Essays on Institutional Asset Management and Financial Markets

D I S S E R T A T I O N
of the University of St. Gallen,
School of Management,
Economics, Law, Social Sciences
and International Affairs
to obtain the title of
Doctor of Philosophy in Management

submitted by

Christian Ehmann

from

Germany

Approved on the application of

Prof. Dr. Manuel Ammann

and

Prof. Dr. Markus Schmid

Dissertation no. 4516

Difo-Druck GmbH, Bamberg 2016

The University of St. Gallen, School of Management, Economics, Law, Social Sciences and International Affairs hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St. Gallen, May 30, 2016

The President:

Prof. Dr. Thomas Bieger

To my family

Fei & Mama

Acknowledgements

I would like to thank my supervisor Prof. Dr. Manuel Ammann for his constant support, his patient guidance and his helpful advice during my PhD studies at the University of St. Gallen. Furthermore, I want to thank Kristian Blickle for his ongoing advice, his friendship and the invaluable suggestions he made for our research paper on CoCo bonds.

Zurich, March 2016

Christian Ehmann

Table of Content

List of Tables

List of Exhibits

Summary

This thesis investigates three topics related to institutional asset management and financial markets.

Chapter 1 investigates the relationship between governance structures, investment performance, and realised asset allocation of Swiss occupational pension funds with empirical data. Based on survey data that has been collected from 139 Swiss pension plans, we find that pension fund governance is positively related to investment performance, as measured by excess return over the risk-free rate, benchmark outperformance, and Sharpe ratio. The study finds empirical evidence that the sample pension funds of the top governance quartile outperform those of the bottom quartile by approximately 1% in terms of average excess returns and passive benchmark deviation. Moreover, the study results indicate that asset allocation decisions are not related to governance, but rather to institutional factors such as fund size or legal form.

Chapter 2 analyses the announcement effects of contingent convertible securities (CoCo bonds) on the issuing banks' stock returns and credit default swap spread changes. Using a sample of 34 international financial institutions and 87 CoCo bond issues that have been announced on 55 different dates, we examine abnormal stock price reactions and CDS spread changes before and after the announcement dates. The study finds that the announcement of CoCo bonds correlates with positive abnormal stock returns and negative CDS spread changes in the immediate post-announcement period. The effects are most pronounced for first-time issues (i.e., when the issuer has no CoCo bonds outstanding yet). We explain these effects with a set of theories that include the lowered probability of costly bankruptcy proceedings, a signaling framework that is based on pecking order theory and the cost advantage over equity stemming from the tax shield that CoCos offer. We also examine the factors that are associated with the post-announcement abnormal stock returns and find that, among other things, first-time issues increase and call provisions reduce the positive abnormal returns.

Chapter 3 investigates the performance of exchange-traded funds (ETFs) that are listed on XETRA and NYSE Arca. Analysing a sample of 505 equity ETFs that have a geographic investment focus, we find that tracking errors are existent and significantly different from zero. The study furthermore examines the factors that are related to tracking friction and to NAV premiums/discounts. The empirical results show that costs, intraday volatility of fund shares, rebalancing frequency and domicile of incorporation are related to tracking friction, whereas the NAV premiums and discounts are affected by fund size, trading volume, bid-ask spreads and price volatility of fund shares.

Zusammenfassung

Die vorliegende Dissertation untersucht drei Themenstellungen im Bereich der institutionellen Vermögensverwaltung und der Finanzmarktforschung.

Kapitel 1 untersucht den Zusammenhang zwischen Governance-Strukturen, Anlageperformance und realisierter Vermögensallokation von beruflichen Vorsorgeeinrichtungen in der Schweiz. Basierend auf Umfragedaten die von 139 Schweizer Pensionskassen erhoben wurden finden wir heraus, dass Pensionskassen-Governance positiv mit Anlageperformance, gemessen anhand von Überschussrendite über dem risikolosen Zinssatz sowie Benchmark-Outperformance und Sharpe Ratios, korreliert. Die Studie findet empirische Evidenz dafür, dass die Pensionskassen des Top-Governance-Quartils diejenigen des niedrigsten Governance-Quartils um ca. 1% hinsichtlich Überschussrendite und Benchmarkabweichung übersteigen. Darüber hinaus zeigen die Studienergebnisse, dass Entscheidungen der Vermögensallokation nicht primär mit der Governance zusammenhängen, sondern eher mit institutionellen Faktoren wie Kassengrösse oder Rechtsform verbunden sind.

Kapitel 2 analysiert die Ankündigungseffekte von bedingten Pflichtwandelanleihen (sog. „CoCo Bonds") auf die Aktienrenditen und CDS-Spread Veränderungen der emittierenden Banken. Basierend auf einer Stichprobe bestehend aus 34 internationalen Finanzinstituten und 87 CoCo Bond Tranchen die an 55 verschiedenen Tagen emittiert wurden untersuchen wir abnormale Aktienpreis- und CDS-Veränderungen in der zeitlichen Periode um die Ankündigung der Pflichtwandelanleihen. Die Studie zeigt, dass die Ankündigung einer bedingten Pflichtwandelanleihe positiv mit abnormalen Aktienrenditen und negativ mit CDS-Spread Veränderungen korreliert. Die Effekte sind am stärksten für Erstankündigungen, das heisst, wenn die Bank bisher noch keine CoCo Bonds emittiert hat. Wir erklären diese Effekte mit diversen Theorien. Diese umfassen die reduzierte Wahrscheinlichkeit von kostspieligen Insolvenzverfahren, einem Signalling-Rahmen basierend auf der Hackordnungstheorie, sowie dem Kostenvorteil, welchen derartige Anleihen gegenüber Eigenkapitalemissionen besitzen. Die Studie untersucht zusätzlich die Faktoren, die mit den abnormalen Aktienrenditen in der Post-Ankündigungsperiode verbunden sind und findet heraus, dass Erstemissionen von CoCo Bonds die abnormalen Renditen erhöhen und Kündigungsklauseln, die innerhalb der Anleihenstruktur bestehen, die Renditen reduzieren.

Kapitel 3 untersucht die Performance von börsengehandelten Indexfonds (sog. „ETFs") die an der XETRA Plattform der Frankfurter Wertpapierbörse sowie an der Arca Plattform der New Yorker Börse NYSE gehandelt werden. Basierend auf einer Stichprobe die aus 505 Aktien-ETFs besteht finden wir heraus, dass „Tracking Errors" existieren und signifikant von Null abweichen. Die Studie analysiert darüber hinaus die Faktoren, die statistisch mit diesen Benchmarkabweichungen sowie mit den Aufschlägen (Premiums) bzw. Abschlägen (Discounts) zum Nettoinventarwert (NAV) verbunden sind. Die empirischen Ergebnisse zeigen, dass Fondskosten, intratägliche Volatilität von Fondsanteilen, Rebalancierungsfrequenz sowie Fondsdomizil statistisch mit den Tracking Fehlern verbunden sind, wohingegen Premiums und Discounts zum NAV im Wesentlichen durch Fondsgrösse, Handelsvolumina, Geld-Brief Spannen, sowie Preisvolatilität der Anteile bedingt sind.

Synthesis

Institutional asset management has become an increasingly important business area for banks and other financial intermediaries since the beginning of the 21st century. Strong growth rates of institutional assets, the rise of securitization as well as increasingly sophisticated portfolio management practices have put this asset management segment in the spotlight of both public and academic interest. This doctoral thesis investigates three topics in the area of institutional asset management and financial markets. It contains three empirical studies that focus on investment governance, investment processes, performance, and the financial instruments that have been more recently employed by different kinds of international institutional investors. The thesis hence contributes to the empirical literature on institutional asset management and financial markets and provides new insights into the particularities of the processes as well as the equity- and fixed income based investment vehicles that large institutional investors have included recently in their portfolio allocation mix. It combines an in-depth analysis of the investors' governance and asset management processes with two comprehensive empirical investigations of the instruments that those investors may use to enhance returns and optimize risks for their beneficiaries. This with the reasoning to provide the reader with a comprehensive picture of the interdependencies between applied investment processes and employed investment vehicles.

The first study (Chapter 1) focuses on the governance processes of Swiss occupational pension funds - one of the largest institutional investor group in the country. It investigates the statistical relationship between investment governance, investment performance and realised asset allocation with empirical data that has been collected by means of a standardized written mail survey. Based on survey data that has been received from 139 Swiss occupational pension plans with a total asset base in excess of 285 billion Swiss Franc (representing approximately 43% of the universe assets by the end of 2012), the study finds that pension fund governance is positively related to investment performance, as measured in terms of excess return over the risk-free rate, outperformance against several passive benchmarks, and Sharpe ratios. The study finds empirical evidence that the sample pension funds of the top governance quartile outperform those in the bottom quartile by around 1% in terms of average excess returns and passive benchmark deviation. Moreover, the study results indicate that realised asset allocation is significantly related to institutional factors (e.g., such as fund size or the legal form of the fund), yet only marginally to pension fund governance. The study ultimately concludes, that pension fund governance matters for investment performance – without giving any statements on the direction of this causal relationship. This has important practical implications: Although the study does not give any indication on the direction of causality, it shows that pension fund managers in Switzerland might benefit from investing and/or extending their governance systems and processes, as this will ultimately benefit active plan participants and pensioners in terms of higher returns on their investment.

Following the investigation of the governance processes of a very particular type of institutional investor, the second study (Chapter 2) focuses on a very recent financial innovation which might be a valuable risk- and return-enhancing instrument for institutional investors in general: Contingent Convertible Securities (so-called CoCo bonds). Although those instruments are – at the moment of finishing this thesis – not yet very popular with European institutional portfolio managers due to the prevailing lack of standardization of their terms as well as a lack of empirical research on their behaviour (particularly during times of financial market unrest), they offer great potential. The second chapter of this thesis therefore focuses on the announcement effects of such securities on the issuing entities' abnormal stock returns and CDS spreads. It provides the reader with three major insights: First, the particular characteristics of these new financial instruments are outlined in detail and it is shown how CoCo bonds can benefit a diversified portfolio in terms of risk- and return-enhancing traits. Second, the study shows that the abnormal stock returns of the CoCo bond issuing financial institutions increase in the immediate post-announcement period. Based on a sample consisting of 87 CoCo bond issues that have been announced on 55 different dates during the period between January 2009 and June 2014, the study finds that the announcement of a CoCo bond correlates with positive abnormal stock returns on the issuers' side. The magnitude of this effect is found to amount to approximately 1% in the immediate post-announcement period. Moreover, the study results show that the issuers' CDS spreads narrow significantly following an announcement of such a specific hybrid debt security. Thirdly, the study reconciles those findings and puts them into the context of different financial market theories. The empirical results are explained with a set of theories that include the lowered probability of costly bankruptcy proceedings, a signalling framework that is based on pecking order theory and the cost advantage over equity stemming from the tax shield that CoCos offer. The study ultimately concludes that CoCo bonds – being a Basel III compliant instrument – have a statistically measurable effect on a bank's balance sheet as well as an effect on the perception of the institution's risk structure by financial market participants. It thus provides an important contribution to the discussion of the effects (and their underlying reasons) of these new type of hybrid debt security.

While the second chapter focuses on an investment vehicle that is classified as belonging to the fixed income investment universe, the third chapter focuses on an equity-linked collective investment instrument that has become increasingly popular with global institutional investors in the past decade: Exchange-traded funds (ETFs). The success of the ETF market can mainly be attributed to 3 interlinked reasons: First, the cost advantage that those vehicles offer compared to actively managed mutual funds. Second, their increased liquidity – a factor that is often of utmost importance for investors such as pension funds or investment portfolios of financial institutions, for example. Third, the inability of many actively managed mutual fund managers to beat the market in the long run. Since many institutional investors have increased their portfolio allocations to ETFs in the recent decade, Chapter 3 of this thesis investigates their performance as well as their pricing efficiency (as measured in terms of premiums and discounts to NAV) based on a sample of 505 equity ETFs that are listed on the XETRA platform of the Frankfurt Stock Exchange as well as the Arca platform of the New York Stock Exchange (NYSE). The study finds, that tracking errors are existing and significantly different from zero. Moreover, it investigates the factors that are associated with this tracking friction and finds that, amongst other things, costs, intraday price volatility, investment target market and domicile of incorporation are essential factors that are related to tracking errors. In addition, the study finds that fund size, trading volume, bid-ask spreads and the price volatility of fund shares are related to premiums and discounts to NAV. Those discounts and premiums were particularly large during the global financial crisis of 2007/08 and most visible for exchange-traded funds that focused on emerging market and Asia/Pacific equities. The study ultimately concludes that institutional investors will have to focus on the identified factors when selecting ETFs for their portfolios. Particularly in light of ongoing regulatory changes in Europe and the United States, the identification of the factors that affect performance, liquidity and pricing efficiency of exchange-traded funds will become increasingly important in the next years. Overall, this doctoral thesis (consisting of 3 independend yet interlinked empirical studies) concludes that both processes (and thereof in particular governance designs) and investment instruments are key components to consider for institutional investors. It hence provides a valuable academic contribution to the empirical literature on institutional investors' governance systems, the announcement effects of CoCo bonds, and the performance of exchange-traded funds.

Chapter 1

Is Governance Related to Investment Performance and Asset Allocation? Empirical Evidence from Swiss Pension Funds

Manuel Ammann, Christian Ehmann

Abstract

This study investigates the relationship between governance, investment performance, and asset allocation of pension funds in Switzerland. Our sample includes survey data from 139 Swiss occupational pension plans for which we develop a governance metric comprising attributes of organisational design, management incentives, target setting, investment strategy, investment processes, risk management, monitoring, and transparency. We find empirical evidence that pension fund governance is positively related to excess returns, benchmark outperformance, and Sharpe ratios. Pension funds in the top governance quartile outperform those in the bottom quartile by approximately 1% in terms of average excess returns and benchmark deviation. Furthermore, our study results indicate that asset allocation decisions are not related to governance, but rather to institutional factors such as fund size and legal form.

1.1 Introduction

In the last decade, severe losses in pension asset values and occurrences of fraud in a number of occupational pension plans around the world have highlighted the importance of good governance practices in pension fund management[1]. We investigate the relationship between governance, performance, and asset allocation by drawing on unique survey data obtained from 139 Swiss pension plans. Switzerland has one of the largest occupational pension systems in Europe insuring more than 3.9 million members at the end of 2013. Total assets held by registered Swiss pension schemes exceeded CHF 720 billion, equalling approximately 113% of the country's GDP of 2013 (Swiss Federal Statistical Office, 2015). Consequently, governance weaknesses can have systemic implications. To mitigate these risks, Swiss legislators have taken a number of measures to improve the governance quality of public and private pension arrangements in the recent past[2]. Additionally, the Swiss Pension Fund Association (ASIP), the umbrella organisation of occupational pension plans in Switzerland, has been propagating self-regulatory measures since many years and published its first governance charta as early as 2008.

Pension fund governance goes beyond such regulatory requirements and comprises more than transparency or conflict of interest regulations, however. It includes classical governance elements such as organisational structures and management incentives, but also portfolio strategy planning and the entire investment and risk management process. In theory, sound governance structures should be associated with better plan performance. Pension funds with efficient management organisations, structured investment processes, and comprehensive risk management systems should be able to achieve superior investment performance at the benefit of their members. Academic literature on this topic is very scarce, however. While a plethora of scholars have focused on the relationship between corporate governance and firm performance (e.g., amongst others, Ammann, Oesch, and Schmid, 2011; Bhagat and Bolton, 2008; Brown and Caylor, 2006; Core, Holthausen, and Larcker, 1999; or Gompers, Ishii, and Metrick, 2003), only little attention has been paid to pension fund governance and its relationship to investment performance. Ammann and Zingg (2010) are

---

[1] For empirical evidence on the impacts of the financial crisis of 2008 on global pension assets, see Keeley and Love (2010) or Impavido and Tower (2009).

[2] The federal parliament has passed the "Structural Reform of Occupational Pensions and Benefits" in March 2010 with the goal of improving governance, transparency, and supervision within the occupational insurance system. The provisions of the second implementation stage, which came into force in August 2011, aim at strengthening disclosure requirements and fostering integrity of managers involved in the pension schemes' administration and asset management processes. The objective of the newly created independent supervisory authority (OAK) is to ensure compliance on a centralised, federal level.

amongst the few who adopt a comprehensive view on pension fund governance and examine its relationship to plan performance for the Swiss occupational insurance system with empirical data. Our study goes one step further and investigates the governance architectures of pension schemes in Switzerland and associations with their realised investment performance and asset allocation.

Neither historical performance data nor data on governance structures is publicly available for Swiss pension funds. To circumvent this issue, we collect the information via a proprietary survey. We focus on six different governance areas: organisational design, management incentives, target setting and investment strategy, investment processes, risk management, and managerial transparency. Our proprietary dataset contains data from 139 entities, covering almost 43% of total assets of the Swiss pension universe as of the end of 2012.

While previous studies have measured pension fund governance quality mostly with rather subjective measures (e.g., such as self-perceptions or opinions of senior managers, trustees or CEOs), our standardised questionnaire solely includes assessment criteria that are based on objectively quantifiable facts. To assess the sample plans' governance structures in the most objective way, we create the Swiss Pension Fund Governance Score (G-SCORE). The G-SCORE consists of 6 individual sub-scores that cover major governance areas and is based on the answers of the responding entities.

To relate governance to investment performance, we run multivariate regressions using four different portfolio performance metrics as dependent variables. We thereby control for institutional factors such as fund size, fund type, plan model, legal form, risk coverage, internal cost structures and the ratio of active plan members to pension beneficiaries.

Our analysis shows that pension fund governance is positively related to the surveyed plans' realised performance of the years 2010 – 2012. We find that the pension funds included in the top G-SCORE quartile outperform those in the bottom quartile by approximately 1% in terms of average excess returns and passive benchmark deviation.

To test whether the governance structures are indirectly related to investment performance through asset allocation decisions, we furthermore regress the sample funds' realised asset allocation weights as of the end of 2012 on our governance scores and control variables. The examination shows that primarily non-governance-related, but institutional variables such as fund size or legal form (i.e., public vs. private funds) explain allocation weights. We thus conclude that asset allocation decisions are mainly independent of the prevailing pension fund governance structures.

The remainder of this paper is structured as follows: Section 2 provides an overview of the previous academic literature pertaining to international pension fund governance. It draws on both empirical research and best-practice literature. In section 3, we develop an objective governance metric for Swiss occupational pension plans: the Swiss Pension Fund Governance Score (G-SCORE). The details about the construction of this scoring system are shown in sub-sections 3.1 – 3.6. Section 4 presents the characteristics of our data sample. Section 5 evaluates the current governance state of the sample pension funds and describes the results of the survey. It also explains the model that we employ to relate pension fund governance to investment performance and asset allocation decisions. Section 6 presents the empirical results while section 7 concludes the main findings.

1.2 Literature

While literature on pension fund governance has proliferated in the aftermath of the global financial crisis, most authors have focused on the development of universal best-practice recommendations. Clark and Urwin (2008; 2010) develop a set of governance best-practice factors for pension schemes in the UK and put them into the context of the global financial crisis. They conclude that organisational coherence, board member commitment and expertise, and a structured investment process are the key drivers of good pension fund governance. Best-practice principles concerning organisational design, leadership structure, responsibility allocation, and risk management were also promoted by Clapman (2007) and the Organisation for Economic Co-operation and Development. To address conflicts of interest within the investment process and promote financial security of pension plan benefits, the OECD has published *Guidelines on Pension Fund Asset Management* in 2006 (OECD, 2006). More recently, as a response to the global financial crisis, it has revised its *Guidelines for Pension Fund Governance* which were first issued in 2002 and published *Good Practices for Pension Funds' Risk Management Systems* in cooperation with the International Organisation of Pension Supervisors (OECD, 2009; 2011). Those standards set a relatively universal framework to address the most critical governance issues for various kinds of pension entities.

Although regulatory requirements for private pension arrangements differ across countries, governance concerns seem to be not extensively country-specific. Previous research points to this. Yermo and Stewart (2008) identify major governance weaknesses of occupational pension fund systems in OECD- and selected non-OECD countries and propose improvements in the areas of mission clarity, board composition, and board member education. Board composition and trustee expertise is also regarded as a critical factor by Clark, Caerlewy-Smith, and Marshall (2006), Jackowicz and Kowalewski (2012), and Harper (2008). For U.S. public pension funds, Harper investigates whether the trustee board composition affects the plans' performance. While he finds no direct statistical relationship between board composition and excess returns, he finds evidence that the composition of the board of trustees plays an important role for the plans' funding status and asset allocation, which indirectly affect fund performance. Dobra and Lubich (2013) corroborate those findings with a larger dataset. While a number of other authors have addressed the effects of public pension fund governance mechanisms[3], empirical research about the governance structures of private pension arrangements and their associations with investment performance has gained less attention in the academic literature. Ambachtsheer, Capelle, and Scheibelhut (1998) and Ambachtsheer and Ezra (1998) were among the first scholars who investigated this relationship. By means of a questionnaire, the authors find a positive correlation between governance quality, as proxied by their "CEO Score", and investment performance. Ambachtsheer, Capelle, and Lum (2008) confirm those results with a more comprehensive dataset in a follow-on study. The authors find that "good-quality" pension funds outperformed "bad-quality" funds by around 200 basis points per year. Since their score metric is reported based on the self-perception of senior pension fund executives, the authors' governance quality measure is not entirely objective, however. More recent empirical studies have focused on more objective governance metrics, such as board composition, ownership structures, and pension fund activism. Jackowicz and Kowalewski (2012), for example, investigate the effect of certain board member characteristics on risk-adjusted pension fund performance. Studying a sample of defined contribution plans in Poland, the authors find that the number of outsiders on trustee boards is positively correlated to Sharpe ratio. Furthermore, they find evidence that both age and educational background of trustees is related to the funds' risk-adjusted return on invested assets.

Although Switzerland has one of the world's largest occupational pension system[4], literature on Swiss pension fund governance is almost non-existing. Brandenburger and Hilb (2008) provide a comprehensive governance compendium, yet no empirical analyses. To this

[3] See, for instance, Mitchell and Hsin (1997), Impavido (2002), Yang and Mitchell (2008), Hess (2005), and Albrecht, Shamsub, and Giannatasio (2007).
[4] As measured in total pension assets as percentage of the gross domestic product in 2013.

end, the only study that empirically investigates the relationship between pension fund governance and investment performance in Switzerland is provided by Ammann and Zingg (2010). To proxy governance quality, the authors employ a questionnaire asking Swiss pension fund executives about objectively measurable criteria that are based on verifiable facts. While they find a positive relationship between governance and performance, their study is confined to a very narrow time window and to only one performance measure: the "net value added"[5]. This article therefore fills the gap in the literature by examining the associations between governance structures, asset allocation weights, and investment performance of Swiss occupational pension schemes. By adopting a holistic view on pension fund governance, it extends the work of Ammann and Zingg in three important ways: First, we investigate to what extent governance factors affect performance indirectly through asset allocation decisions. Second, our study takes into account the scope of the pension funds' risk management practices, which have become of central interest in the aftermath of the global financial crisis. Third, we use a much greater variety of investment performance measures including risk-adjusted return measures and different benchmark tracking errors. Additionally, we extend the return examination window to three years, using annual investment performance data from 2010 to 2012. We hence contribute to both the empirical literature on pension fund governance and the literature on the objective evaluation of asset management governance of institutional investors in general.

1.3 Swiss Pension Fund Governance Score (G-SCORE)

To evaluate pension fund governance structures objectively and comprehensively, we develop the Swiss Pension Fund Governance Score (G-SCORE). The G-SCORE is methodologically related to corporate governance indices that aggregate individual firm governance attributes cumulatively (e.g., also see Ammann, Oesch, and Schmid, 2011, 2013; Bebchuck and Cohen, 2005; Bebchuck, Cohen, and Ferrell, 2008; Brown and Caylor, 2006; Gompers, Ishii, and Metrick, 2003). We apply this commonly employed method to assess pension fund governance. The G-SCORE draws from previous empirical research findings and, to some extent, best-practice considerations from the academic literature. While we do not claim that the theoretical literature recommendations are necessarily in line with "good" governance due to contradictory empirical evidence for certain score components, we take them as practical reference points for our valuation framework. Although many of the score constituents might theoretically be desirable from a governance point of view, we do not state

[5] For a detailed composition and explanation of the net value added metric, see Ammann and Zingg (2010).

that occupational pension funds should apply or pursue them in order to improve their governance quality. Neither do we postulate how governance structures should optimally look like. In fact, some of the elements that are included in our scoring model are discussed rather controversially in the literature since empirical evidence is contradictory. This particularly pertains to components such as the pursuit of active tactical asset allocation and the design of compensation structures for trustee board members. Our study instead aims at detecting those factors that are potentially related to plan performance and asset allocation decisions.

While previous authors have proxied governance quality with rather subjective metrics, we constrain ourselves to entirely objective factors that are investigated by means of a standardised survey that was sent by mail to Swiss occupational pension funds. For each answer that is deemed to be theoretically desirable from a governance point of view, a pension fund receives 1 point on our G-SCORE. Otherwise, a fund receives 0 points. Consequently, a high score is associated with a comprehensive or "theoretically desirable" governance structure. Taking a holistic view on pension fund governance, we create 6 sub-scores as well as an overall composite score. The 6 sub-scores evaluate pension fund governance in terms of organisational design (ORGA Score), management objectives setting (MANO Score), target setting and investment strategy definition (TSIS Score), investment processes (INVP Score), risk management procedures (RIMA Score), and the degree of managerial transparency (MOTR Score). The composite G-SCORE is computed as the sum of all individual sub-scores. Details on the construction of the 6 sub-scores and the composite G-SCORE are shown in the following sub-sections.

1.3.1 Organisation Score (ORGA)

The first sub-score assesses a pension fund's governance structure with respect to its organisational setup and responsibility allocation. Our Organisation Score (ORGA) can assume values between 0 and 10. A high score indicates a high degree of organisational coherence. Table 1.1 shows the detailed composition of the ORGA Score.

The *OECD Guidelines for Pension Fund Governance* recommend clear identification and assignment of responsibilities. Since clear lines of authority are an essential component of good pension fund governance, we argue that Swiss pension funds should have organisational regulations that explicitly allocate the most important areas of responsibilities to their governing bodies (1)[6]. Clear separation of power between those bodies might furthermore contribute to transparency in decision-making and reduce the risks of fraud and management misconduct. Therefore, we punish pension funds whose board members hold both executive and supervisory functions (1). To ensure a high degree of objectivity and independence in decision-making and monitoring, the supervisory body might consider establishing specialised board committees that are assigned with specific tasks. Wright et al. (2013) describe that sub-committees are effective in bringing greater specialisation and objectivity by board members as well as greater attention to discrete issues. The Organisation Score therefore rewards pension funds whose board structure includes sub-committees (1).

To effectively steer their business operations, many occupational pension schemes in Switzerland employ a full-time CEO who is solely in charge of pension fund issues. However, smaller pension funds often assign the administration responsibility to one (or several) employee(s) of the sponsor firm, who dedicate part of their working time to pension fund matters since employing a full-time CEO would be disproportionately costly. The decision of whether a full-time CEO is economically sensible or not thus needs to be made in light of a pension fund's size. The Organisation Score therefore rewards smaller funds and punishes larger funds for not having a CEO who dedicates 100% of his employment time to pension issues (1)[7].

In addition to the executive officers, the board of trustees plays a key role in occupational pension fund governance. Its main functions are the definition and implementation of the pension plan's investment strategy, the advisory of the CEO, and the ongoing monitoring of activities in the best interest of the scheme's stakeholders. Corporate governance literature on board structure points to a negative relationship between board size and firm performance. It is argued that large boards are less effective than small boards due to coordination and agency problems[8]. For U.S. pension funds, Impavido (2002) claims that the number of trustees should be limited, as this reduces individual free-riding incentives and maximises board effectiveness. Harper (2008) finds a negative statistical relationship between trustee board size and funding levels of U.S. public pension plans. We apply this literature to occupational pension schemes in Switzerland. In line with those findings, we hypothesize that trustee board size is negatively related to the investment performance of Swiss pension

[6] E.g., by means of an activity distribution matrix or management organisation chart.

[7] Large pension funds are defined as having plan assets in excess of 1,000 mn CHF as averaged over the years 2010 – 2012 whereas small funds are those with less than 1,000 mn CHF assets under management.

[8] See, for example, Lipton and Lorsch (1992) or Jensen (1993).

funds[9]. However, while we also acknowledge that large boards might be more difficult to manage and are thus less effective, we challenge the notion that there is an absolute number of trustees that is optimal (as suggested by Clark and Urwin, [2008]) irrespective of the size of the fund. Since we expect that larger pension funds will naturally have larger trustee boards, we decline a "one-size-fits-all" approach and put board size in relation to pension fund size. The Organisation Score therefore rewards pension funds with plan assets of less than 100 million CHF: for having not more than 6 trustee board members; with plan assets in excess of 100 million CHF, but less than 1,000 million CHF: for having not more than 8 trustee board members; and with plan assets in excess of 1,000 million CHF: for having not more than 12 trustee board members. The above-stated size thresholds are based on the sample means of the respective pension fund size category. Disproportionate deviations from the average number of trustees can thus be detected in a relatively simple manner[10]. We follow the same logic for the size of the investment committee. Since the investment committee is also an important governance body, its dimension should be in appropriate relation to a pension plan's assets. Hence, the Organisation Score rewards pension funds with plan assets of less than 100 million CHF: for not having more than 3 investment committee members; with plan assets in excess of 100 million CHF, but less than 1,000 million CHF: for having not more than 4 investment committee members and; with plan assets in excess of 1,000 million CHF: for having not more than 6 investment committee members[11].

Since the board of trustees is the key element in the management framework of Swiss pension schemes, its human capital is of critical importance for the funds' governance quality. We therefore additionally reward pension funds that have an appropriate board composition pertaining to 1) age structure and 2) trustee expertise. Age structure of boards has been a central point of interest in the corporate governance literature. Kanagaretnam, Lobo, and Whalen (2007) state that boards with older members are considered to be less efficient, as those members do not actively participate in board activities anymore. Brown and Caylor (2006) provide empirical evidence. For U.S. public pension funds, Harper (2008) finds that longer board terms lead to lower net returns. Since an over-aged trustee board might potentially suffer from inner inertia and lower monitoring effectiveness, our Organisation Score assigns 1 point to pension funds that have specified a mandatory retirement age

[9] It should be noted that there is no regulatory minimum or maximum number of trustee board members for pension funds in Switzerland.

[10] To test for robustness, those thresholds are varied in the empirical analysis (e.g., changed to the sample median of each size category, the mean or median of the entire data sample, or to the fixed numbers as recommended by Clark and Urwin, [2008]). The results of these variations are discussed in section 6.

[11] If a pension fund stated to have no investment committee, no points were assigned. The size thresholds were also based on the sample mean and tested for robustness in the empirical section.

provision (1). Good governance furthermore requires that all board members possess adequate qualification, knowledge, and expertise to steer and monitor the pension funds' strategic and operational activities. In the aftermath of the financial crisis this requirement has particularly gained in importance. Increasing complexity concerning pension issues and changing conditions on the global capital markets more than ever require highly qualified trustees. However, since Article 51 of the Swiss Federal Law on Occupational Old-age, Survivors' and Disability Pension Plans (BVG) calls for paritarian representation of employers and employees on the board of trustees, there is an inherent trade-off between representation and expertise within Swiss occupational pension funds. This has also been documented by Clark (2007) for UK pension funds and U.S. mutual funds. While this is an institutional problem, it is furthermore difficult to determine an "optimal" qualification level for trustees or executives. Since an entirely objective measure for adequate qualification and expertise is difficult to define, we follow the recommendation of Clark (2004), who proposes that pension fund trustees should optimally possess relevant professional qualifications and obtain ongoing task-specific training. In line with this recommendation, the Organisation Score rewards pension funds whose board members are solely elected on the basis of their specialised knowledge regarding pension issues (1)[12]. Furthermore, we argue that it might be beneficial for pension funds to have a task-specific educational training concept for their trustees regarding 1) legal provisions and regulatory requirements, 2) the investment strategy(-ies) of the pension fund and, 3) the risk management practices of the pension fund. Since we believe that all those topics are essential, we reward pension funds that have an education programme containing all three elements (1). In order to fill the gap of a lack of internal expertise, pension funds' governing bodies should furthermore draw on independent external specialists or consultants that are specialised in pension matters, actuarial issues, and investment management. The *OECD Guidelines on Pension Fund Governance* support this view by stipulating that the appointment of independent professionals to the governing body is an effective way to promote good governance (1).

[12] i.e., no ex-officio members

Table 1.1: Composition of the ORGA Score

The Swiss Pension Fund Governance Score is divided into 6 sub-scores. The Organisation Score (ORGA) evaluates a pension fund's organisational form and coherence. It ranges from 0 to 10 whereby a high score indicates a high degree of organisational coherence and sound responsibility allocation.

Best Practice	Assessment Criteria	Score
Clarity of responsibilities and separation of power	Organisational regulations	1
	Clear separation of executive and monitoring functions	1
	Specialisation of board of trustees in sub-committees	1
Effectiveness and efficiency of management decision-making	Full-time chief executive officer (CEO) (depending on fund size)	1
Reasonable board composition	No excessive number of trustees	1
	No excessive number of investment committee members	1
	Mandatory retirement age	1
Adequate internal qualification and expertise	No ex-officio members	1
	Comprehensive education concept	1
	External specialists part of governing bodies	1
Total ORGA Score		**10**

1.3.2 Management Objectives Score (MANO)

The second sub-score evaluates a pension fund's governance structure with respect to objectives setting and management incentive design. Our Management Objectives Score (MANO) has a minimum value of 0 and a maximum value of 7, whereby a high score indicates a high degree of objectives and incentives setting. Table 1.2 shows the detailed composition of the MANO Score.

The definition of management objectives and the design of supportive incentive structures are focal points of governance systems. While literature on those aspects primarily focuses on corporate boards, we believe that corporate governance principles are also applicable for pension funds' trustee boards. Yermo and Stewart (2008) point to the problem that boards of trustees often lack a clear mission statement and engage in operational duties which should be left to internal management staff or external service providers. Since a clear specification of organisational goals helps the board to concentrate on its primary tasks, we postulate that an occupational pension fund should have an own written statement regarding its overall strategic targets (1). To reconcile strategic targets with management tasks, clear objectives should be defined for the board of trustees (1). Good pension fund governance might furthermore require incentive structures that link board member compensation to performance. Ambachtsheer, Capelle, and Scheibelhut (1998) persuasively argue that organisational goals should be clear and compensation policies should be related to the achievement of those goals in order to align the economic interests of plan members with the interests of management. Clark and Urwin (2010) furthermore assert that competitive compensation structures aligned with effective performance measurement will enhance the professional competence of trustee boards. While this argumentation is persuasive in theory, the above-stated recommendations are only scarcely implemented by Swiss pension funds in reality. To investigate whether competitive incentive structures for board members are effectively related to performance and asset allocation, we hypothesise that they have a positive effect and therefore reward pension funds whose board members receive performance-linked financial compensation (1)[13]. Since competitive incentive structures should not only be established for the board of trustees, but also for operational executives, we furthermore argue that well-governed pension funds should define individual management objectives for their CEOs (1) and regularly measure the CEO's performance against those pre-defined objectives (1)[14]. To align CEO interests with the interests of plan members, the MANO Score also assigns 1 point to pension plans whose CEO compensation is linked to the CEO's individual management objectives and/or investment performance (1). Lastly, in order to be able to effectively deal with conflicts of interest and other governance-related internal issues, a pension fund should have implemented an own written code of conduct to which all bodies involved in the management and oversight process of the pension plan must abide to (1). Existing governance chartas (e.g., such as the ASIP-charta or the OECD guidelines) might thereby be useful as a reference point.

[13] Pension funds that reported fixed financial compensation or solely reimbursement of expenses received 0.5 and 0 points, respectively.

[14] If a pension fund reported to have no CEO, the maximum achievable points in this sub-score was set to 4.

Table 1.2: Composition of the MANO Score

The Swiss Pension Fund Governance Score is divided into 6 sub-scores. The Management Objectives Score (MANO) evaluates a pension fund's governance structure in terms of objective definition. It ranges from 0 to 7 whereby a higher score indicates a higher degree of management objectives and incentives setting.

Best Practice	Assessment Criteria	Score
Mission clarity	Own written mission statement	1
Clear management objectives and supportive compensation structures	Management objectives designed for board of trustees	1
	Performance-linked financial compensation of board members	1
	Individual management objectives defined for CEO	1
	Performance-linked financial compensation of CEO	1
Ongoing performance monitoring of executives	Regular performance evaluation of CEO	1
Awareness of governance and internal compliance issues	Own written code of conduct	1
Total MANO Score		**7**

1.3.3 Target Setting and Investment Strategy Score (TSIS)

The third sub-score evaluates a pension fund's governance structure with respect to its target setting and investment strategy definition process. The TSIS Score can assume values between 0 and 10. A high score indicates a highly structured approach regarding target setting and investment strategy design. Table 1.3 shows the detailed composition of the Target Setting and Investment Strategy Score.

A structured investment planning process and a clear target of financing are fundamental prerequisites for superior pension fund performance. The minimum required yield is the return a pension fund needs to achieve on a long-term basis in order to keep its financial balance. Ammann and Zingg (2010) describe that the minimum required return net of asset management costs should at least consider guaranteed interest on pension liabilities, longevity risk, accumulation of value fluctuation reserves, and administration costs (1). Since all those parameters can change over time, it might be reasonable to review this minimum yield regularly, at least on an annual basis (1)[15]. To guarantee an optimal portfolio construction process, a pension fund should have realistic expectations about the return and the volatility of its strategic asset allocation (2)[16]. Furthermore, since both the expected return of the strategic asset allocation and the minimum required yield can change over time, the two performance figures should be reviewed against each other on a regular basis (1). To achieve a long-term balance between assets and liabilities, the pension fund's expected policy return[17] must exceed (or at least be equal to) the minimum required yield (1). Policy return and asset allocation decisions are frequently taken by the board of trustees in investment strategy meetings. Since such decisions have a substantial impact on the long-term performance of a pension fund, we claim that they should be accompanied by external investment management specialists. Therefore, we reward pension funds that employ independent external experts that participate in investment strategy meetings (1). While a pension fund's strategic asset allocation determines the long-term asset class weights, short-term deviations from the policy structure may theoretically enhance portfolio performance. Empirical evidence on the benefits of tactical asset allocation is contradictory, however. Andonov et al. (2011) find evidence that U.S. defined benefit plans were able to obtain superior performance from intentional changes in their strategic asset allocation and market timing decisions. Other scholars, such as Blake, Lehmann, and Timmermann (1999) or Blake et al. (2013) find counterevidence for British pension schemes. To investigate whether short-term deviations from the strategic allocation are beneficial or detrimental for Swiss pension fund portfolios, the TSIS Score assigns 1 point to funds that pursue active tactical asset allocation (1). Simultaneously, in order to ensure that short-term deviations of asset class weights from the strategic policy do not materially change the long-term investment strategy, we argue that pension fund managers should regularly compare their effective (i.e., realised) portfolio allocation to their strategic asset allocation (1). Potential rebalancing needs can thus be detected in timely manner. Furthermore, in order to be able to respond adequately to structural changes in capital market conditions, a pension fund's management should regularly review its long-term investment strategy, at least on an annual basis (1).

[15] The Investment Strategy and Target Setting Score assigns 0.5 points if the minimum required yield is reviewed at least biannually and 0 points for no regular reviews.

[16] The estimates were deemed realistic if 1) the historical mean return of the investment strategy was greater than or equal to the reported expected return and 2) if the historical volatility was lower than or equal to the reported expected volatility of the strategic asset allocation. A 10% tolerance level was applied.

[17] If the expected return was not deemed realistic, the historical mean return was assessed instead.

Table 1.3: Composition of the TSIS Score

The Swiss Pension Fund Governance Score is divided into 6 sub-scores. The Target Setting and Investment Strategy Score (TSIS) evaluates a pension fund's quality in terms of target setting and investment strategy design. It ranges from 0 to 10 whereby a higher score indicates a higher quality in terms of target setting and systematic investment strategy definition.

Best Practice	Assessment Criteria	Score
Clear targets of financing	Estimate of minimum required yield contains all essential factors	1
	Annual review of minimum required yield	1
Systematic investment strategy planning	Realistic estimate of the strategic asset allocation's expected return	1
	Realistic estimate of the strategic asset allocation's expected volatility	1
	Expected return of strategic asset allocation regularly reviewed against minimum required yield	1
	Expected return of strategic asset allocation ≥ minimum required yield	1
	Independent external experts participate in investment strategy meetings	1
	Pension fund pursues active tactical asset allocation	1
	Regular comparisons of effective to strategic asset allocation	1
	Regular investment strategy review	1
Total TSIS Score		**10**

1.3.4 Investment Process Score (INVP)

The fourth sub-score evaluates a pension fund's governance structure with respect to its asset management processes. The Investment Process Score (INVP) can assume values between 0 and 10. A high score indicates a highly structured investment management process. Table 1.4 shows the detailed composition of the INVP Score.

The implementation of the determined investment strategy requires a structured investment process. To follow a systematic portfolio management process most pension funds have established investment regulations including objectives and general principles, investment guidelines, controlling, accounting, and reporting procedures as well as loyalty regulations in asset management. Since both regulatory and strategic changes may require the revision of established regulations, our Investment Process Score rewards pension funds that review their investment regulations at least on an annual basis (1)[18]. Best practice in asset management furthermore stipulates a high degree of portfolio diversification in order to reduce idiosyncratic risks. A fundamental pillar in the Swiss occupational pension system is the separation between plan assets and assets of the plan sponsor. Article 57 of the Ordinance on Occupational Old-age, Survivors' and Disability Pension Plans (BVV2) stipulates that non-collateralised investments with the employer must not exceed 5 per cent of plan assets, whereas a number of exceptions apply for collateralised investments. In order to reduce exposure to idiosyncratic employer risks, we reward pension funds that do generally not allocate more than 5 per cent of their assets to employer investments, be it in the form of debt or equity (1).

Decisions about investment style have a substantial impact on a pension fund's performance net of costs. The principles of prudence, diligence, and reasonable care therefore require a detailed investment analysis for each asset class (1). This analysis particularly includes decisions about active versus passive investment approaches, direct versus indirect investing decisions, and the appointment of external investment managers. Such decisions might be efficiently implemented by a chief investment officer with clear responsibilities and execution powers (1).

Occasional events of misconduct and cronyism in assigning mandates to external asset managers by Swiss pension funds have demonstrated the need for objectivity and transparency in the asset manager selection process. To ensure a merit-based assignment of mandates, pension funds should establish explicit selection and dismissal criteria that are objectively quantifiable (1). Investment consultants that assist the manager search can potentially streamline the process by reaping economies in evaluating information (1)[19]. To guarantee unbiased trustee decision-making, we also argue that external asset managers should not participate in investment strategy meetings (1).

In order to avoid conflicts of interest, it has become common practice for institutional investors to assign external asset management mandates based on competitive tendering procedures. While a competitive tendering procedure is not required for occupational pension

[18] Pension funds that reported a biannual frequency received 0.5 points on the score.

[19] Goyal and Wahal (2008) find that investment consultants add value for U.S. small sponsor plans in the form of higher post-hiring manager returns.

funds under Swiss law, competition amongst bidding investment managers is likely to benefit pension plan members (1)[20]. Since manager fees reduce the net investment performance at the detriment of beneficiaries, we furthermore argue that well-governed pension funds should regularly re-negotiate, or at least revise, the direct costs of external asset management mandates, at best on an annual basis (1)[21]. Additionally, to avoid significant mismatches between assets and liabilities, we hypothesise that it is beneficial for pension funds to conduct an ongoing asset-liability management, so as to ensure the plan's long-term financial health (1).

Table 1.4: Composition of the INVP Score

The Swiss Pension Fund Governance Score is divided into 6 sub-scores. The Investment Process Score (INVP) evaluates a pension fund's governance structure in terms of its asset management processes. It ranges from 0 to 10 whereby a higher score indicates a higher investment process quality.

Best Practice	**Assessment Criteria**	**Score**
Systematic investment process	Annual review of investment regulations	1
	Detailed investment analysis for each asset class	1
	Dedicated chief investment officer	1
Objectivity and transparency in employing external asset managers	Catalogue of criteria for the selection and dismissal of external asset managers	1
	External asset manager selection supported by investment consultant	1
	External asset manager mandates assigned based on competitive tendering procedure	1
	Regular revisions of external asset management costs	1
	External asset managers do not participate in investment strategy meetings	1
Elimination of idiosyncratic risks	Investments with employer < 5%	1
	Ongoing asset-liability management	1
Total INVP Score		**10**

[20] E.g., in the form of lower costs or better services.

[21] For biannual re-negotiations or revisions, we assign 0.5 score points.

1.3.5 Risk Management Score (RIMA)

The fifth sub-score evaluates a pension fund's risk management framework. A pension fund can obtain a minimum of 0 points and a maximum of 15 points in this category. A high score indicates a comprehensive risk management design. Table 1.5 shows the detailed composition of the RIMA Score.

Risk management is at the heart of each investment process. The recent financial crisis has highlighted the importance of this discipline particularly. The *OECD Guidelines on Pension Fund Asset Management* recommend that pension entities should establish a sound risk management process that measures and appropriately controls a plan's overall portfolio risk profile. In line with this recommendation, we claim that Swiss pension funds should regularly assess their own risk-bearing capacity (1) and have a clearly defined risk budget in terms of a maximum value-at-risk or pre-defined stop loss threshold (1). The risks that pension funds bear are manifold. They can be classified into portfolio risks and plan-specific risks. Portfolio risks essentially comprise investment and market risks, default risks, counterparty risks and liquidity risks. Plan-specific risks include funding risks, actuarial, operational, and regulatory risks, as well as the solvency risk of the plan sponsor. Our Risk Management Score thus rewards pension funds whose risk management framework considers all essential portfolio and plan-specific risk factors (7)[22]. Additionally, since those risk factors have different impact magnitudes on pension entities, their potential detrimental effects need to be assessed on a regular basis by using quantitative risk measurement tools[23]. Quantitative assessments of portfolio risk factors should be conducted on both total portfolio level (1) and per asset management mandate (1). In order to account for severely adverse actuarial and financial market scenarios, we furthermore assert that stress tests might be valuable tools to include in a plan's risk management framework (1). Our RIMA Score moreover assigns 1 point to entities that have established a strategic emergency plan for disaster risks (1). Pre-defined guidelines for violations of tactical fluctuation margins can supplement the risk steering process and prevent excessive deviations from the strategic asset allocation (1). The *OECD Guidelines on Pension Fund Asset Management* moreover stipulate that pension plans should adequately address currency risks when investing in foreign assets. While investments in foreign currencies may benefit a portfolio in terms of diversification aspects and mean-variance optimisation, we argue that, for general risk management reasons, pension funds should have established clear and binding rules concerning the management of foreign

---

[22] Since public pension funds have an implicit state guarantee in a default event, they are not subject to solvency risk of the sponsor. The Risk Management Score accounts for this issue.

[23] E.g., such as value-at-risk, volatility of returns, or quantitative tail risk measurement techniques.

exchange risks (1)[24]. Such guidelines can include hedging policies and tools as well as explicit weight thresholds for certain currency exposures.

Table 1.5: Composition of the RIMA Score

The Swiss Pension Fund Governance Score is divided into 6 sub-scores. The Risk Management Score (RIMA) evaluates a pension fund's risk management quality. It ranges from 0 to 15 whereby a high score indicates a comprehensive risk management design.

Best Practice	Assessment Criteria	Score
Clear understanding of risk factors	Regular assessment of own risk-bearing capacity	1
	Clearly defined risk budget	1
Comprehensive risk management framework	Investment and market risks	1
	Default and counterparty risks	1
	Financing and liquidity risks	1
	Solvency risk of the plan sponsor	1
	Actuarial risks	1
	Operational risks	1
	Regulatory risks	1
Ongoing risk monitoring	Regular quantitative assessment of total portfolio risk	1
	Regular quantitative assessment of portfolio risk per asset management mandate	1
Effective risk steering tools	Risk management framework includes stress tests	1
	Strategic emergency plan for disaster risks	1
	Pre-defined guidelines for violations of tactical fluctuation margins	1
	Clear guidelines concerning the management of foreign exchange risks	1
Total RIMA Score		**15**

[24] Article 55e BVV2 requires Swiss pension funds to not invest more than 30 per cent of total plan assets in unhedged foreign currency assets.

1.3.6 Monitoring and Transparency Score (MOTR)

The sixth and final sub-score evaluates a pension fund's governance with respect to its performance monitoring process and degree of managerial transparency. The Monitoring and Transparency Score (MOTR) can assume values between 0 and 8. A high score indicates a high monitoring quality and a high degree of transparency. Table 1.6 shows the detailed composition of the MOTR Score.

Good pension fund governance requires transparency in decision-making as well as ongoing monitoring of investment activities. An effective monitoring process provides objective, decision-relevant information to the board of trustees and enables a timely and systematic measurement of investment performance. To ensure a high degree of objectivity in the investment management process, portfolio performance should be regularly assessed by means of quantitative performance metrics (1)[25]. Quantitative assessment of investment returns should be conducted on both total portfolio level and per asset management mandate in order to obtain a holistic performance picture (1). An independent investment controller who supervises investment actions might support this process (1). Furthermore, comparisons of key performance metrics amongst peer pension plans enables learning from best-performing funds. The Monitoring and Transparency Score therefore assigns 2 points to pension funds that regularly undertake peer group benchmarking regarding administration costs, asset management costs, investment performance and risk structure (2)[26].

A further key issue in pension fund governance is the avoidance of conflicts of interest of board members. Corporate governance regulations in Switzerland require the disclosure of all board members' mandates in the annual report. We argue that this requirement should also apply to pension funds and claim that all mandates of trustee board members should be disclosed in the annual report (1)[27]. Lastly, new legal regulations following the Minder-Initiative that was passed in March 2013 oblige Swiss pension funds to exercise their shareholder voting rights of portfolio stocks at the companies' annual general meeting. To exercise the rights in the best interests of plan beneficiaries, we stipulate that pension funds should have established a comprehensive information concept for the plan members regarding the exercise of their voting rights (1). Lastly, in order to facilitate access to information and hence foster transparency for all stakeholder groups, we argue that a pension fund's annual report should be made available to the general public online if possible (1).

[25] E.g., such as Jensen's alpha, Sharpe ratio, information ratio, etc.
[26] For each element, the score assigns 0.5 points.
[27] E.g., such as other trustee board mandates or corporate supervisory board mandates, political offices, etc.

Table 1.6: Composition of the MOTR Score

The Swiss Pension Fund Governance Score is divided into 6 sub-scores. The Monitoring and Transparency Score (MOTR) evaluates a pension fund's governance structure with regards to its monitoring process and its degree of managerial transparency. It ranges from 0 to 8 whereby a higher score indicates a higher monitoring quality and transparency degree.

Best Practice	Assessment Criteria	Score
Objective investment performance assessment	Independent investment controller	1
	Quantitative assessment of total investment performance	1
	Quantitative assessment of investment performance per asset management mandate	1
Benchmarking with industry peers	Peer group benchmarking in terms of:	
	- Administration costs	0.5
	- Asset management costs	0.5
	- Investment performance	0.5
	- Risk structure	0.5
Transparent information disclosure	All mandates of board members disclosed in the annual report	1
	Information concept for plan members about shareholder voting rights	1
	Annual report available on the internet	1
Total MOTR Score		**8**

1.4 Summary Statistics of the Sample

The occupational pension system in Switzerland comprises a total number of 2,073 pension funds by the end of 2012 (Swiss Federal Statistical Office, 2014). Occupational insurance is mandatory. Every employee older than 17 years who receives an annual salary in excess of 21,060 CHF is compulsorily required to join a registered pension scheme. Self-employed people and employees that do not fulfil the requirement criteria are exempt from mandatory insurance, yet may voluntarily join a pension plan to benefit from occupational old-age provision pursuant to the Federal Law on Occupational Old-age, Survivors' and Disability Pension Plans. Due to the limited availability of public data, we conduct a mail survey among 1,600 entities in order to evaluate their governance structures quantitatively. Of those, 139 returned completed questionnaires. This equals a response rate of around 9%. Pension fund executives were asked about the governance criteria as described in detail in the sub-sections 3.1 – 3.6 of this paper and their realised investment performance net of costs for the years 2003 – 2012. The questionnaire furthermore contained questions about the institutional structure of the pension plan, its financial situation and risk coverage, its effective asset allocation as of the end of 2012 (including its benchmark performance), and its administration and asset management costs for the years 2010 – 2012. Table 1.7 provides the summary statistics of our sample as well as comparative statistics to the Swiss pension fund universe. Sample and universe data is reported as of the end of 2012.

Table 1.7: Pension fund characteristics

Number of pension plans, plan types, plan models, and risk coverage structures of our data sample compared to the entire Swiss pension fund universe. Sample and universe data is reported as of the end of 2012.

	Sample	Universe
Number of occupational pension funds	139	2,073
thereof pension funds under public law	22.3%	4.4%
thereof pension funds under private law	77.7%	95.6%
Plan type		
Defined contribution plan	80.6%	91.4%
Defined benefit plan	15.1%	5.3%
Dual plan	4.3%	3.3%
Plan model		
Closed pension fund	77.0%	89.4%
Collective pension fund	11.5%	5.4%
Multi-employer plan	11.5%	5.2%
Risk coverage		
Autonomous*	71.2%	40.4%
Partly autonomous	24.5%	51.1%
Full insurance	4.3%	8.5%

* pension funds with excess of loss- or stop-loss insurance are also considered autonomous

Table 1.7 shows that our sample is not representative in terms of the number of pension funds. It only covers around 7% of all registered Swiss occupational pension schemes as of the end of 2012. However, we consider our sample representative as far as total plan assets are concerned. It covers almost half of Switzerland's pension universe assets in all three years under scrutiny, as shown in Table 1.8. The table below furthermore shows that the sample is strongly heterogeneous in terms of the pension fund sizes. For the year 2012, the plan assets range from CHF 5.2 million (smallest fund) to CHF 34.9 billion (largest fund). The average plan assets per pension fund in 2012 amount to approximately CHF 2,061 million with a standard deviation of CHF 4,644 million. Hence, the sample average significantly exceeds the average pension fund size of CHF 324.6 million across all occupational pension schemes in Switzerland in 2012, implying that our sample is biased towards larger pension funds. The sample median for 2012 amounts to CHF 315 million. The sample is thus strongly influenced by a small number of very large pension funds. This is not surprising: More than 22% of pension funds that are included in our sample are set up under public law. Those funds are organised on either the cantonal or the federal level. Since they insure a large number of public sector employees, they are naturally very large in terms of assets under management. By the end of 2012, Switzerland administered 91 public pension funds which held almost 30% of total universe plan assets (Swiss Federal Statistical Office, 2014). Of those, 31 are included in our sample. Hence, compared to the Swiss pension fund universe, public pension funds are overrepresented in our data.

Table 1.8: Pension fund assets and actuarial parameters

Plan assets, coverage ratios, technical interest rates, and the ratio of active plan members to retirees of our sample funds for the years 2010 – 2012. The data is based on the 139 returned questionnaires.

	2010	**2011**	**2012**
Pension plan assets*	**262,854**	**265,199**	**286,495**
(in % of Swiss universe)	*(42.3%)*	*(42.4%)*	*(42.6%)*
Average assets per pension fund	1,891.0	1,907.9	2,061.1
Median	283.3	301.0	315.0
Min	3.0	3.9	5.2
Max	33,158.0	32,984.0	34,938.0
Average coverage ratio	103.5%	101.0%	104.3%
Average technical interest rate**	3.6%	3.5%	3.3%
Ratio active participants to pensioners	2.99	2.96	2.92

* without assets from insurance contracts; in million CHF

** 2 pension funds did not report technical interest rates for the years 2010 - 2012

Our questionnaire also included questions about the risk coverage on the pension entities' liability side. As shown in Table 1.7, more than 71% of sample funds bear old-age, death, and disability risks themselves. This is a typical characteristic for larger pension funds. As compared to the entire pension fund universe, autonomous pension plans are thus also overrepresented in the sample, whereas partly autonomous plans are underrepresented. Funds that fully insure their liability risks (including investment risks) account for only a very small sample fraction. Table 1.8 additionally summarises selected actuarial parameters for the years 2010 - 2012. It shows that the arithmetic mean of the coverage ratios in all three years is in excess of 100%. In 2012, only 19.4% of pension funds in our sample had funding ratios below 100%. This implies that our sample is biased towards rather fully funded pension funds. Since the risk-bearing capacity of a pension plan is partly related to its funding level, the sample is therefore likely to include funds that are more inclined to invest in riskier assets. It is furthermore noteworthy that our sample includes a relatively large fraction of pensioners. The average ratio of active participants to pensioners for the years 2010 - 2012 amounts to around 3, whereas the same average amounts to approximately 5.1 for the Swiss universe (Swiss Federal Statistical Office, 2014). In 2012, the plans in our sample include almost half of Switzerland's' recipients of occupational old-age and disability benefits. This might possibly have implications for the funds' aggregated asset allocation.

Since we aim to investigate the pension schemes' performance net of costs, we also asked pension fund executives about their internal costs structures. Table 1.9 depicts a detailed breakdown of the general administration costs, direct asset management costs, and indirect asset management costs of transparent collective investment vehicles for our sample funds for the years 2010 – 2012[28]. It shows that the general administration costs as measured in basis points of total assets have been slightly declining since 2010[29]. By contrast, direct asset management costs, which include fees of external asset managers, have been slightly increasing. While data about administration costs was reported by all surveyed funds for the years 2010 - 2012, direct and indirect asset management costs were disclosed to a lesser extent. Only about 50% of pension funds in the sample reported total expense ratios (TERs) for the transparent collective investment vehicles included in their portfolios by the end of 2012. For the years 2011 and 2010, the percentages were even lower. Many sample funds

[28] Direct asset management costs are defined as expenses that are included in a pension fund's profit and loss account (e.g., costs for external asset management mandates) whereas indirect asset management costs are defined as expenses that are not directly included in a pension fund's income statement but related to collective investment vehicles (e.g., such as annual fund management fees, loads for mutual funds, etc.).

[29] The great majority of pension funds in our sample bear their general administration costs themselves. Only for a small number of funds, the sponsor bears those costs partly or entirely.

stated that they did not know or systematically measure the soft costs that are implied in the collective investments of their portfolios. Direct asset management costs were reported by all plans for 2012. To our surprise, pension fund executives seem to be relatively insensitive in terms of external asset manager fees. Although more than two thirds of responding entities reported that they appoint external portfolio management mandates based on competitive tendering procedures, 41% of funds surveyed stated that the do not regularly re-negotiate (or at least revise) the fees for such mandates with their asset managers. Only about 17% responded to enter into negotiations on an annual basis or more frequently. Furthermore, less than 40% of plans in our sample reported to benchmark direct asset management costs with their peers. Approximately 10% of plans answered to have no external asset managers on board, but manage their assets exclusively internally. Although recent regulatory initiatives in Switzerland have addressed the issue of cost transparency, it seems that they have not yet brought the desired effects. Since January 1, 2012 new legal regulations concerning cost transparency require the disclosure of the proportion of investment vehicles with non-transparent cost structures included in Swiss pension fund portfolios. Our survey results indicate that the implementation of this regulation has been relatively weak so far. Less than half of the entities in our sample reported data for the year 2012. On average, funds that did report data had invested around 5% of their total assets into such vehicles by the end of 2012.

Table 1.9: Asset management and administration costs

Administration costs, asset management costs, proportions of non-transparent investment vehicles, and total expense ratios (TERs) of transparent collective investment vehicles in our sample for the years 2010 to 2012.

	2010	**2011**	**2012**
General administration costs*	17.1	16.7	15.7
Direct asset management costs*	17.5	17.7	17.8
Proportion of non-transparent investment vehicles**	*N/A*	*N/A*	4.9
TER of transparent collective investment vehicles***	28.0	36.1	33.7

* arithmetic mean of all reporting funds; figures stated in basis points of total assets.

** in per cent of total assets; pursuant Article 48a (3) BVV2; only 69 pension funds reported data for 2012.

*** average total expense ratio of cost-transparent collective investment vehicles included in the asset portfolio of the pension funds; figures are stated in basis points of cost-transparent assets; only 63 pension funds reported data for 2012. For 2011 and 2010, we only received data from 27 and 18 entities, respectively.

1.5 Pension Fund Governance in Switzerland

1.5.1 Results of the survey

To examine the current governance state of our sample pension funds, we create the Swiss Pension Fund Governance Score (G-SCORE). The G-SCORE metric is based on the responses of the 139 occupational pension funds that have completed and returned our standardised questionnaire. The basis for the questionnaire are the assessment criteria as described in section 3 of this paper. Table 1.10 summarises the results of the 6 sub-scores and the overall composite score for the sample. The composite G-SCORE is computed as the sum of all individual sub-scores. It can assume values between 0 and 60 whereby a high score implies a sound and comprehensive internal governance structure. The maximum achievable points for each category are reported in parentheses.

Table 1.10: Summary results of the Swiss Pension Fund Governance Score

The table shows the summary statistics for the 6 sub-scores and the overall composite score. Maximum achievable points for each category are shown in parentheses. The results are based on 139 pension funds.

	Mean	Median	SD	Min	Max	MPSM*
ORGA Score (10)	5.1	5.0	1.9	1.0	9.0	51.4%
MANO Score (7)	2.9	3.0	1.7	0.0	6.5	41.0%
TSIS Score (10)	6.5	6.5	1.5	1.5	9.5	64.8%
INVP Score (10)	6.1	6.0	1.8	2.0	10.0	60.5%
RIMA Score (15)	8.3	8.6	3.7	0.0	15.0	55.2%
MOTR Score (8)	3.6	4.0	1.5	0.0	7.5	44.8%
Composite G-SCORE (60)	**32.4**	**33.6**	**8.9**	**10.5**	**49.5**	**54.0%**

* MPSM = Mean as percentage of score maximum

The table above shows the governance state of our sample pension funds as measured by the G-SCORE. On average, pension plans obtained 32.4 points on the composite score. The mean as a percentage of the score maximum lies slightly above 50%. Composite G-SCORE points range from 10.5 (lowest) to 49.5 (highest). Half of the pension funds obtained scores in excess of 33.6. No pension fund in our sample achieved the maximum score that can be possibly reached (60 points). The statistical distribution of the composite score is slightly skewed to the left and marginally mesokurtic.

Governance structures were found to be relatively comprehensive in the areas of target setting and investment strategy definition, investment processes and risk management. In the areas of management objective design, monitoring effectiveness and transparency there is still room for improvement, however. Although clear management objectives are an essential component of good governance, only about 34% of pension funds in our sample reported to have an own written statement regarding their strategic goals (i.e., mission statement). Even more notably, only 22% reported to have defined management objectives for the board of trustees, whereas more than 72% of entities had defined management objectives for the CEO or senior pension fund executive(s). In opposition to the recommendations of Ambachtsheer, Capelle, and Scheibelhut (1998), compensation policies for both executive and supervisory committee members of Swiss occupational pension plans are not reasonably linked to performance. Only 3 pension funds reported that their CEOs' financial compensation is linked to individual objectives or the funds' investment performance. Almost two thirds of CEOs or senior executives receive fixed financial compensation while the remainder receives fixed financial compensation with a variable component. For trustee boards, performance-linked compensation is effectively not existing in Switzerland. No single pension fund in our sample compensates its trustee board members based on the achievement of individual objectives or plan performance. The majority of trustees are solely reimbursed for their expenses or obtain a flat-fee expense allowance. Only 1.4% of pension funds include a variable component in their trustee compensation package. About 14% of trustees do not receive financial compensation at all.

We furthermore find evidence for potential governance issues in the areas of risk management and monitoring and transparency. The risk management quality of our sample pension funds is found to be relatively bipolar, as indicated by the high standard deviation of the RIMA Score. Notwithstanding this finding, our survey reveals that risk monitoring and steering is an important issue on the agenda of plan managers. Only about 12% of funds in our sample reported to undertake no active risk management. Regular assessment of risk-bearing capacity is conducted by more than 90% of the plans. However, although most pension funds do make use of risk management practices, specific risk factors such as foreign exchange risks or portfolio tail risks receive less attention. Only 15.8% of funds reported to have a strategic emergency plan for disaster risks in place. While a number of European financial regulators require mandatory stress tests for occupational pension arrangements, only about one third of pension funds in our sample include internal stress tests in their risk management frameworks. Particularly larger pension funds with plan assets in excess of CHF 1 billion do not systematically conduct such analyses[30]. Even more notably, although the pension plans in our sample have allocated, on average, more than 37% of their portfolio funds to assets that are denominated in foreign currencies by the end of 2012, only around 50% of entities have established explicit regulations concerning foreign exchange risks.

Ammann and Zingg (2010) find that board composition is a key governance issue in Switzerland in terms of excessively large trustee boards. Accounting for pension fund size, we find that 75.5% of plans have a moderate number of board members. However, our analysis reveals that almost one fourth of trustees hold both executive and oversight functions. Furthermore, we find evidence for a lack of professional expertise among the governing bodies. More than 70% of funds in our sample reported to have trustee board members that are not elected because of their specialised knowledge regarding pension issues. Task-specific education programs for trustees are neither pervasive. Around 39% of sample funds have not established any education or training concept for trustees or executives. Independent external experts or specialists are part of the board of trustees in only around 31% of cases. This is an alarming result given the extensive fiduciary responsibility that board members have to the pension plans' beneficiaries. Although recommended in the literature, mandatory retirement provisions for board members and board term limits are not common in Switzerland. Only around 24% of pension funds in our sample make use of maximum age thresholds while around 18% have established term limits. Minor issues were also identified in the area of monitoring and transparency. This particularly pertains to transparency regarding investment decisions. More than 30% of pension funds reported that their external asset managers participate in investment strategy meetings. Since external asset managers have a strong incentive to influence decisions in such meetings towards their own goals, there is potential for conflicts of interest. Furthermore, in contrast to corporate boards in Switzerland, trustee boards are not legally required to disclose their members' additional mandates in the plans' annual report. Our survey reveals that only very few (8.6%) pension entities in our sample

[30] Of the 44 large funds in our sample (as measured by plan assets at the end of 2012), only 19 reported to include stress testing techniques in their risk management frameworks.

disclose those mandates on a voluntary basis. Transparency is moreover lacking in terms of informing plan stakeholders about internal policies to exercise shareholder voting rights. Although new legal regulations require the mandatory exercise of voting rights attached to portfolio stocks, less than one third of funds in the sample have established an explicit information concept for their active members and pensioners.

Overall, we do not find any systematic governance weaknesses in the Swiss occupational pension fund system. It is possible, however, that this may be driven by a self-selection bias in the sense that pension funds with inferior governance structures may not have responded to our questionnaire request. Since our sample is moreover biased towards larger funds, we might potentially overestimate the governance quality of the entire Swiss pension plan universe. Those limitations might also have implications for the interpretations of the empirical results as described below.

1.5.2 Methodology

In the following sections, we examine the relationship between governance and investment performance of Swiss occupational pension funds. To do this, we regress different performance measures on our composite G-SCORE and its constituent sub-scores. Measuring performance of pension portfolios is more complicated than of other collective investment vehicles. First, certain metrics are not suitable for pension plans, particularly when a pension fund manager outsources all or part of the portfolio allocation to external asset managers. Alpha is such an example. Second, even if alpha was used as performance measure, multifactor models to estimate alpha would be very difficult to employ due to the vast heterogeneity of the funds' asset allocations and the multitude of their risk factors. Therefore, in order to obtain a comprehensive understanding of pension fund performance, we draw on four different quantitative measures. Those metrics are estimated by the following model:

$$PF\_PM = \beta_0 + \beta_1 SCORE_j + \beta_2 Size + \beta_3 Public + \beta_4 DBPlan + \beta_5 ClosedFund + \beta_6 Autonomous + \beta_7 RatioAP + \beta_8 AMCosts + \beta_9 AdminCosts + \varepsilon$$

whereby *PF_PM* is a vector of the different performance measures and *SCORE* is a variable consisting of either our composite governance score (*j=1*) or one of its constituent sub-scores (*j=2…6*). Since we expect that pension fund size affects performance, we include the natural logarithm of the average pension assets of the period 2010 - 2012 into the equation (*Size*). To disentangle differences between public and private pension funds, we furthermore include the variable *Public*, which is a dummy variable assuming the value 1 for public pension funds and zero otherwise. Further control dummies are *DBPlan* and *ClosedFund*, which assume the value 1 for a defined benefit plan and a closed pension fund, respectively. Since we also want to investigate the relationship between the risk coverage on a pension fund's passive side and performance, we include the dummy variable *Autonomous*, which assumes the value 1 for autonomous pension funds and zero for all partly autonomous or fully insured funds. We furthermore expect that pension plans with more pensioners relative to active members have a different risk and return attitude that might affect asset allocation and hence indirectly performance. Therefore, we include the variable *RatioAP* into the equation, where *RatioAP* expresses the ratio of active participants to pensioners as averaged over the years 2010 - 2012. In their study, Ammann and Zingg (2010) find that asset management costs are negatively related to pension funds' investment performance as measured by their net value added variable. Since we expect that both administration and asset management costs reduce plan performance at the detriment of beneficiaries, we finally include the explanatory variables *AdminCosts* and *AMCosts* into the regression. Both variables are measured as average costs in basis points of total assets over the 3-year investigation period.

To obtain an initial overview of the relationship on a non-risk-adjusted basis, the dependent variable vector *PF_PM* includes the geometric mean return (in excess of the risk-free rate) net of costs as computed over the years 2010 - 2012 (*ExcessReturn*). In the following, this 3-year time period is referred to as the evaluation period. The risk-free rate is proxied by the average yield of 10-year Swiss confederation bonds.

To measure the value added by active asset management, we compare a pension fund's return net of portfolio management fees (R_{PF}) against the return of a passively implemented benchmark strategy (R_{PB}). A positive deviation from the benchmark indicates superior portfolio management, whereas a negative deviation indicates an underperformance relative to the passive strategy. The benchmark that we use for this analysis is based on standard market indices proxying major asset classes and the relative weights of the effective asset allocations as reported by the pension funds in our sample as of the end of 2012. In order to compare a pension fund's return against the benchmark return, we compute an individual allocation benchmark for each fund in the sample by multiplying the asset allocation weights with the annual returns of each asset class index. The detailed breakdown of the benchmark indices for each asset class is shown in Appendix 1.A. Since the effective asset allocations of Swiss pension funds have not changed fundamentally over the last three years, we assume the weights to remain constant during the evaluation period[31]. To capture the total out- or underperformance of the k^{th} fund in this period, we compute the mean of the annual deviations from the benchmark of the years 2010 - 2012 (*TE_AllocationBenchmark*). A positive average tracking error should indicate an added value by the pension fund manager.

$$TE\_AllocationBenchmark_k = \frac{\sum_{i=1}^{3}(R_{PFk,i} - R_{PBk,i})}{3}$$

An additional, yet similar performance measure that we employ is a pension fund's deviation to its policy benchmark. Individual policy benchmark data for each fund was collected with our proprietary questionnaire[32]. The tracking error is computed as the mean difference between a pension fund's net return (R_{PF}) and the return of its individual policy benchmark index (R_{IB}) in the evaluation period (*TE_PolicyBenchmark*).

$$TE\_PolicyBenchmark_k = \frac{\sum_{i=1}^{3}(R_{PFk,i} - R_{IBk,i})}{3}$$

Lastly, to capture pension fund performance on a risk-adjusted basis, the *PF_PM* vector includes the pension funds' Sharpe ratios (*Sharpe*). Sharpe ratios are computed as the difference of the pension plans' geometric mean return of the years 2010 - 2012 (μ_k) and the risk-free rate as proxied by the geometric annual average yield of 10-year Swiss confederation bonds (Rf_k) divided by the pension funds' annual volatility (σ_k) for the 10-year period. To eliminate distortionary effects of large outliers, pension portfolios with Sharpe ratios in excess of 1 are excluded from the analysis (3 funds excluded).

$$Sharpe_k = \frac{\mu_k - Rf_k}{\sigma_k}$$

[31] For a detailed breakdown of the aggregated asset allocation weights of all Swiss pension funds for the years 2004 - 2012 see Appendix 1.B.

[32] Some few pension funds did report that they do not measure their performance against a benchmark. In those few cases, we used the passive benchmark instead.

Motivated by the empirical findings of Harper (2008), who finds that board composition of U.S. public pension funds is related to asset allocation decisions and thus indirectly to performance, we additionally examine the relationship between our governance variables and the effective asset allocation weights of the pension funds in our sample. Asset allocation data was obtained from each pension fund as of the end of 2012. To investigate this relationship, we make use of the following multivariate model:

$$AC_n = \theta_0 + \theta_1 G-SCORE_j + \theta_2 Size + \theta_3 Public + \theta_4 DBPlan + \theta_5 ClosedFund + \theta_6 Autonomous + \theta_7 RatioAP + \varepsilon$$

whereby AC_n is a vector of the different asset class weights, *G-SCORE* is our composite governance score and the remaining explanatory variables are the same as employed in the performance analysis above[33]. Regressions are run stepwise on each weight in order to determine which factors are related to asset allocation decisions. As a robustness check, we additionally include the 3-year average coverage ratios in both the performance analysis and the asset allocation analysis as regressors (*CovRatio*). The empirical results of this robustness test are outlined in section 6.

To account for the problem of multicollinearity, we compute correlations between the explanatory variables in both the performance and the asset allocation analysis. This statistical examination shows that governance is highly correlated to pension fund size. This has already been documented by Ammann and Zingg (2010), yet to a lesser extent. To avoid distortionary effects stemming from multicollinearity, the variable *Size* was orthogonalised before applied in the regression equation.

[33] Asset management costs (*AmCosts*) and administration costs (*AdminCosts*) have been deliberately excluded from this regression, as those variables are not deemed to be related to a pension fund's asset allocation mix.

1.6 Empirical Findings

Table 1.11 shows the results of the initial analysis of the sample funds' governance categories. We split our sample into G-SCORE quartiles and sort them from highest (1) to lowest (4). The table below shows that the arithmetic average of each respective performance metric within each governance quartile decreases monotonically for all of the analysed metrics. For both variables *ExcessReturn* and *TE_AllocationBenchmark*, the average within the highest governance quartile exceeds the average within the lowest quartile by approximately 1%. Pension funds within the highest G-SCORE quartile furthermore underperform, on average, their individual policy benchmarks (i.e., *TE_PolicyBenchmark*) by around 75 basis points less than their lowest quartile counterparts. The Sharpe ratio difference between quartile 1 and 4 is also positive, as shown in the table below.

Table 1.11: Quartile analysis

The table shows the arithmetic average of each of the four analysed performance measures for each respective G-SCORE quartile category. Δ High-Low shows the difference between the top quartile average and the bottom quartile average of each employed metric. *ExcessReturn* is the average excess return of the years 2010 – 2012. *TE_AllocationBenchmark* is the average deviation from the passive benchmark strategy for the years 2010 – 2012. *TE_PolicyBenchmark* is the average deviation from the pension funds own policy benchmark for the years 2010 – 2012. *Sharpe* is the pension funds' Sharpe ratio, as defined in section 5.2 of this paper.

	G-SCORE Quartile				
	Highest			Lowest	
Performance Metric	1	2	3	4	Δ High-Low
ExcessReturn	2.65%	2.21%	1.81%	1.62%	+1.02%***
TE_AllocationBenchmark	-0.36%	-0.83%	-1.20%	-1.33%	+0.97%***
TE_PolicyBenchmark	-0.31%	-0.60%	-0.88%	-1.06%	+0.75%**
Sharpe	0.376	0.299	0.295	0.271	+0.105**

*** 1% significance ** 5% significance * 10% significance

In order to control for other factors that might be related to superior net investment performance, we conduct the multivariate regressions, as defined in chapter 1.5.2. Table 1.12 shows the empirical results of the relationship between governance and the sample funds' excess performance during the evaluation period. Our analysis reveals that governance is positively related to average excess returns. Overall governance structure, as measured by our G-SCORE, affects mean excess returns by around 3 basis points. The result is statistically significant at the 5% level. Particularly target setting and investment strategy definition as well as risk management design is strongly positively related to the average investment performance in excess of the risk-free rate. This is not surprising, as the TSIS Score includes essential governance factors that are directly related to a pension fund's portfolio strategy. The analysis of the individual TSIS Score components shows that particularly independent external experts that participate in investment strategy meetings have a substantial positive relation to performance. Pension plans in our sample that draw on such outside advisers have a higher mean excess return by approximately 51 basis points. To test the effect of the coverage ratio, we add the independent variable *CovRatio* to the regression. While we are aware of the fact that this variable might be endogenous in the sense that higher raw investment performance leads to higher coverage ratios, we still include it for robustness reasons. The analysis shows that the funding levels are strongly positively related to the funds' average excess returns achieved during the evaluation period. All coefficient estimates for the variable *CovRatio* are highly statistically significant. We also document a negative correlation between the variables *CovRatio* and *Public*, implying that the public pension funds of our sample have, on average, lower funding levels than the privately organised schemes. It is furthermore noteworthy that, if coverage ratios are included into the regression, the constant term decreases and its statistical significance vanishes almost entirely, whereas the models' adjusted R^2s increase. The funding level thus seems to capture a large part of the models' unobserved explanatory variation.

We furthermore find evidence that pension fund size is strongly positively related to average excess performance. Our analysis shows that larger pension funds have been able to achieve, on average, higher excess returns than smaller funds during the evaluation period. This result can be explained by the fact that larger pension schemes are usually backed by larger employers that can draw on a broader pool of qualified human resources and better funding sources. Hence, they are likely to have more institutionalised internal governance processes. This has also been documented by Yermo and Stewart (2008), who claim that small funds are less likely to achieve comparable levels of performance than large funds, even gross of fees, due to weaker governance structures and inconsistent internal processes. It might also explain why governance is strongly correlated to plan size in our sample. By contrast, legal form, pension fund type, pension fund model, risk coverage, and administration and asset management costs do not affect the mean excess performance measurably.

Surprisingly, autonomous pension funds, which are usually large in size, do not have a significantly higher average investment performance. Neither do we find any statistically robust evidence for an effect of direct asset management costs, which should theoretically reduce the net performance.

The relationship between governance and the value added by a pension fund's asset manager is shown in Table 1.13 and Table 1.14. Our results also point to a positive relationship between governance structure and the 3-year arithmetic mean difference between net fund return and the return of the passive benchmark strategy. The effect has a magnitude of approximately 2.8 basis points per G-SCORE point. This result is again primarily driven by the constituent sub-scores TSIS and RIMA.

In addition to governance, our data shows that the ratio of active plan members to plan pensioners is positively related to outperformance as measured by the variable *TE_AllocationBenchmark*. Pension funds with more active members underperform the passive benchmark to a lesser extent. This might be explained by the different risk attitude and asset allocation of pension funds that have more active members relative to pensioners. Our hypothesis is further examined below. Moreover, we find that larger pension funds do not only have higher average excess performance, but also underperform the passive investment strategy to a lesser extent. In order to test the results of the *TE_AllocationBenchmark* variable for robustness, we furthermore measure outperformance with the mean tracking error of a plan's investment performance to its own policy benchmark as reported in our questionnaire. Using this performance metric, we find similar results. As shown in Table 1.14, target setting and investment strategy definition is primarily related to mean outperformance of a fund's policy benchmark. The effect for the TSIS Score is as large as around 21.5 basis points. The coefficient is significant even at the 1% level. Interestingly, in the analysis of the individual TSIS Score components on *TE_PolicyBenchmark,* the size factor disappears entirely for this variable. The positive mean deviation from the individual policy benchmark can thus not be explained by the average pension assets under management. This might be due to the fact that the funds' customised policy benchmarks are often chosen inconsistently with their effective asset allocations. The relatively low adjusted R^2s for this particular model and the large negative constant term additionally point to this. Including the variable *CovRatio* into the regression does not improve the results. While we find some evidence that funding levels are positively related to mean outperformance, this finding is not consistent throughout all sub-score analyses.

In contrast to our expectations, organisational setup and investment process design is neither related to mean excess returns nor to benchmark outperformance. We find no empirical evidence that board governance factors such as separation of executive and supervisory functions, trustee board size, or the existence of an education concept are related to superior investment performance. Even if we alter the above-defined size thresholds for the board of trustees or the investment committees, we find no statistically significant results. Neither do we find any effect for investment process factors such as asset manager selection procedures or the existence of a chief investment officer. Those factors do not explain excess returns or positive benchmark deviations for the funds in our sample. This result is somewhat counterintuitive, as particularly the components of the INVP Score are directly associated with a pension fund's asset management processes. To validate these findings, we conduct an examination of the individual INVP Score components for those funds that reported to have external asset managers on board[34]. The analysis validates our initial results. We do not find any empirical evidence that external asset manager selection procedures are related to superior performance. While structured procedures are nonetheless desirable in order to avoid conflicts of interests, their relationship to performance is not statistically measurable.

We furthermore find no conclusive evidence for a relationship between the degree of transparency, as measured by our MOTR Score, and excess returns or average benchmark outperformance. While transparency is an important governance variable that aims to protect the interests of plan members, factors such as the disclosure of board members' additional mandates or peer group benchmarking practices have no direct effect on plan performance. This is rather evident, as those "soft" factors are not immediately related to portfolio choice or investment management. Although neither directly associated with the investment process, we do find some evidence that the design of management objectives is related to both mean excess returns and outperformance as measured by the variable *TE_AllocationBenchmark*. The statistical significance of those results is weak, however. The analysis of the individual score constituents of the MANO Score reveals that particularly the existence of an own mission statement drives the results. Pension funds in our sample that have an own written statement regarding their overall strategic goals have a higher average excess return by approximately 41 basis points and have positively deviated from the passive benchmark by around 44 basis points on average during the evaluation period. Board and senior management compensation policies, by contrast, do not have any measurable effect.

[34] Of the 139 respondents, 14 stated that they had not assigned external mandates by the end of 2012.

To account for different portfolio risk structures, we finally regress Sharpe ratios on our model. The results in Table 1.15 indicate that governance is also positively related to the risk-adjusted excess returns. The significant positive coefficient estimates for both the TSIS Score and the RIMA Score clearly point to this. Hence, regardless of which performance measure employed, we find that superior investment performance, both on a non-risk adjusted and risk-adjusted basis, seems to be particularly related to a pension fund's target setting and investment strategy definition process and, yet to lesser extent, its risk management design. Organisational structure, investment processes and transparency are found to be less important for performance. It should be noted that since all performance metrics are computed with realised 3-year data, our results might be somewhat "backward-predicting", however, as some governance variables might have changed over the 3-year period[35]. The lack of publicly available data for Swiss pension funds as well as the trade-off between the scope of the survey and the response rate made it impossible to analyse a data panel. However, most of our governance variables are rather "sticky" in nature and unlikely to be altered on a frequent basis. It should furthermore be noted that our results allow no inferences about any causal relationship between governance and performance. While it might be likely that good pension fund governance drives superior investment performance, the causality might also run reversely in the sense that funds with good performance can, for whatever reasons, install better governance structures.

Lastly, in opposite to the findings of Andonov, Bauer, and Cremers (2011), we find that tactical asset allocation is detrimental for the funds in our sample. The coefficient estimate for this TSIS Score constituent is significantly negative for the variables *ExcessReturn* and *TE_AllocationBenchmark*, indicating that short-term fluctuations from the policy structure rather destroy than add value for plan beneficiaries. This implies that the sample plan managers were not able to achieve persistent gains from market timing or security selection practices during the evaluation period. Due to the relatively large coefficient standard errors, the statistical validity of this result is somewhat limited, however. For the variables *TE_PolicyBenchmark* and *Sharpe*, no statistically significant effect is found.

[35] For the Sharpe ratio analysis, we deliberately exclude the control variables *RatioAP*, *AMCosts*, and *AdminCosts* in order to avoid a time-dimension problem. 3 portfolios with Sharpe ratios in excess of 1 were excluded.

Table 1.12: Governance and excess returns

The table shows the results of the regressions (1 - 7) of our model on the 3-year average excess return of the sample pension funds for the period 2010 – 2012 (*ExcessReturn*). Adjusted R^2s of the models are shown in the bottom line of the table. T-statistics are shown in parentheses. Coefficient estimates are reported in basis points. The results are based on 139 pension funds.

Dependent Variable = *ExcessReturn*

	1	2	3	4	5	6	7
G-SCORE	2.8**						
	(2.40)						
ORGA Score		0.6					
		(0.12)					
MANO Score			9.1*				
			(1.78)				
TSIS Score				14.4***			
				(2.61)			
INVP Score					1.3		
					(0.26)		
RIMA Score						5.5**	
						(2.26)	
MOTR Score							8.7
							(1.38)
Constant	139.9***	226.7***	198.2***	145.6***	221.8***	189.1***	199.5***
	(2.99)	*(5.53)*	*(5.93)*	*(3.42)*	*(5.23)*	*(5.67)*	*(5.54)*
Size	22.5*	42.0***	33.0***	38.4***	41.6***	28.0**	199.5***
	(1.70)	*(3.29)*	*(2.84)*	*(3.75)*	*(3.65)*	*(2.31)*	*(5.54)*
Public	-8.9	-14.7	-14.8	-10.6	-14.8	-13.4	-14.4
	(-0.45)	*(-0.70)*	*(-0.74)*	*(-0.53)*	*(-0.73)*	*(-0.68)*	*(-0.72)*
DBPlan	-11.9	-13.8	-14.8	0.6	-13.5	-15.1	-12.7
	(-0.60)	*(-0.68)*	*(-0.74)*	*(0.03)*	*(-0.67)*	*(-0.77)*	*(-0.64)*
ClosedFund	-5.8	-8.1	-8.7	-0.3	-7.4	-13.0	-3.7
	(-0.31)	*(-0.42)*	*(-0.46)*	*(-0.02)*	*(-0.38)*	*(-0.68)*	*(-0.19)*
Autonomous	-8.7	-10.7	-4.0	-28.1	-10.9	-3.8	-12.7
	(-0.42)	*(-0.51)*	*(-0.19)*	*(-1.31)*	*(-0.52)*	*(-0.18)*	*(-0.61)*
RatioAP	0.24	0.28	0.27	0.23	0.27	0.27	0.30
	(1.07)	*(1.27)*	*(1.21)*	*(1.02)*	*(1.20)*	*(1.24)*	*(1.36)*
AMCosts	-0.34	-0.15	-0.06	-0.25	-0.14	-0.38	-0.30
	(-0.49)	*(-0.21)*	*(-0.09)*	*(-0.37)*	*(-0.20)*	*(-0.54)*	*(-0.43)*
AdminCosts	-0.30	-0.19	-0.18	-0.42	-0.21	-0.32	-0.12
	(-0.45)	*(-0.29)*	*(-0.26)*	*(-0.63)*	*(-0.30)*	*(-0.47)*	*(-0.32)*
R^2 adj.	*0.165*	*0.128*	*0.149*	*0.172*	*0.128*	*0.161*	*0.140*

*** 1% significance ** 5% significance * 10% significance

Table 1.13: Governance and outperformance of the passive benchmark

The table shows the results of the regressions (1 - 7) of our model on the 3-year arithmetic mean of the difference between the net fund return and the return of the passively implemented strategy for the period 2010 – 2012 (*TE_AllocationBenchmark*). Adjusted R^2s of the models are shown in the bottom line of the table. T-statistics are shown in parentheses. Coefficient estimates are reported in basis points. The results are based on 139 pension funds.

Dependent Variable = *TE_AllocationBenchmark*

	1	2	3	4	5	6	7
G-SCORE	2.8**						
	(2.28)						
ORGA Score		-0.7					
		(-0.12)					
MANO Score			9.4*				
			(1.73)				
TSIS Score				10.3*			
				(1.74)			
INVP Score					1.7		
					(0.33)		
RIMA Score						6.5**	
						(2.53)	
MOTR Score							8.8
							(1.31)
Constant	-154.4***	-59.5	-96.1***	-123.8***	-74.2*	-111.6***	-94.0***
	(-3.10)	*(-1.37)*	*(-2.71)*	*(-2.70)*	*(-1.65)*	*(-3.17)*	*(-2.46)*
Size	20.0	41.5***	30.4**	37.4***	38.9***	23.0*	33.2***
	(1.42)	*(3.06)*	*(2.46)*	*(3.39)*	*(3.22)*	*(1.80)*	*(2.70)*
Public	-20.6	-27.8	-26.6	-23.7	-26.4	-24.9	-26.3
	(-0.97)	*(-1.25)*	*(-1.26)*	*(-1.11)*	*(-1.22)*	*(-1.19)*	*(-1.23)*
DBPlan	-6.6	-8.3	-9.6	1.8	-8.2	-10.2	-7.5
	(-0.33)	*(-0.39)*	*(-0.45)*	*(0.08)*	*(-0.38)*	*(-0.49)*	*(-0.35)*
ClosedFund	-30.5	-32.9	-33.4	-27.2	-31.8	-38.5*	-28.3
	(-1.52)	*(-1.61)*	*(-1.65)*	*(-1.33)*	*(-1.54)*	*(-1.92)*	*(-1.38)*
Autonomous	-14.8	-17.2	-10.0	-29.5	-17.1	-8.7	-18.9
	(-0.68)	*(-0.77)*	*(-0.45)*	*(-1.28)*	*(-0.77)*	*(-0.40)*	*(-0.85)*
RatioAP	0.61**	0.66***	0.64***	0.62***	0.64***	0.64***	0.68***
	(2.59)	*(2.77)*	*(2.72)*	*(2.60)*	*(2.65)*	*(2.77)*	*(2.85)*
AMCosts	-0.27	-0.07	0.01	-0.15	-0.07	-0.35	-0.24
	(-0.37)	*(-0.09)*	*(0.01)*	*(-0.21)*	*(-0.09)*	*(-0.48)*	*(-0.32)*
AdminCosts	-0.56	-0.46	-0.44	-0.62	-0.47	-0.60	-0.47
	(-0.79)	*(-0.64)*	*(-0.61)*	*(-0.86)*	*(-0.65)*	*(-0.85)*	*(-0.66)*
R^2 adj.	*0.177*	*0.144*	*0.163*	*0.164*	*0.144*	*0.184*	*0.155*

*** 1% significance   ** 5% significance   * 10% significance

Table 1.14: Governance and outperformance of the policy benchmark

The table shows the results of the regressions (1 - 7) of our model on the 3-year arithmetic mean of the difference between the net fund return and the return of the pension funds' individual policy benchmarks for the period 2010 – 2012 (*TE_PolicyBenchmark*). Adjusted R^2s of the models are shown in the bottom line of the table. T-statistics are shown in parentheses. Coefficient estimates are reported in basis points. The results are based on 139 pension funds.

Dependent Variable = *TE_PolicyBenchmark*

	1	2	3	4	5	6	7
G-SCORE	3.0**						
	(2.09)						
ORGA Score		-2.1					
		(-0.32)					
MANO Score			5.0				
			(0.79)				
TSIS Score				21.5***			
				(3.22)			
INVP Score					6.8		
					(1.14)		
RIMA Score						4.6	
						(1.52)	
MOTR Score							12.0
							(1.56)
Constant	-164.4***	-56.2	-85.1**	-193.6***	-111.3**	101.7**	-109.9**
	(-2.85)	*(-1.12)*	*(-2.05)*	*(-3.75)*	*(-2.15)*	*(-2.46)*	*(-2.49)*
Size	3.0*	27.3*	19.4	18.2	18.3	12.5	14.8
	(0.19)	*(1.77)*	*(1.35)*	*(1.47)*	*(1.31)*	*(0.83)*	*(1.04)*
Public	-22.9	-32.0	-29.6	-22.7	-26.7	28.2	-28.6
	(-0.93)	*(-1.25)*	*(-1.20)*	*(-0.95)*	*(-1.08)*	*(-1.15)*	*(-1.16)*
DBPlan	13.8	12.4	-11.3	33.2	12.8	10.7	13.3
	(0.57)	*(0.50)*	*(-0.46)*	*(1.35)*	*(0.52)*	*(0.44)*	*(0.54)*
ClosedFund	2.5	-0.3	-0.4	11.6	3.9	-4.1	6.1
	(0.11)	*(-0.01)*	*(-0.01)*	*(0.51)*	*(0.16)*	*(-0.17)*	*(0.26)*
Autonomous	17.0	-14.3	18.4	-11.2	14.5	20.6	12.2
	(0.67)	*(0.56)*	*(0.71)*	*(-0.43)*	*(0.57)*	*(0.80)*	*(0.48)*
RatioAP	0.20	0.26	0.24	0.16	0.19	0.24	0.28
	(0.73)	*(0.94)*	*(0.89)*	*(0.61)*	*(0.68)*	*(0.89)*	*(1.01)*
AMCosts	-1.19	-0.95	-0.93	-1.14	-0.96	-1.17	-1.20
	(-1.40)	*(-1.10)*	*(-1.09)*	*(-1.38)*	*(-1.12)*	*(-1.37)*	*(-1.39)*
AdminCosts	0.18	0.28	0.30	-0.04	0.25	0.19	0.27
	(0.22)	*(0.33)*	*(0.37)*	*(-0.05)*	*(0.31)*	*(0.23)*	*(-0.32)*
R^2 adj.	*0.045*	*0.014*	*0.017*	*0.086*	*0.023*	*0.030*	*0.031*

*** 1% significance   ** 5% significance   * 10% significance

Table 1.15: Governance and Sharpe ratios

The table shows the results of the regressions (1 - 7) of our model on the pension funds' Sharpe ratios for the period 2010 – 2012 (*Sharpe*). Adjusted R^2s of the models are shown in the bottom line of the table. T-statistics are shown in parentheses. Coefficient estimates are reported in basis points. 3 pension funds with Sharpe ratios in excess of 1 have been excluded. The results are based on 136 pension funds.

Dependent Variable = *Sharpe*

	1	2	3	4	5	6	7
G-SCORE	0.004*						
	(1.92)						
ORGA Score		0.002					
		(0.16)					
MANO Score			0.023**				
			(2.39)				
TSIS Score				0.024**			
				(2.40)			
INVP Score					0.013		
					(0.14)		
RIMA Score						0.007	
						(1.58)	
MOTR Score							0.003
							(0.25)
Constant	0.189**	0.326***	0.259***	0.177**	0.327**	0.270***	0.323***
	(2.22)	*(4.80)*	*(5.29)*	*(2.34)*	*(-4.55)*	*(4.84)*	*(5.40)*
Size	0.007	0.033	0.011	0.032*	0.034*	0.018	0.033*
	(0.33)	*(1.48)*	*(0.54)*	*(1.82)*	*(1.75)*	*(0.88)*	*(1.68)*
Public	0.028	0.020	0.020	0.026	0.019	0.021	0.019
	(0.75)	*(0.52)*	*(0.55)*	*(0.70)*	*(0.51)*	*(0.56)*	*(0.51)*
DBPlan	-0.077**	-0.801**	-0.085**	-0.056	-0.080**	-0.081**	-0.079**
	(-2.06)	*(-2.12)*	*(-2.29)*	*(-1.46)*	*(-2.10)*	*(-2.16)*	*(-2.10)*
ClosedFund	-0.012	-0.160	-0.019	-0.000	-0.015	-0.002	-0.015
	(-0.34)	*(-0.45)*	*(-0.54)*	*(-0.01)*	*(-0.43)*	*(-0.61)*	*(-0.41)*
Autonomous	0.004	-0.003	0.015	-0.277	-0.003	0.001	-0.003
	(0.10)	*(-0.07)*	*(0.41)*	*(-0.72)*	*(-0.08)*	*(0.24)*	*(-0.09)*
R^2 adj.	*0.045*	*0.028*	*0.069*	*0.069*	*0.028*	*0.046*	*0.028*

*** 1% significance ** 5% significance * 10% significance

To relate pension fund governance to asset allocation decisions, we run regressions of the pension funds' effective asset class weights as of the end of 2012 on the G-SCORE and control variables. Table 1.16 shows the results of this examination. While we find some evidence that governance is negatively related to the proportion of domestic equity investments, our analysis reveals that asset allocation decisions are not primarily associated with governance structure, but rather with size, legal form, and a pension fund's ratio of active members to retirees. As shown in Table 1.16, the Swiss pension funds in our sample invest on average around 0.165% less in equities denominated in Swiss franc for each G-SCORE point. The result is significant at the 5% level. This might be explained by the fact that plans with high G-SCOREs do have more comprehensive risk management systems in place that allow them to invest a larger proportion of their funds in foreign assets which entail additional risk factors[36]. In fact, the analysis of the individual constituent sub-scores reveals that primarily RIMA and ORGA drive those results. Apart from governance, particularly size seems to be an important factor affecting asset allocation. Our analysis shows that larger funds invest a substantially larger proportion of their assets in foreign equities (+4.26%) and alternative investments (+2.78%). Since some alternative asset classes such as specialised hedge funds or closed-end private equity funds often require a high minimum investment amount, this finding has economic justification. Diversification considerations let smaller funds refrain from such investments. Furthermore, we find strong evidence that larger pension funds allocate a larger fraction of their investable funds to equities and invest less in real estate (domestic and foreign) and liquid cash holdings. This finding indicates that they generally opt for riskier asset classes which might additionally explain their higher mean excess returns in the evaluation period. Some part of their superior excess performance hence might come at the cost of higher risk and asset volatility. Since larger pension schemes have more institutionalised risk management structures that allow them to control riskier investments, such asset allocation decisions are evident from an economic point of view. The significant positive correlation ($\rho = +0.53$) between pension fund size and our RIMA Score corroborates this further.

In addition to plan size, we find that both a pension fund's legal form and its relation of active members to pensioners are related to its asset allocation decisions. Our empirical results show that pension arrangements that are set up under public law invest around 6.36% more in domestic real estate and hold a significantly larger part of employer investments (primarily in the form of federal government, cantonal, or municipal bonds). The regression

[36] E.g., such as currency risks, political risks, etc.

estimates furthermore indicate that public pension funds grant more mortgages than private pension funds and allocate less capital to foreign equities and domestic bonds. This might be an indication for a home bias tendency. Our findings show that state-run pension schemes tend to exhibit a rather domestic investment focus regarding real estate and equity investments. Although our results point to a negative relationship between public funds and domestic bond allocations, there is some evidence that state-run plans substitute domestic bonds with government or municipal bonds that are to be classified as investments with the employer under their investment statutes.

Finally, for robustness reasons, we include the pension funds' average coverage ratios for the years 2010 - 2012 as additional control variable (*CovRatio*) into the regression analysis. While a fund's coverage ratio should theoretically affect its asset allocation mix, we find no statistically significant evidence for a systematic relation between the funding level and the asset class allocation for any of the asset class weights analysed.

Table 1.16: Determinants of asset allocation weights

The table shows the results of the stepwise regressions of our model on the effective asset allocation weights as of the end of 2012 of the pension funds in our sample. Individual asset class allocations are taken as dependent variables. Asset classes are defined as follows: CHF cash holdings (= Cash); Investments with the employer (= InvEmp); Bonds denominated in CHF (=BondsDom); Bonds denominated in foreign currencies (= BondsFX); Mortgages (= Mortg); Equities denominated in CHF (= EquityDom); Equities denominated in foreign currencies (= EquitxFX); Real estate investments denominated in CHF (= REDom); Real estate investments denominated in foreign currencies (= REFX); Alternative investments (= AI); Figures are reported in basis points. The regressions are based on the allocations of all 139 pension funds in our sample.

Dependent Variable	**Cash**	**InvEmp**	**BondsDom**	**BondsFX**	**Mortg**	**EquityDom**	**EquityFX**	**REDom**	**REFX**	**AI**	**Other**
G-SCORE	5.2	-0.4	7.6	5.9	0.2	-16.5**	-0.1	8.4	-0.1	-5.3	-5.0*
	(0.60)	*(-0.08)*	*(0.51)*	*(0.55)*	*(0.06)*	*(-2.38)*	*(-0.01)*	*(0.62)*	*(-0.05)*	*(-0.79)*	*(-1.71)*
Constant	509.8	-6.0	2793.0***	916.6**	271.7**	1601.7***	1674.7***	1168.7**	150.6	685.6***	233.7**
	(1.54)	*(-0.04)*	*(4.80)*	*(2.21)*	*(2.01)*	*(5.96)*	*(4.34)*	*(2.24)*	*(1.37)*	*(2.65)*	*(2.08)*
Size	-214.1**	-29.7	-99.7	48.1	50.8	-150.1**	425.6***	-369.8***	35.3	277.9***	25.6
	(-2.38)	*(-0.69)*	*(-0.63)*	*(0.43)*	*(1.38)*	*(-2.06)*	*(4.06)*	*(-2.60)*	*(1.18)*	*(3.96)*	*(0.84)*
Public	24.3	233.9***	-579.0**	-189.2	141.4**	111.9	-354.2**	636.2***	44.5	-62.5	-7.4
	(0.17)	*(3.33)*	*(-2.24)*	*(-1.03)*	*(2.35)*	*(0.94)*	*(-2.07)*	*(2.74)*	*(0.91)*	*(-0.55)*	*(-0.15)*
DBPlan	112.1	-78.3	-729.0***	302.9*	34.1	137.5	322.4*	3.2	-9.2	-24.9	-70.8
	(0.77)	*(-1.13)*	*(-2.86)*	*(1.67)*	*(0.58)*	*(1.17)*	*(1.91)*	*(0.01)*	*(-0.19)*	*(-0.22)*	*(-1.44)*
ClosedFund	-92.6	83.5	-372.1	-64.5	-131.3**	13.2	34.8	412.8*	6.1	79.2	30.8
	(-0.68)	*(1.28)*	*(-1.55)*	*(-0.38)*	*(-2.35)*	*(0.12)*	*(0.22)*	*(1.91)*	*(0.13)*	*(0.74)*	*(0.66)*
Autonomous	114.7	22.8	-178.3	194.5	-78.2	99.9	-154.5	151.7	-22.2	-142.7	-7.7
	(0.77)	*(0.32)*	*(-0.68)*	*(1.05)*	*(-1.29)*	*(0.83)*	*(-0.89)*	*(0.65)*	*(-0.45)*	*(-1.23)*	*(-0.15)*
RatioAP	3.5**	-0.2	7.3**	0.1	-0.1	-3.5***	-0.1	-6.7***	-0.3	-0.6	0.6
	(2.21)	*(-0.29)*	*(2.59)*	*(0.04)*	*(-0.12)*	*(-2.69)*	*(-0.07)*	*(-2.65)*	*(-0.46)*	*(-0.49)*	*(1.03)*
R^2 *adj*	*0.070*	*0.049*	*0.175*	*0.011*	*0.129*	*0.176*	*0.195*	*0.115*	*-0.012*	*0.119*	*0.005*

*** 1% significance ** 5% significance * 10% significance

Table 1.16 also shows that sample plans with more active members relative to pension beneficiaries allocate a higher proportion of funds to domestic bonds and have more cash holdings whereas they invest less in domestic real estate and equities denominated in Swiss franc. Pension funds with fewer pensioners thus seem to have a higher need for liquidity and a lower tolerance towards risky investments than funds with more pensioners.

1.7 Conclusion

This paper examines the relationship between governance structures, investment performance, and asset allocation decisions of occupational pension plans in Switzerland. Based on survey responses from 139 entities, we find empirical evidence that pension fund governance is positively related to investment performance, but only marginally to the funds' asset class choices. This has important implications for the industry in that it shows that the establishment of comprehensive governance structures might directly benefit plan members. While our study does not give any indication of the direction of causality, however, it shows that good governance pertaining to target setting, investment strategy definition, and risk management design is positively related to both excess- and risk-adjusted net fund returns. For our analysis, we draw on four different portfolio performance measures: 1) average excess return, 2) passive benchmark outperformance, 3) individual policy benchmark outperformance, and 4) Sharpe ratio. Regardless of which measure we employ, we find both statistically and economically significant positive effects for the composite G-SCORE metric, as well as for the sub-scores that cover target setting and investment strategy and risk management. The investigation of those individual sub-score components furthermore shows that particularly independent external experts that participate in investment strategy meetings are associated with superior performance. Risk management design is also found to be an important factor that is related to net investment performance. While we find a positive relationship between comprehensive risk management practices and excess returns and passive benchmark deviations, we do not find statistically significant effects when analysing Sharpe ratios. The analysis of the individual score components for the management objectives score (MANO Score) furthermore reveals that a clear specification of organisational goals and strategic targets by means of a written mission statement is positively related to passive benchmark outperformance.

For investment allocation decisions, we find that governance structures are only of little importance. The 2012 realised year-end asset allocation weights of our sample pension portfolios are primarily related to institutional factors such as size, legal form, and the ratio of active plan members to pensioners. Our study does not find conclusive empirical evidence that governance is related to those realised allocation weights.

Appendix 1.A: Composition of the passive benchmark strategy (SAA return)

The table shows the composition of the passive benchmark strategy. The indices proxy the performance of the major asset classes.

Asset Class	Benchmark Index
Cash	3-Month CHF Libor
Investments with Employer - Loans	SBI Domestic AAA-BBB Total Return Index*
Investments with Employer - Equity	Swiss All Share Index
Bonds - in CHF	SBI Total AAA-BBB Total Return Index**
Bonds - Foreign currency	Barclays Global Aggregate Total Return Index (unhedged)
Bonds - Foreign currency hedged	Barclays Global Aggregate Total Return Index (CHF-hedged)
Equity - Switzerland in CHF	Swiss Performance Index
Equity - Foreign currency	MSCI World ex Switzerland Total Return Index (unhedged)
Equity - Foreign currency hedged	MSCI World ex Switzerland Total Return Index (CHF-hedged)
Mortgages	SNB Average Swiss Mortgage Rate
Real Estate - Switzerland in CHF***	KGAST Immo Index
Real Estate - Switzerland in CHF***	DB Rüd Blass Swiss Real Estate Fund Index
Real Estate - Switzerland in CHF***	SIX Real Estate Funds Total Return Index
Real Estate - Foreign currency	Dow Jones Global Select Real Estate Securities Index
Alternative Investments - Private Equity	LPX Composite Total Return Index
Alternative Investments - Hedge Funds	HFRX Global Hedge Fund Index
Alternative Investments - Commodities	Dow Jones UBS Commodity TR Index
Alternative Investments - Infrastructure	MSCI World Infrastructure Index
Alternative Investments - Other	HFRX Equal Weighted Strategies Index
Other Assets	12-Month CHF Libor
Risk-free rate	Yield on 10yr Swiss Confederation Bonds (annual average)

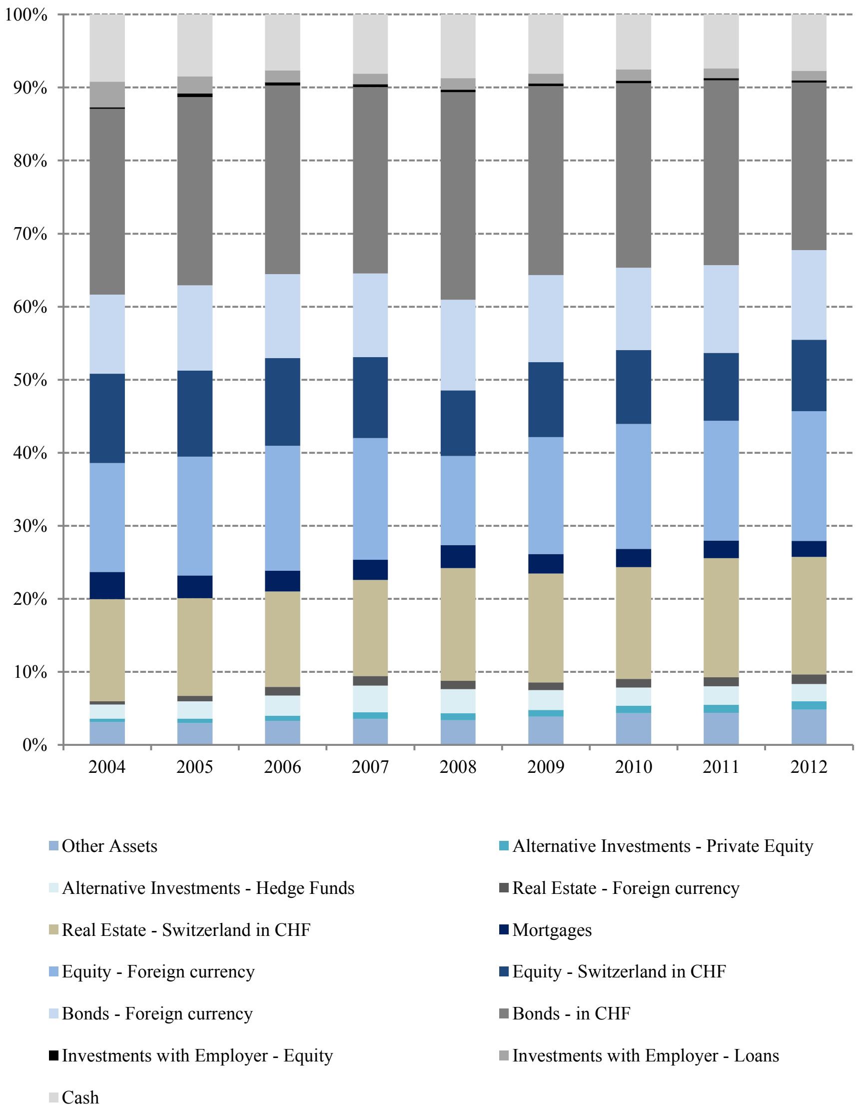
* Index data available since 2007; for the years prior to 2007, we use the old SBI Domestic Total Return Index

** Index data available since 2007; for the years prior to 2007, we use the old SBI Total Return Index

*** The benchmark data for the asset class "Real Estate - Switzerland in CHF" is composed of all three indices with equal weight

Appendix 1.B: Asset allocation of Swiss pension funds 2004-2012

The graph shows the aggregated asset allocation weights of all Swiss occupational pension funds for the years 2004 – 2012. Data is retrieved from the Swiss Federal Statistical Office (2014).



Chapter 2

Announcement Effects of Contingent Convertible Securities: Evidence from the Global Banking Industry

Manuel Ammann, Kristian Blickle, Christian Ehmann

Abstract

This paper investigates the announcement effects of contingent convertible securities (CoCo bonds) issued by global banks between January 2009 and June 2014. Using a sample of 34 financial institutions and 87 CoCo bond issues, we examine abnormal stock price reactions and CDS spread changes before and after the announcement dates. We find that the announcement of CoCo bonds correlates with positive abnormal stock returns and negative CDS spread changes in the immediate post-announcement period. The effects are most pronounced for first-time issues. We explain these effects with a set of theories that include the lowered probability of costly bankruptcy proceedings, a signaling framework that is based on pecking order theory and the cost advantage of CoCos over equity (tax shield). We also examine the factors that are associated with the post-announcement abnormal stock returns and find that, among other things, first-time issues increase and call provisions reduce the positive abnormal returns.

2.1 Introduction

During the 2007/08 financial crisis, public-sector capital was frequently used as a fail-safe to prevent the collapse of systemically relevant financial institutions. Increased government debt levels, disgruntled tax payers and a distortion of bankers' economic incentives were the ultimate consequences of such support mechanisms. Contingent convertible debt securities, or CoCo bonds, have been regarded as an innovative remedy to mitigate those problems. By automatically being written down or converting into equity capital in the event of certain pre-defined triggers, these hybrid securities ameliorate an entity's capital position at critical times. CoCo bonds have enjoyed interest from both regulators and bank managers since their conceptual creation. In many jurisdictions adopting Basel III, CoCo bonds can be used as core capital to meet regulatory requirements. The advent of the CoCo bond and the concomitant discussions of a "bail-in" could be seen as marking a shift in the way regulators plan to treat destabilized financial institutions in the future.

Accordingly, total global issue volumes of CoCo bonds have reached approximately 115 billion USD since January 2009. While the market for CoCos is still relatively small, as compared to the volumes of bank-issued (non-contingent) subordinated debt and senior unsecured debt instruments, it is steadily growing. In 2013, 26 global financial institutions issued 34 CoCo bonds with a total face value of around 40 billion USD. In the first half of 2014 alone, issue volumes already reached 36.5 billion USD. In comparison, according to information provided by Dealogic, the total volume of equity issued by global financial corporations amounted to approximately 154 billion USD in 2014. In the period from January to May 2014, European banks have issued around 36 billion USD of new equity, as stated by the Financial Times (2014). Hence, the importance of CoCo bond issues, compared to initial or seasoned equity issues undertaken by financial intermediaries, is clearly on the rise. Appendix 2.A shows the volumes of global contingent convertible bond issues from 1 January 2009 until 30 June 2014. According to an industry report released by Standard and Poor's (2010), CoCo bond volumes are expected to reach 1 trillion USD until the year 2020.

Whereas the announcement effects of conventional convertible securities on issuer stock prices have been widely discussed, research on the announcement effects of contingent convertible bonds issued by banks is still absent. Our study fills this gap in the literature and investigates both the abnormal stock price and credit default swap spread reactions to the announcement of CoCos. We make use of a sample of 34 international banks and 87 distinct

CoCo bond issues with a total nominal issue volume of around 80 billion USD. As such, we capture a significant portion of this new security market. Following the standard methodology of Brown and Warner (1985) and Campbell, Lo, and MacKinlay (1997), we conduct an event study that investigates the reactions of the CoCo bond issuers' stock prices and CDS spreads in the immediate post-announcement period.

Empirical research on conventional convertible debt securities suggests a negative relationship between an announcement and the post-announcement abnormal stock returns of the issuing entities. Duca, Dutordoir, Veld, and Verwijmeren (2012) report significant negative announcement effects of convertible offerings for firms in the United States between 1984 and 2008. Earlier studies, such as those by Dann and Mikkelson (1984), Billingsley and Smith (1996), Mikkelson and Partch (1986), and Lewis, Rogalski, and Seward (1999) find similar results[37]. The event study results of De Roon and Veld (1998) show positive, yet insignificant announcement effects of convertible bond issues in the Dutch market. Burlacu (2000) finds negative effects in France; Ammann, Fehr, and Seiz (2006) in Germany and Switzerland. Overall, the negative announcement effects of convertible securities are mostly explained as resulting from the signal the issues send to incumbent equity owners. For a more detailed discussion on this issue, see Wallace, Glascock, and Schwarz (1995), Stein (1992), and De Spiegeleer, Schoutens, and van Hulle (2014).

Unlike the above-mentioned studies, we find that CoCo bonds have a positive announcement effect on stock prices. Moreover, we find that the CDS spreads of the institutions in our sample narrow significantly in the immediate post-announcement period. Our analysis shows that the sample banks´ announcement of a contingent convertible bond is, on average, correlated with a +1.0% cumulative abnormal stock return on the days t_0 and t_{+1}. The inclusion of an issuer call provision in the bond structure reverts the positive price effect. Both stock price and CDS effects are more pronounced for first-time issues (i.e., when the issuing institution has no CoCo securities outstanding yet).

Our research contributes to two strands of the literature. First, it complements the corporate finance research on abnormal stock returns around announcement dates of hybrid debt securities. As CoCo bonds are a recent development, we add novel information to this

[37] For a comprehensive overview of the literature on conventional convertible bond announcement effects, see De Roon and Veld (1998).

particular field. Second, our paper adds to the banking literature on the market perceptions of a financial institution's risk structure as well as its optimal capital structure[38].

The remainder of this paper is structured as follows: Section 2 develops our hypotheses and briefly reviews the specific design of CoCo bonds. Section 3 describes the dataset in detail and outlines the employed methodology. Section 4 shows the empirical results while section 5 concludes the main findings.

2.2 Hypotheses and CoCo Design

2.2.1 Hypothesis development

Below, we detail five possible reasons for why both equity and credit markets may react positively to CoCo bond issues. We expect positive stock price reactions primarily because CoCo bonds (i) are a positive signal for equity holders (pecking order), (ii) have a cost advantage over equity due to their preferential tax treatment, and (iii) avoid debt overhang. We expect a tightening of the CDS spread primarily because CoCo bonds (iv) reduce a bank's probability of default (bankruptcy cost) and may (v) align owner and creditor incentives. This will depend on the structure of the CoCo bond, making an analysis of CoCo bond features important.

First, a bank issuing CoCos sends a positive signal to the capital market. It may treat CoCo bonds as constituting core capital, despite their debt classification. An institution's alternative, assuming it needs to increase its capital base, would be to issue equity. Pecking order theory, as developed by Myers and Majluf (1984), stipulates that equity is the least preferred source of financing for an entity in need of capital. A number of empirical studies that followed their theoretical work find negative stock price reactions to the announcements of equity issues (e.g., Asquith and Mullins, 1986; Barclay and Litzenberger, 1988; Masulis and Korwar, 1986; or Spiess and Affleck-Graves, 1995; to mention only a few). Those studies argue that equity issues are a negative signal for investors due to asymmetric information. CoCos are preferable to equity as they rank higher in the pecking order. If market participants anticipate that the bank must increase its capital, the announcement of a CoCo bond can be a

[38] For an in-depth discussion on those issues, see Admati, DeMarzo, Hellwig, and Pfleiderer (2011, 2012) or DeAngelo and Stulz (2013).

positive signal to investors. According to this hypothesis, a CoCo bond issue should lead to a positive abnormal stock price change.

Second, CoCo bonds enjoy favorable tax treatment in many jurisdictions. Avdjiev, Kartasheva, and Bogdanova (2013) estimate that approximately 64% of CoCos outstanding in mid-2013 have tax-deductible coupons. This tax shield lowers funding cost and gives CoCos a cost advantage over common equity. A bank's decision, assuming it has to raise its capital, is therefore a decision of whether to make use of this tax shield effect or not. Previous studies have shown that the value of such tax shields can be substantial (e.g., see Cooper and Nyborg, 2008; Graham, 2000; Kemsley and Nissim, 2002; or Van Binsbergen, Graham and Yang, 2010). Schepens (2015), talking specifically about CoCos, confirms that debt-taxation can be used as an important regulatory instrument, given its impact on a bank's capital structure choice. Consequently, a CoCo announcement should have a positive effect on the stock return of the issuing institution.

Third, CoCos help an institution avoid debt overhang and allow banks to make use of projects with a positive NPV, even in times of crises[39]. This concept is highlighted by Pennacchi, Vermaelen, and Wolff (2014) when discussing CoCo design. Banks whose equity has been eroded by financial difficulties may be forced to re-establish capital ratios before they can attract investors again. Since issues of new equity are unpopular, a bank would forego lending/investing as it seeks to re-establish adequate capital ratios. The conversion of CoCos into equity (or even a direct write-down) may help such a bank avoid debt overhang and allow it to attract creditors or new equity investors for projects with a positive NPV (see Chen et al., 2013). The prospect of avoiding a negative spiral of problems associated with debt overhang may be welcomed by both equity capital markets and creditors.

Fourth, the presence of CoCos provides an additional layer of capital that makes bankruptcy less likely (e.g., see Flannery 2005, 2015; Chen, Glassermann, Nouri, and Pelger, 2013). Hilscher and Raviv (2014) show that, in terms of improving stability, CoCo bonds have a comparable effect to a bank issuing the same amount of new equity. Existing bond holders naturally benefit from new securities that rank lower in seniority. Prior conventional debt is less likely to be subject to default or restructuring if the bank's losses are first absorbed by CoCo bond holders. Particularly when the bank retires existing debt for CoCo bonds, the relative protection of the remaining creditors becomes stronger. Especially in an environment

[39] For a discussion of debt overhang, see Myers (1977).

in which the prospect of a bailout that does not involve creditor participation has become less likely, CoCo bonds may benefit creditors.

Fifth, many researchers have argued that CoCos can influence the incentives of shareholders and management. However, not all scholars agree on whether CoCo bonds align the incentives of shareholders with those of creditors, or misalign them. On the one hand, CoCos may decrease the probability of costly default, as discussed above. This could, depending on the structure of the conversion mechanism, incentivize equity owners to take greater risks (e.g., see Berg and Kaserer, 2015 or Koziol and Lawrenz, 2012 for a discussion). On the other hand, CoCos that convert into equity (particularly into equity with voting rights) will introduce conservative risk-averse shareholders into the group of existing owners upon conversion, as argued by Vallée (2014), Coffee (2010), or Flannery (2015). This would imply a reduction in bank-risk appetite at a time when the institution is in turmoil, possibly improving creditors' position. Moreover, Flannery (2015) points out that because CoCos force shareholders to internalize the negative consequences of their company's poor performance, they can discipline managers. Owners may be averse to triggering an actual conversion event and thereby reduce risk-taking. In fact, Hilscher and Raviv (2014) show that CoCos that convert into equity diminish shareholder incentives to increase asset risks. Similarly, Chen et al. (2013) show that CoCos for which the conversion price is not set too high do not induce additional risk-taking.

Overall, the risk appetite of bank owners after a CoCo issue likely depends on the bank's situation as well as the bond's specific design. Therefore, it is worth analyzing the impact of some common features on the market reactions in more detail. We expect bonds which constitute core capital to be more valuable to investors. Conversely, bonds that include a call provision (which allows management to retract the bond) may indicate that management is not fully committed to using CoCos in the long term; this may reduce their positive impact.

Finally, we hypothesize that first-time issues should see more pronounced market reactions than secondary issues of CoCo bonds. A first-time issue contains new information about the strategy of the institution. It signals that, with some probability, capital requirements of the future will be met with additional CoCo bonds, increasing the positive effects.

2.2.2 Structure and design of contingent convertible securities

Contingent convertible bonds are similar to conventional convertible debt instruments in certain respects. CoCos include standard bond features such as pre-defined maturities or coupons that entitle the investor to regular interest payments in normal times. However, they are mandatorily converted into ordinary shares[40] (or written down) at certain trigger events. Typically (though not exclusively) this occurs when the equity capital of the issuing institution falls below a pre-defined trigger level. The mandatory conversion ensures automatic recapitalization of the bank in financial distress.

Basel III regulation stipulates more stringent equity capital thresholds than Basel II but explicitly allows part of this regulatory capital to be held in the form of CoCo bonds. Under the Basel III framework, contingent convertible securities can either qualify as Additional Tier 1 (AT1) capital or Tier 2 (T2) capital. To qualify as AT1 capital, CoCo bonds must be issued with perpetual maturity and a trigger level of at least 5.125% (Avdjiev et al., 2013). CoCos with fixed maturities or with lower (or otherwise more flexible) trigger mechanisms may only qualify as T2 capital[41]. Avdjiev et al. (2013) describe that CoCo securities with low triggers are not eligible to qualify as AT1 capital since they have a limited loss-absorption capacity. Since January 2012, the ratio of 5.125% CoCos that are emitted have increased significantly. A potential explanation of this continuing trend is the gradually increased core capital requirement for banks that follows from the gradual adoption of the Basel III framework by national institutions.

While regulators typically specify book-value triggers, banks have a plethora of options in designing individual CoCo-security structures. Beside accounting-based triggers, these include, for example, market-based triggers or discretionary triggers that are based on a supervisory authority's judgment about a financial institution's solvency. Theoretically, an "optimal" trigger should rely on a measure that most accurately indicates potential distress. Much of the current debate on this topic centers on market-based triggers. For a literature summary on the discussion about different contingent capital designs, see Calomiris and Herring (2011). Proponents of market-based triggers argue that they are most effective in overcoming inconsistencies in book-value calculations and are least prone to accounting manipulation. However, opponents claim that market prices, particularly those of bank stocks, are a poor indicator of effective risk. Their argument focuses on the notion that unjustifiable

[40] A conversion-to-equity CoCo bond directly increases the core equity tier 1 capital, whereas a CoCo bond with a write-down provision indirectly increases the equity capital by decreasing the outstanding debt.
[41] In our sample, two bonds with long-term fixed-date maturities still qualify as AT1 capital.

conversions could occur during a market panic. The discussion about the optimal design of such securities is hence still ongoing. Given that we differentiate according to regulatory capital (i.e., AT1 vs. T2) as well as the particular conversion type in our analysis below, our study offers a contribution to this discussion.

2.3 Data and Methodology

2.3.1 Data

The market for contingent capital is relatively young. Between 1 January 2009 and 30 June 2014, 52 global financial institutions issued 126 contingent convertible securities with a cumulated notional volume of approximately 115 billion USD. Lloyds Bank was one of the first entities that issued a large-scale CoCo bond in the fourth quarter of 2009. The UK-based banking corporation issued several so-called “Enhanced Capital Notes” qualifying as lower tier 2 capital with a face value of around 13.7 billion USD, triggering conversion if the corporation’s core tier 1 capital falls below 5% (De Spiegeleer et al., 2014). The note was offered in exchange for the group’s outstanding subordinated debt and existing hybrid securities. Since then, other multinational banks have followed and have issued a plethora of such hybrid debt securities with different designs during the period under investigation.

We first gather information on all 126 CoCo securities that have been issued during the period 1 January 2009 until 30 June 2014. Announcement and issue dates, notional issue volumes, conversion mechanisms, event trigger thresholds and other bond-specific criteria are sourced from Bloomberg and the offering memoranda of the securities. Historical stock price data, CDS spreads and historical credit ratings of the bond-issuing institutions are retrieved from DataStream.

We define the announcement date to be the day on which the information about the convertible debt security issue is made publicly available by an ad-hoc press release. The announcement must include a precise statement of the issue volume and trigger mechanism to be included in the sample. Issue dates are defined as those dates on which the securities are ultimately offered to investors. Those particular dates are disclosed in the securities’ offering memoranda.

CoCo bonds have also been issued by financial institutions other than banks, such as insurance companies or other specialized financial services providers. However, since regulatory requirements and risk structures of other financial services firms might be different and difficult to compare cross-sectionally, we deliberately exclude their securities from our analysis. We focus solely on banking institutions with SIC-Codes: 6000-6159. For the empirical analysis, we furthermore exclude securities for three reasons: First, we remove those issues for which the announcement date is not clearly defined. Second, we remove those issues for which announcement information has been released in connection with other company-specific information[43]. Third, we exclude those securities for which no issuer stock price data was available for the period t_{-300} to t_{+30}, whereby t_0 denotes the CoCo bond announcement date. Finally, for most analyses, we exclude issues that follow too closely upon one another so that abnormal stock returns cannot be computed.

Our final sample thus consists of 87 CoCo bond issues conducted by 34 financial institutions (situated in 18 different countries) and announced on 55 different dates. The analysis of the stock price reactions is consequently based on 55 individual observations. The total notional amount of all analyzed CoCo bonds amounts to approximately 78.4 billion USD as of the end of June 2014[44]. In terms of nominal issue volume, we hence cover almost 70% of the overall CoCo bond market as of the end of the second quarter 2014.

For the analysis of the announcement effects on CDS spreads, it is necessary to reduce the final sample further due to the limited availability of traded 5-year senior credit default swaps. Our CDS sample consists of 24 financial institutions (for which traded 5-year senior CDS were available) and 54 announcement dates. It should be noted that the CDS sample includes some observations that were removed for the stock price analysis due to an overlap of the estimation windows for certain consecutive issues, as described above.

[43] i.e., such as quarterly results, information about earnings, mergers, takeovers or major divestments, expected dividends, receptions of bail-out capital contributions, significant reductions of balance sheet risk exposures (i.e., through asset sales) or issues of other securities three days before or after the announcement.

[44] Securities that have been issued in other currencies than the US dollar have been converted into US dollar based on the exchange rate prevailing on their individual issue dates.

2.3.2 Descriptive statistics

Applying the filter criteria as described above, our final sample includes 87 contingent convertible securities that have been issued by 34 international banking corporations during the period between 1 January 2009 and 30 June 2014. The announcements were released on 55 different dates, implying 55 observations. Table 2.1 reports the detailed summary statistics of the features of the securities that are included in our final sample.

Table 2.1: Summary statistics of the sample CoCo bond features

The table reports the maturity types, regulatory capital classifications, conversion mechanisms, coupon types and other features of the contingent convertible securities included in our final sample. The statistical summary is based on 87 CoCo bonds released on 55 different dates. Data is reported as of 30 June 2014.

	By number	By issue volume
Maturity type		
Dated securities	64.4%	53.1%
Perpetual securities	35.6%	46.9%
Security features		
Securities with issuer call options	55.2%	66.7%
Securities without issuer call options	44.8%	33.3%
Security trigger levels		
Securities with 5.125% CET1/RWA trigger level	18.4%	25.1%
Securities with other trigger levels (incl. PONV[1] triggers)	81.6%	74.9%
Regulatory capital classification		
Additional Tier 1 capital (AT1)	37.9%	49.0%
Tier 2 capital (T2)	62.1%	51.0%
Conversion mechanism		
Conversion-to-equity (CE)	60.9%	44.7%
Principal write-down (PWD)	39.1%	55.3%
Coupon type		
Fixed coupon	47.1%	35.9%
Fixed-to-floating coupon	42.5%	57.3%
Floating coupon	10.4%	6.8%
Issue currency		
Securities denominated in EUR	23.0%	25.2%
Securities denominated in USD	36.8%	55.6%
Securities denominated other currencies	40.2%	19.2%

[1] PONV = Point-of-non viability trigger

More than half of the securities in our final sample are dated and have maturities that range from 4.8 years to 45 years, with the longest bond maturing in 2057. The average maturity of dated securities is approximately 12 years with the majority of bonds having a 10-year maturity structure. Around one third of the sample CoCo bonds are issued with perpetual maturities (making them eligible to classify as AT1 capital instruments). Their issue volume accounts for approximately half of the total notional volume of all examined securities as of 30 June 2014[45]. All perpetual and some dated securities include call provisions for the issuer. Call provisions are embedded in around 55% of all CoCo bonds that are included in our sample. The average time span between the issue and the first possible call date is approximately 6 years. Although more than half of the total issue volume is denominated in US dollars, our final sample does not include any US-based banks. One potential explanation why US-based financial institutions have not (yet) issued contingent capital instruments until now is the unfavorable tax treatment of such securities under prevailing U.S. tax law. The interest paid on these instruments is, at the time of the writing of this paper, not deductible from the corporate tax base under the U.S. tax regime. For a more detailed discussion on the tax issues, see De Spiegeleer et al. (2014).

Our data indicates that there is no predominant loss absorption mechanism on the market. The fraction of securities (by issue volume) with an equity conversion mechanism is around 44.7%, whereas the remainder is structured with full or partial principal write-down provisions. The principal write-downs are either temporary or permanent, whereby most CoCo bonds with write-down provisions make use of full and permanent write-downs.

Of the 87 securities in our final sample, 16 have a CET1/RWA trigger level of exactly 5.125%[46]. Those account for approximately one fourth of the total accumulated issue volume of all sample CoCos and about half of the securities that qualify as AT1 capital. Our data also indicates that the amount of CoCo bonds with such triggers has been steadily increasing since 2009. This has already been documented by Avdjiev et al. (2013), who explain this trend by both the increased capital requirement under the Basel III regime and the relative cost advantage over contingent convertible securities with higher trigger levels. From a theoretical point of view, the issuance of higher-trigger CoCos should be more expensive than the issuance of lower-trigger CoCos since the former lead to an earlier loss absorption by the bond holders in the case of conversion.

[45] As measured in US dollar terms.
[46] 5.125% is the minimum standard for securities to still qualify as tier 1 capital under the Basel III regime.

It should finally be noted that our sample is relatively heterogeneous in terms of the bond-issuing financial institutions. This pertains particularly to the geographical distribution and reach, the entities' balance sheet sizes as well as their target markets. Moreover, they differ fundamentally in terms of their credit risk structures, as indicated by the dispersed cross-sectional distribution of the long-term issuer credit ratings and the large standard deviation of the CDS spread levels at the time of the CoCo bond issue dates. Unfortunately, CDS information is only available for 24 sample banks; all CDS analyses are consequently performed on a sub-sample, as mentioned above. Of these, the majority had an S&P long-term issuer rating in the A or BBB category, with no institution having a credit rating below BB+ at the time of its CoCo bond announcement. The highest issuer credit rating prevailing on an announcement date was AA-. This rating was assigned to 3 institutions in the sample. Table 2.2 reports further descriptive statistics about the features of the CoCo bonds in our sample and their issuing institutions.

Table 2.2: Descriptive statistics

The table reports descriptive sample statistics as of 30 June 2014. The statistics are based on 87 CoCo bonds that have been issued by 34 banking institutions on 55 different dates. *ISSUESIZE* is the notional amount of a single CoCo bond issue. *BSSIZE* is the balance sheet size of an entity as measured by the amount of total assets that is disclosed in the annual report of the year prior to the year of the debt security issuance. *ISSUETIME* is the time span between the announcement date and the issue date. *MATURITY* is the maturity of the dated CoCo securities included in our sample. *CALLTIME* is the time span between the issue date and the first possible call date after issuance of those bonds that include a call provision for the issuer. *VOLATILITY* is the historical volatility of the issuers' stock prices in the estimation window period $T_{ES} = [t_{-110}; t_{-11}]$. *COUPON* is the nominal coupon rate of the hybrid debt securities. $\Delta EQY(t_0)$ is the unconditional stock return of the issuers on day t_0. *TIER1* is the tier 1 capital ratio of the 34 financial institutions 6 months prior (rounded to the preceding quarter) to the CoCo bond announcement. *CDS* is the issuers' senior 5-year credit default swap spread level on day t_0. $\Delta CDS(+3)$ is the difference of the issuers' senior 5-year CDS spread between day t_{+3} and t_0 as measured in basis points. $\Delta CDS(+10)$ is the difference of the issuers' senior 5-year CDS spread between day t_{+10} and t_0 as measured in basis points.

Variable	Unit	N	Mean	Median	SD	Min	Max
ISSUESIZE[1]	mn USD	87	900.6	800.0	750.5	6.7	3'000.0
BSSIZE[2]	bn USD	34	896.4	343.3	685.0	2.6	2'815.0
ISSUETIME	days	87	15.0	9.0	11.2	0.0	42.0
MATURITY	years	56	12.1	10.2	6.0	4.8	45.3
CALLTIME	years	48	6.0	5.0	2.3	0.2	12.0
VOLATILITY	%	55	2.5	2.0	1.9	0.7	13.0
COUPON	%	87	8.2	7.9	2.7	2.2	16.1
$\Delta EQY(t_0)$	%	55	0.9	0.2	3.3	-6.1	17.7
TIER1	%	55	12.7	11.8	3.2	8.0	19.7
CDS[3]	bps	54	159.6	129.9	118.4	70.4	844.4
$\Delta CDS(+3)$[3]	bps	54	-2.7	-1.3	7.0	-36.9	7.4
$\Delta CDS(+10)$[3]	bps	54	-4.2	-1.7	11.1	-33.9	27.7

[1] converted into US dollars with the exchange rates prevailing on the respective issue dates; the large Lloyds´ CoCo bond issue in 2009 was split into several tranches.

[2] converted into US dollars with the exchange rates prevailing on the respective balance sheet dates.

[3] CDS data was available only for 24 financial institutions and 54 CoCo bond announcements, respectively.

2.3.3 Methodology

To measure the announcement effects of contingent convertible bond issues on stock returns, we conduct an event study following the standard methodology as proposed by Brown and Warner (1985) and Campbell et al. (1997). In the first stage, we define abnormal stock returns based on predictions from a single-factor market model. We choose different MSCI country financial stock indices (e.g., such as the *MSCI Spain Financials Index* for Spanish banks) as market proxies. We thereby control for both country-level and industry-sector effects. We define the estimation window as $T_{ES} = [t_x; t_y]$[47], where $x < y < 0$ and t_0 denotes announcement date. We estimate the abnormal returns for the period $T_{EV} = [t_{-10}; t_{+20}]$[48] with $t_0 \in T_{EV}$ and $T_{EV} \not\subset T_{ES}$. We compute the abnormal returns in the period before and after the CoCo bond announcement day for various event windows denoted as τ_{EV}, whereby $\tau_{EV} \subset T_{EV}$. With the above-set specification, the estimation window and the event window do not overlap, as recommended by MacKinlay (1997), so that the parameter estimates are not influenced by the returns around the event date.

We aggregate the abnormal returns in a second step and thereby continue to follow the approach as proposed by Campbell et al. (1997). We compute the cross-sectional means of the banks' abnormal stock returns on specific days within the event window T_{EV} (*MARs*) as well as the average cumulative abnormal returns (*MCARs*) of all securities for certain event window ranges $\tau_{EV} = [t_a; t_b]$, where $a < b$. To draw inferences, we test the null hypothesis that the announcement events[49] do not have any impact on the abnormal stock returns, or, put differently, that *MCAR* is equal to zero using

$$MCAR(t_a, t_b) \sim N\left[0, \mathrm{var}(MCAR(t_a, t_b))\right]$$

To test for statistical significance, we employ the approach as suggested by Fields and Mais (1991) who test statistical significance based on standardized abnormal returns. The assumption is that abnormal returns are multivariate normal and independent. We therefore test the null hypothesis that the average abnormal return is zero. We compute (t_{SAR}):

[47] To test for robustness, we compute the market model factor loadings for different estimation window ranges by varying the *x* and *y* parameters. The empirical results of those robustness tests are comprehensively described in section 4.4 of this paper.

[48] Event window lengths are also varied for comparative purposes in section 4.

[49] We additionally test issue-date effects in the same manner (see Appendix).

$$t_{SAR}(t_a, t_b) = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} \sum_{t=t_a}^{t_b} \frac{AR_{it}}{SD_{iT}}$$

where AR_{it} are abnormal returns of bank i for date t and SD_{iT} denotes the standard deviation of the sum of the AR_{it} series over the time period τ_{EV} as computed in Fields and Mais (1991).

In addition to abnormal stock price reactions, we also investigate the sample banks' abnormal credit default swap spread changes. We therefore employ an index-adjustment model as defined by Norden and Weber (2004) with the modifications of Hull, Predescu, and White (2004). Daily index values are computed as the equally weighted cross-sectional mean of all sample CDS spreads for a particular rating category. Index levels were constructed for the two S&P issuer rating categories 1) AAA-A and 2) BBB and lower in the default setting. To test whether spread changes are significantly different from zero, we apply cross-sectional parametric *t*-tests. For liquidity reasons, the daily 5-year CDS mid-spreads on the senior USD-denominated underlying are included in our study[50]. This ensures a (i) high degree of comparability and (ii) avoids reducing the CDS sample further.

2.4 Results

2.4.1 Abnormal stock returns following announcement

In this section, we show that the announcement of CoCo bond issues is associated with abnormal positive stock returns. In a first step, we estimate the abnormal stock returns for each individual financial institution i in our final sample for each of the days in the time window $T_{EV} = [t_{-10}; t_{+20}]$. We set the estimation window length to $T_{ES} = [t_{-100}; t_{-11}]$. The end of the estimation window is set to t_{-11} in order to avoid the inclusion of return observations in the immediate period prior to the announcement date[51]. The 90-day calibration period should contain a sufficient number of observations in order to ensure an adequate model fit. It should be noted, however, that no uniform consensus on the optimal number of days in an estimation period exists. For a theoretical discussion of this issue, see Sorokina, Booth, and Thornton

[50] For some institutions, only USD-denominated CDS were available. For the few European institutions that had no US-dollar denominated debt outstanding, we employ the 5-year senior unsecured Euro-denominated CDS.

[51] This might, inter alia, decrease the probability of including insider-induced return fluctuations prior to the CoCo bond announcement date.

(2013). In order to test our results for robustness, we vary the lengths of the estimation window in section 4.4.

We analyze the unconditional mean returns (*MR*) for the days following the announcement date. Subsequently, we compute the mean abnormal returns (*MARs*) over all bank stocks for all days t_{-2} to t_{+10}. The abnormal returns are the differences between model predictions (based on the estimation period) and observed returns. In a second step, we compute the mean cumulative return (*MCR*) as well as the mean cumulative abnormal returns (*MCARs*) for all stocks *i* for various event window lengths before and after the announcement date t_0. Table 2.3 displays the results of the entire sample.

We find that the returns of bank stocks following the announcement of a CoCo bond issue are, on average, positive. Importantly, we find that the mean abnormal returns are significantly positive on the day of the announcement. As can be seen in Panel 1 of Table 2.3, returns are 0.31 percentage points higher on the announcement day than predicted. While abnormal returns increase to 0.70 percentage points on the subsequent day, the effect is no longer significant. Moreover, we find that cumulative abnormal returns, computed over windows that include the announcement day, are significantly positive. As can be seen in Panel 2 of the table below, the effect is more pronounced for shorter window lengths and dissipates somewhat as more time is allowed to pass and other factors influence returns. Mean cumulative abnormal returns range from 0.29 percentage points for the two days t_{-1} and t_0 to 1.01 percentage points for the two days t_0 and t_{+1}. The effects are economically significant, representing large two-day returns. We furthermore find that the above effects are only present for the announcement date and not the issue date itself, implying that the market prices the effect at announcement. The above analysis is replicated for issue dates. Since the time span between a CoCo bond's announcement and issue date is in some cases very short (for some securities announcement and issue dates even fall on the same day), we define a new sub-sample and exclude those CoCo bonds for which this time span is less than two days (9 issues excluded). This exclusion will ensure that the issue effect is not absorbed by the announcement effect. Appendix 2.B shows the results.

Table 2.3: Abnormal stock returns around the CoCo bond announcement date

The table reports the average abnormal stock returns (*MARs*) and the average cumulative abnormal stock returns (*MCARs*) of the 34 banks in our sample for different time periods around the announcement date t_0. The analysis is based on 87 CoCo bond issues that have been announced on 55 different dates and includes both initial and all subsequent bond announcements. *Delta MAR* reports the *MAR* difference to t_0. *MR* reports the cross-sectional mean of the unconditional stock returns. *MCR* reports the mean of the cumulative raw stock returns. Test-statistics are shown in parentheses.

Panel 1

Days (*t*)	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+10**
MR (in %)	0.66	0.25	0.27	0.91**	-0.18	0.35	0.48	0.17	0.15
t-stat	*(1.30)*	*(0.85)*	*(0.75)*	*(2.06)*	*(-0.41)*	*(0.75)*	*(1.17)*	*(0.38)*	*(0.51)*
MAR (in %)	0.55	-0.02	0.31**	0.70	0.13	0.23	0.56	0.10	0.32
Delta MAR	-	-	-	*+0.39*	*-0.18*	*-0.08*	*+0.25*	*-0.21*	*-0.01*
t-test									
t_{SAR}	*(1.22)*	*(0.41)*	*(1.98)*	*(1.08)*	*(0.08)*	*(0.17)*	*(1.04)*	*(-0.29)*	*(0.86)*

N=55; *** 1% significance ** 5% significance * 10% significance

Panel 2

τ_{EV} [t_a; t_b]	**[-5;-1]**	**[-1;0]**	**[-1;+1]**	**[0;+1]**	**[0;+5]**	**[+2;+5]**	**[2;+10]**	**[+2;+20]**
MCR (in %)	0.54	0.53	1.44***	1.18***	1.99	0.81	0.24	0.59
t-stat	*(0.64)*	*(1.38)*	*(3.19)*	*(2.77)*	*(1.37)*	*(0.57)*	*(0.22)*	*(0.41)*
MCAR (in %)	-0.23	0.29*	0.99**	1.01**	2.03	1.02	0.96	2.02
t-test								
t_{SAR}	*(-0.43)*	*(1.69)*	*(2.01)*	*(2.15)*	*(1.62)*	*(0.49)*	*(0.96)*	*(0.35)*

N=55; *** 1% significance ** 5% significance * 10% significance

2.4.2 Announcement effects: Abnormal CDS spread reactions

To examine potential effects of contingent capital announcements on the issuing entities' credit default swap spread changes, we furthermore investigate the banks' abnormal CDS spread reactions before and after the CoCo bond announcement dates. In a first step, we predict the abnormal CDS spread changes with the rating index model, as described in section 3.3. To draw inferences from those predictions, we aggregate the abnormal changes and test them for statistical significance. Results are shown in Table 2.4.

Table 2.4: Abnormal CDS spread changes around the CoCo bond announcement date

The table reports the average abnormal CDS spread changes (*ASCs*) and the average cumulative abnormal CDS spread changes (*CASCs*) of the 24 sample banks for which 5-year senior CDS data was available around the CoCo bond announcement date t_0. The data is based on 54 CoCo bond announcements. ΔCDS and ΔCCDS report the absolute average and absolute average cumulative CDS spread changes in basis points, respectively.

Panel 1

Days (*t*)	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+10**
ΔCDS (in bps)	-0.03	0.07	-0.59	-0.71	-0.59	-1.45***	-0.54*	-0.94	-0.09
t-stat	*(-0.08)*	*(0.10)*	*(-0.85)*	*(-1.32)*	*(-1.12)*	*(-3.54)*	*(-1.89)*	*(-1.45)*	*(-0.19)*
Index Model									
ASC (bps)	-0.10	0.10	0.18	-0.23	-0.17	-0.93***	-1.00	-1.17*	-0.05
t-stat	*(-0.33)*	*(0.13)*	*(0.41)*	*(-0.47)*	*(-0.39)*	*(-2.73)*	*(-0.98)*	*(-1.76)*	*(-0.14)*

N=54; *** 1% significance ** 5% significance * 10% significance

Panel 2

τ_{EV} [t_a; t_b]	**[-5;-1]**	**[-1;0]**	**[-1;+1]**	**[0;+1]**	**[0;+5]**	**[+2;+5]**	**[2;+10]**	**[+2;+20]**
ΔCCDS (in bps)	-0.34	-0.52	-1.23	-1.30	-4.81***	-3.52***	-3.45**	-3.19
t-stat	*(-0.20)*	*(-0.48)*	*(-1.13)*	*(-1.45)*	*(-3.21)*	*(-3.21)*	*(-2.44)*	*(-1.13)*
Index Model								
CASC (in bps)	0.27	0.28	0.05	-0.05	-3.33	-3.27**	-2.48*	-1.90
t-stat	*(0.19)*	*(0.20)*	*(0.03)*	*(-0.05)*	*(-1.60)*	*(-2.27)*	*(-1.70)*	*(-0.80)*

N=54; *** 1% significance ** 5% significance * 10% significance

Our analysis shows that the absolute spread changes (ΔCDS) are slightly negative for all days immediately following the CoCo bond announcement. We do not find any statistically significant effects for day t_0 and day t_{+1}, however. Investigating the cumulative abnormal spreads, we find a significant spread tightening in the periods $\tau_{EV}[t_{+2}; t_{+5}]$ and $\tau_{EV}[t_{+2}; t_{+10}]$. Our results hence point to a lagged decrease in the abnormal CDS spreads of our sample banks in the period following the announcement date of a contingent capital issue. The slower reaction of CDS markets is slightly surprising, though the magnitude of the effect remains significant from an economic perspective up to 5 basis points. In order to disentangle the effects for initial and subsequent CoCo bond offerings, we again split the sample and investigate the spread changes within the sub-samples.

2.4.3 Extension – Initial vs. subsequent CoCo bond offerings

Our empirical results from section 4.1 point to a significant positive announcement effect on both unconditional and abnormal stock returns. However, from a theoretical perspective, it is conceivable that the effect is stronger for initial security offerings than for subsequent offerings, as described above.

In order to disentangle the announcement effects for initial and subsequent CoCo bond offers on abnormal stock returns, we create two new sub-samples: The first sub-sample (*SS1*) includes only announcements of initial security offerings, whereas the second sub-sample (*SS2*) includes only announcements of subsequent security offerings. If an institution in our sample has announced only one CoCo bond during the period January 2009 to June 2014, the announcement is included solely in the first sub-sample *(SS1)*. Results are shown in Tables 2.5 and 2.6.

Table 2.5: Announcement effects of initial CoCo bond announcements

The table reports the average abnormal stock returns (*MARs*) and the average cumulative abnormal stock returns (*MCARs*) of the 34 banks in our newly created sub-sample *(SS1)* for different time periods around the announcement date t_0. The analysis includes solely the initial security announcements. *Delta MAR* reports the MAR difference to t_0. *MR* reports the cross-sectional mean of the raw stock returns. *MCR* reports the mean of the cumulative raw returns. Test-statistics are shown in parentheses.

Panel 1

Days (*t*)	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+10**
MR (in %)	1.09	0.45	-0.08	1.57**	-0.06	0.29	0.34	-0.02	0.41
t-stat	*(1.39)*	*(0.99)*	*(-0.16)*	*(2.35)*	*(-0.09)*	*(0.43)*	*(0.53)*	*(-0.04)*	*(1.10)*
MAR (in %)	1.05**	0.02	0.14	1.09	0.33	0.41	0.76	0.24	0.59
Delta MAR	-	-	-	*+0.95*	*+0.19*	*+0.27*	*+0.62*	*+0.10*	*+0.46*
t-test									
t_{SAR}	*(2.40)*	*(0.43)*	*(1.21)*	*(1.50)*	*(0.76)*	*(0.60)*	*(0.40)*	*(-0.23)*	*(1.08)*

N=34; *** 1% significance ** 5% significance * 10% significance

Panel 2

τ_{EV} [t_a; t_b]	**[-5;-1]**	**[-1;0]**	**[-1;+1]**	**[0;+1]**	**[0;+5]**	**[+2;+5]**	**[2;+10]**	**[+2;+20]**
MCR (in %)	0.88	0.37	1.94***	1.50***	2.09	0.60	0.56	0.74
t-stat	*(0.69)*	*(0.68)*	*(3.17)*	*(2.69)*	*(0.92)*	*(0.26)*	*(0.33)*	*(0.34)*
MCAR (in %)	0.30	0.16	1.25*	1.22*	2.95*	1.73	1.70	3.31
t-test								
t_{SAR}	*(0.44)*	*(1.17)*	*(1.82)*	*(1.90)*	*(1.69)*	*(0.74)*	*(1.05)*	*(0.23)*

N=34; *** 1% significance ** 5% significance * 10% significance

Table 2.6: Announcement effects of subsequent CoCo bond announcements

The table reports the average abnormal stock returns (*MARs*) and the average cumulative abnormal stock returns (*MCARs*) of the 15 banks in our newly created sub-sample *(SS2)* for different time periods around the announcement date t_0. The analysis is based on 21 CoCo bond issues and includes solely the subsequent security announcements. *Delta MAR* reports the MAR difference to t_0. *MR* reports the cross-sectional mean of the raw stock returns. *MCR* reports the mean of the cumulative raw returns. Test-statistics are shown in parentheses.

Panel 1

Days (*t*)	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+10**
MR (in %)	-0.02	-0.06	0.83	-0.16	-0.39	0.45	0.71**	0.39	-0.27
t-stat	*(-0.05)*	*(-0.20)*	*(1.58)*	*(-0.55)*	*(-0.85)*	*(0.83)*	*(2.10)*	*(1.28)*	*(-0.56)*
MAR (in %)	-0.25	-0.08	0.59*	0.07	-0.19	-0.06	0.24	-0.13	-0.12
Delta MAR	-	-	-	*-0.52*	*-0.78*	*-0.65*	*-0.35*	*-0.72*	*-0.71*
t-test									
t_{SAR}	*(-1.09)*	*(0.12)*	*(1.66)*	*(-0.16)*	*(-0.83)*	*(-0.49)*	*(1.18)*	*(-0.17)*	*(0.01)*

N=21; *** 1% significance ** 5% significance * 10% significance

Panel 2

τ_{EV} [t_a; t_b]	**[-5;-1]**	**[-1;0]**	**[-1;+1]**	**[0;+1]**	**[0;+5]**	**[+2;+5]**	**[2;+10]**	**[+2;+20]**
MCR (in %)	-0.01	0.78	0.61	0.67	1.83*	1.17	-0.27	0.35
t-stat	*(-0.01)*	*(1.64)*	*(1.00)*	*(1.01)*	*(1.78)*	*(1.50)*	*(-0.30)*	*(0.25)*
MCAR (in %)	-1.09	0.51	0.58	0.67	0.53	-0.13	-0.25	-0.06
t-test								
t_{SAR}	*(-1.26)*	*(1.26)*	*(0.94)*	*(1.06)*	*(0.47)*	*(-0.16)*	*(0.23)*	*(0.28)*

N=21; *** 1% significance ** 5% significance * 10% significance

First-time announcements seem to have a stronger positive abnormal stock return effect than subsequent security offerings. Mean cumulative abnormal returns of initial offerings are significantly positive for $\tau_{EV}[t_{-1};\ t_{+1}]$, $\tau_{EV}[t_0;\ t_{+1}]$ as well as for $\tau_{EV}[t_0;\ t_{+5}]$, amounting to 1.25 percentage points, 1.22 percentage points, and 2.95 percentage points, respectively. While the mean cumulative abnormal return impact of subsequent offers is still positive in the short term, it is no longer significant.

We furthermore observe a slightly more substantial decrease in abnormal CDS spreads of the banks in our cross-section at the announcement of an initial CoCo bond offering. The cumulative abnormal CDS spreads (*CASCs*) narrow significantly, on average, by around 8 basis points in event window period $\tau_{EV}[t_0;\ t_{+5}]$. Moreover, on all 5 days following the CoCo-security announcement, both the unrestricted and the abnormal CDS reaction is negative. Results can be observed in Appendix 2.C. It should be noted, however, that the sample size issue is exacerbated for the CDS analysis given the limited availability of data. Overall, the observations support our hypotheses developed above. Moreover, banks issuing first-time CoCos are signaling a strategic change towards employing such hybrid capital instruments in the future.

2.4.4 Robustness tests

The *MAR* and *MCAR* results described above are robust to changes in the length of the estimation window. We compute the results for 50-, 75-, and 120-day T_{ES} periods. In all three alternative calibrations, we find a significant positive announcement effect on day t_0 as well as in the event window $\tau_{EV}[t_0;\ t_{+1}]$. The change in the estimation windows does not change the factor loadings, nor does it alter the average R_2 or the out-of-sample root mean squared errors of the employed market models markedly. We infer that the 90-day window is reasonably chosen. It should perhaps be noted that alterations of the estimation window length change the sample slightly. To avoid including CoCo bond announcements in the estimation window, some observations, for banks that issue successive CoCos in relatively small time intervals, are dropped. Conversely, we include previously dropped observations when estimation windows are shortened. The fact that our results do not change supports the notion that our inferences are robust[52]. If we are less stringent with our sample cleaning procedure and include, for instance, issues that coincide with the release of other information, the magnitude of our results is diminished somewhat. This applies more strongly to the effect of abnormal

[52] Similarly, excluding individual banks that issue several tranches of CoCos at once (i.e. Lloyds) does not change the results.

stock returns than to CDS spread changes. It is possible that our observations, especially the effect of stock price movements, are highly sensitive to market perceptions that can be influenced by many factors. If information about an issue is leaked prior to announcement, the market reaction on the announcement date will be subdued. We cannot control for this type of leakage, however, particularly in light of the vast heterogeneity of banks included in our cross-section[53].

Inferences in section 4.2 are also robust to changes of the rating index model. While in the default setting, we split the CDS index into the two S&P issuer rating categories 1) AAA to A and 2) BBB and lower, we also compute the results for the total index. We still find abnormal CDS spread decreases for both total and initial CoCo bond announcements (see Appendix 2.D).

It should be noted that our analysis might suffer from a slight selection bias, as our CDS sub-sample includes only those banks for which senior 5-year credit default swaps were available. Those banks that do not have actively traded CDS outstanding are not taken into account, which might have implications on the inferential power of our results. It is furthermore noteworthy that although CDS spreads generally tend to react very fast to the advent of new information, it seems that this is not the case for the investigated contingent capital announcements in our sample. In fact, we do not find any statistically significant effect on the immediate bond announcement day (t_0) or the day after (t_1), neither for initial nor for all hybrid debt securities in our sample. The announcement effect is lagged and most evident in the period 5 to 20 days following the announcement. We examine whether this is a function of the fact that some institutions do not use the US dollar as their primary currency, which may make their USD-denominated CDS less liquid. We cannot categorically rule out this possibility. However, we find no evidence that the USD credit default swaps are less liquid than their EUR-denominated counterparts. In fact, looking at the frequency with which they re-price, USD-denominated CDS are more (or at least equally) liquid. Moreover, it should be noted that some institutions in our sample do not make use of a home-currency CDS, but only USD-denominated instruments.

Finally, hedging activity (e.g., if underwriters hedge against the exposure of CoCo bonds they keep on their books) might affect the CDS reactions in the post-announcement period, particularly if the CDS market is not fully liquid. We cannot rule this out. However, if

[53] We do, however, not find evidence that larger issues, which might theoretically be subject to more information leakage, behave markedly differently to smaller issues in the 10 days prior to the announcement date.

this were the case, we might expect to see a counter-reaction of the prices when the hedge is unwound (as the issue is sold off to clients). We do not find evidence for such an effect.

2.4.5 Multivariate analyses

In previous sections, we identified significant positive abnormal stock returns in the immediate period that follows the announcement dates of our sample CoCo bonds. While we control for country-specific effects in the analysis of stock price reactions and entity-specific effects in the CDS spread investigation, we have not yet examined the role of the bond-specific features. In order to identify the design characteristics of the contingent capital securities that might affect the abnormal stock returns, we now regress bond-specific factors on the observed *MARs* and *MCARs* (as computed in section 4.1[54]). Those regressions take the following forms:

$$MAR(t) = \alpha_0 + \alpha_1 BONDSIZE + \alpha_2 TIMESPAN + \alpha_3 REGCAP + \alpha_4 CALL + \alpha_5 CONV + \alpha_6 TRIGGER + \varepsilon$$

$$MCAR(t_a, t_b) = \beta_0 + \beta_1 BONDSIZE + \beta_2 TIMESPAN + \beta_3 REGCAP + \beta_4 CALL + \beta_5 CONV + \beta_6 TRIGGER + \varepsilon$$

Since the size of a CoCo bond issue is likely to be connected with an issuer's post-announcement abnormal stock return, we include the variable *BONDSIZE* in our regression, where *BONDSIZE* is defined as the natural logarithm of the contingent capital security's face value over total capital at issuance as measured in US dollar terms[55]. Since the lag between the announcement and the issue date might have an impact on the *MARs* and *MCARs*, we furthermore control for the variable *TIMESPAN*, which is defined as the number of days between the announcement and the ultimate issue date of the hybrid debt securities. This

[54] For econometric issues that might arise from only very few observations, we do not conduct a multivariate analysis for the abnormal CDS spread reactions.

[55] If a bank has announced multiple CoCo bonds (or several CoCo bond tranches) on the same day, we take the aggregated notional value of all those securities. The face values that are issued in currencies other than the US dollar are converted in US dollars with the exchange rate prevailing on their respective issue date. Total capital is computed using last available data and represents size of the bank in the year prior to the issue. The data is winsorised at the 90th percentile to avoid our results being driven by outliers; this slightly reduces the relative *BONDSIZE* for two banks but not the inferences discussed below.

TIMESPAN variable is reported at announcement. In order to investigate to what extent the regulatory capital classification of the issued CoCos affects the abnormal stock price reaction, we also include the dummy variable *REGCAP* in our regression, which takes on the value 1 if the proceeds from the CoCo bond issue are classified as Additional Tier 1 capital and 0 if they are classified as Tier 2 capital. We furthermore control for the contingent capital's conversion mechanism and the inclusion of issuer call provisions with the dummy variables *CONV* and *CALL*, respectively. For a conversion-to-equity mechanism, the variable *CONV* takes on the value 1 and 0 for all other conversion types (e.g., such as temporary or permanent principal write-downs). The dummy variable *CALL* assumes the value 1 if the CoCo bond includes call provisions that may be exercised at the discretion of the issuer and assumes the value 0 for plain vanilla CoCo bonds without any embedded issuer call options. Lastly, we control for the hybrid bonds' trigger level by including the variable *TRIGGER*, which is a dummy variable taking on the value 1 for a conversion trigger level of 5.125% and above. We also examine the relation between the individual regressors by computing their pairwise correlations. The correlation matrix shows that the absolute values of the regressors' correlation coefficients are all below 0.5. We find a moderate positive correlation between the variable *REGCAP* and *TRIGGER* ($\rho = +0.45$), though this is to be expected. CoCo bonds that are classified as AT1 capital are more likely to have a trigger level of exactly 5.125%. Given the small sample size inherent to our analysis, standard errors are inflated to a certain extent. While we are cautious about our inferences, we still find that some of the above-mentioned factors exert a statistically significant influence. Results for the abnormal stock return analysis (*MARs*) for different days t before and after the announcement day t_0 can be found in Table 2.7. Additionally, Table 2.8 reports the empirical results of the abnormal stock return analysis (*MCARs*) for different event window periods $\tau_{EV}[t_a; t_b]$.

Table 2.7: Bond-specific factors and abnormal stock returns (*MARs*)

The table shows the results of the multivariate regressions of the observed *MARs* on the bond-specific variables for different days *t* before and after the CoCo bond announcement day t_0. T-statistics are shown in parentheses. Coefficient estimates are reported in basis points. The regressions are based on 55 bond announcements. If an institution has announced multiple CoCo bond tranches on the same day, the aggregated notional value of all issued CoCos by this issuer is taken into the regression equation. R_2s are reported in the bottom line of the table.

Days (*t*)	**0**	**+1**	**+2**	**+3**	**+4**
CONSTANT	-45.1	-268.7	397.1	382.3*	-91.3
	(-0.24)	*(-1.12)*	*(1.66)*	*(1.72)*	*(-0.37)*
BONDSIZE	-18.9	-69.9**	73.2**	64.6**	-9.6
	(-0.71)	*(-2.08)*	*(2.18)*	*(2.08)*	*(-0.27)*
TIMESPAN	3.9	-3.8	1.9	-3.5	-7.0
	(0.80)	*(-0.62)*	*(0.31)*	*(-0.63)*	*(-1.10)*
REGCAP	142.7*	39.3	-30.5	-114.4	20.0
	(1.84)	*(0.40)*	*(-0.31)*	*(-1.27)*	*(0.20)*
CALL	-107.2	-197.3*	95.5	102.6	67.3
	(-1.18)	*(-1.73)*	*(0.84)*	*(0.97)*	*(0.56)*
CONV	32.2	66.9	14.9	43.4	70.3
	(0.48)	*(0.79)*	*(0.18)*	*(0.56)*	*(0.80)*
TRIGGER	-155.8**	49.1	13.9	91.3	88.4
	(-2.19)	*(0.55)*	*(0.16)*	*(1.10)*	*(0.95)*
Adj. R^2	*0.03*	*0.02*	*-0.00*	*0.04*	*-0.02*

N=55; *** 1% significance ** 5% significance * 10% significance

Table 2.8: Bond-specific factors and cumulative abnormal stock returns (*MCARs*)

The table shows the results of the multivariate regressions of the observed *MCARs* on the bond-specific variables for different event window periods. T-statistics are shown in parentheses. Coefficient estimates are reported in basis points. The regressions are based on 55 bond announcements. If an institution has announced multiple CoCo bond tranches on the same day, the aggregated notional value of all issued CoCos by this issuer is taken into the regression equation. R_2s are reported in the bottom line of the table.

τ_{EV} [t_a; t_b]	[-1;0]	[-1;+1]	[0;+1]	[0;+5]
CONSTANT	-122.5	-391.2*	-313.8	494.7
	(-0.76)	*(-1.70)*	*(-1.67)*	*(0.55)*
BONDSIZE	-32.9	-102.8***	-88.8***	72.0
	(-1.45)	*(-3.19)*	*(-3.37)*	*(0.57)*
TIMESPAN	3.3	-0.4	0.1	-10.5
	(0.81)	*(-0.08)*	*(0.02)*	*(-0.46)*
REGCAP	29.8	69.0	182.0**	19.8
	(0.45)	*(0.74)*	*(2.39)*	*(0.05)*
CALL	-117.3	-314.6***	-304.5***	108.7
	(-1.52)	*(-2.88)*	*(-3.40)*	*(0.25)*
CONV	-30.4	36.5	99.1	267.9
	(-0.53)	*(0.45)*	*(1.50)*	*(0.84)*
TRIGGER	6.6	55.7	-106.6	*87.3*
	(0.11)	*(0.65)*	*(-1.52)*	*(0.26)*
Adj. R^2	*-0.02*	*0.15*	*0.24*	*-0.07*

N=55; *** 1% significance ** 5% significance * 10% significance

We observe a significant negative coefficient for the variable *BONDSIZE* on day t_{+1} in Table 2.7 pertaining to daily abnormal announcement effects (*MAR)*. This indicates that larger issues reduce positive abnormal returns associated with the announcement. Investors may be more apprehensive about the potential of dilution if the issue represents a larger proportion of the institutions capital base. For the event window period $\tau_{EV}[t_0;\ t_{+1}]$, we find similar results (see Table 2.8). The issue size affects the immediate positive announcement effect of the bonds in our sample negatively. However, for longer time periods, the effect is not significant. We furthermore find that *CALL* is associated with an *MCAR* reduction in the period $\tau_{EV}[t_0;\ t_{+1}]$. Including a call provision reduces the cumulative abnormal returns by about 300 basis points. This observation is robust over different estimation windows[56]. As a call provision enables the issuer to retract the bond in favor of cheaper sources of financing, typically at the issuer's discretion, the positive signal may not be as pronounced.

Whether a bond can be considered Tier 1 capital is also associated with positive abnormal returns. This too follows from the logic of our above argument: the market values the bank´s ability of gaining additional Tier 1 capital without issuing equity. Interestingly, the fact that a bond can be converted into equity (as opposed to being written down) has little impact on the market's perception; the coefficient on *CONV* is insignificant. This may be an indication that the market does not view the differences in the risk-taking incentives between write-down and conversion-to-equity, as discussed in section 2.2, as critical. Finally, CoCo bonds with a higher (i.e., earlier) trigger are less valued by existing stock holders (as measured by the impact on the MAR).

2.5 Conclusion

This paper investigates announcement effects of contingent convertible securities on the issuing institutions' stock returns and credit default swap spreads. For the CoCo issuers in our sample, we find significant positive abnormal stock price reactions and significant negative abnormal CDS spread changes in the immediate period following the announcement date. These reactions are more pronounced for first-time issuers, indicating that the market may infer information about the strategic orientation of the bank from these events. The magnitude of the effects is influenced in part by the structure of the bond; call provisions, in particular, reduce the size of the positive stock-price effect.

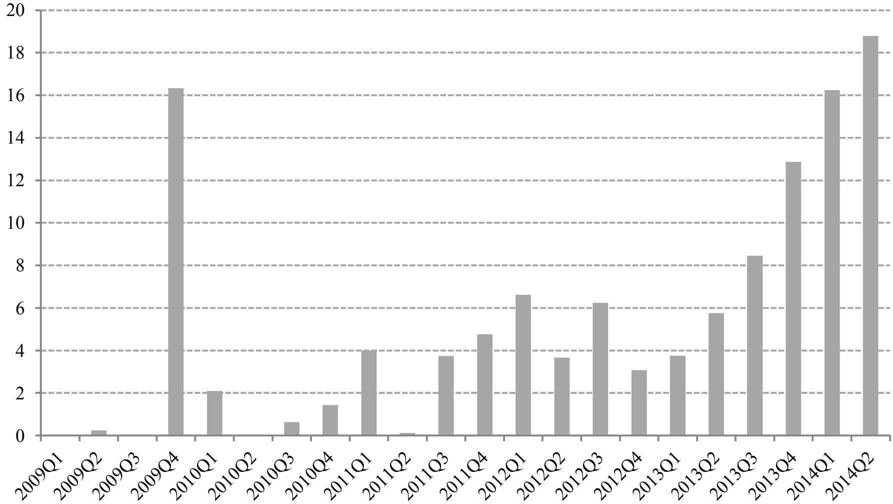
[56] The explanatory power the multivariate model decreases for longer event window periods.

We explain the negative CDS spread reactions by the additional layer of protection that CoCo bonds offer to senior creditors. Especially in the face of a changing regulatory framework, which makes government-induced bailouts less likely, the additional protection can be valuable in future years. Since CoCos reduce the likelihood of an all-out default (possibly by also aligning creditor and owner incentives), the bankruptcy risk drops and the CDS spreads narrow.

We explain the positive announcement returns of the banks' stocks in a number of ways. First, we suggest that the issue of a CoCo bond includes a positive signal for equity investors. The decision in favor of CoCos and against common equity (which ranks lower in the pecking order) might be positively received by market participants. Second, with CoCo bonds, a financial institution can exploit the tax shield effect that is associated with those hybrid debt securities. Third, CoCo bonds can help an institution avoid unprofitable debt overhang in the future. Anticipating that these effects might positively influence shareholder value, equity owners seem to interpret the issuance of CoCo bonds as a positive signal.

Appendix 2.A: Nominal issue volumes of global contingent convertible securities

The graph shows the nominal issue volumes of contingent convertible securities that have been issued by global financial institutions during the period 1 January 2009 to 30 June 2014 on a quarterly basis. Figures are reported in billion US dollars.



Appendix 2.B: Abnormal stock returns around the CoCo bond issue date

The table reports the average abnormal stock returns (*MARs*) and the average cumulative abnormal stock returns (*MCARs*) of the 28 banks in our sub-sample for different time periods around the CoCo bonds' issue dates t_{i0}. The analysis is based on 46 bond announcements and includes both initial and all subsequent bond issues. *Delta MAR* reports the *MAR* difference to t_0. *MR* reports the cross-sectional mean of the raw stock returns. *MCR* reports the mean of the cumulative raw stock returns. Test-statistics are shown in parentheses.

Panel 1

Days (t_i)	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+10**
MAR (in %)	0.49	-0.51	0.07	0.23	-0.05	0.05	0.09	-0.05	0.21
Delta MAR	-	-	-	*+0.16*	*-0.12*	*-0.02*	*+0.02*	*-0.12*	*+0.14*
t-test									
t_{SAR}	*(1.07)*	*(-1.10)*	*(-0.36)*	*(1.09)*	*(0.29)*	*(0.39)*	*(0.24)*	*(-0.04)*	*(0.86)*

N=46; *** 1% significance ** 5% significance * 10% significance

Panel 2

τ_{EV} [t_a; t_b]	**[-5;-1]**	**[-1;0]**	**[-1;+1]**	**[0;+1]**	**[0;+5]**	**[+2;+5]**	**[2;+10]**	**[+2;+20]**
MCAR (in %)	-0.79	-0.43	-0.20	0.30	0.34	0.04	0.57	-0.43
t-test								
t_{SAR}	*(-0.78)*	*(-1.03)*	*(-0.22)*	*(0.50)*	*(0.73)*	*(0.59)*	*(0.82)*	*(-0.27)*

N=46; *** 1% significance ** 5% significance * 10% significance

Appendix 2.C: Announcement effects: abnormal CDS spread reactions of initial CoCo bond offering announcements

The table reports the average abnormal CDS spread changes (*ASCs*) and the average cumulative abnormal CDS spread changes (*CASCs*) of the 24 sample banks for which 5-year CDS data was available around the CoCo bond announcement date t_0. The analysis includes solely the 24 initial CoCo bond announcements. ΔCDS and ΔCCDS report the absolute average and absolute average cumulative CDS spread changes in basis points, respectively.

Panel 1

Days (*t*)	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+10**
ΔCDS (in bps)	0.09	1.25	-0.13	-1.48	-1.72*	-1.09*	-0.37	-2.30*	-0.13
t-stat	*(0.15)*	*(1.07)*	*(-0.11)*	*(-1.34)*	*(-1.77)*	*(-1.91)*	*(-0.82)*	*(-1.70)*	*(-0.27)*
Index Model									
ASC (bps)	0.53	0.11	-0.16	-1.37	-0.78	-1.13**	-2.32	-2.37*	0.09
t-stat	*(1.10)*	*(0.07)*	*(-0.11)*	*(-1.54)*	*(-1.02)*	*(-2.05)*	*(-1.03)*	*(-1.75)*	*(0.20)*

N=24; *** 1% significance ** 5% significance * 10% significance

Panel 2

τ_{EV} [t_a; t_b]	**[-5;-1]**	**[-1;0]**	**[-1;+1]**	**[0;+1]**	**[0;+5]**	**[+2;+5]**	**[2;+10]**	**[+2;+20]**
ΔCCDS (in bps)	3.20	1.12	-0.36	-1.61	-7.09**	-5.48**	-5.84**	-5.97
t-stat	*(0.95)*	*(0.51)*	*(-0.17)*	*(-1.08)*	*(-2.49)*	*(-2.45)*	*(-2.55)*	*(-1.39)*
Index Model								
CASC (in bps)	2.79	-0.05	-1.42	-1.52	-8.13**	-6.61**	-6.46**	-6.36*
t-stat	*(0.96)*	*(-0.02)*	*(-0.43)*	*(-0.84)*	*(-1.96)*	*(-2.23)*	*(-2.54)*	*(-1.67)*

N=24; *** 1% significance ** 5% significance * 10% significance

Appendix 2.D: Announcement effects: abnormal CDS spread changes around the CoCo bond announcement date (rating-category independent CDS index)

The table reports the average abnormal CDS spread changes (ASCs) and the average cumulative abnormal CDS spread changes (CASCs) of the 24 sample banks for which 5-year senior CDS data was available around the CoCo bond announcement date t0. Panel 1 reports the results for both initial and subsequent CoCo bond offerings (54 announcements). Panel 2 reports the results for only the initial CoCo bond offerings (24 announcements). The analysis is conducted for the total (i.e., the rating-category independent) CDS index.

Panel 1 – Initial and subsequent CoCo bond announcements

Days (*t*)	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+10**
Index Model									
ASC (bps)	0.10	0.29	0.35	-0.36	-0.08	-0.87**	0.02	-0.83	0.13
t-stat	*(0.34)*	*(0.50)*	*(0.41)*	*(-0.67)*	*(-0.20)*	*(-2.52)*	*(0.08)*	*(-1.16)*	*(0.31)*

τ_{EV} [t_a; t_b]	**[-5;-1]**	**[-1;0]**	**[-1;+1]**	**[0;+1]**	**[0;+5]**	**[+2;+5]**	**[2;+10]**	**[+2;+20]**
Index Model								
CASC (in bps)	0.43	0.64	0.29	-0.01	-1.77	-1.76	-0.05	2.42
t-stat	*(0.34)*	*(0.50)*	*(0.19)*	*(-0.01)*	*(-1.25)*	*(-1.58)*	*(-0.04)*	*(-1.01)*

N=54; *** 1% significance ** 5% significance * 10% significance

Panel 2 – Initial CoCo bond announcements

Days (*t*)	**-2**	**-1**	**0**	**+1**	**+2**	**+3**	**+4**	**+5**	**+10**
Index Model									
ASC (bps)	0.71	0.68	0.02	-1.62*	-0.78	-1.32**	-0.05	-2.26	0.25
t-stat	*(1.44)*	*(0.56)*	*(0.01)*	*(-1.70)*	*(-1.08)*	*(-2.49)*	*(-0.09)*	*(-1.56)*	*(0.47)*

τ_{EV} [t_a; t_b]	**[-5;-1]**	**[-1;0]**	**[-1;+1]**	**[0;+1]**	**[0;+5]**	**[+2;+5]**	**[2;+10]**	**[+2;+20]**
Index Model								
CASC (in bps)	3.36	0.69	-0.93	-1.61	-6.02**	-4.42**	-2.75	-0.85
t-stat	*(1.37)*	*(0.25)*	*(-0.30)*	*(-0.77)*	*(-2.45)*	*(-1.98)*	*(-1.31)*	*(-0.24)*

N=24; *** 1% significance ** 5% significance * 10% significance

Chapter 3

Performance of Exchange-Traded Funds: New Evidence from Equity ETFs listed on XETRA and NYSE Arca

Christian Ehmann

Abstract

This paper investigates the performance of exchange-traded funds (ETFs) listed on XETRA and NYSE Arca. Analyzing a sample of 505 equity ETFs, we find that tracking errors are existent and significantly different from zero. We furthermore examine the factors that are related to tracking friction and to NAV premiums/ discounts. Our empirical results show that costs, intraday volatility of fund shares, rebalancing frequency and domicile of incorporation are related to tracking friction. Moreover, we find that the deviations between the ETFs' market prices and their NAVs were particularly large during the global financial crisis of 2007/08. Our panel regression results reveal that those premiums/discounts are affected by fund size, trading volume, bid-ask spreads and price volatility of fund shares.

3.1 Introduction

Exchange-traded products (ETPs) have gained wide popularity amongst private and institutional investors in the past decade. Lower costs and higher liquidity as compared to actively managed mutual funds as well as the inability of many mutual fund managers to sustainably beat the market in the long-run have put those passive investment vehicles in the center of investor interest. As of the end of Q2-2015, global ETPs had gathered almost 3 trillion USD in assets under management (AuM), with equity-related products accounting for more than 80% of the worldwide market share. According to data provided by Blackrock, the global ETP industry has grown by around 27% per year on average over the last 15 years (Blackrock, 2015a). While the United States are by far the largest market as measured in terms of global assets, ETP volumes in Europe have also experienced substantial growth. The XETRA-platform of the Frankfurt Stock Exchange was the first European exchange that allowed ETP trading and currently dominates the market in Europe in terms of trading volume. Total net asset values of all XETRA-listed ETPs amounted to approximately 360 billion USD at the end of 2014. This corresponds to a 55% average annual growth rate in assets since the launch of the XTF-segment for exchange-traded products in April 2000. Even more notably, Europe has become the market leader in terms of product diversity[57]. In fact, since 2003, products that track the performance of assets other than stocks (e.g., such as ETPs on commodity- or fixed income indices) have increasingly attracted investors' funds. Of the 1,055 ETPs that were listed on XETRA as of the end of March 2015, around 40% of products were based on underlyings other than equity (Deutsche Börse, 2015). In the United States, equity products are still the predominant type, with NYSE Arca being the leading exchange. At the end of March 2015, 1,487 exchange-traded products with approximately 2 trillion USD total AuM were listed on this platform. With around 21% of the entire U.S. ETP trading volume and 90% of AuM representation, NYSE Arca is currently the leading ETP exchange in the United States (NYSE, 2015). According to an industry forecast by Blackrock, total global ETP assets are expected to exceed 6 trillion USD by the year 2019 (Blackrock, 2015a).

Exchange-traded funds (ETFs) are passive investment vehicles that aim to replicate an equity benchmark index. In contrast to actively managed mutual funds that primarily focus on alpha, the performance of equity ETFs is usually measured against the deviation from their benchmark. In theory, investors should prefer products with a high replication quality, or expressed differently, with a low benchmark tracking error. A number of previous academic

[57] According to Blackrock (2015b), of the 5,595 globally existing ETPs, 2,299 products were listed on European exchanges.

studies have investigated the factors that affect those tracking errors. Early studies, such as those by Pope and Yadav (1994), Frino and Gallagher (2001) or Kostovetsky (2003) show that tracking errors are particularly driven by costs, liquidity issues, and fund cash flows. More recent studies in this area have taken further factors into account. Studying a sample of 36 Swiss ETFs, Milonas and Rompotis (2006) find that tracking friction is positively related to the level of risk in the fund. Shin and Soydemir (2010) cite intraday price volatility and changes in exchange rates as important sources of tracking errors. Chu (2011) finds evidence that the magnitude of tracking errors of Hongkong-listed ETFs is positively related to fund expenses and negatively related to fund size. Newer studies have also focused on the recent financial innovations in the market, such as inverse and leveraged exchange-traded funds. A number of studies investigate the risks and structural dynamics of such products that make extensive use of derivative instruments[58]. Charupat and Miu (2011), for instance, examine tracking errors of leveraged ETFs. Using a small sample of 8 Canadian funds, they find that the deviations are small for short holding periods, but large for longer-term investment horizons. This has also been found by Cheng and Madhavan (2009), who explain the long-term performance drag with the elevated implicit transaction costs stemming from the daily rebalancing activity. Since the rebalancing frequency for standard (i.e., delta-1) ETFs ranges usually from weekly to yearly, their implicit transaction costs are significantly lower than those of the "exotic" products.

Most of the above-mentioned studies suffer from a lack of data representativeness, however, as their sample sizes are mostly strongly limited (usually < 50 ETFs). The only recent study that uses a larger cross-section is the one by Meinhardt, Mueller and Schoene (2014) who investigate the differences between 421 physically and synthetically replicating equity- and fixed income ETFs listed in Germany. However, their study does not take into account a number of factors that might have an impact on tracking errors, such as daily volatility of fund prices, tax domiciles or security lending policies, nor does it differentiate between delta-1 and exotic products. Moreover, their investigation period is confined to only a very narrow time frame as well as to solely European ETF providers. These shortcomings apply to most studies that focus on tracking errors or pricing efficiency of exchange-traded funds. To fill this gap in the literature, we investigate the tracking friction and the premiums/discounts to NAV for a large sample of 505 exchange-traded funds that are listed in Frankfurt (XETRA) and in New York (NYSE Arca). We solely focus on equity ETFs that replicate benchmark indices with a regional investment focus (e.g., such as ETFs tracking the

[58] E.g., see Charupat and Miu, 2011; Cheng and Madhavan, 2009; Curcio, Anderson, and Guirguis, 2012; Hurlin et al., 2015; Jarrow, 2010; Guedj, Li, and McCann, 2010; Shum and Kang, 2013; or Rompotis, 2013.

MSCI Germany Index, the *MSCI France Index*, etc.). Our empirical investigation furthermore covers a 19-year time period, ranging from 1996 to 2014. We find empirical evidence that tracking errors are positively related to total expense ratios, trading volume, daily rebalancing frequency, and intraday volatility of fund prices and negatively to the tax domicile of the ETF. Furthermore, we show that the exotic products in our cross-section (i.e., leveraged or inverse ETFs) exhibit lower tracking friction than their delta-1 peers. Our panel regression results finally show that NAV premiums/discounts are affected by fund size, trading volume, bid-ask spreads and price volatility of fund shares.

The remainder of this paper is structured as follows. Section 2 describes the current regulatory changes with regards to tracking friction disclosure by global ETF providers. Section 3 describes the data and the methodology employed for the tracking error and NAV premium/discount computations. Section 4 shows the empirical results while section 5 concludes the main findings.

3.2 Tracking Friction and Financial Regulation

Given the strong global growth in ETF assets as well as the systemic risks that accompany the continuing trend of employing derivative-based index replication strategies, financial regulators have established new regulatory frameworks that address the issue of tracking friction in recent years. In their final report, the Board of the International Organization of Securities Commissions (IOSCO) recommends the disclosure of both realised tracking difference and realised tracking error in order to foster information transparency for ETF investors (IOSCO, 2013). Following the recommendation of the Financial Stability Board, the European Securities and Markets Authority (ESMA) has gone one step further and published guidelines on exchange-traded funds in 2012 requiring providers of UCITS-compliant ETFs to disclose information on the anticipated level of tracking error in their annual reports (ESMA, 2012). Financial regulatory authorities of other countries have established similar requirements in the recent past. Hongkong, for instance, requires all SFC-registered index-tracking ETFs to disclose tracking error risks (including the circumstances under which they occur) in a Key Features Summary since the beginning of 2015 (SFC, 2015). In the United States, the majority of SEC-registered exchange-traded funds are regulated under the Investment Company Act of 1940. While the 1940 Act prescribes strict disclosure requirements in terms of risks for investors, it is less strict on the disclosure of expected or realised tracking errors. In fact, the disclosure requirement of tracking friction is, at the time of writing this paper, primarily observed as being a European regulatory trend. One reason for this divergence might be the relatively restrictive SEC policies concerning the use of derivative-based replication methods in the United States. In Europe, by contrast, ETFs are regulated under the UCITS III Directive which allows fund providers to employ derivatives for both hedging *and* investment purposes. As a consequence, there has been a stronger trend towards the use of synthetic replication techniques in the European ETF market. Since such replication strategies are perceived more risky by the regulator (e.g., due to increased opacity and/or elevated counterparty risks), tracking errors have come particularly into the focus of European regulatory bodies. With the increased efforts to strengthen investor protection rights within the European Union, the factors that affect tracking errors will therefore be of particular interest for providers of UCITS-compliant exchange-traded funds in future years. Especially when it comes to the estimation of expected future return deviations from the benchmark index, ETF providers will have to be fully aware of their determinants. Although our study does not explicitly examine the underlying causal relationships, the regression analyses conducted in section 4 of this paper add a valuable contribution to this discussion, as they take into account a multitude of different factors that might be associated with tracking friction. Moreover, our study differentiates between delta-1 and exotic products to investigate the differences between those two groups.

3.3 Data and Methodology

3.3.1 Data

We empirically investigate the performance and the pricing efficiency of equity ETFs that are traded on the XETRA platform of the Frankfurt Stock Exchange as well as on the Arca platform of the New York Stock Exchange[59]. As of 31 December 2014, 1,422 exchange-traded products with more than 360 billion USD assets under management were listed on XETRA (Deutsche Börse, 2015). NYSE Arca counted 1,470 ETPs with total AuM of approximately 1.89 trillion USD at the same time (NYSE, 2014). Our analysis solely focuses on exchange-traded funds that track the performance of equity market indices. Other ETPs are not in the focus of our investigation and therefore excluded from the sample[60]. We furthermore exclude all equity ETFs that replicate the development of specific industry sector-, strategy-, or style indices. Instead, our final sample solely includes funds with a

[59] A comprehensive list of all XETRA- and NYSE-listed ETFs can be found on the exchange websites.
[60] We exclude all exchange-traded products that track the performance of fixed income securities or indices, commodities, currencies and hedge funds as well as otherwise rather exotic products, such as exchange-traded notes, ETPs on currency baskets, volatility indices or multi-asset baskets.

purely geographic or regional investment focus. To determine a fund's geographic focus in the most consistent way, we follow the exchange classifications and divide the sample ETFs into 5 different investment target markets: 1) Europe, 2) North America, 3) Asia/Pacific, 4) Emerging Markets and 5) Global[61]. The investigated time frame ranges from 1 March 1996 to 31 December 2014.

Since we estimate the tracking errors, inter alia, with a linear regression model using daily data, we exclude those ETFs with less than 50 daily NAV observations as well as those for which daily benchmark index levels, trading volumes or NAV data were not available on Bloomberg. For the analysis of the pricing efficiency, we delete some few premiums/discounts in excess of ±10%, as those are likely to stem from data errors. Inception dates, daily net asset values, daily closing prices of fund shares, intraday highest and lowest prices of fund shares, bid-ask spreads, benchmark index data and other fund-related characteristics were obtained from Bloomberg.

Applying the filter criteria as described above, our final sample includes 377 XETRA-listed equity ETFs and 128 NYSE Arca-listed equity ETFs that have been launched by leading international ETF providers during the period between March 1996 and September 2014. Our investigation hence covers a large cross-section consisting of 505 exchange-traded funds that replicate 328 different benchmark indices. The funds in the sample have a total cumulative net asset value of almost 900 billion USD, representing approximately 40% of total ETF assets of both exchanges. Since XETRA and NYSE Arca are the largest trading platforms for exchange-traded products in Europe and the US, respectively, we consider our study representative as far as the total net asset values are concerned. The study is not representative in terms of the number of ETFs, however, due to the exclusions described above. Table 3.1 reports the summary statistics of selected features of the exchange-traded funds that are included in our sample.

[61] The classification "Europe" includes all ETFs with the following national target markets as defined by the exchanges: Germany, France, Greece, United Kingdom, Italy, Austria, Portugal, Switzerland, Spain, Europe, and Eurozone.

Table 3.1: Summary statistics of the sample ETFs

The table reports the domiciles of incorporation, index tracking mechanisms, benchmark index replication methods, securities lending policies, currency hedging approaches and portfolio rebalancing frequencies of all 505 exchange-traded funds in our final sample. Data is reported as of 31 December 2014.

	#ETFs	in %
Fund Domiciles		
Luxembourg	145	28.1%
Ireland	83	16.4%
United States	128	25.3%
Others	149	29.5%
Index Tracking Mechanisms		
Delta-1	472	93.5%
Leveraged	19	3.8%
Inverse	14	2.8%
Benchmark Index Replication Methods		
Full replication	256	50.7%
Synthetic replication	188	37.2%
Optimized sampling	58	11.5%
Securities Lending Policies		
Securities lending allowed	178	35.2%
Securities lending not allowed	271	53.7%
Unknown	56	11.1%
Currency Hedging Strategies		
Hedged	34	6.7%
Unhedged	471	93.3%
Portfolio Rebalancing Frequencies		
Yearly	28	5.5%
Semi-annually	59	11.7%
Quarterly	231	45.7%
Monthly	17	3.4%
Daily	85	16.8%
Not specified	85	16.8%

The great majority of the ETFs in our sample are delta-1 products, aiming to track their benchmark indices on a one-to-one basis. Around 7% of the funds do not pursue a linear delta-1 approach and employ financial leverage or inverse tracking structures (hereafter referred to as "exotic" products). Our data furthermore shows that derivative-based index replication strategies are very common amongst European ETF providers. Almost half of the XETRA ETFs that are included in the sample are replicated synthetically. This has also been described by Naumenko and Chystiakova (2015), who explain this trend with lower regulatory constraints in the European market as compared to the U.S. market. In fact, of the 128 NYSE Arca ETFs, approximately 77% pursue a physical index replication strategy while only one single ETF employs a derivative-based approach. Optimized sampling (i.e., the method of selecting a portfolio allocation that replicates the benchmark index as closely as possible with only a limited number of securities), by contrast, is less commonly employed in Europe, as our data indicates. Securities lending policies also seem to be rather restricted amongst the European funds in our sample. By contrast, of the 99 physically replicated American ETFs, more than two thirds engage in securities lending practices.

It should be furthermore noted that our sample is relatively heterogeneous in terms of both the funds' assets under management and their fee structures. The cross-sectional mean fund assets significantly exceed the median, implying that the sample mean is driven by a small number of very large funds. Theoretically, since larger ETFs might be able to exploit economies of scale in terms of management costs, fund size might potentially be negatively related to tracking friction. The total expense ratios (TERs) of all sample ETFs range between 2 and 110 basis points. Funds that track equity indices of the investment target markets *Emerging Markets* and *Asia/Pacific* have significantly higher average expense ratios than those that track the performance of the other three markets. This might be attributed to the lower liquidity of the securities in those markets, which makes the underlying benchmarks more difficult and/or expensive to replicate for ETF providers. Our data furthermore shows that the fees of the NYSE Arca-listed funds are, on average, slightly higher than the expenses of the XETRA ETFs. We do not find any significant differences in the fee structures of exotic products, however. Leveraged or inverse ETFs are, on average, only 3 basis points more expensive than their delta-1 counterparts. Table 3.2 reports further descriptive statistics of the exchange-traded funds included in our sample.

Table 3.2: Descriptive statistics of the sample ETF characteristics

The table reports the descriptive statistics of the 505 equity ETFs included in our sample as of 31 January 2014. *FundAge* shows the ETFs' daily NAV observations since their inception. *Size* is the net asset value per fund share as expressed in US dollar terms. *Volume* is the average daily trading volume of the ETFs since fund inception. *Volatility* is the ETFs' daily trading price volatility since fund inception. *TER* is the total expense ratio of the funds as reported by the exchanges. *Alpha* is the annualized cross-sectional alpha coefficient of the ETFs as computed in equation (4) using daily data. *DP* shows the ETFs' cross-sectional average premium/discount against their NAV since inception.

Variable	Unit	Mean	Median	SD	Min	Max
FundAge	days	1,373.2	1,215.0	931.6	69.0	3,985.0
Size	USD	66.5	39.0	85.1	1.0	992.4
Volume	000' units	122.6	10.7	835.7	0.1	16,214.7
Volatility	%	0.5	0.3	0.5	0.0	4.3
TER	bps	43	35	20	2	110
Alpha	no unit	0.001	-0.005	0.048	-0.260	0.033
DP	%	0.1	0.0	0.2	-0.4	1.3

3.3.2 Performance and tracking errors of exchange-traded funds

Tracking errors of exchange-traded funds are commonly defined as deviations between the performance of the ETF (as measured in terms of daily NAV changes) and its underlying benchmark index. As such, they are a statistical measure of a fund's index replication quality. Previous studies have measured tracking errors in a number of different ways[62]. To obtain a comprehensive picture of the funds in our sample, we compute five different tracking error metrics that are commonly employed in the academic literature on ETF performance. Firstly, following the linear approach as employed, amongst others, by Shin and Soydemir (2010), we estimate the average absolute tracking difference for each fund, which is simply the arithmetic mean of the absolute differences between the ETF's realized return and its benchmark index:

$$TE_{1,i} = \frac{\sum_{t=1}^{T} \left| \Delta NAV_{i,t} - \Delta IND_{i,t} \right|}{T} \tag{1}$$

where $\Delta NAV_{i,t}$ is the daily percentage change of ETF i's net asset value, $\Delta IND_{i,t}$ is the daily percentage change of the underlying benchmark index level and T is the number of daily observations since inception of fund i. Since this approach suffers from the fact that it is not possible to determine the effective out- or underperformance of the ETF relative to its benchmark index, we additionally compute the mean absolute downside deviation of the return differential, as suggested by Merz (2015):

$$TE_{2,i} = \frac{1}{T*} \sum_{t=1}^{T} \left(\left| \Delta NAV_{i,t} - \Delta IND_{i,t} \right| \left| ND_{i,t} < 0 \right. \right) \tag{2}$$

where $ND_{i,t}$ equals the value of $\Delta NAV_{i,t} - \Delta IND_{i,t}$ and $T*$ is the number of negative return differential observations. We furthermore apply the non-centric, quadratic approach as suggested by Vardharaj, Fabozzi, and Jones (2004) and estimate the standard deviation of the fund's active return, where the active return is defined as the difference between the ETF's realized return and its benchmark's realized return.

[62] see Clarke, Krase, and Statman (1994), Cresson, Cudd, and Lipscomb (2002), Frino and Gallagher (2001), Milonas and Rompotis (2006), Pope and Yadav (1994), Shin and Soydemir (2010), Palomba and Riccetti (2012) or Vardharaj, Fabozzi, and Jones (2004) for a discussion of the different methodologies.

$$TE_{3,i} = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}\left(ND_{i,t} - \overline{ND_i}\right)^2}$$

where $ND_{i,t}$ equals the value of $\Delta NAV_{i,t}$ - $\Delta IND_{i,t}$ and $\overline{ND_i}$ is the arithmetic mean of $ND_{i,t}$. As stated by Vardharaj et al. (2004), an exchange-traded fund that aims to passively replicate a benchmark index should theoretically have zero active returns, or, put differently, should have a tracking error of zero. In their empirical study, the authors find a positive relationship between tracking error and benchmark volatility. We also control for a volatility factor in the empirical analysis conducted in section 4.

To measure the performance of exchange-traded funds, Pope and Yadav (1994) and Cresson, Cudd, and Lipscomb (2002) employ a linear regression model. Pope and Yadav (1994) estimate tracking error as the standard error of the following regression equation:

$$\Delta NAV_{i,t} = \alpha_i + \beta_i \Delta IND_{i,t} + \varepsilon_{i,t} \tag{4}$$

where α_i denotes ETF i's excess return over its benchmark index, β_i denotes the systemic risk of the ETF and $\varepsilon_{i,t}$ denotes the error term of the regression. Shin and Soydemir (2010) describe that if ETFs perfectly replicate their benchmark indices, the standard deviation of the regression's residual should be zero. Moreover, if alpha is not significantly different from zero, the performance of the exchange-traded fund is not different from its benchmark index. Significant alphas in either direction would therefore support the existence of tracking errors. Insignificant alpha coefficients, on the other hand, would point to non-existence of tracking errors. In order to test our performance results for robustness, we therefore estimate the significance levels of the alpha coefficients of the regressions for each fund, as shown in equation (4) above. To control for data frequency selection biases, we estimate the alpha coefficients with both daily (α_d) and monthly (α_m) data frequency as well as the standard errors of the regressions, as denoted by the variable SE. To disentangle the factors that are related to those tracking error estimations, we employ multivariate factor models as shown in section 4.1.

3.3.3 *Premiums and discounts of exchange-traded funds*

In order to obtain a comprehensive view on the efficiency of the European and the U.S. ETF market, we furthermore compute the daily premiums/discounts of our sample exchange-traded funds against their net asset values. We define premiums/discounts with the following equation:

$$DP_{i,t} = \frac{P_{i,t} - NAV_{i,t}}{NAV_{i,t}} \tag{5}$$

where $DP_{i,t}$ denotes ETF i's discount or premium against its NAV on day t, $P_{i,t}$ denotes the closing market price of ETF i's share on day t and $NAV_{i,t}$ denotes ETF i's closing net asset value (per fund share) on day t. We say that if the value of $DP_{i,t}$ is positive, the ETF trades at a premium, and if it is negative, it trades at a discount. In theory, due to arbitrage considerations, premiums and discounts of ETF share prices to their fair market value should be zero, on average[63]. However, transaction costs might possibly limit arbitrage activities, so that small premiums or discounts might still persist over time. This has also been shown by Shin and Soydemir (2010) who find evidence in support of the hypothesis that high transaction costs (as measured in bid-ask spread terms) positively affect premiums or discounts of exchange-traded funds. For further empirical evidence on the limits of such arbitrage transactions, see Engle and Sarkar (2006) or Ackert and Tiang (2008). In order to capture both cross-sectional and time-series variations of the realised premiums or discounts of our sample ETFs, we employ fixed-effects panel regressions using cluster-robust standard errors. The regression results are shown in section 4.3.

[63] This is because of the open-end nature of ETFs. Investors can redeem fund shares at any time to the sponsor in exchange for the net asset value. Large NAV deviations would hence be eliminated by arbitrage transactions.

3.4 Empirical Results

3.4.1 Sources of ETF tracking errors

Tracking errors of equity ETFs can have various sources. Previous studies mention costs, dividends, taxation issues, trading volume, fund cash flows, securities lending policies, exchange rates, number of securities in the benchmark index, volatility of fund share prices, benchmark index replication methods or differences in market trading hours as the principal factors that affect tracking errors (e.g., see Elia, 2012; Frino and Gallagher, 2001; Johnson, 2009; Kostovetsky, 2003; Milonas and Rompotis, 2006; Naumenko and Chystiakova, 2015; or Shin and Soydemir, 2010 for empirical evidence). Therefore, in order to investigate the factors that might affect the tracking errors of the ETFs in our cross-section, we run multivariate regressions of the following form:

$$\begin{aligned} TE_i = {} & \beta_0 + \beta_1 LSize_i + \beta_2 LVolume_i + \beta_3 LVolatility_i + \beta_4 TER_i + \beta_5 EM_i \\ & + \beta_6 Exchange_i + \beta_7 Replication_i + \beta_8 SecLend_i + \beta_9 TaxDomicile_i \\ & + \beta_{10} Exotic_i + \beta_{11} CURHedged_i + \beta_{12} DailyReba_i + \varepsilon_i \end{aligned}$$

Since larger exchange-traded funds might realize economies of scale in asset management and administration expenses (which in turn might affect tracking performance), we control for fund size in our regression with the variable *LSize*, where *LSize* is defined as the natural logarithm of a fund's NAV per share (in USD) as of the end of 2014. We additionally control for an ETF's market liquidity as measured by the variable *LVolume*, where *LVolume* is defined as the natural log of the average daily trading volume since inception of the fund. Shin and Soydemir (2010) moreover find a positive relationship between the volatility of the funds' daily market prices and their tracking errors. We account for this volatility factor with the variable *LVolatility*[64]. Furthermore, since fund expenses are deducted directly from the NAV, we control for an ETF's total expense ratio with the variable *TER*, where *TER* is expressed in basis points of total assets as reported by the exchanges.

A further potential source of tracking friction might be the investment target market. Blitz and Huij (2012) show that exchange-traded funds with exposure to global emerging market equities exhibit substantially higher tracking errors than previously reported levels for

---

[64] We compute the volatility factor in the same manner as Shin and Soydemir (2010), where $Volatility = \frac{1}{n}\sum_{t=1}^{n}\frac{P_{t,high}-P_{t,low}}{P_{t,close}}$ and $P_{t,high}$ and $P_{t,low}$ are the highest and the lowest intraday fund share prices, respectively, and $P_{t,close}$ is the closing price of the ETF as reported by the exchange.

ETFs that track the performance of developed equity market indices. They explain this effect with the structurally larger cross-sectional dispersion in stock returns prevailing in such markets. To control for target market fixed-effects, we include the dummy variable *EM* into our regression equation, which assumes a value of 1 if the ETF is classified into either the Emerging Market or the Asia/Pacific segment (excluding Japan) and zero otherwise. Additionally, in order to control for listing-country fixed effects, we include the dummy variable *Exchange*, which takes on the value 1 if the ETF is traded on XETRA and zero if it is traded on NYSE Arca.

Empirical evidence on the impact of the replication method of the benchmark index on ETF tracking errors is mixed. Based on a sample of 48 equity ETFs, Elia (2012) finds that synthetic ETFs demonstrate significantly smaller tracking errors than their physical counterparts. Meinhardt et al. (2014) find no differences in tracking errors for either method for a larger sample. Naumenko and Chystiakova (2015), by contrast, show that synthetically replicated ETFs that are traded on the Swiss Stock Exchange have higher tracking errors than those that employ a full replication approach. In order to examine the effect of the index replication mechanism, we include the dummy variable *Replication* into the regression, which assumes 1 if the ETF is physically replicated (i.e., employs a full replication method) and zero for all other replication methods (e.g., such as derivatives-based methods or optimized sampling approaches).

Johnson (2013) describes that securities lending practices can reduce the negative impact of costs on tracking errors. We control for securities lending policies with the dummy variable *SecLend*, which assumes a value of 1 if the ETF engages in securities lending and zero otherwise[65]. Blitz, Huij, and Swinkels (2012) moreover find that the tax treatment of dividends by both the ETF and its benchmark index explain tracking friction. Many tax jurisdictions levy a withholding tax on dividends that are paid by domestic corporations to foreign investors. However, the default assumption of most gross total return indices is that dividends are reinvested fully (i.e., without any withholding tax deduction)[66]. Withholding tax rates vary considerably across countries. In our sample, the tax jurisdictions of Luxembourg and Ireland apply the lowest dividend withholding tax rates, amounting to 15% and 20% respectively. Performance differences between benchmark indices and ETFs that are domiciled in those countries might therefore be lower than those of funds that are domiciled in other countries which apply higher withholding tax rates. In order to control for taxation

[65] If no information about securities lending policy was available, the variable assumes the value zero.
[66] See Johnson (2013) or Blitz, Huij, and Swinkels (2012) for a detailed discussion on the taxation issues.

treatments, we include the dummy variable *TaxDomicile* which assumes 1 if the ETF is domiciled in either Ireland or Luxembourg and zero if it is domiciled in any other country. To test whether exotic products have different tracking errors than their delta-1 counterparts, we additionally include the dummy *Exotic* into the regression, which assumes 1 for leveraged and inverse ETFs and zero for all delta-1 products. To detect whether currency hedging is related to tracking friction, we include the dummy variable *CURHedged*, which becomes 1 if the ETF is currency hedged and zero if no currency hedging is applied. Lastly, since rebalancing frequency might also have an effect on tracking friction, we add the variable *DailyReba*, which is 1 if the ETF rebalances its portfolio on a daily basis and zero for all other rebalancing frequencies.

In order to account for the problem of multicollinearity, we compute the pairwise correlations amongst the regressors. The correlation matrix shows a moderate positive correlation between the intraday volatility of the fund prices and the average trading volume of the fund shares since inception. Furthermore, those exchange-traded funds in our sample that replicate their benchmark indices physically are more prone to engage in securities lending, as indicated by the positive correlation of the variables *Replication* and *SecLend*. We moreover find a moderate negative correlation between *SecLend* and *Exchange*, indicating that securities lending policies are more common with American ETFs that are traded on NYSE Arca. It should lastly be noted that ETFs that track the performance of stock indices in the Emerging Markets or Asia/ Pacific category exhibit a positive correlation to total expense ratios. The funds in our sample that invest in those equity markets demand higher fees from investors than those that invest in developed or global equity market segments. This has also been found by Blitz and Huij (2012) and Shin and Soydemir (2010). Since all correlation coefficients are below 0.6, our multivariate model does not suffer from a severe multicollinearity issue. Table 3.3 shows the regression results for all 505 sample ETFs. Table 3.4 shows the regression results of the analysis of the tracking errors, as defined with the market model shown in equation (4).

Table 3.3: Sources of tracking errors – All ETFs

The table shows the results of the multivariate regressions of the three tracking error measures TE_1, TE_2, and TE_3 for all sample ETFs. T-statistics are shown in parentheses. Coefficient estimates are reported in basis points. Adjusted R_2s are reported in the bottom line of the table. The regressions are based on 505 ETFs.

Dependent Variables	**TE_1**	**TE_2**	**TE_3**
Constant	-7.2	-5.1	-49.6*
	(-0.46)	*(-0.32)*	*(-1.68)*
LSize	0.3	0.1	3.9
	(0.22)	*(0.10)*	*(1.47)*
LVolume	1.9**	1.8**	4.8***
	(2.48)	*(2.28)*	*(3.23)*
LVolatility	4.5***	4.5***	6.8***
	(3.68)	*(3.65)*	*(2.92)*
TER	0.4***	0.4***	0.8***
	(5.61)	*(5.52)*	*(5.89)*
EM	5.4*	5.3*	6.4
	(1.67)	*(1.66)*	*(1.05)*
Exchange	22.6***	22.3***	43.9***
	(5.95)	*(5.87)*	*(6.10)*
Replication	4.8*	4.7*	9.7*
	(1.70)	*(1.67)*	*(1.82)*
SecLend	1.6	2.1	12.6**
	(0.51)	*(0.67)*	*(2.11)*
TaxDomicile	-10.8***	-11.0***	-20.3***
	(-3.97)	*(4.02)*	*(-3.93)*
Exotic	-12.0**	-13.3**	-9.4
	(2.30)	*(-2.56)*	*(-0.96)*
CURHedged	-7.0	-6.7	-8.5
	(-1.46)	*(-1.41)*	*(-0.95)*
DailyReba	10.4***	9.3***	30.0***
	(3.04)	*(2.70)*	*(4.62)*
Adj. R^2	*0.22*	*0.21*	*0.22*

*** 1% significance ** 5% significance * 10% significance

Table 3.4: Factors affecting ETF performance – All ETFs

The table shows the results of the multivariate regressions using the ETFs' annualized alphas and standard errors of the regressions as dependent variables. T-statistics are shown in parentheses. Adjusted R_2 are reported in the bottom line of the table. $\boldsymbol{\alpha_d}$ denotes the annualized alpha coefficient of the regression shown in equation (4) as computed with daily data. $\boldsymbol{\alpha_m}$ denotes the annualized alpha coefficient of the regression shown in equation (4) as computed with monthly data. *SE* denotes the standard error of the two regressions and is reported in basis points. The regressions are based on 505 ETFs.

Dependent Variables	α_d	SE_d	α_m	SE_m
Constant	0.016	47.8*	0.203	-25.4
	(0.57)	*(-1.76)*	*(-0.46)*	*(-0.91)*
LSize	-0.001	3.7	-0.150	-0.6
	(-0.45)	*(1.54)*	*(-0.38)*	*(-0.24)*
LVolume	0.000	4.9***	0.009	4.0***
	(0.19)	*(3.61)*	*(0.39)*	*(2.83)*
LVolatility	0.005***	5.9***	0.029	7.8***
	(2.23)	*(2.76)*	*(0.85)*	*(3.52)*
TER	0.000	0.8***	0.005** *	0.9***
	(0.36)	*(5.87)*	*(2.35)*	*(6.32)*
EM	-0.001	5.8	0.047	10.1*
	(-0.15)	*(1.04)*	*(0.51)*	*(1.75)*
Exchange	0.032***	35.4***	0.391***	46.0***
	(4.78)	*(5.38)*	*(3.67)*	*(6.77)*
Replication	-0.076	9.7**	-0.067	8.7*
	(-1.53)	*(2.00)*	*(-0.86)*	*(1.74)*
SecLend	-0.106*	9.6	0.045	10.1*
	(-1.89)	*(1.77)*	*(0.51)*	*(1.79)*
TaxDomicile	-0.002	-16.7***	-0.169***	-21.5***
	(-0.45)	*(-3.55)*	*(-2.21)*	*(-4.41)*
Exotic	-0.147	-7.3	-0.184	-22.4**
	(-1.58)	*(-0.82)*	*(-1.26)*	*(-2.41)*
CURHedged	-0.013	-7.4	-0.039	-15.9*
	(-1.55)	*(-0.90)*	*(-0.29)*	*(-1.87)*
DailyReba	-0.04	25.2***	-0.074	25.6***
	(-0.68)	*(4.24)*	*(-0.77)*	*(4.66)*
Adj. R^2	*0.09*	*0.21*	*0.03*	*0.27*

*** 1% significance ** 5% significance * 10% significance

The regression analysis shows that the product category and the tax domicile of an ETF are negatively related to tracking error. Funds in our sample that are domiciled in Luxembourg or Ireland exhibit, on average, significantly lower tracking friction than the funds that are domiciled in other tax jurisdictions. A possible reason for this effect might be the comparatively low withholding tax rates for dividend distributions to foreign investors that apply in those jurisdictions, as mentioned above. The results furthermore indicate that exotic products (i.e., ETFs with leveraged or inverse index replication structures) have lower tracking errors than their delta-1 peers. The exotic products in our cross-section have a significantly lower average absolute downside deviation. We estimate this effect to around 13 basis points for TE_2. For the standard deviation of the active returns (TE_3) we still find a negative coefficient estimate, yet no statistical significance. Table 3.5 provides an additional summary of the three tracking error measures by investment focus and product classification.

By contrast, costs, trading volume, daily rebalancing frequency, physical replication and the intraday volatility of the ETF prices are positively related to tracking friction for the funds in our sample. Consistent with the findings of Shin and Soydemir (2010), we find that an increase in the daily volatility by 1% increases the average absolute downside deviation and the standard deviation of the funds' active returns by approximately 5 and 7 basis points, respectively. Our data furthermore indicates that tracking errors of XETRA-listed ETFs are substantially larger than those of NYSE-listed funds. As shown in Table 3.3, all regression coefficients for the dummy variable *Exchange* are positive and statistically significant. European ETF providers hence seem to perform worse in terms of index replication quality. The analysis of the funds' excess returns and standard errors or the regressions also point to this. Lastly, we find evidence that daily portfolio rebalancing is positively related to all tracking error measures, except for the alpha measure. The reason for this effect might stem from transaction costs that occur at rebalancing (e.g., bid-ask spreads of stocks or timing gaps) which might reduce an ETF's index tracking quality.

Fund size, as measured in terms of NAV per share, has no measurable effect. We do neither find fully conclusive results for the index replication method. While all regression coefficients for TE_1, TE_2 and TE_3 are positive for the full replication dummy variable, we only find marginal statistical significance. Similarly, we do not find any consistent effects for securities lending or currency hedging policies. While our data does not conclusively show that Emerging Market ETFs suffer from lower replication quality, we find evidence that tracking errors are systematically higher for funds that focus on the Asia/Pacific region. The statistics in Table 3.5 additionally point to this. The findings of the analyses of the regression standard errors SE_d and SE_m, as a fourth statistical measure of tracking friction, are consistent with the results obtained for TE_1, TE_2 and TE_3.

We furthermore find that, based on the estimated alphas as shown in equation (4), the risk-adjusted returns of the sample ETFs are significantly inferior to their benchmark indices. 59% of sample funds exhibit a daily alpha coefficient below zero, while the remainder is mostly very close to zero. For the monthly alphas, the percentage of negative coefficients is slightly lower, amounting to approximately 50%. Only 13 of the 505 ETFs included in the sample exhibit an annualized daily alpha coefficient in excess of +0.1. For a graphical representation of the distribution of the daily and monthly alpha coefficients, see Appendix 3.A and 3.B. Hence, consistent with the findings of previous studies, the passive investment vehicles that are examined in our cross-section do not systematically outperform their benchmarks. It should thereby be noted, however, that only 18.6% of the daily alphas are significantly different from zero (at least at the 10% level). This implies that the explanatory power of the performance analysis based on excess returns is somewhat limited. The low adjusted R^2s additionally point to this.

3.4.2 Tracking errors: Delta-1 vs. exotic products

To test our results obtained in section 4.1 for robustness, we firstly exclude all exotic products from the sample. Table 3.6 and table 3.7 show the regression results of only the delta-1 ETFs (i.e., those equity ETFs that track their benchmark on a one-to-one basis). Since exchange-traded funds with inverse or leveraged index replication methods were found to have lower tracking errors as compared to their delta-1 peers, we exclude them from the analysis for comparative reasons.

Table 3.5: ETF tracking errors by investment target market and product classification

The table shows the descriptive statistics of the 3 different tracking error measures as computed in section 3.2. Country classifications are based on the classifications as specified by the exchanges. The product category "Exotic" includes all inverse and leveraged ETFs. Tracking errors are reported in basis points.

TE_1 (in bps)

Country Target	#ETFs	Mean	Median	SD	Min	Max
Europe	185	12.2	3.6	18.3	0.1	111.3
North America	85	20.3	3.7	26.2	0.5	96.6
Asia/Pacific	125	33.9	13.7	40.3	1.1	199.0
Emerging Markets	66	26.6	20.8	23.6	0.8	126.3
Global	44	20.9	8.1	24.0	0.3	89.0
All	505	21.6	6.9	28.8	0.1	199.0
Delta-1	472	21.8	7.3	28.9	0.1	199.0
Exotic	33	17.6	2.7	28.3	0.4	111.3

TE_2 (in bps)

Country Target	#ETFs	Mean	Median	SD	Min	Max
Europe	185	9.0	2.6	15.4	0.0	86.5
North America	85	19.5	2.6	26.5	0.0	97.9
Asia/Pacific	125	28.0	5.6	41.2	0.1	206.2
Emerging Markets	66	17.2	5.8	24.0	0.1	120.3
Global	44	12.8	3.0	20.8	0.1	86.1
All	505	16.9	3.6	28.1	0.0	206.2
Delta-1	472	17.0	3.6	28.3	0.0	206.2
Exotic	33	15.4	1.9	24.5	0.2	86.5

TE_3 (in bps)

Country Target	#ETFs	Mean	Median	SD	Min	Max
Europe	185	35.6	23.5	39.9	0.2	292.4
North America	85	38.4	21.7	40.3	3.7	182.5
Asia/Pacific	125	67.5	47.7	81.8	3.6	496.0
Emerging Markets	66	47.7	42.1	38.8	4.2	257.5
Global	44	40.5	30.8	35.1	0.5	147.5
All	505	46.0	30.0	54.5	0.2	496.0
Delta-1	472	45.8	30.6	53.6	0.2	496.0
Exotic	33	48.1	22.4	66.5	4.3	292.4

Table 3.6: Sources of tracking errors – Delta-1 ETFs

The table shows the results of the multivariate regressions of the three tracking error measures TE_1, TE_2, and TE_3 for all delta-1 ETFs in the sample. T-statistics are shown in parentheses. Coefficient estimates are reported in basis points. Adjusted R_2s are reported in the bottom line of the table. The regressions are based on 472 ETFs.

Dependent Variables	**TE_1**	**TE_2**	**TE_3**
Constant	4.9	5.8	-34.1
	(0.29)	*(0.34)*	*(-1.07)*
LSize	0.1	-0.0	3.4
	(0.04)	*(-0.02)*	*(1.24)*
LVolume	1.4*	1.3	3.9**
	(1.67)	*(1.56)*	*(2.51)*
LVolatility	5.5***	5.5***	7.7***
	(3.99)	*(3.92)*	*(2.99)*
TER	0.4***	0.4***	0.8***
	(5.32)	*(5.21)*	*(5.87)*
EM	5.1	5.1	6.0
	(1.59)	*(1.57)*	*(0.99)*
Exchange	24.5***	24.1***	46.6***
	(6.35)	*(6.18)*	*(6.49)*
Replication	4.7*	4.7*	9.1*
	(1.69)	*(1.67)*	*(1.76)*
SecLend	1.7	2.2	13.2**
	(0.55)	*(0.69)*	*(2.27)*
TaxDomicile	-12.5***	-12.6***	-23.3***
	(-4.44)	*(-4.42)*	*(-4.44)*
CURHedged	-7.2	-6.8	-9.3
	(-1.52)	*(-1.43)*	*(-1.06)*
DailyREBA	10.6***	9.8***	28.5***
	(2.87)	*(2.63)*	*(4.17)*
Adj. R^2	*0.24*	*0.23*	*0.23*

*** 1% significance ** 5% significance * 10% significance

Table 3.7: Factors affecting ETF performance – Delta-1 ETFs

The table shows the results of the multivariate regressions using the ETFs' annualized alphas and standard errors of the regressions as dependent variables. T-statistics are shown in parentheses. Adjusted R_2 are reported in the bottom line of the table. $\boldsymbol{\alpha_d}$ denotes the annualized alpha coefficient of the regression shown in equation (4) as computed with daily data. $\boldsymbol{\alpha_m}$ denotes the annualized alpha coefficient of the regression shown in equation (4) as computed with monthly data. *SE* denotes the standard error of the two regressions and is reported in basis points. The regressions are based on the 472 delta-1 ETFs.

Dependent Variables	α_d	SE_d	α_m	SE_m
Constant	0.310	-35.6	-0.169	-5.4
	(0.98)	*(-1.22)*	*(-0.34)*	*(-0.18)*
LSize	-0.001	3.4	-0.018	-1.5
	(-0.37)	*(1.36)*	*(-0.41)*	*(-0.59)*
LVolume	-0.000	4.2***	0.008	3.0**
	(-0.22)	*(2.94)*	*(0.34)*	*(2.06)*
LVolatility	0.006***	6.6***	0.035	9.2***
	(2.53)	*(2.80)*	*(0.85)*	*(3.75)*
TER	0.000	0.8***	0.005**	0.9***
	(0.15)	*(5.84)*	*(2.33)*	*(6.28)*
EM	-0.001	5.4	0.041	9.3
	(-0.18)	*(0.98)*	*(0.43)*	*(1.62)*
Exchange	0.035***	37.8***	0.407***	48.9***
	(5.00)	*(5.72)*	*(3.61)*	*(7.16)*
Replication	-0.008	9.2*	-0.072	8.3*
	(-1.54)	*(1.93)*	*(-0.89)*	*(1.68)*
SecLend	-0.011*	10.1*	0.045	10.6*
	(-1.89)	*(1.89)*	*(0.49)*	*(1.92)*
TaxDomicile	-0.005	-19.4***	-0.178**	-23.5***
	(-0.95)	*(-4.03)*	*(-2.15)*	*(-4.72)*
CURHedged	-0.013	-8.0	-0.039	-16.6**
	(-1.51)	*(0.99)*	*(-0.28)*	*(-1.98)*
DailyREBA	-0.005	23.9***	-0.088	28.2***
	(-0.78)	*(3.79)*	*(-0.82)*	*(4.33)*
Adj. R^2	*0.09*	*0.22*	*0.03*	*0.29*

*** 1% significance ** 5% significance * 10% significance

The analysis of the delta-1 ETFs yields results that are consistent with those obtained in section 4.1. It should be noted that the model fit statistics of the delta-1 regressions are slightly higher than those obtained for the full sample. This might be an indication of outliers in the exotic ETF sub-set. Since our data indicates that XETRA-listed ETFs perform worse in terms of tracking quality than their NYSE peers, we match the XETRA and NYSE sub-samples in a next step. To do this, we firstly remove all exotic products in the XETRA sub-set. Secondly, we exclude all ETFs that employ derivative-based replication methods, since those are not common for U.S. products. Our matched sample hence includes 317 delta-1 ETFs that are either fully replicated or employ optimized sampling approaches. Table 3.8 shows the regression results of the matched sample.

In the robustness tests, we identify the same factors as for the entire sample: volatility of daily fund share prices, costs and exchange specification are related to tracking friction. For the analysis of the matched sample, however, the significance of the coefficients for trading volume and daily rebalancing frequency vanishes. Cash drags stemming from daily rebalancing hence seem to come primarily from transaction costs of the derivative-based replication strategies. In order to obtain a comprehensive picture of the ETF performance, section 4.3 furthermore analyzes the factors that are related to the premiums/discounts of an ETF's fund share to its net asset value.

Table 3.8: Sources of tracking errors – Matched sample

The table shows the results of the multivariate regressions of the three tracking error measures TE_1, TE_2, and TE_3 for the matched sample. T-statistics are shown in parentheses. Coefficient estimates are reported in basis points. Adjusted R_2s are reported in the bottom line of the table. The regressions are based on 317 ETFs.

Dependent Variables	**TE_1**	**TE_2**	**TE_3**
Constant	37.2	38.7	1.7
	(1.45)	*(1.50)*	*(0.03)*
LSize	0.2	-0.0	6.2
	(0.08)	*(-0.03)*	*(1.49)*
LVolume	-0.4	-0.5	1.0
	(-0.38)	*(-0.45)*	*(0.48)*
LVolatility	9.5***	9.4***	14.2***
	(3.97)	*(3.89)*	*(3.10)*
TER	0.4***	0.4***	1.0***
	(4.20)	*(4.08)*	*(4.98)*
EM	4.3	4.1	7.0
	(1.03)	*(0.98)*	*(0.88)*
Exchange	22.1***	21.6***	42.9***
	(4.78)	*(4.61)*	*(4.81)*
Replication	6.9*	6.9*	13.5*
	(1.77)	*(1.76)*	*(1.80)*
SecLend	3.2	3.7	17.5**
	(0.86)	*(0.99)*	*(2.45)*
CURHedged	-2.0	-1.9	-1.8
	(-0.32)	*(-0.32)*	*(-0.15)*
DailyREBA	2.6	0.3	7.2
	(0.21)	*(0.02)*	*(0.30)*
Adj. R^2	*0.16*	*0.15*	*0.16*

*** 1% significance   ** 5% significance   * 10% significance

3.4.3 Sources of NAV premiums and discounts

In this section, we analyze the sample ETFs' premiums/discounts to their net asset values. Previous studies have shown that the premiums or discounts of exchange-traded funds are related to fund size, exchange rates, transaction costs, trading volume, momentum, differences in market trading hours or investment target markets (e.g., see Bergström and Tang, 2001; Delcoure and Zhong, 2007; Engle and Sarkar, 2006; Shin and Soydemir, 2010 for some empirical evidence). To proxy transaction costs, we follow the approach as employed by Shin and Soydemir (2010) and Delcoure and Zhong (2007) who use bid-ask spreads of ETF shares as a quantitative measure of such costs. In theory, higher transaction costs should impede arbitrage activities in connection with the ETF creation/redemption process. The distortion of such transactions might potentially induce higher premiums or discounts. Since transaction costs are partly a function of market liquidity, we additionally control for an ETF's daily trading volume, as reported by Bloomberg. More active trading should, in theory, reduce the difference between a fund's price and its fundamental value. We furthermore control for the size of the fund. Ackert and Tiang (2008) moreover find that mispricing of fund shares is related to past momentum. We therefore also include a momentum variable that controls for past changes in the ETFs' net asset values. Lastly, to test whether the intraday volatility of an ETF's share is related to premiums or discounts, we include the volatility variable as defined in section 4.1. To comprehensively investigate the factors that are associated with daily NAV premiums/discounts, we postulate the following regression equation:

$$DP_{i,t} = \beta_0 + \beta_1 LSize_{i,t} + \beta_2 LVolume_{i,t} + \beta_3 Spread_{i,t} + \beta_4 Momentum_{i,t} \\ + \beta_5 Volatility_{i,t} + \varepsilon_{i,t}$$

where $DP_{i,t}$ is ETF i's premium or discount to its net asset value on day t, $LSize_{i,t}$ is the fund's NAV per share as reported in US dollar terms, $LVolume_{i,t}$ is the natural logarithm the ETF's daily trading volume, $Spread_{i,t}$ is the ETF's bid-ask spread as reported in US dollar terms, $Momentum_{i,t}$ is its NAV change from day t-1 to t, and $Volatility_{i,t}$ is the intraday volatility of an ETF's share price on day t, as defined above. In a first step, we analyze the sample ETFs' premiums and discounts by splitting the total sample into 1) target market categories and 2) exchange categories. Exhibit 3.1 and Exhibit 3.2 graphically show the average absolute discounts/premiums in those categories over time. Table 3.10 finally reports the results of the panel regressions for the entire sample and selected sub-samples.

Exhibit 3.1: Average absolute NAV premiums/discounts by investment target market

The graph below shows the sample ETFs' average absolute premiums/discounts over time by investment target market classification. The left scale reports the average absolute premiums/discounts in basis points.

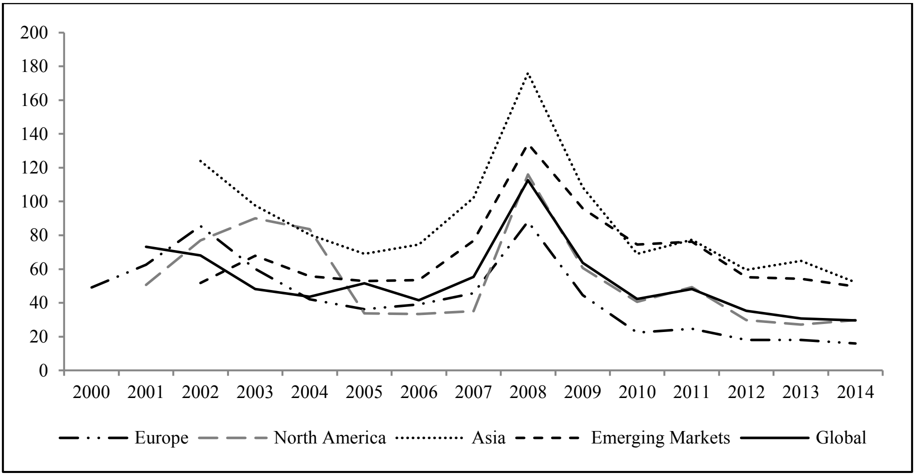
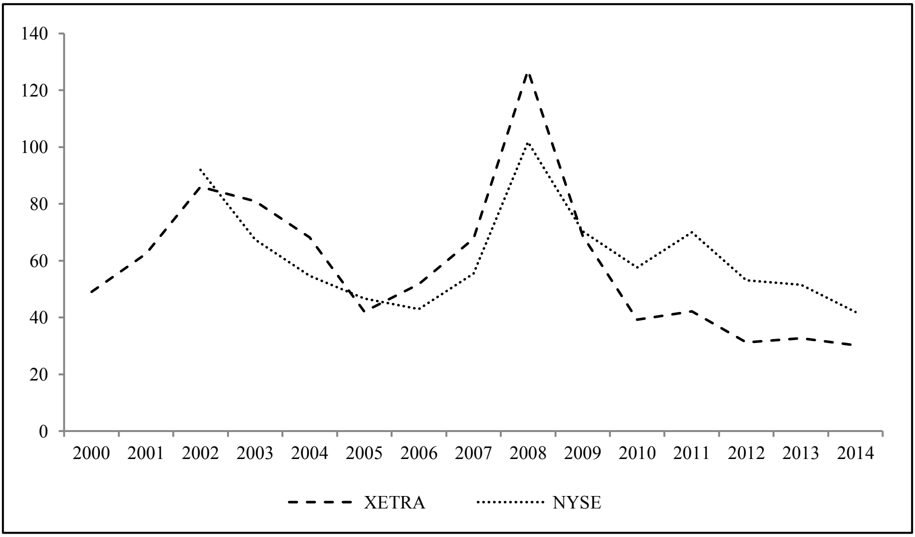


Exhibit 3.2: Average absolute NAV premiums/discounts by exchange

The graph below shows the sample ETFs' average absolute premiums/discounts over time by exchange classification. The left scale reports the average absolute premiums/discounts in basis points.



Our time-series analysis shows that the deviations between the sample ETFs' share prices and their NAVs were particularly large during the global financial crisis of 2007/08. The cross-sectional average absolute premium/discount for all 505 sample funds increased by around 57 basis points in 2008 (121 bps) as compared to 2007 (64 bps). As shown in Exhibit 3.1, particularly funds that track benchmark indices with an investment focus on the Asia/Pacific region or the Emerging Markets classification exhibit systematically higher average absolute premiums/discounts than those funds that replicate rather developed equity market indices. While this finding holds for most years since 2000, it was particularly visible during the financial crisis. We furthermore find that during January 2007 and December 2008, the sample ETFs more frequently traded at a discount to their NAV. The percentage of daily discount observations (i.e., those observations where $DP_{i,t} < 0$) to total observations was significantly higher for those two years as compared to the previous years. It reached 45.9% in 2008 for the entire sample. Those discounts were particularly substantial for the investment target markets Asia/Pacific, North America and Emerging Markets. For those target markets, we also record the highest discount observation ratio in both the crisis and the post-crisis period. We explain this with the lower liquidity of both the ETF shares and the underlying securities in those markets during that time that might have fuelled those deviations. Our data furthermore indicates that, in the post-crisis period, the sample ETFs more frequently traded at discounts, as compared to the pre-crisis period. In general, however, our sample ETFs have historically traded more frequently at small premiums. Table 3.9 summarizes the ratios of discount observations to premium observations for each year in the period under review. For XETRA-listed ETFs, we observe significantly higher average premiums and discounts during the crisis-period as compared to their NYSE peers. This pattern reverses, however, in the post-crisis period. Since 2009, average discounts range between 38 and 28 bps.

Table 3.9: Ratios of discount observations to premium observations

The table shows the ratios of the number of observations of realized discounts to realized premiums for each year in the examination period for both all sample ETFs and different investment target markets.

Year	*All ETFs*	*Europe*	*North America*	*Asia/Pacific*	*Emerging Markets*	*Global*
2014	0.73	0.54	0.98	0.91	0.86	0.59
2013	0.67	0.52	0.95	0.79	0.77	0.45
2012	0.80	0.73	1.05	0.80	0.81	0.63
2011	0.84	0.78	0.95	0.96	0.82	0.64
2010	0.77	0.73	1.06	0.82	0.53	0.64
2009	0.75	0.82	0.98	0.71	0.54	0.57
2008	0.85	0.89	0.89	0.95	0.70	0.57
2007	0.71	0.77	0.92	0.67	0.57	0.42
2006	0.64	0.62	0.82	0.61	0.67	0.45
2005	0.61	0.62	0.74	0.56	0.49	0.58
2004	0.61	0.63	0.80	0.54	0.50	0.36
2003	0.69	0.84	0.91	0.32	0.67	0.46
2002	0.89	0.91	0.80	1.22	1.50	0.86
2001	0.61	0.60	0.91	*N/A*	*N/A*	0.55
2000	0.62	0.62	*N/A*	*N/A*	*N/A*	*N/A*

Table 3.10: Sources of NAV premiums/discounts

The table shows the results of the panel regressions of the factors that influence the sample ETFs' daily premiums/discounts. T-statistics are shown in parentheses. The number of ETFs in each sub-set is shown in the bottom line of the table.

Dependent Variable = $DP_{i,t}$	***All ETFs***	***Delta-1 ETFs***	***XETRA ETFs***	***NYSE ETFs***
Constant	0.0046***	0.0063***	0.0052***	0.0029
	(3.80)	*(4.59)*	*(3.26)*	*(1.51)*
LSize	-0.0009***	-0.0137***	-0.0011***	-0.0000
	(-2.82)	*(-3.63)*	*(-2.69)*	*(-0.12)*
LVolume	0.0002***	0.0002***	0.0003***	-0.0004***
	(4.24)	*(3.70)*	*(7.73)*	*(-2.69)*
Spread	0.0003***	0.0003***	0.0014***	0.0001
	(4.01)	*(3.69)*	*(6.11)*	*(0.87)*
Momentum	-0.0932***	-0.0882***	-0.1474***	0.0457***
	(-9.46)	*(-8.21)*	*(-14.44)*	*(4.69)*
Volatility	-0.2081***	-0.2167***	-0.3334***	-0.0335***
	(-10.97)	*(-10.17)*	*(-15.41)*	*(-3.18)*
ETF Obs #	*505*	*472*	*377*	*128*

*** 1% significance ** 5% significance * 10% significance

In line with the findings of Shin and Soydemir (2010), we find that transaction costs, as measured in terms of bid-ask spreads of fund shares are positively related to the ETFs' premiums or discounts. Those transaction costs might hinder arbitrage activities in the creation/redemption process which, in turn, might increase the deviations between the fund prices and the NAV per share. The coefficient estimate reported in Table 3.10 is strongly significant and largest for XETRA-listed ETFs, implying that transaction costs have a particularly high effect on European ETFs. For NYSE-listed funds, we still find a positive estimate, yet no statistical significance. This might be attributable to the greater market liquidity prevailing in the U.S. ETF market and the associated lower spreads.

We furthermore find that trading volume is positively related to premiums and discounts, except for NYSE-listed ETFs. This is somewhat counterintuitive, as it would imply that more active trading of fund shares would increase the deviation between an ETF's price and its net asset value. The findings are not consistent for the NYSE-listed funds, where we observe a negative relationship, as theoretical considerations would generally suggest. We explain this puzzle by drawing on the findings of the study of Ackert and Tiang (2008), who observe an inverted U-shaped relationship between fund premiums and market liquidity. The authors find empirical evidence that more active trading reduces mispricing patterns, yet only after a certain level of liquidity is reached. The analysis of our trading volume data shows that the average trading volume of NYSE-listed ETFs is significantly higher than the average trading volume of funds that are listed on XETRA. The U.S. ETF market is therefore much more liquid than the market in Europe. Hence, more active trading at lower levels of market liquidity (prevailing at XETRA) might lead to an increase in premiums/discounts of the funds in our sample, whereas at higher levels of market liquidity (prevailing at NYSE), it reduces the premiums/discounts. Ackert and Tiang (2008) explain this non-linear relationship with the potential impact of noise trading which vanishes in markets with high trading turnover. Our study results therefore largely support the authors' theory.

A high degree of intraday volatility, by contrast, reduces the sample ETFs' premiums/discounts significantly. Table 3.10 shows that all parameter estimates are negative and statistically significant at the 1% level. For NYSE-traded ETFs, the magnitude of the effect is much lower, yet still measurable. We explain this with the nature of the creation/redemption process of ETFs. A high level of intraday volatility might attract arbitrageurs who take advantage of the price fluctuations, driving fund prices towards their fundamental value.

We furthermore find evidence that the 1-day momentum and the size of a XETRA ETFs are negatively related to the premiums/discounts. Since larger sample funds might benefit from economies of scale in terms of transaction costs, the price deviation from their net asset value should be observable to a lesser extent. The findings also support the empirical results of Ackert and Tiang (2008) and Shin and Soydemir (2010), who also find a positive relationship between past momentum and premiums. One underlying reason might be the differences in market trading hours of the ETF shares and the benchmark constituents. The resulting stale pricing is likely to contribute to substantial NAV deviations, as our study results indicate.

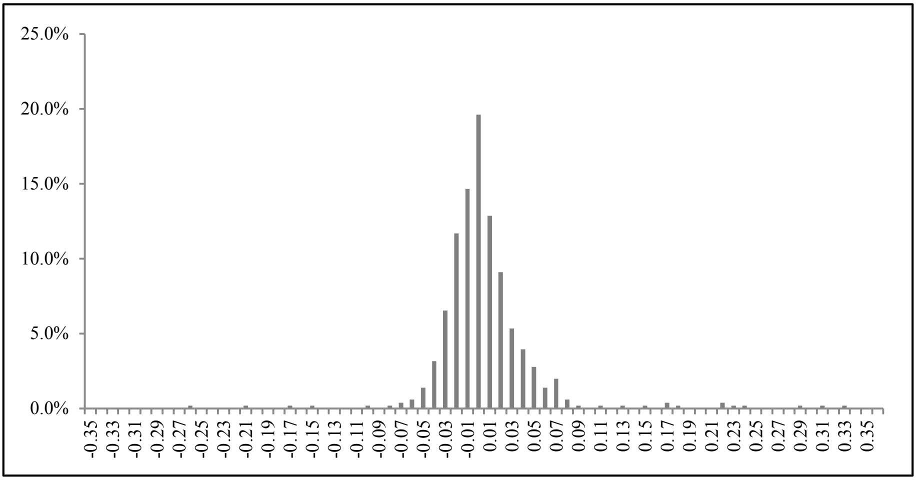
3.5 Conclusion

In this paper, we provide new empirical evidence on the replication quality and pricing efficiency of exchange-traded funds that are listed on XETRA and NYSE Arca. Analyzing the tracking errors of a large cross-section consisting of 505 equity ETFs, we identify several factors that are related to tracking friction: Total expense ratios, trading volume, intraday volatility of fund shares, investment target market and daily rebalancing frequency of ETF portfolios are positively related to tracking friction, whereas the product classification "exotic" and the fund domicile are negatively related to tracking friction. Tracking errors of ETFs that replicate equity indices of target markets with rather illiquid securities (e.g., such as in the Asia/Pacific region or in Emerging Markets) are found to be significantly higher than those that replicate the development of benchmark indices of rather developed equity markets. Our findings thus support the previous study results of Blitz and Huij (2012) and Shin and Soydemir (2010). We furthermore find that European ETF providers perform significantly worse in terms of index replication quality than their U.S. peers. The empirical results obtained in this paper indicate that ETFs that are listed on the XETRA platform of the Frankfurt Stock Exchange exhibit substantially larger return deviations from their underlying benchmarks than their U.S. counterparts.

Our analysis of the market efficiency furthermore shows that the ETFs' premiums/discounts to their net asset values have peaked during the global financial crisis and have remained at elevated levels thereafter. In the period 2010 – 2014, absolute average premiums/discounts lie in the range between 20 and 75 basis points. This is economically significant and has important implications for both private and institutional investors who aim to allocate a proportion of their investable funds to ETFs with a geographic investment focus. The realized deviations are largest for the target markets Asia/Pacific and Emerging Markets. We therefore support the empirical findings of Petajisto (2013), who also found substantial NAV premiums/discounts during the financial crisis for funds that hold international or illiquid equity securities whose "[…] NAVs are most difficult to determine in real time." While we investigate the factors that are associated with the pricing efficiency and tracking friction, it should be noted that we do not examine the underlying causal relationships. Explicitly, our study does not give any indication of the direction of causality; neither for the factors that are related to tracking errors nor for the factors that are associated with NAV discounts or premiums.

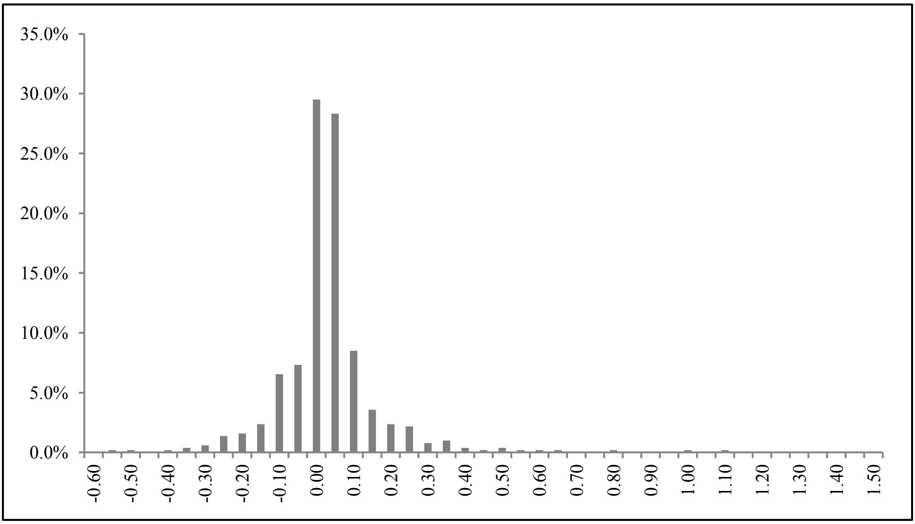
Appendix 3.A: Statistical distribution of alpha coefficients (all ETFs)

The figure shows the histogram of the annualized alpha coefficients as computed in equation (4) for all 505 ETFs in the sample. The alphas are computed with daily data frequency.



Appendix 3.B: Statistical distribution of alpha coefficients (all ETFs)

The figure shows the histogram of the annualized alpha coefficients as computed in equation (4) for all 505 ETFs in the sample. The alphas are computed with monthly data frequency.



List of References

Ackert, L. F., & Tiang, Y. S. (2008). Arbitrage, liquidity, and the valuation of exchange traded funds. *Financial Markets, Institutions & Instruments, 17(5),* 331-362

Admati, A., DeMarzo, P., Hellwig, M., and Pfleiderer, P. (2011). Fallacies, irrelevant facts and myths in the discussion of capital regulation: Why bank equity is not expensive. *University of Stanford Working Paper*

Admati, A., DeMarzo, P., Hellwig, M., and Pfleiderer, P. (2012). Debt overhang and capital regulation. *Working Paper*

Albrecht, W., Shamshub, H., & Giannatasio, N. A. (2007). Public pension fund governance practices and financial performance. *Journal of Public Budgeting, Accounting & Financial Management, 19(2),* 245-267

Ambachtsheer, K. P., Capelle, R., & Lum, H. (2008). The pension governance deficit: Still with us. *Rotman International Journal of Pension Management, 1(1),* 14-21

Ambachtsheer, K. P., Capelle, R., & Scheibelhut, T. (1998). Improving pension fund performance. *Financial Analysts Journal, 54(6),* 15-21

Ambachtsheer, K. P., & Ezra, D. D. (1998). *Pension fund excellence: Creating value for shareholders.* New York: John Wiley & Sons.

Ammann, M., Fehr, R., & Seiz, M. (2006). New evidence on the announcement effect of convertible and exchangeable securities. *Journal of Multinational Financial Management, 16(1),* 43-63

Ammann, M., & Zingg, A. (2010). Performance and governance of Swiss pension funds. *Journal of Pension Economics and Finance, 9(1),* 95-128

Ammann, M., Oesch, D., & Schmid, M. (2011). Corporate governance and firm valuation: International evidence. *Journal of Empirical Finance, 18(2011),* 36-55

Ammann, M., Oesch, D., & Schmid, M. (2013). Product market competition, corporate governance, and firm value: Evidence from the EU-Area. *European Financial Management, 19(3),* 209-250

Andonov, A., Bauer, R., & Cremers, M. (2011) Can large pension funds beat the market? Asset allocation, market timing, security selection and the limits of liquidity. *Maastricht and Yale University Working Paper*

Asquith, P., & Mullins, D. W. (1986). Equity issues and offering dilution. *Journal of Financial Economics, 15(1986),* 61-89

Avdjiev, S., Kartasheva, A., & Bogdanova, B. (2013). CoCos: A primer. *Bank for International Settlements Quarterly Review (September 2013),* 43-56

Barclay, M. J., & Litzenberger, R. H. (1988). Announcement effects of new equity issues and the use of intraday price data. *Journal of Financial Economics, 21(1),* 71-99

Bebchuk, L., & Cohen, A. (2005). The costs of entrenched boards. *Journal of Financial Economics, 78(2),* 409-433

Bebchuk, L., Cohen, A., & Ferrell, A. (2008). What matters in corporate governance? *Review of Financial Studies, 22(2),* 783-827

Berg, T., & Kaserer, C. (2015). Does contingent capital induce excessive risk-taking? *Journal of Financial Intermediation, 24(3),* 356-385

Bergström, C., & Tang, E. (2001). Price differentials between different classes of stocks: An empirical study on Chinese stock markets. *Journal of Multinational Financial Management, 11(4-5),* 407-426.

Bhagat, S., & Bolton, B. (2008). Corporate governance and firm performance. *Journal of Corporate Finance, 14(2008),* 257-273

Billingsley, R. S., & Smith, D. M. (1996). Why do firms issue convertible debt? *Financial Management, 25(2),* 93-99

Blackrock (2015a). *ETP Landscape – Industry Highlights June 2015*

Blackrock (2015b). *ETP Landscape – Industry Highlights May 2015*

Blake, D., Lehmann, B. N., & Timmermann, A. (1999). Asset allocation dynamics and pension fund performance. *Journal of Business, 72(4),* 429-461

Blake, D., Timmermann, A., Rossi, A. G., Tonks, I., & Wermers, R. (2013). Decentralized investment management: Evidence from the pension fund industry. *Journal of Finance, 68(3),* 1133-1178

Blitz, D., & Huij, J. (2012). Evaluating the performance of global emerging market equity exchange-traded funds. *Emerging Markets Review, 13(2),* 149-158

Blitz, D., Huij, J., & Swinkels, L. (2012). The performance of European index funds and exchange-traded funds. *European Financial Management, 18(4),* 649-662

Brandenburger, B., & Hilb, M. (2008). *Pensionskassen-Governance*. Zürich: NZZ Verlag

Brown, L. D., & Caylor, M. L. (2006). Corporate governance and firm valuation. *Journal of Accounting and Public Policy, 25(2006),* 409-434

Brown, S. J., & Warner, J. B. (1985). Using daily stock returns: The case of event studies. *Journal of Financial Economics, 14(1985),* 3-31

Burlacu, R. (2000). New evidence on the pecking order hypothesis: The case of French convertible bonds. *Journal of Multinational Financial Management, 10(3-4),* 439-459

Calomiris, C. W., & Herring, R. J. (2011). Why and how to design an contingent convertible debt requirement that helps solve our too-big-to-fail problem. *Journal of Applied Corporate Finance, 25(2),* 39-62

Campbell, J. Y., Lo, A. W., & MacKinlay, A. C. (1997). *The econometrics of financial markets.* Princeton: Princeton University Press

Charupat, N., & Miu, P. (2011). The pricing and performance of leveraged exchange-traded funds. *Journal of Banking and Finance, 35(4),* 966-977

Chen, N., Glasserman, P., Nouri, B., & Pelger, M. (2013). Contingent capital, tail risk, and debt-induced collapse. *Columbia Business School Research Paper No. 13-90*

Cheng, M., & Madhavan, A. (2009). The dynamics of leveraged and inverse exchange-traded funds. *Journal of Investment Management, 7(4),* 43-62

Chu, P. K. K. (2011). Study on the tracking errors and their determinants: Evidence from Hong Kong exchange-traded funds. *Applied Financial Economics, 21(5),* 309-315

Clapman, P. (2007). Committee on fund governance – Best practice principles. *Discussion Paper at the Stanford Institutional Investors' Forum*

Clark, G. L. (2004). Pension fund governance: Expertise and organisational form. *Journal of Pension Economics and Finance, 3(2),* 233-253

Clark, G. L. (2007). Expertise and representation in financial institutions: UK legislation on pension fund governance and US regulation of the mutual fund industry. *21st Century Society: Journal of the Academy of Social Sciences, 2(1),* 1-24

Clark, G. L., Caerlewy-Smith, E., & Marshall, J. C. (2006). Pension fund trustee competence: Decision-making in problems relevant to investment practice. *Journal of Pension Economics and Finance, 5(1),* 91-110

Clark, G. L., & Urwin, R. (2008). Best-practice pension fund governance. *Journal of Asset Management, 9(1),* 2-21

Clark, G. L., & Urwin, R. (2010). Innovative models of pension fund governance in the context of the global financial crisis. *Pensions, 15(1),* 62-77

Clarke, R.G, Krase, S., & Statman, M. (1994). Tracking errors, regret, and tactical asset allocation. *Journal of Portfolio Management, 20(3)*, 16-24.

Coffee, J. C. (2010). Bail-ins versus bail-outs: Using contingent capital to mitigate systemic risk. *Columbia Law and Economics Working Paper No. 380*

Cooper, I. A., & Nyborg, K. G. (2008). The value of tax shields is equal to the present value of tax shields. *Journal of Financial Economics, 81(1),* 215-225

Core, E. J., Holthausen, R. W., & Larcker, D. F. (1999). Corporate governance, chief executive officer compensation, and firm performance. *Journal of Pension Economics and Finance, 51 (1999),* 371-406

Cresson, J., Cudd, R., & Lipscomb, T. (2002). The early attraction of S&P index funds: Is perfect tracking performance an illusion? *Managerial Finance, 28,* 1-8

Curcio, R. J., Anderson, R. I., & Guirguis, H. (2012). Should tracking error prevent the use of leveraged ETFs in the real estate portfolio? *Journal of Index Investing, 3(3),* 75-95

Dann, L., & Mikkelson, W. (1984). Convertible debt issuance, capital structure change and financing-related information: Some new evidence. *Journal of Financial Economics, 13(1984),* 157-186

DeAngelo, H., & Stulz, R. (2013). Why high leverage is optimal for banks. *NBER Working Paper No. 19139*

De Roon, F. & Veld, C. (1998). Announcement effects of convertible bond loans and warrant-bond loans: An empirical analysis for the Dutch market. *Journal of Banking & Finance, 22(12),* 1481-1506

De Spiegeleer, J., Schoutens, W., & Van Hulle, C. (2014). *The handbook of hybrid securities: Convertible bonds, CoCo bonds, and bail-in.* New York: Wiley

Delcoure, N., & Zhong, M. (2007). On the premiums of iShares. *Journal of Empirical Finance, 14(2),* 168-195

Deutsche Börse (2015). *Exchange-traded funds (ETFs).* http://www.boerse-frankfurt.de/de/etfs/etfs+indexfonds

Dobra, M., & Lubich, B. H. (2013). Public pension governance and asset allocation. *JCC: The Business and Economics Research Journal, 6(1),* 83-101

Duca, E., Dutordoir, M., Veld, C., & Verwijmeren, P. (2012). Why are convertible bond announcements associated with increasingly negative abnormal stock returns? An arbitrage-based explanation. *Journal of Banking & Finance 36(11)*, 2884-2899

Elia, M. (2012). Tracking error of traditional and synthetic European exchange-traded funds. *University of Turin Working Paper*

Engle, R. F., & Sarkar, D. (2006). Premiums-discounts and exchange traded funds. *Journal of Derivatives, 13(4),* 27-45

ESMA (2012). Guidelines for competent authorities and UCITS management companies – Guidelines on ETFs and other UCITS issues. *ESMA Publication ESMA/2012/832EN*

Fields, L. P., & Mais, E. L. (1991). The valuation effects of private placements of convertible debt. *Journal of Finance, 46(5),* 1925 - 1932

Financial Times (2014, May 22). European banks' equity raising hits record high. *Financial Times Online*

Flannery, M. (2005). No pain, no gain: Effecting market discipline via reverse convertible debentures. In Scott, Hal S. (Editor). *Capital Adequacy beyond Basel: Banking, Securities and Insurance.* Oxford: Oxford University Press

Flannery, M. (2015). Stabilizing large financial institutions with contingent capital certificates. *Quarterly Journal of Finance (November 2015) Online Version*

Frino, A., & Gallagher, D. (2001). Tracking S&P 500 index funds. *Journal of Portfolio Management, 28(1),* 44-55

Gompers, P., Ishii, J., & Metrick, A. (2003). Corporate governance and equity prices. *The Quarterly Journal of Economics, 118(1),* 107-155

Goyal, A., & Wahal, S. (2008). The selection and termination of investment management firms by plan sponsors. *Journal of Finance, 63(4),* 1805-1847

Graham, J. R. (2000). How big are the tax benefits of debt? *Journal of Finance, 55(5),* 1901-1941

Guedj, I., Li. G., & McCann, C. (2010). Leveraged and inverse ETFs, holding periods, and investment shortfalls. *Journal of Index Investing, 1(3),* 45-57

Harper, J. T. (2008). Public sector pension governance in the United States: Up to the task? *Rotman International Journal of Pension Management, 1(1),* 22-28

Hess, D. (2005). Protecting and politicizing public pension fund assets: Empirical evidence on the effects of governance structures and practices. *University of California, Davis Law Review, 39,* 187-227

Hilscher, J., & Raviv, A. (2014). Bank stability and market discipline: The effect of contingent capital on risk taking and default probability. *Journal of Corporate Finance, 29,* 542-560

Hull, J., Predescu, M., & White, A. (2004). The relationship between credit default swap spreads, bond yields, and credit rating announcements. *Journal of Banking and Finance, 28(11),* 2789-2811

Hurlin, C., Iseli, G., Pérignon, C., & Yeung, S. (2015). The counterparty risk exposure of ETF Investors. *HEC Paris Research Paper No. FIN-2014-1050*

Impavido, G. (2002). On the governance of public pension fund management. *World Bank Policy Research Working Paper Series 2878*

Impavido, G., & Tower, I. (2009). How the financial crisis affects pensions and insurance and why the impacts matter. *IMF Working Paper WP/09/151*

IOSCO (2013). *Principles for the regulation of exchange traded funds.*

Jackowicz, K., & Kowalewski, O. (2012). Crisis, internal governance mechanisms and pension fund performance: Evidence from Poland. *Emerging Markets Review, 13(1),* 493-515

Jarrow, R. A. (2010). Understanding the risk of leveraged ETFs. *Finance Research Letters, 7(3),* 135-139

Jensen, M. C. (1993). The modern industrial revolution, exit, and the failure of internal control systems. *Journal of Finance, 48(3),* 831-880

Johnson, W. F. (2009). Tracking errors of exchange-traded funds. *Journal of Asset Management, 10(4),* 253-262

Johnson, W. F. (2013). On the right track: Measuring tracking efficiency in ETFs. *Morningstar ETF Research Working Paper*

Kanagaretnam, K., Lobo, J., & Whalen, J. (2007). Does good corporate governance reduce information asymmetry around quarterly earnings announcements? *Journal of Accounting and Public Policy, 26(4),* 497-522

Keeley, B., & Love, P. (2010). *From crisis to recovery – The causes, course and consequences of the great recession.* OECD Publishing

Kemsley, D., & Nissim, D. (2002). Valuation of the debt tax shield. *Journal of Finance, 57(5),* 2045-2073

Kostovetsky, L. (2003). Index mutual funds and exchange-traded funds. *Journal of Portfolio Management, 29(4),* 80-92

Koziol, C., & Lawrenz, J. (2012). Contingent convertibles: Solving or seeding the next banking crisis? *Journal of Banking and Finance, 36(1),* 90-104

Lewis, C., Rogalski, R., Seward, J., (1999). Is convertible debt a substitute for straight debt or for common equity? *Financial Management, 28(1),* 5-27

Lipton, M., & Lorsch, J. W. (1992). A modest proposal for improved corporate governance. *Business Lawyer, 48(1),* 59-77

MacKinlay, A. C. (1997). Event studies in economics and finance. *Journal of Economic Literature Vol. XXXV (March 1997),* 13-39

Masulis, R. W., & Korwar, A. N. (1986). Seasoned equity offerings: An empirical investigation. *Journal of Financial Economics, 15(1986),* 91-118

Meinhardt, C., Mueller, S., & Schoene, S. (2014). Physical and synthetic exchange traded funds: the good, the bad, or the ugly? *Journal of Investing, 24(2),* 35-44

Merz, T. (2015). The tracking risk of exchange-traded funds revisited: A multivariate regression approach. *SML Working Paper No. 4*

Mikkelson, W. H., & Partch, M. M. (1986). Valuation effects of security offerings and the issuance process. *Journal of Financial Economics, 15(1986),* 31-60

Milonas, N. T., & Rompotis, G. G. (2006). Investigating European ETFs : The case of the Swiss exchange-traded funds. In: *The Annual Conference of HFAA, Thessaloniki, Greece*

Mitchell, O. S., & Hsin, P.-L. (1997). Public sector pension governance and performance. In S. Valdés-Prieto (pp. 92-126): *The Economics of Pensions: Principles, Policies, and International Experience.* Cambridge: Cambridge University Press

Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics, 5(2),* 147-175

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics, 13(1984),* 187-221

Naumenko, K., & Chystiakova, O. (2015). An empirical study on the differences between synthetic and physical ETFs. *International Journal of Economics and Finance, 7(3),* 24-35

Norden, L., & Weber, M. (2004). Informational efficiency of credit default swap and stock markets: The impact of credit rating announcements. *Journal of Banking & Finance, 28(11),* 2813-2843

NYSE (2014). *U.S. ETP Monthly Flash December 2014.*

NYSE (2015). *U.S. ETP Monthly Flash March 2015.*

OECD (2006). *OECD Guidelines on Pension Fund Asset Management*. OECD Policy Guidelines

OECD (2011). *OECD/IOPS Good Practices for Pension Funds' Risk Management Systems*. OECD Policy Guidelines

OECD (2009). *OECD Guidelines on Pension Fund Governance*. OECD Policy Guidelines

Palomba, G., & Ricetti, L. (2012). Portfolio frontiers with restrictions to tracking error volatility and value at risk. *Journal of Banking & Finance, 36(9),* 2604-2615

Pennachi, G., Vermaelen, T., & Wolff, C. P. (2014). Contingent capital: The case of COERCs. *Journal of Financial and Quantitative Analysis, 49(3),* 541-574

Petajisto, A. (2013). Inefficiencies in the pricing of exchange-traded funds. *New York University Working Paper*

Pope, P.F., & Yadav, P.K. (1994). Discovering errors in tracking error. *Journal of Portfolio Management, 20(2),* 27-32

Schepens, G. (2015). Taxes and bank capital structure. *Journal of Financial Economics, forthcoming*

Rompotis, G. (2013). On leveraged and inverse leveraged exchange traded funds. *The IEB International Journal of Finance, 2014 (9),* 150-181

SFC (2015). Guidelines for regulating index-tracking exchange traded funds. *SFC Guidelines (Online Version)*

Shin, S., & Soydemir, G. (2010). Exchange-traded funds, persistence in tracking errors and information dissemination. *Journal of Multinational Finance, 20(2010),* 214-234

Shum, P. M., & Kang, J. (2013). Leveraged and inverse ETF performance during the financial crisis. *Managerial Finance, 13(5),* 476-508

Sorokina, N., Booth, D. E., & Thornton, J. H. (2013). Robust methods in event studies: Empirical evidence and theoretical implications. *Journal of Data Science, 11(2013),* 575-606

Spiess, D. K., & Affleck-Graves, J. (1995). Underperformance in long-run stock returns following seasoned equity offerings. *Journal of Financial Economics, 38(3),* 243-267

Standard and Poor's (2010). Potential $1 trillion bank contingent capital-style issuance faces uncertain investor interest. *Technical Report Ratings Direct Standard & Poors, December 2010*

Stein, J. C. (1992). Convertible bonds as „back door" equity financing. *Journal of Financial Economics, 32(1),* 3-21

Swiss Federal Statistical Office (2014). *Die berufliche Vorsorge in der Schweiz – Kennzahlen der Pensionskassenstatistik 2006 – 2012.* Neuchâtel: Bundesamt für Statistik

Swiss Federal Statistical Office (2015): *Results of the pension fund statistic.* BFS Website

Vallée, B. (2014). Call my maybe? The effects of exercising contingent capital. *HBS Working Paper*

Van Binsbergen, J. H., Graham, J. R., & Yang, J. (2010). The cost of debt. *Journal of Finance, 65(6),* 2089-2136

Vardharaj, R. F., Fabozzi, J., and Jones, J. F. (2004): Determinants of tracking error for equity portfolios. *Journal of Investing, 13(2),* 37-47

Wallace, N., D., Glascock, J. L., & Schwarz, T. V. (1995). Signaling with convertible debt. *Journal of Financial and Quantitative Analysis, 30(3),* 425-440

Wright, M., Siegel, D. S., Keasey, K., & Filatotchev, I. (2013). *The Oxford Handbook of Corporate Governance.* Oxford: Oxford University Press

Yang, T., & Mitchell, O. S. (2008). Public pension governance, funding, and performance: A longitudinal appraisal. In J. Evans & J. Piggot (Eds.), *Pension Fund Governance: A Global Perspective* (pp. 179-199). London: Edward Elgar

Yermo, F., & Stewart, J. (2008). Pension fund governance – Challenges and potential solutions. *OECD Working Papers on Insurance and Private Pensions No. 18*

Curriculum Vitae

Christian Ehmann
Swiss Institute of Banking and Finance
University of St. Gallen
Rosenbergstrasse 52
CH-9000 St. Gallen

EDUCATION

University of St. Gallen, Switzerland (expected 2016)
PhD in Finance at the Chair of Finance

European Business School (EBS) (12/2010)
Oestrich-Winkel, Germany
Master of Science in Finance (M.Sc.)

European Business School (EBS) (06/2009)
Oestrich-Winkel, Germany
Bachelor of Science in General Management / Business Law (B.Sc.)

RESEARCH PAPERS

"Is Governance Related to Performance and Asset Allocation? Empirival Evidence from Swiss Pension Funds"

"Announcement Effects of Contingent Convertible Securities: Evidence from the Global Banking Industry"

"Performance of Exchange-Traded Funds: New Evidence from Equity ETFs Listed on XETRA and NYSE Arca"