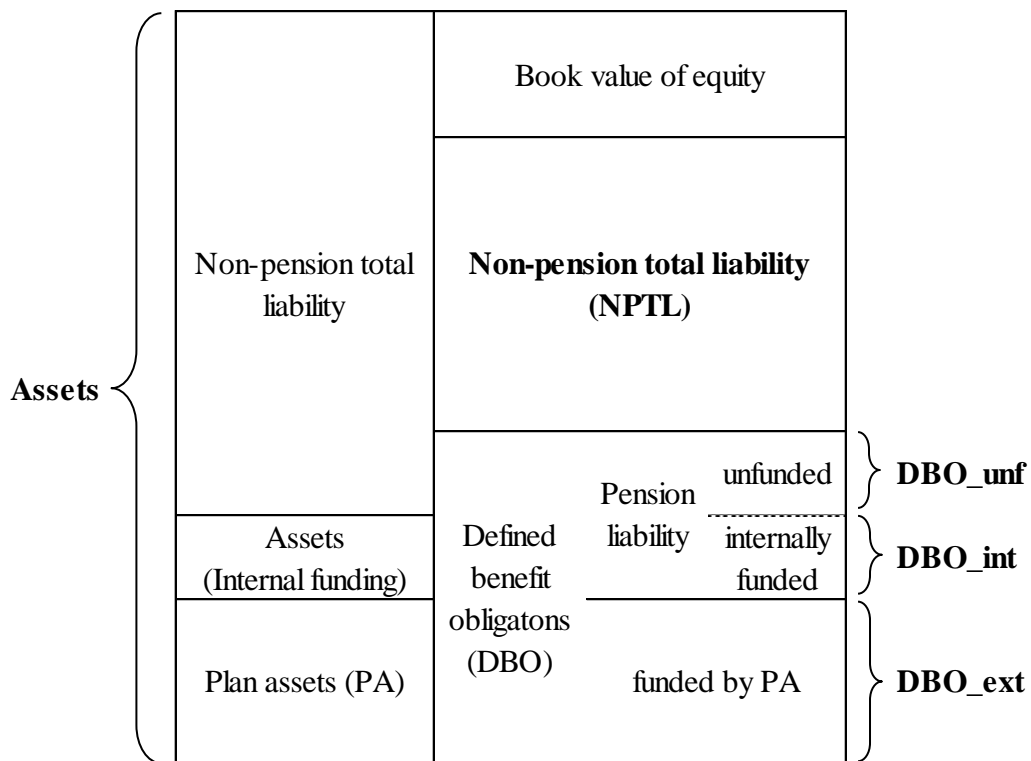
Panel B: Sensitivity Analyses

$FOREIGN_{it}$	The scaled rank of the percentage of foreign investors for each firm i for year t , measured at the end of fiscal year t , calculated by ranking the variable into five groups ranging from 0 to 4 and then scaled by 4 (sources: hand-collection; Worldscope data item noshfr).
$ANALYSTS_{it}$	The scaled rank of the number of analysts following for each firm i for year t , measured at the end of fiscal year t , calculated by ranking the variable into five groups ranging from 0 to 4 and then scaled by 4 (source: hand-collection).
EXP_2_{it}	Exposure of firm i 's book value of equity to the size of a pension plan for year t , equal to pension assets of firm i , divided by firm i 's book value of equity multiplied by 100, both measured at the end of fiscal year t (source: Worldscope data items 18807, 03501).

<i>LEV_{2it}</i>	Leverage ratio of firm <i>i</i> for year <i>t</i> , equal to total debt of firm <i>i</i> , divided by firm <i>i</i> 's total assets, both measured at the end of fiscal year <i>t</i> (source: Worldscope data items 03255, 02999).
<i>MVE_{4it}</i>	Market value of equity of firm <i>i</i> , measured four months after the end of firm <i>i</i> 's fiscal year <i>t</i> , divided by firm <i>i</i> 's sales of year <i>t</i> , measured at the end of fiscal year <i>t</i> (source: Worldscope data items 05350, 050XX, 05301, 01001).
<i>Pre</i>	Indicator variable equal to 1 for periods before the introduction of IAS 19R, ranging from 1999 to 2012, and 0 otherwise.
<i>Post</i>	Indicator variable equal to 1 for periods after the introduction of IAS 19 R, beginning in 2013 until 2020, and 0 otherwise.
<i>Corridor_{it}</i>	Indicator variable equal to 1 for firm <i>i</i> , if the firm is using the corridor method of recognizing actuarial gains and losses in fiscal year <i>t</i> and 0 otherwise.
<i>OCI_{it}</i>	Indicator variable equal to 1 for firm <i>i</i> , if the firm is using the OCI method of recognizing actuarial gains and losses in fiscal year <i>t</i> and 0 otherwise (source: hand-collection).

4.11.2 Appendix B: Decomposition of pension-related balance sheet items

The illustration below shows the decomposition of book value of equity to derive balance sheet variables used in the empirical models of this paper. Bold face indicates balance-sheet variables that are used in the regression model. See Appendix A for a detailed definition of these variables. The major focus of the regression model is to examine pricing differences among pension funding alternatives. Therefore, I separate defined benefit obligations (DBO) into DBO funded by external funds (plan assets), DBO funded by internal funds and DBO that are unfunded. The latter two positions are recorded as pension liability in the balance sheet. The remaining two variables are *non-pension total assets* (NPTL) and *Assets*, of which the latter represents the assets of a firm that are equal to the amount of DBO funded by internal funds.



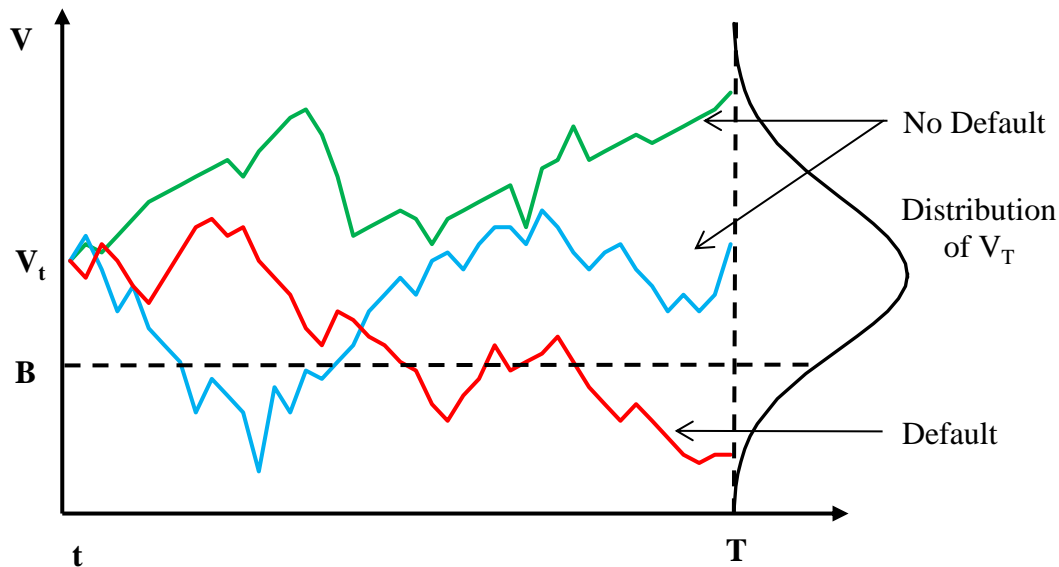
4.11.3 Appendix C: Structural models of risk of debt

Panel A: Classical approach – The Merton Model (1974)

This section outlines the structural model by Merton of 1974 (Merton Model) that will serve as basis for further analysis of the riskiness of debt. In the Merton Model a firm is financed by equity E_t and a single zero bond D_t , with a face value of B payable at maturity T .⁹³ Accordingly, the market value of assets of the firm V_t is

$$V_t = E_t + D_t. \quad (4)$$

This equation shows that the Merton Model is consistent with the first Modigliani-Miller theorem, as firm value of assets depends on the sum of equity and liability but not on their ratio. In the Merton Model default only may happen at time T if the firm is not able to fulfil its payment obligation ($V_T < B$). The illustration below shows default in the Merton Model.



Even if firm value of assets falls below the bond's face value before the bond expires, a firm does not default in case it is above the threshold at maturity T . Consequently, there are two scenarios. First, $V_T < B$, which means the obligation can't be paid by the assets of the

⁹³ Merton analyzed the valuation of corporate debt with three funding alternatives: zero-coupon debt, callable debt, and coupon-bearing debt. As further literature mainly focuses on zero-coupon debt, I use this alternative as starting point for my description of the riskiness of debt. Moreover, I adjust the original specification of Merton (1974) to connect it more easily to my actual study.

firm. In this case, default occurs, and bond investors will take over the firm due to the seniority of their claims. Bond investors will receive V_T and equity is worthless. Second, if $V_T > B$, the asset value exceeds the face value B of the bond. Bond investors will receive B and equity investors $V_T - B$.

The two scenarios for equity investors can be summarized by

$$E_T = \max(V_T - B, 0). \quad (5)$$

The representation of the payoff to equity investors illustrates a call option. The equity investors own a call option on the assets of the firm with a strike price equal to B , the face value of debt. Conversely, the two scenarios for bond investors can be expressed by

$$D_T = \min(B, V_T) = B - \max(0, B - V_T), \quad (6)$$

which equals a put option owned by bond investors with a strike price of B . By formulating the capital structure and the pay-off scenarios in terms of options, the Merton Model is able to use the Black-Scholes formula (Black and Scholes, 1973) and to calculate the value of the options by incorporating risk in terms of probability of default.

Accordingly, the probability of default is defined as

$$PD(t, T) = N \left[-\frac{\log \left(\frac{V_t}{B} \right) + m(T - t)}{\sigma \sqrt{(T - t)}} \right], \quad (7)$$

where m is calculated by

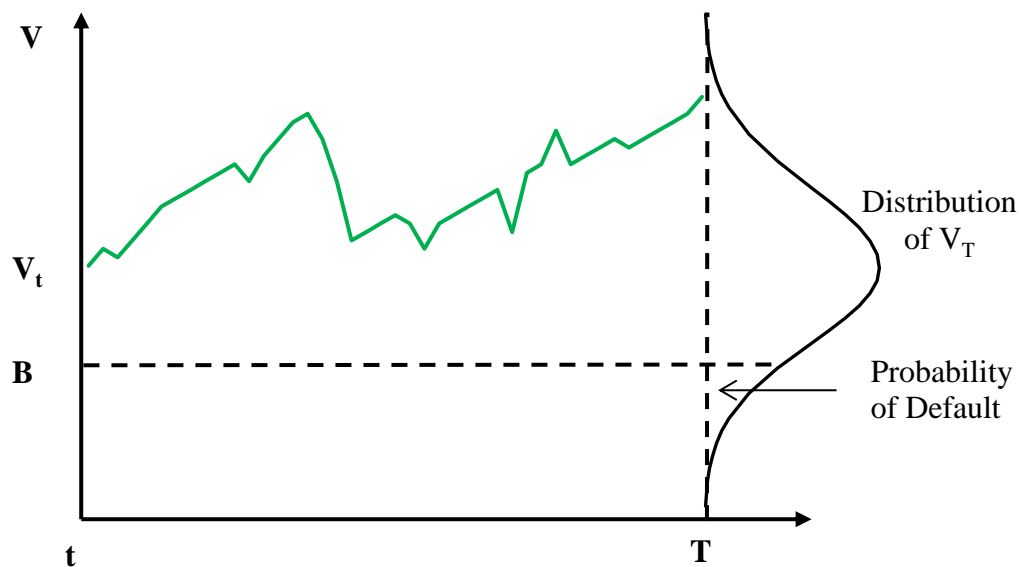
$$m = \left(\mu - \frac{\sigma^2}{2} \right). \quad (8)$$

According to the model probability of default (PD) at time T , measured at time t is a function of the actual distance to default plus an expected growth rate of firm's assets, denoted by m .⁹⁴ The distance to default is calculated as logarithm of the actual market value of the assets of

⁹⁴ Remember, equation (2) shows the market value of assets the firm (V_t) that is financed by equity (E_t) and a single zero bond (D_t) with a face value of B . Hence, the distance to default is calculated by dividing the market value of assets the firm (V_t) by the face value of debt B , which equals the capital structure of the firm.

the firm (V_t), divided by the face value of the bond B . The expected growth rate of firm's assets m equals the geometric Brownian motion times time to maturity, which is the standard model for the evolution of asset prices (Giesecke, 2004). It is calculated by subtracting half of the volatility of the assets (σ^2) from the expected return of firm's assets μ . In the calculation of PD , N is the standard normal distribution function and σ times the root of time to maturity is used as denominator to convert the numbers into standard normal units.

Equations (8) and (9) make it clear that the probability of default is determined by the maturity of debt ($T - t$), the capital structure V_t/B and the business risk of the assets σ^2 (Sundaresan, 2013). The figure below illustrates the approach graphically.



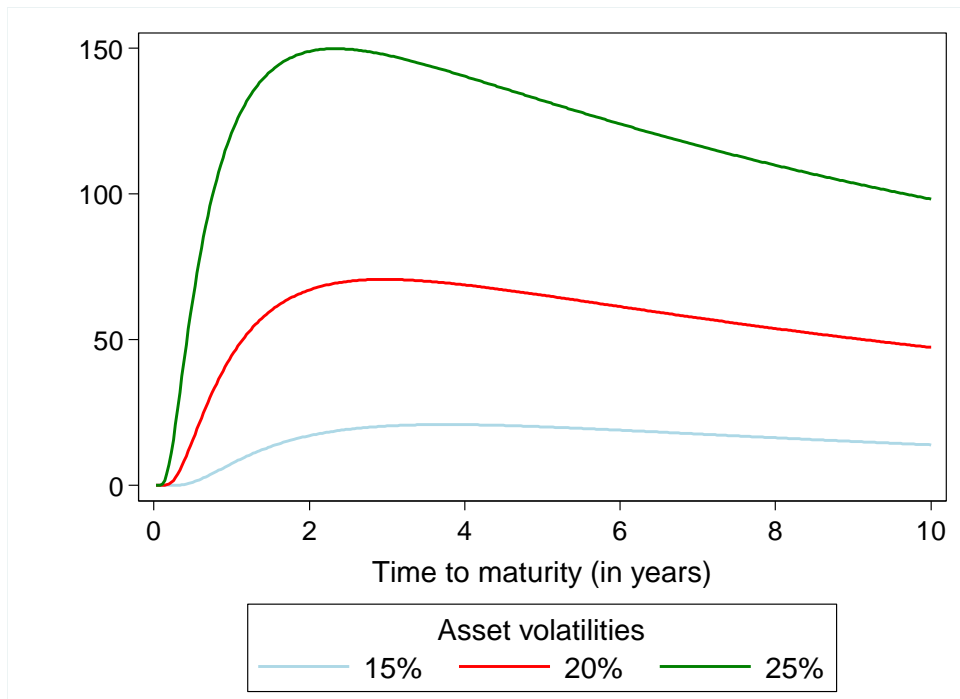
The figure depicts the probability of default in the Merton Model. As outlined above, default only may happen if the value of the assets of the firm are below the face value of debt at maturity T ($V_T < B$). To calculate the probability of default, we need assumptions about the distribution of assets at time T , the expected return of the assets and their volatility, as well as the actual distance to default (natural logarithm of V_t/B). Consider, for example, a firm at time $t = 0$ with a firm value of $V_0 = 100$ and a zero bond with a strike price $B = 75$ at time $T = 1$. The expected return of firm's assets is $\mu = 5\%$ and the volatility of the assets is $\sigma = 15\%$.

Putting these values into equations (8) and (9), yield

$$m = \left(0.05 - \frac{0.15^2}{2} \right) = 0.03555 \text{ and} \quad (9)$$

$$PD(0, 1) = N \left[- \frac{\ln \left(\frac{100}{75} \right) + 0.03555(1 - 0)}{0.15\sqrt{(1 - 0)}} \right] = 0.0100. \quad (10)$$

The growth rate of firm's assets m is approximately 3.6%. It is lower than the expected return of firm's assets, as volatility erodes the returns. Incorporating the growth rate m into equation (8) yields a probability of default of $PD = 1.0\%$. In this example, an increase in volatility of two basis points to $\sigma = 17\%$ increases the probability of default to $PD = 1.9\%$. The risk, debt investors bear from higher probabilities of default is manifested in higher credit spreads. Credit spreads are the difference between a default-free bond and default-able bond. The overview below illustrates this relationship based on the example and plots the term structure of credit spreads for varying asset volatilities.



Note: The figure shows credit spreads according to Merton (1974) for varying asset volatilities σ and a term structure of zero to ten years. Leverage equals 75% and rate of return equals 5%.

Apart from an intuitive appeal of the theory, also empirical studies provide strong support for the link between credit spreads and default probabilities. For example, Young Ho et al. (2004) test the theoretical prediction by using a sample of 182 bond prices of American firms in the period between 1986 and 1997. In their study the authors test the Merton Model and compare the results to four other refined structural models. For all models the results confirm theoretical predictions, but most models do not generate spreads as high as spreads seen in bond markets. While the link between risk of debt and credit spreads has been widely studied, Cardinale (2007) was the first, who made this link also explicit for corporate pension plans by testing if pension information is priced bond spreads.

Appendix C: Structural models of risk of debt (cont'd)

Panel B: Assumptions and extensions of the classical approach

Merton (1974) examines the pricing of equity and credit risky debt in an option pricing framework in the context of following assumptions:

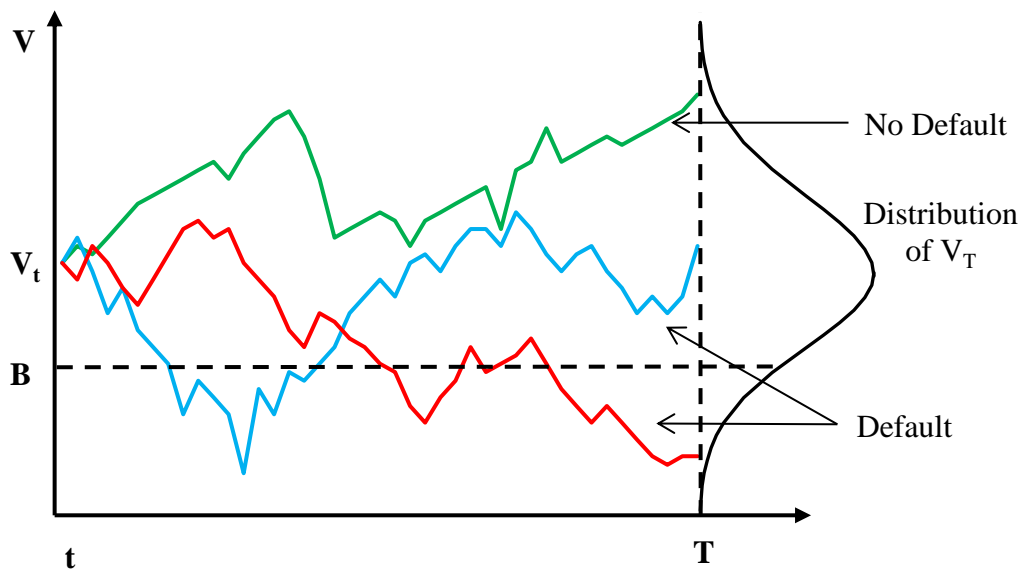
1. There are no transaction costs, taxes, or problems with indivisibilities of assets.
2. There are a sufficient number of investors with comparable wealth levels so that each investor believes that he can buy and sell as much of an asset as he wants at the market price.
3. There exists an exchange market for borrowing and lending at the same rate of interest.
4. Short sales of all assets, with full use of the proceeds, are allowed.
5. Trading in assets takes place continuously in time.
6. The Modigliani-Miller theorem that the value of the firm is invariant to its capital structure obtains.
7. The term structure is flat and known with certainty, i.e., the price of a riskless discount bond that promises a payment of one dollar at time T in the future is $P(t, T) = e^{-r(T-t)}$, where r is the (instantaneous) riskless rate of interest, the same for all time.
8. The dynamics for the value of the firm, V , through time can be described by a diffusion-type stochastic process.

Assumptions 1-4 reflect perfect market assumptions. As Merton (1974) outlined, these assumptions can be easily relaxed. Assumption 7 is made to focus on credit risk and not on the term structure ($T - t$) of debt. Thus, the paper of Merton concentrates on assumptions 5, 6 and 8. Assumption 5 is used nearly in all following papers in the literature (Sundaresan, 2013). As outlined in the explanation of equation (4), assumption 6 is derived in the paper. Moreover, inferences of the paper are independent of the validity of the Modigliani-Miller theorem (Merton, 1974).

Literature has extended and refined the approach by several dimensions to overcome limitations caused by these assumptions.⁹⁵ Instead of a default event only at maturity time T ,

⁹⁵ Literature reviews of the Merton Model and its extensions are provided, for example, by Uhrig-Homburg (2002), Giesecke (2004) or Sundaresan (2013).

Black and Cox (1976) model a default event if the firm's asset value drops below a certain time dependent barrier $B(t)$. This approach makes the time of default uncertain and can be explained by a safety covenant, which is the right of debt holders to take over the borrowing firm. The next figure illustrates default events according to the extension of the Merton Model by Black and Cox (1976):



In this model default occurs as firm value of assets fall below the threshold $B(t)$. In comparison to the original specification of the Merton Model, default events increase in this example from one to two.

Other extensions of the Merton Model include Leland (1994) and Mella-Barral and Perraudin (1997), who follow an idea described in Black and Cox (1976), modeling default as a strategic option of the management. Furthermore, Longstaff and Schwartz (1995) relax assumption 7 of the Merton Model and allow interest rates to float. Their model extends the framework of Merton (1974) and Black and Cox (1976) by the incorporation of both default and interest rate risk.

In sum, all of the outlined studies and most of the literature follow the approach by Merton (1974) and model debt and equity prices in a Black-Scholes option pricing framework with business risk in terms of asset volatility σ^2 as major input.

4.12 Figures

Figure 1: Overview on corporate pension plans

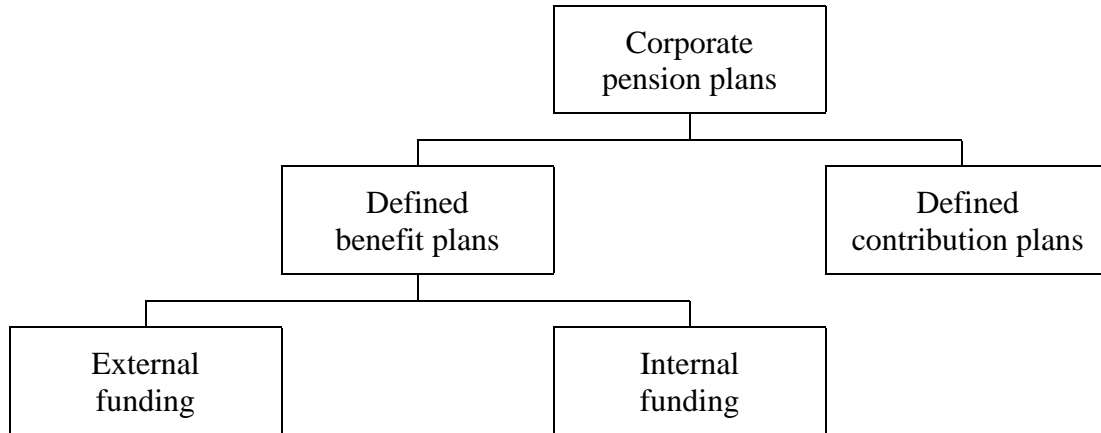


Figure 1 illustrates the different kinds of occupational pension schemes and their funding alternatives (Pellens et al., 2014).

Figure 2: Measurement of defined benefit obligations

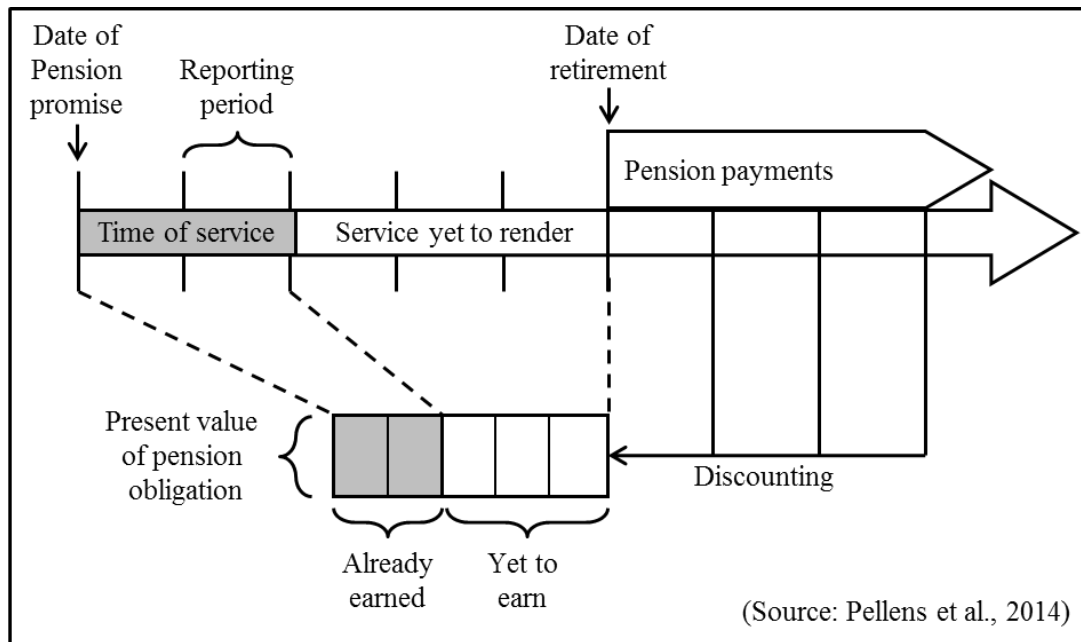


Figure 2 shows the determination and measurement of defined benefit obligations (Pellens et al., 2014).

Figure 3: Scheme of cash outflows of funding alternatives over time

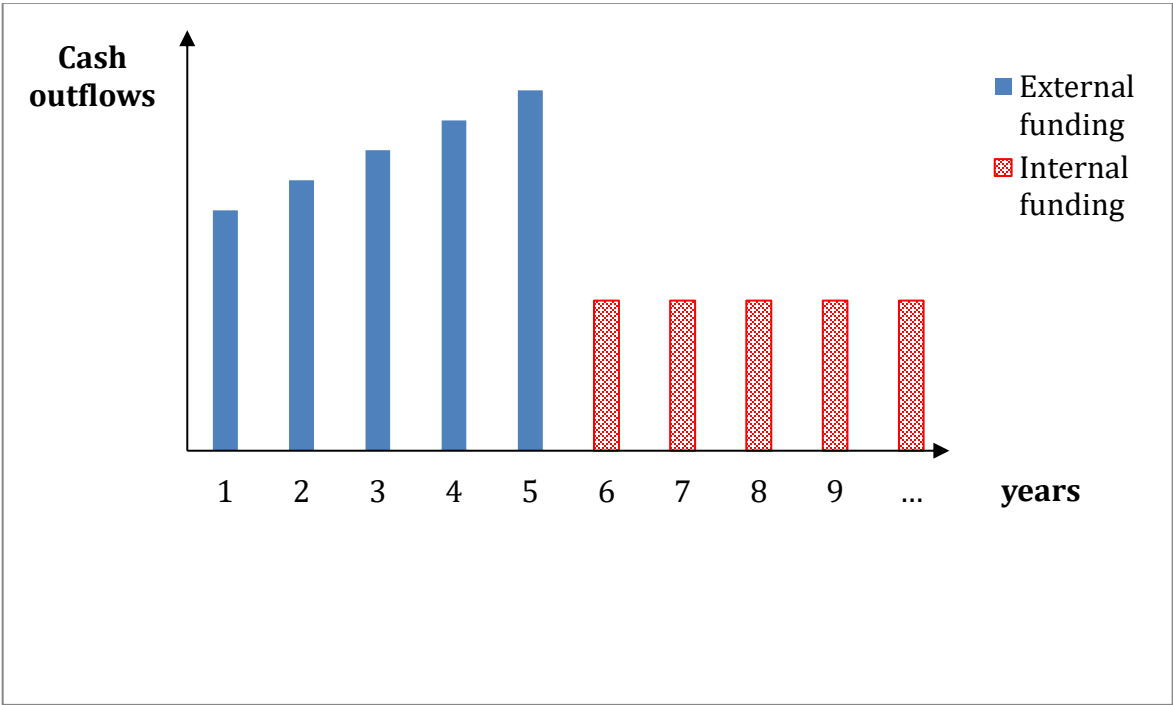


Figure 3 illustrates the difference in the timing of cash outflows between internally and externally funded pension plans.

Figure 4: Funding of DBO and determinants of the probability of default

Determinants of the Probability of Default			
Type of DBO	Maturity of Debt	Asset Volatility	Capital Structure
Internal	When payments fall due	Assets of the firm	
Unfunded	Before payments fall due	Assets of the firm	Independent from the way of funding
External	When payments fall due	Assets different from the assets of the firm	

Figure 4 summarizes the determinants of the probability of default for pension obligations according to the way of funding. The first column lists the funding status of pension obligations, while the first two lines list the determinants of the probability of default.

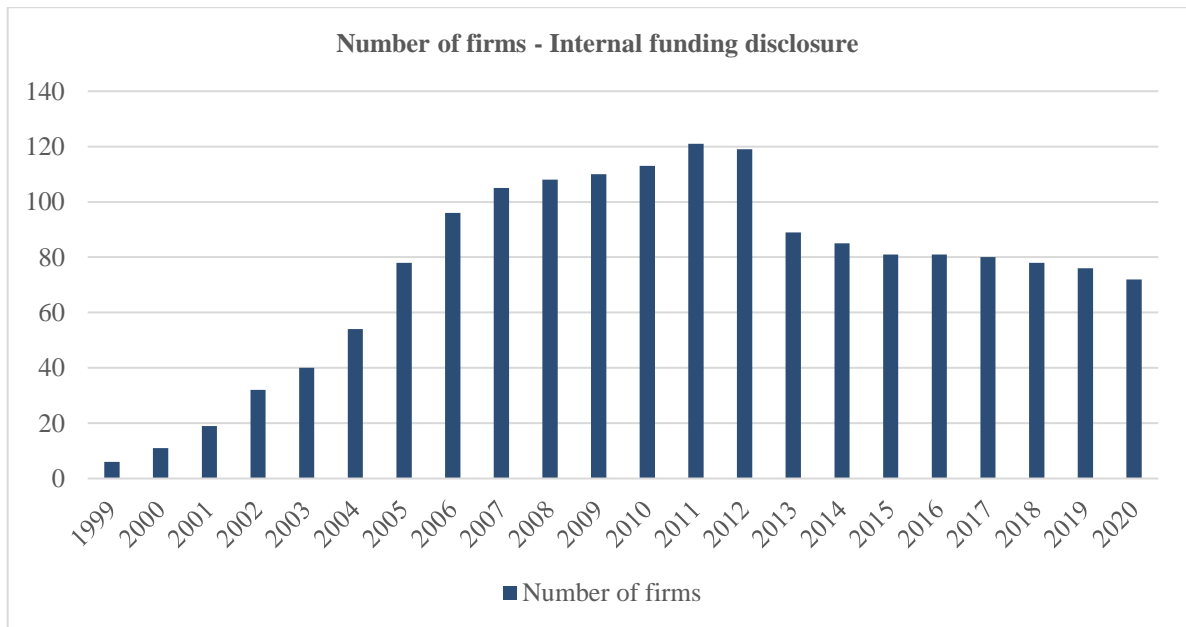
4.13 Tables

Table 1: Sample Selection

Panel A: Number of firm-year observations

	<u>Number of firm-year observations</u>
Firm-year observations of companies listed within Prime Standard for shares of Deutsche Börse Group between 1999 to 2020	5,456
Less firm-year observations:	
without defined benefit pension plans or internal funding	-3,498
without plan assets	-573
in which a firm is not publicly listed	-100
of financial firms with two-digit SIC codes from 60 to 69	-73
that miss information to calculate test variables	0
in which a firm is reporting under IFRS	-12
for firms with less than 10 years within sample	-294
Remaining firm-year observations:	905

Panel B: Number of firms per year



Panel A of Table 1 shows the sample selection process. The initial sample consists of all firm-year observations of firms listed within Prime Standard for shares of Deutsche Börse Group from 1999 to 2020. I exclude firm-year observations for firms without DBO plans and without information on internal funding or plan assets. Furthermore, I exclude observations in which a firm is not publicly traded, does lack information for calculating test variables or does not report under IFRS. Finally, I exclude firm-year observations of financial companies (two-digit SIC codes from 60 to 69) and firms with less than 10 years in the sample, resulting in a total of 905 firm-year observations derived from data of 58 unique firms.

Panel B provides an overview of the number of firm-year observation per year for all sample firms including firms with less than 10 years in the sample.

Table 2: Summary Statistics

Panel A: Number of firm-year observations

Variable	N	Mean	Std	Q1	Median	Q3
<i>MVE</i>	905	8,174	14,245	560	2,128	8,626
<i>Assets</i>	905	22,642	46,259	1,205	3,628	20,686
<i>NPTL</i>	905	13,874	32,647	583	1,906	11,624
<i>DBO_unf</i>	905	523	1,326	2	27	340
<i>DBO_int</i>	905	960	2,549	27	89	517
<i>DBO_ext</i>	905	1,836	3,855	23	157	1,471
<i>NI-PX</i>	905	389	1,071	11	85	355
<i>PX</i>	905	-136	267	-103	-16	-4
<i>MTB</i>	905	1.9	1.2	1.0	1.6	2.5
<i>INF</i>	905	59	22	47	62	75
<i>EXP</i>	905	60	80	17	36	66
<i>LEV</i>	905	16	11	7	15	23

Panel B: Pearson and Spearman correlations

	<i>MVE</i>	<i>Assets</i>	<i>NPTL</i>	<i>DBO_unf</i>	<i>DBO_int</i>	<i>DBO_ext</i>
<i>MVE</i>		0.65***	0.54***	0.66***	0.36***	0.68***
<i>Assets</i>	0.89***		0.98***	0.62***	0.79***	0.65***
<i>NPTL</i>	0.85***	0.99***		0.54***	0.78***	0.55***
<i>DBO_unf</i>	0.65***	0.68***	0.65***		0.30***	0.76***
<i>DBO_int</i>	0.58***	0.77***	0.76***	0.44***		0.37***
<i>DBO_ext</i>	0.78***	0.88***	0.85***	0.75***	0.68***	
<i>NI-PX</i>	0.65***	0.54***	0.50***	0.32***	0.32***	0.45***
<i>PX</i>	-0.77***	-0.89***	-0.86***	-0.72***	-0.82***	-0.90***
<i>MTB</i>	0.28***	-0.05	-0.06*	0.05	-0.21***	-0.02
<i>INF</i>	0.30***	0.30***	0.30***	0.17***	0.25***	0.23***
<i>EXP</i>	0.20***	0.40***	0.40***	0.44***	0.59***	0.62***
<i>LEV</i>	0.14***	0.27***	0.33***	0.03	0.18***	0.12***

Panel B: Pearson and Spearman correlations (*cont'd*)

	<i>NI-PX</i>	<i>PX</i>	<i>MTB</i>	<i>INF</i>	<i>EXP</i>	<i>LEV</i>
<i>MVE</i>	0.62***	-0.63***	0.16***	0.17***	0.05	0.13***
<i>Assets</i>	0.59***	-0.81***	-0.13***	0.20***	0.14***	0.17***
<i>NPTL</i>	0.54***	-0.73***	-0.12***	0.20***	0.13***	0.16***
<i>DBO_unf</i>	0.35***	-0.77***	-0.02	0.16***	0.29***	0.11***
<i>DBO_int</i>	0.44***	-0.73***	-0.13***	0.19***	0.19***	0.09***
<i>DBO_ext</i>	0.49***	-0.79***	-0.06*	0.20***	0.31***	0.11***
<i>NI-PX</i>		-0.47***	-0.03	0.14***	-0.10***	0.07**
<i>PX</i>	-0.43***		0.11***	-0.22***	-0.32***	-0.12***
<i>MTB</i>	0.15***	0.06		0.13***	0.14***	-0.14***
<i>INF</i>	0.16***	-0.27***	0.13***		0.05	0.08**
<i>EXP</i>	-0.04	-0.63***	-0.02	0.18***		-0.03
<i>LEV</i>	0.05	-0.12***	-0.14***	0.07*	-0.03	

Table 2: Summary Statistics (*cont'd*)

Notes:

Table 2 provides descriptive statistics for the variables used in the main analyses of Table 3. All variables are defined in Appendix A. Continuous variables have been winsorized at the 1% level.

Panel A of Table 2 provides descriptive statistics for the main variables of interest. All variables (except for *MTB*, *INF*, *EXP* and *LEV*) are expressed in millions of Euros. *MTB*, *EXP* and *LEV* are expressed as ratio, while *INF* is expressed in percentages.

Panel B of Table 2 shows correlation coefficients between the variables used in the empirical analysis. The upper (lower) diagonal shows Pearson (Spearman) correlation coefficients. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test).

Table 3: Pricing of internal funding

Panel A: Regression Results

Variable	Predicted Sign	Base Model	DBO Model
		(1)	(2)
<i>Assets</i>	+	1.88 *** (8.07)	1.89 *** (8.16)
<i>NPTL</i>	-	-2.03 *** (7.07)	-2.04 *** (7.13)
<i>PL</i>	-	-2.53 *** (6.00)	
<i>DBO_unf</i>	-		-2.03 * (1.86)
<i>DBO_int</i>	-		-2.65 *** (6.74)
<i>DBO_ext</i>	-	-1.93 *** (4.71)	-2.06 *** (4.78)
<i>NI-PX</i>	+	0.00 (0.05)	-0.00 (0.02)
<i>PX</i>	-	-7.26 * (1.71)	-6.83 (1.39)
<i>MTB</i>	+	0.41 *** (10.49)	0.41 *** (10.76)
<i>Const</i>		-0.67 *** (6.95)	-0.66 *** (7.04)
Adjusted-R ²		0.78	0.78
N		905	905

Panel B: Test of Pension Coefficients

Tests	Base Model		DBO Model	
	(1)	(2)	(1)	(2)
	F-stat.	<i>p</i> -value	F-stat.	<i>p</i> -value
<i>PL = NPTL</i>	1.99	(.158)		
<i>PL = External</i>	1.93	(.165)		
Internal = Unfunded			0.48	(.489)
Internal = External			1.72	(.190)
Unfunded = External			0.00	(.979)

This table presents analyses whether the pricing of internally funded and unfunded pension plans differ from each other. Across all regressions the dependent variable is *MVEit*. All variables are defined in Appendix A. All continuous variables have been winsorized at the 1% level.

In Panel A and Panel B, I test H_1 by comparing the coefficients on *DBO_unf* and *DBO_int*. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.

Panel A provides results of the regression of *MVEit* on pension variables. The first column (1) presents results of the Pension Liability model, which equals the base model of prior literature. Column (2) presents results of the DBO model. In this model, pension liabilities are separated into *DBO_unf* and *DBO_int*.

Panel B provides F-statistics of testing whether pension coefficients are different from Non-pension Total Liabilities and whether pension coefficients are different from each other.

Table 4: Cross-sectional differences in the pricing of internal funding

Panel A: Regression Results

Variable	Predicted Sign	<i>TREAT = INF</i> (1)	<i>TREAT = ECO</i>	
			<i>EXP</i> (2)	<i>LEV</i> (3)
<i>Assets</i>	+	1.84 *** (7.39)	1.73 *** (8.14)	1.91 *** (8.22)
<i>NPTL</i>	-	-2.00 *** (6.24)	-1.86 *** (7.06)	-2.08 *** (7.14)
<i>DBO_unf</i>	-	0.46 (0.38)	6.45 ** (2.28)	-3.29 ** (2.37)
<i>DBO_unf</i> × <i>TREAT</i>	+ / -	-4.48 ** (2.34)	-9.39 *** (2.85)	3.41 * (1.83)
<i>DBO_int</i>	-	-1.84 *** (3.54)	-3.21 *** (2.97)	-2.82 *** (6.85)
<i>DBO_int</i> × <i>TREAT</i>	+	1.25 * (1.89)	1.13 (1.06)	0.94 ** (2.02)
<i>DBO_ext</i>	-	-3.12 *** (3.81)	-1.70 (1.10)	-1.21 ** (2.47)
<i>DBO_ext</i> × <i>TREAT</i>	+ / -	1.63 ** (2.34)	0.09 (0.06)	-1.60 ** (1.99)
<i>NI-PX</i>	+ / -	-0.00 (0.02)	0.00 (0.94)	-0.00 (0.16)
<i>PX</i>	-	-7.41 (1.37)	-5.85 (1.63)	-3.27 (0.84)
<i>MTB</i>	+	0.41 *** (10.12)	0.39 *** (10.98)	0.41 *** (10.86)
<i>Const</i>		-0.64 *** (6.54)	-0.63 *** (6.92)	-0.67 *** (7.02)
Adjusted-R ²		0.78	0.80	0.79
N		818	905	905

Panel B: Test of Pension Coefficients

Tests	<i>TREAT = INF</i>		<i>TREAT = ECO</i>			
	(1)		(2)		(3)	
	F-stat.	p-value	F-stat.	p-value	F-stat.	p-value
<i>Test of lowest rank</i>						
Internal = Unfunded	4.70**	(.030)	1.32	(.251)	0.13	(.718)
Internal = External	2.10	(.147)	1.26	(.261)	10.05***	(.002)
Unfunded = External	4.03**	(.045)	1.98	(.159)	1.68	(.194)
<i>Test of highest rank</i>						
Internal = Unfunded	4.34**	(.037)	12.60***	(.000)	5.58**	(.018)
Internal = External	0.75	(.387)	0.81	(.369)	1.20	(.274)
Unfunded = External	3.17**	(.075)	5.03**	(.025)	4.77***	(.029)

Table 4: Cross-sectional differences in the pricing of internal funding (*cont'd*)

Notes:

This table presents analyses examining the effect of cross-sectional differences on the pricing of pension information. Across all regressions the dependent variable is *MVEit*. See Appendix A for detailed definitions of all variables. All continuous variables have been winsorized at the 1% level.

In Panel A and Panel B, I test H_{2A} and H_{2B} by comparing the coefficients on *DBO_unf* and *DBO_int*, for the lowest and highest rank of cross-sectional differences. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Panel A provides the regression results of equation (3), including the interaction of pension obligations variables with information processing differences (*INF*) and economic differences (*ECO*). In column (1), *INF* is measured as quintile rank of the institutional ownership of a firm ranging from 0 (low institutional ownership) to 4 (high institutional ownership) scaled by 4. *ECO* is measured as quintile rank of *EXP* in column (2) and as *LEV* in column (3), ranging from 0 (low) to 4 (high) and then scaled by 4.

Panel B provides F-statistics on analyses testing whether pension obligation coefficients are different from each other for firms in the lowest rank of *INF* (*ECO*) and for firms in the highest rank of *INF* (*ECO*).

Table 5: Sensitivity Analyses – Alternative independent variables

Panel A: Regression Results

Variable	Predicted Sign	<i>TREAT = INF</i>		<i>TREAT = ECO</i>	
		<i>FOREIGN</i> (1)	<i>ANALYSTS</i> (2)	<i>EXP_2</i> (3)	<i>LEV_2</i> (4)
<i>Assets</i>	+	1.85 *** (5.29)	1.43 *** (4.58)	1.70 *** (7.48)	1.88 *** (8.51)
<i>NPTL</i>	-	-1.96 *** (4.91)	-1.49 *** (4.23)	-1.83 *** (6.58)	-2.06 *** (7.38)
<i>DBO_unf</i>	-	-2.91 * (1.91)	0.78 (0.50)	4.66 (1.55)	-2.97 ** (2.10)
<i>DBO_unf</i> × <i>TREAT</i>	+ / -	-4.57 ** (2.23)	-7.17 *** (3.23)	-7.23 ** (2.10)	3.02 (1.51)
<i>DBO_int</i>	-	-1.09 (1.26)	-0.87 (0.83)	-2.42 *** (4.69)	-3.10 *** (6.14)
<i>DBO_int</i> × <i>TREAT</i>	+	1.68 (1.62)	2.35 ** (2.21)	0.25 (0.39)	1.58 *** (2.81)
<i>DBO_ext</i>	-	-0.35 (0.45)	-2.22 *** (3.96)	-0.04 (0.02)	-1.11 ** (2.10)
<i>DBO_ext</i> × <i>TREAT</i>	+ / -	2.76 ** (2.16)	2.43 * (1.90)	-1.55 (0.79)	-1.97 ** (2.27)
<i>NI-PX</i>	+ / -	1.93 *** (3.80)	0.00 (1.47)	0.00 (1.06)	-0.00 (0.20)
<i>PX</i>	-	-1.95 (0.36)	-4.28 (0.38)	-4.46 (1.11)	-3.95 (0.92)
<i>MTB</i>	+	0.40 *** (6.73)	0.39 *** (6.02)	0.40 *** (10.85)	0.41 *** (11.05)
<i>Const</i>		-0.74 *** (4.49)	-0.57 *** (5.06)	-0.65 *** (6.97)	-0.65 *** (7.18)
Adjusted-R ²		0.79	0.79	0.79	0.79
N		548	213	905	905

Panel B: Test of Pension Coefficients

Tests	<i>TREAT = INF</i>				<i>TREAT = ECO</i>			
	<i>FOREIGN</i> (1)		<i>ANALYSTS</i> (2)		<i>EXP_2</i> (3)		<i>LEV_2</i> (4)	
	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.
<i>Test of lowest rank</i>								
Internal = Unfunded	4.00**	(.046)	2.41	(.121)	0.22	(.636)	0.01	(.920)
Internal = External	2.03	(.154)	0.29	(.593)	0.77	(.381)	12.08***	(.001)
Unfunded = External	4.38**	(.036)	1.56	(.211)	0.79	(.374)	1.24	(.265)
<i>Test of highest rank</i>								
Internal = Unfunded	7.44***	(.006)	7.67***	(.006)	5.47**	(.019)	3.06*	(.080)
Internal = External	1.51	(.219)	0.32	(.573)	1.37	(.242)	3.17*	(.075)
Unfunded = External	6.81***	(.009)	3.94**	(.047)	1.13	(.288)	4.09**	(.043)

Table 5: Sensitivity Analyses – Alternative independent variables

(cont'd)

Notes:

This table presents sensitivity analyses examining the effect of cross-sectional differences on the pricing of pension information with the help of alternative measurements of independent variables for *INF* and *ECO*. Across all regressions the dependent variable is *MVEit*. See Appendix A for detailed definitions of all variables. All continuous variables have been winsorized at the 1% level.

In Panel A and Panel B, I test H_{2A} and H_{2B} by comparing the coefficients on *DBO_unf* and *DBO_int*, for the lowest and highest rank of cross-sectional differences. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Panel A provides the regression results of equation (3), including the interaction of pension obligations variables with information processing differences (*INF*) and economic differences (*ECO*). In column (1), *INF* is measured as quintile rank of the foreign investors of a firm ranging from 0 (low institutional ownership) to 4 (high % of foreign investors) scaled by 4. In column (2), *INF* is proxied by the number of analysts following a firm, again ranging from 0 (low) to 4 (high). *ECO* is measured as quintile rank of *EXP_2* in column (3) and as *LEV_2* in column (4), ranging from 0 (low) to 4 (high) and then scaled by 4.

Panel B provides F-statistics on analyses testing whether pension obligation coefficients are different from each other for firms in the lowest rank of *INF* (*ECO*) and for firms in the highest rank of *INF* (*ECO*).

Table 6: Sensitivity Analyses – Alternative dependent variable

Panel A: Regression Results

Variable	Predicted Sign	DBO	TREAT =	TREAT = ECO	
		Model (1)	INF (2)	EXP (3)	LEV (4)
<i>Assets</i>	+	1.72 *** (9.64)	1.68 *** (8.72)	1.62 *** (10.85)	1.74 *** (9.93)
<i>NPTL</i>	-	-1.85 *** (8.04)	-1.84 *** (7.05)	-1.74 *** (8.88)	-1.89 *** (8.21)
<i>DBO_unf</i>	-	-1.97 ** (2.16)	0.70 (0.66)	4.85 * (1.87)	-3.09 *** (2.86)
<i>DBO_unf</i> × <i>TREAT</i>	+ / -		-4.74 *** (3.24)	-7.62 *** (2.72)	3.06 ** (2.09)
<i>DBO_int</i>	-	-2.57 *** (6.72)	-1.70 *** (2.80)	-3.84 *** (3.78)	-2.73 *** (6.50)
<i>DBO_int</i> × <i>TREAT</i>	+		1.25 * (1.75)	1.77 * (1.95)	0.91 (1.56)
<i>DBO_ext</i>	-	-1.90 *** (5.55)	-3.06 *** (4.40)	-1.80 (1.41)	-1.06 ** (1.96)
<i>DBO_ext</i> × <i>TREAT</i>	+ / -		1.82 *** (2.73)	0.19 (0.15)	-1.56 ** (2.09)
<i>NI-PX</i>	+ / -	-0.01 *** (3.81)	-0.01 *** (4.00)	-0.01 *** (3.03)	-0.01 *** (4.16)
<i>PX</i>	-	-6.73 (1.36)	-6.35 (1.21)	-6.16 (1.61)	-3.36 (0.78)
<i>MTB</i>	+	0.35 *** (11.66)	0.36 *** (10.90)	0.34 *** (11.62)	0.36 *** (12.44)
<i>Const</i>		-0.52 *** (6.79)	-0.50 *** (6.19)	-0.48 *** (6.51)	-0.52 *** (6.84)
Adjusted-R ²		0.77	0.78	0.79	0.78
N		905	818	905	905

Panel B: Test of Pension Coefficients

Tests	DBO		TREAT =		TREAT = ECO			
	Model (1)		INF (2)		EXP (3)		LEV (4)	
	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.
Test of lowest rank								
Internal = Unfunded	0.61	(.435)	6.20**	(.013)	1.63	(.201)	0.12	(.726)
Internal = External	2.32	(.128)	2.23	(.136)	1.77	(.183)	7.30***	(.007)
Unfunded = External	0.01	(.941)	5.90**	(.015)	2.80*	(.094)	2.24	(.134)
Test of highest rank								
Internal = Unfunded			5.13**	(.024)	12.50***	(.001)	4.73**	(.030)
Internal = External			0.43	(.512)	1.80	(.180)	1.03	(.311)
Unfunded = External			7.00***	(.008)	4.19**	(.041)	5.15**	(.023)

Table 6: Sensitivity Analyses – Alternative dependent variable
(*cont'd*)

Notes:

This table presents sensitivity analyses examining the effect of cross-sectional differences on the pricing of pension information. Across all regressions the calculation of the dependent variable MVE_{it} was changed. The variable now measures the market value of equity of firm i , four instead of three months after the end of firm i 's fiscal year t ($MVE_{i,t+4}$). See Appendix A for detailed definitions of all other variables. All continuous variables have been winsorized at the 1% level.

In Panel A and Panel B, I test H_1 and H_2 by comparing the coefficients on DBO_{unf} and DBO_{int} , for the lowest and highest rank of cross-sectional differences. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Panel A provides the regression results of equation (3), including the interaction of pension obligations variables with information processing differences (INF) and economic differences (ECO). In column (1), the DBO Model presented in Table 3 was recalculated. Column (2) presents the results of the cross-sectional analysis regarding INF . Columns (3) and (4) present cross-sectional results for ECO , measured as EXP and LEV , respectively. Again, all variables in cross-sectional analyses are measured by using the ranking method described in the notes of previous tables.

Panel B provides F-statistics on analyses testing whether pension obligation coefficients are different from each other for firms in the lowest rank of INF (ECO) and for firms in the highest rank of INF (ECO). The test statistics for the DBO Model are provided in the overview on the lowest rank for the sake of simplicity of the illustration.

Table 7: Sensitivity Analyses – Introduction of IAS 19R

Panel A: Regression Results

Variable	Predicted Sign	DBO Model		TREAT = INF	
		Pre (1)	Post (2)	Pre (3)	Post (4)
<i>Assets</i>	+	1.23 *** (7.17)	2.47 *** (8.60)	1.19 *** (7.07)	2.53 *** (8.84)
<i>NPTL</i>	-	-1.28 *** (7.05)	-2.83 *** (7.50)	-1.22 *** (6.18)	-2.94 *** (8.14)
<i>DBO_unf</i>	-	-1.57 (1.39)	-2.62 * (1.74)	1.04 (0.91)	3.18 *** (7.09)
<i>DBO_unf</i> × <i>TREAT</i>	+ / -			-4.32 * (1.90)	-9.82 *** (6.04)
<i>DBO_int</i>	-	-1.41 *** (3.15)	-3.19 *** (7.58)	-0.87 * (1.95)	-1.97 *** (3.27)
<i>DBO_int</i> × <i>TREAT</i>	+			0.99 ** (2.13)	2.21 *** (2.74)
<i>DBO_ext</i>	-	-1.06 *** (3.20)	-3.27 *** (5.75)	-1.45 *** (3.62)	-6.53 *** (9.05)
<i>DBO_ext</i> × <i>TREAT</i>	+ / -			0.44 (1.07)	4.38 *** (8.42)
<i>NI-PX</i>	+ / -	1.01 ** (2.52)	-0.00 * (1.77)	1.12 *** (2.63)	-0.00 * (1.65)
<i>PX</i>	-	0.59 (0.11)	-20.59 *** (2.64)	-0.16 (0.03)	-29.55 ** (2.42)
<i>MTB</i>	+	0.33 *** (8.30)	0.40 *** (11.27)	0.37 *** (11.03)	0.40 *** (9.51)
<i>Const</i>		-0.42 *** (5.90)	-0.81 *** (7.26)	-0.47 *** (7.11)	-0.81 *** (6.21)
Adjusted-R ²		0.79	0.80	0.83	0.82
N		445	440	402	400

Panel B: Test of Pension Coefficients

Tests	DBO Model				TREAT = INF			
	Pre (1)		Post (2)		Pre (3)		Post (4)	
	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.
Test of lowest rank								
Internal = Unfunded	0.03	(.861)	0.18	(.672)	1.72	(.201)	6.21***	(.001)
Internal = External	0.70	(.404)	0.01	(.911)	5.23**	(.183)	0.43	(.107)
Unfunded = External	0.18	(.671)	0.13	(.718)	3.32*	(.094)	1.70***	(.005)
Test of highest rank								
Internal = Unfunded					9.07***	(.001)	11.8***	(.030)
Internal = External					2.43	(.180)	4.33**	(.311)
Unfunded = External					2.53	(.041)	7.16***	(.023)

Table 7: Sensitivity Analyses – Introduction of IAS 19R (*cont'd*)

Panel C: Regression Results

Variable	Predicted Sign	<i>TREAT = ECO (EXP)</i>		<i>TREAT = ECO (LEV)</i>	
		Pre (1)	Post (2)	Pre (3)	Post (4)
<i>Assets</i>	+	1.56 *** (12.17)	2.36 *** (8.59)	1.23 *** (7.14)	2.49 *** (9.66)
<i>NPTL</i>	-	-1.65 *** (11.39)	-2.73 *** (7.81)	-1.28 *** (7.08)	-2.90 *** (8.58)
<i>DBO_unf</i>	-	-7.05 *** (4.24)	10.31 *** (3.53)	-0.01 (0.01)	-5.17 *** (4.10)
<i>DBO_unf</i> × <i>TREAT</i>	+ / -	6.74 *** (4.30)	-14.52 *** (4.54)	-2.99 ** (2.16)	6.58 *** (3.78)
<i>DBO_int</i>	-	-4.59 *** (7.12)	-3.09 ** (2.19)	-1.43 *** (3.33)	-3.61 *** (9.01)
<i>DBO_int</i> × <i>TREAT</i>	+	3.17 *** (4.92)	0.21 (0.15)	0.14 (0.32)	1.52 *** (3.07)
<i>DBO_ext</i>	-	-2.42 ** (2.35)	-6.21 *** (4.05)	-0.98 ** (2.51)	-1.66 *** (3.26)
<i>DBO_ext</i> × <i>TREAT</i>	+ / -	0.58 (0.56)	3.97 ** (2.52)	-0.05 (0.08)	-3.16 *** (3.04)
<i>NI-PX</i>	+ / -	1.02 ** (2.37)	-0.00 (0.91)	0.96 ** (2.43)	-0.00 ** (2.06)
<i>PX</i>	-	2.40 (0.57)	-18.30 *** (2.66)	1.47 (0.30)	-15.29 ** (2.02)
<i>MTB</i>	+	0.31 *** (6.17)	0.39 *** (10.62)	0.33 *** (8.57)	0.41 *** (10.34)
<i>Const</i>		-0.38 *** (5.15)	-0.79 *** (7.40)	-0.42 *** (5.79)	-0.80 *** (6.87)
Adjusted-R ²		0.82	0.82	0.79	0.82
N		445	440	445	440

Panel D: Test of Pension Coefficients

Tests	<i>TREAT = ECO (EXP)</i>				<i>TREAT = ECO (LEV)</i>			
	Pre (1)		Post (2)		Pre (3)		Post (4)	
	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.
<i>Test of lowest rank</i>								
Internal = Unfunded	3.46*	(.063)	2.60	(.726)	1.99	(.158)	1.37	(.241)
Internal = External	1.02	(.313)	1.47	(.007)	0.17	(.677)	9.57***	(.002)
Unfunded = External	3.61*	(.058)	4.41**	(.134)	0.88	(.237)	5.27**	(.022)
<i>Test of highest rank</i>								
Internal = Unfunded	4.92**	(.027)	1.81***	(.001)	2.75*	(.097)	2.60***	(.001)
Internal = External	4.98**	(.026)	3.50*	(.061)	0.58	(.447)	6.24**	(.013)
Unfunded = External	6.55**	(.011)	2.18***	(.001)	0.88	(.349)	1.48***	(.001)

Table 7: Sensitivity Analyses – Introduction of IAS 19R (*cont'd*)

Notes:

This table presents sensitivity analyses examining the effect of the introduction of IAS 19R in 2013 on the pricing of pension information. Across all regressions the dependent variable is *MVEit*. See Appendix A for detailed definitions of all variables. All continuous variables have been winsorized at the 1% level.

In all Panels, I test H_1 and H_2 separately for years before and after the introduction of IAS 19R. To increase the statistical power of the test, I require each firm to account for minimum 8 years in the pre and post period resulting in an adjusted sample for these analyses. Again, I test hypotheses by comparing the coefficients on *DBO_unf* and *DBO_int*, for the lowest and highest rank of cross-sectional differences. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Panels A and C provide the regression results of the DBO Model and the interaction of pension obligations variables with information processing differences (*INF*) and economic differences (*ECO*), for the periods before (columns (1) and (3)) and after (columns (2) and (4)) the introduction of IAS 19R in 2013. Again, all variables in cross-sectional analyses are measured by using the ranking method described in the notes of previous tables.

Panels B and D provide F-statistics on analyses testing whether pension obligation coefficients are different from each other for firms in the lowest rank of *INF* (*ECO*) and for firms in the highest rank of *INF* (*ECO*) for the pre and post period. The test statistics for the DBO Model are provided in the overview on the lowest rank for the sake of simplicity of the illustration.

Table 8: Sensitivity Analyses – Subsample Analysis

Panel A: Regression Results

Variable	Predicted Sign	DBO		TREAT =		TREAT = ECO	
		Model (1)		INF (2)		EXP (3)	LEV (4)
<i>Assets</i>	+	1.87 *** (9.96)		1.82 *** (9.06)		1.71 *** (9.74)	1.89 *** (9.98)
<i>NPTL</i>	-	-2.00 *** (8.88)		-1.96 *** (7.56)		-1.83 *** (8.64)	-2.04 *** (8.84)
<i>DBO_unf</i>	-	-1.50 (1.56)		1.19 (0.68)		5.88 ** (2.34)	-2.64 *** (2.68)
<i>DBO_unf</i> × <i>TREAT</i>	+ / -			-4.55 ** (1.96)		-8.48 *** (2.95)	3.25 * (1.79)
<i>DBO_int</i>	-	-2.60 *** (6.82)		-1.57 *** (2.92)		-3.05 *** (3.17)	-2.70 *** (7.03)
<i>DBO_int</i> × <i>TREAT</i>	+			1.41 ** (2.02)		0.89 (0.87)	0.76 * (1.68)
<i>DBO_ext</i>	-	-2.01 *** (5.70)		-3.00 *** (3.96)		-1.69 (1.10)	-1.33 *** (2.71)
<i>DBO_ext</i> × <i>TREAT</i>	+ / -			1.62 ** (2.07)		0.10 (0.06)	-1.26 * (1.65)
<i>NI-PX</i>	+ / -	-0.00 (0.12)		-0.00 (0.04)		0.00 (0.85)	-0.00 (0.23)
<i>PX</i>	-	-4.92 (1.10)		-3.97 (0.82)		-5.14 (1.61)	-1.56 (0.38)
<i>MTB</i>	+	0.40 *** (12.45)		0.41 *** (11.39)		0.38 *** (12.43)	0.40 *** (12.90)
<i>Const</i>		-0.66 *** (8.63)		-0.65 *** (7.64)		-0.61 *** (8.62)	-0.65 *** (8.68)
Adjusted-R ²		0.80		0.80		0.82	0.81
N		744		671		744	744

Panel B: Test of Pension Coefficients

Tests	DBO		TREAT =		TREAT = ECO			
	Model (1)		INF (2)		EXP (3)		LEV (4)	
	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.
Test of lowest rank								
Internal = Unfunded	1.82	(.178)	3.61*	(.058)	0.68	(.410)	0.00	(.955)
Internal = External	1.94	(.164)	1.26	(.261)	2.04	(.153)	8.49***	(.004)
Unfunded = External	0.22	(.635)	2.64	(.104)	1.85	(.173)	1.13	(.288)
Test of highest rank								
Internal = Unfunded			3.84**	(.049)	13.5***	(.001)	5.30**	(.021)
Internal = External			1.99	(.158)	0.60	(.440)	0.63	(.426)
Unfunded = External			3.30*	(.069)	4.64**	(.031)	4.21**	(.040)

Table 8: Sensitivity Analyses – Subsample Analysis (*cont'd*)

Notes:

This table presents sensitivity analyses examining the effect of years of economic crises as defined in section 4.9.4 on the pricing of pension information, resulting in the exclusion of years 2008, 2012 and 2020. Across all regressions the dependent variable is *MVEit*. See Appendix A for detailed definitions of all variables. All continuous variables have been winsorized at the 1% level.

In Panel A and Panel B, I test H_1 and H_2 by comparing the coefficients on *DBO_unf* and *DBO_int*, for the lowest and highest rank of cross-sectional differences. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Panel A provides the regression results of equation (3), including the interaction of pension obligations variables with information processing differences (*INF*) and economic differences (*ECO*). In column (1), the DBO Model presented in Table 3 was recalculated. Column (2) presents the results of the cross-sectional analysis regarding *INF*. Columns (3) and (4) present cross-sectional results for *ECO*, measured as *EXP* and *LEV*, respectively. Again, all variables in cross-sectional analyses are measured by using the ranking method described in the notes of previous tables.

Panel B provides F-statistics on analyses testing whether pension obligation coefficients are different from each other for firms in the lowest rank of *INF* (*ECO*) and for firms in the highest rank of *INF* (*ECO*). The test statistics for the DBO Model are provided in the overview on the lowest rank for the sake of simplicity of the illustration.

Table 9: Sensitivity Analyses – Differentiating between AGL methods

Panel A: Regression Results

Variable	Predicted Sign	DBO Model		<i>TREAT = INF</i>	
		Corridor (1)	OCI (2)	Corridor (3)	OCI (4)
<i>Assets</i>	+	1.53 *** (5.38)	1.05 *** (5.11)	1.47 *** (5.42)	1.04 *** (5.16)
<i>NPTL</i>	-	-1.60 *** (5.62)	-1.10 *** (4.44)	-1.55 *** (5.55)	-1.08 *** (4.37)
<i>DBO_unf</i>	-	-2.01 *** (3.43)	-0.41 (0.45)	0.32 (0.41)	-0.93 (0.57)
<i>DBO_unf</i> × <i>TREAT</i>	+ / -			-3.97 *** (5.32)	-0.38 (0.13)
<i>DBO_int</i>	-	-2.75 *** (5.12)	-0.88 (1.39)	-2.01 *** (2.93)	-1.20 (1.47)
<i>DBO_int</i> × <i>TREAT</i>	+			1.03 (1.30)	-0.20 (0.31)
<i>DBO_ext</i>	-	-0.97 ** (2.37)	-0.59 * (1.66)	-1.36 ** (2.37)	-0.61 (1.33)
<i>DBO_ext</i> × <i>TREAT</i>	+ / -			1.01 (0.78)	-0.09 (0.14)
<i>NI-PX</i>	+ / -	2.00 *** (3.00)	0.91 ** (2.01)	1.95 *** (3.31)	0.90 ** (1.98)
<i>PX</i>	-	-13.01 ** (2.47)	0.60 (0.09)	-13.66 ** (2.20)	-0.35 (0.05)
<i>MTB</i>	+	0.32 *** (10.85)	0.37 *** (9.69)	0.35 *** (11.33)	0.37 *** (6.92)
<i>Const</i>		-0.52 *** (5.10)	-0.46 *** (6.28)	-0.55 *** (5.46)	-0.44 *** (6.24)
Adjusted-R ²		0.85	0.82	0.87	0.82
N		264	215	235	197

Panel B: Test of Pension Coefficients

Tests	DBO Model				<i>TREAT = INF</i>			
	Corridor (1)		OCI (2)		Corridor (3)		OCI (4)	
	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.
<i>Test of lowest rank</i>								
Internal = Unfunded	1.24	(.265)	0.64	(.425)	2.09	(.148)	0.04	(.851)
Internal = External	5.34**	(.021)	0.32	(.573)	0.20	(.653)	0.61	(.435)
Unfunded = External	1.51	(.218)	0.04	(.848)	4.80**	(.028)	0.03	(.868)
<i>Test of highest rank</i>								
Internal = Unfunded					5.34**	(.021)	0.00	(.973)
Internal = External					0.43	(.511)	0.45	(.505)
Unfunded = External					6.67***	(.010)	0.07	(.794)

Table 9: Sensitivity Analyses – Differentiating between AGL methods (*cont'd*)

Panel C: Regression Results

Variable	Predicted Sign	<i>TREAT = ECO (EXP)</i>		<i>TREAT = ECO (LEV)</i>	
		Corridor (1)	OCI (2)	Corridor (3)	OCI (4)
<i>Assets</i>	+	1.17 *** (5.89)	1.12 *** (5.37)	1.48 *** (5.35)	1.01 *** (5.09)
<i>NPTL</i>	-	-1.21 *** (5.97)	-1.13 *** (4.76)	-1.55 *** (5.70)	-1.13 *** (5.11)
<i>DBO_unf</i>	-	6.84 *** (3.32)	-3.71 (1.36)	-0.71 (0.64)	1.12 (0.66)
<i>DBO_unf</i> × <i>TREAT</i>	+ / -	-7.95 *** (3.60)	4.62 (1.58)	-1.12 (0.57)	-1.98 (1.03)
<i>DBO_int</i>	-	-0.43 (0.35)	-2.65 (1.36)	-2.93 *** (5.66)	-2.05 *** (3.02)
<i>DBO_int</i> × <i>TREAT</i>	+	-0.80 (0.62)	2.11 (1.25)	1.22 ** (2.21)	2.13 *** (3.37)
<i>DBO_ext</i>	-	5.64 *** (3.77)	0.00 (0.00)	0.39 (1.01)	-0.79 * (1.74)
<i>DBO_ext</i> × <i>TREAT</i>	+ / -	-6.70 *** (4.52)	-1.32 (1.19)	-2.99 *** (11.46)	0.37 (0.65)
<i>NI-PX</i>	+ / -	1.40 *** (3.46)	1.04 * (1.74)	1.70 *** (2.71)	1.06 ** (2.40)
<i>PX</i>	-	-6.74 *** (2.60)	-2.68 (0.36)	-12.78 ** (2.44)	-1.02 (0.19)
<i>MTB</i>	+	0.29 *** (10.93)	0.37 *** (8.83)	0.30 *** (7.52)	0.35 *** (9.74)
<i>Const</i>		-0.49 *** (7.13)	-0.48 *** (6.26)	-0.48 *** (5.03)	-0.40 *** (4.73)
Adjusted-R ²		0.89	0.83	0.86	0.83
N		264	215	264	215

Panel D: Test of Pension Coefficients

Tests	<i>TREAT = ECO (EXP)</i>				<i>TREAT = ECO (LEV)</i>			
	Corridor (1)		OCI (2)		Corridor (3)		OCI (4)	
	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.	F-stat.	p-val.
<i>Test of lowest rank</i>								
Internal = Unfunded	0.06	(.804)	0.49	(.483)	0.01	(.908)	0.66	(.417)
Internal = External	0.13	(.719)	2.06	(.151)	1.14	(.286)	0.55	(.458)
Unfunded = External	0.00	(.948)	1.47	(.226)	0.35	(.555)	0.12	(.728)
<i>Test of highest rank</i>								
Internal = Unfunded	23.6***	(.000)	5.13**	(.024)	3.42**	(.064)	6.64***	(.009)
Internal = External	12.8***	(.000)	1.67	(.196)	28.0***	(.000)	1.74	(.187)
Unfunded = External	0.29	(.590)	5.13**	(.024)	0.83	(.363)	0.99	(.320)

Table 9: Sensitivity Analyses – Differentiating between AGL methods (*cont'd*)

Notes:

This table presents sensitivity analyses examining the effect of the method of recognizing actuarial gains and losses on the pricing of pension information. Across all regressions the dependent variable is *MVEit*. See Appendix A for detailed definitions of all variables. All continuous variables have been winsorized at the 1% level.

In all Panels, I test H_1 and H_2 separately for firms using the corridor method and the OCI method of recognizing actuarial gains and losses. I do not consider firms that directly recognize actuarial gains and losses in the P&L statement. Again, I test hypotheses by comparing the coefficients on *DBO_unf* and *DBO_int*, for the lowest and highest rank of cross-sectional differences. *, **, *** indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively (using a two-tailed test). Standard errors are clustered by year and firm.

Panels A and C provide the regression results of the DBO Model and the interaction of pension obligations variables with information processing differences (*INF*) and economic differences (*ECO*) for firms using the corridor method (columns (1) and (3)) and the OCI method (columns (2) and (4)). Again, all variables in cross-sectional analyses are measured by using the ranking method described in the notes of previous tables.

Panels B and D provide F-statistics on analyses testing whether pension obligation coefficients are different from each other for firms in the lowest rank of *INF* (*ECO*) and for firms in the highest rank of *INF* (*ECO*) for the corridor method and the OCI method. The test statistics for the DBO Model in Panel B are provided in the overview on the lowest rank for the sake of simplicity of the illustration.

5 CONCLUSION

The empirical studies of this thesis address the issue of economic consequences of firm's choices within pension accounting standards. Extant literature in the fields of accounting, finance and economics test whether and how pension related information on the balance sheet and P&L affect the market values of companies or the behavior of its managers⁹⁶. This substantial literature provides striking empirical evidence for the notion that pension accounting information indeed affect the market valuation of companies or the actions its managers. This finding reflects the efficiency of capital market participants to incorporate information despite criticisms of the accounting rules. That critique includes, for example, that pension accounting rules are too complicated and crude and that a huge set of governmental regulations, including pension guaranty funds, complicate the analysis of corporate pension schemes (Jin, Merton, & Bodie, 2006). Given the complex nature of corporate pension plans, the respective accounting is subject to ongoing reviews and changes. The latest major change in the accounting for defined benefit pension plans was the introduction of an amended accounting standard IAS 19R in 2013, which is subject of the first two papers of this thesis.

The first study, presented in chapter 2, addresses the question, whether the elimination of the corridor method of recognizing actuarial pension gains and losses in IAS 19R has an effect on the allocation of firms' pension assets. By using a difference-in-differences research methodology, the paper is able to identify a causal relationship between the mandatory IAS 19R adoption and companies' pension asset allocations. The paper predicts and finds that companies, which formerly applied the corridor method shift their pension assets from equities into bonds relative to matched control firms. This reaction is consistent with the notion that cooperations adjust their pension asset allocations to minimize the effect of a potential increase in pension-induced equity volatility. This effect was found less pronounced for companies with larger pension plans and higher funding levels.

The second study, outlined in chapter 3, further investigates the mandatory change to IAS 19R by shifting the focus to equity investors and by investigating whether market values

⁹⁶ For reviews of the literature see, for example, Glaum, 2009 or Kiosse & Peasnell, 2009.

react to the introduction of specific features of the new accounting standard. In more detail as the first study, this paper investigates various channels that are expected to affect investors assessments of firm values. Specifically, I expect and test different market value consequences of the elimination of the corridor method, the elimination of the expected rate of return of pension assets and the introduction of new disclosure requirements for pension information. Findings of the paper support the view that investors find the elimination of the corridor method as well as the introduction of additional disclosure requirements as net costly. Though, replacing the assumption on the expected rate of return of pension assets by the discount rate that is used for calculating defined benefit obligations, is judged as value positive by stockholders. These findings indicate that investors are in favor of pension accounting information that are not easily manipulated by setting discretionary assumptions. Findings on each of the effects are, in part, more pronounced for companies with higher exposures to defined benefit pension plans.

The first two papers are based on the transition from IAS 19 to IAS 19R. However, their findings are not limited to scope of this event. In fact, they show that various stakeholders of companies, namely managers and equity investors, do care about the volatility that is inherent to defined benefit pension plans, which supports prior theoretical work on the cost of debt and contracting theory of companies.

Finally, the third study presented in chapter 4, investigates the economic consequences of the alternatives to fund pension obligations either externally by plan assets or internally by the operations of corporations. Given the complex nature of corporate pension plans and the huge amount of information provided in the notes, I predict and find – on average – no difference in the valuation of unfunded and internally funded defined benefit obligations. Though, cross-sectional analysis considering the information environment of companies proxied by the numbers of analysts following and the percentage of institutional investors show that results are sensitive to these measures. Accordingly, firms with higher levels of institutional investors or more analysts covering a stock, do experience a valuation difference between internally funded and unfunded pension plans. These findings highlight the importance of disclosure requirements and considering cross-sectional analyses in the field of pension research. Moreover, it is consistent with the notion that investors consider pension accounting information as very complex. The same finding of differences in the

pricing of internal und unfunded pension plans, but no valuation differences between internal and external funding, is found for cross-sectional differences in economic factors such as leverage ratios or firms' exposure to pension plans.

Overall, findings of the thesis also demonstrate that investigating pension accounting is likely to remain a worthwhile line of research, despite the vast amount of prior literature. Future research could complement studies of this paper by extending the focus of the respective papers, by picking up general trends that affect the setup and accounting for corporate pension plans or by applying different research methods. Regarding the latter, I use multiple research methodologies in the empirical analyses of the thesis to address each research question. Focusing on the economic consequences of accounting information on equity valuations, Barth et al. (2001) argue for applying a levels model if a study aims to investigate what accounting information is reflected in the value of a firm, while the authors suggest a changes model if the timeliness of accounting information is addressed by the research question. In this regard, I use a levels model for studying the implications of internal funding of pension obligations on the market value of firms in the third paper, presented in chapter 4. In contrast, a change model is applied for studying the economic consequences of the introduction of IAS19R in the second paper, outlined in chapter 3. Both approaches suffer from various general methodological limitations. The major concern of studying the reaction of equity valuations to accounting numbers is that findings reflect only an association but not a causal relation (Holthausen & Watts, 2001). I apply various identification strategies and econometric techniques in the empirical papers of this thesis to mitigate these concerns and increase the validity of my findings.

In studying the economic consequences of pension accounting, I make use of firms' possibilities to choose among various options that are provided by the pension accounting standard. In the best case, investigating these options result in a clear identification of distinct drivers of economic consequences. However, inferences drawn by investigating the decision between alternative options could also suffer from endogeneity problems. This is for example, if company characteristics drive the selection of an option and the observed finding of the study at the same time. In this thesis, most prominently the first paper addresses this issue by applying a difference-in-difference research design and a matching procedure for control firms. Matching procedures and comparisons across companies always require a

sufficiently large number of firms, which is assured due to the described features of the German setting. Together with research design choices and sensitivity analyses, I do not expect my findings to suffer from endogeneity concerns, while I cannot rule out this concern entirely.

Finally, as outlined above, I use a single country setting for all empirical studies. Accordingly, the papers presented above can leverage on the unique characteristics of the German setting, among others the variations in funding levels and the equal distribution of pension accounting choices among sample firms. The decision to use a specific setting, in this case, choosing between a single country or multiple country setting, is driven by the research question and a balance between the identification strategy of effects and the general validity of findings. Given the research questions of the studies that have not been examined in the literature before, the focus on identifying specific consequences was the main driver of using a single country setting. Simultaneously, this choice outlines a field for future research investigating the observed findings in other or multiple countries.

Next to methodological considerations, future research might also extend the research questions from a content-related perspective. For example, papers of this thesis concentrate on the economic consequences on pension asset allocations and on market values of corporations. Future research might consider investigating implications on other stakeholders of firms such as debt holders. Furthermore, possibilities for new studies lie in altering the pension related subject of investigation. Instead of examining shifts in pension asset allocations or funding alternatives, studies could analyze shifts between defined benefit and defined contribution pension plans. In investigating the transition from IAS 19 to IAS 19R, a major focus was set on the elimination of the corridor method and, in part, on changes in disclosure requirements and the change of calculating the (implicit) expected rate of return of pension assets. Especially change in determining the expected returns of plan assets could be a fruitful topic of future research. Prior research has shown the implications of management incentives to manipulate these earnings and the problems of investors to integrate these assumptions in forecasting future cash flows. The current accounting standard IAS 19R eliminates management discretion in the expected rate of return, but also simplifies the assumptions by setting the rate of return equal to the discount rate that is based on bond returns. Comparing this return profile with those of other asset categories used as plan assets,

indicates an underestimation of expected returns of plan assets. How this distortion affects the assessment of firm values by equity investors could be another subject to future research.

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