Empirical essays on the governance of financial institutions

Jan de Dreu

Printed by Ridderprint, Ridderkerk

Empirical essays on the governance of financial institutions

Empirische studies over de governance van financiële instellingen
(met een samenvatting in het Nederlands)

Proefschrift

ter verkrijging van de graad van doctor aan de Universiteit Utrecht op gezag van de rector magnificus, prof.dr. G.J. van der Zwaan, ingevolge het besluit van het college voor promoties in het openbaar te verdedigen op dinsdag 15 oktober 2013 des middags te 4.15 uur

door

Jan de Dreu

geboren op 4 februari 1981 te Buren

Promotoren:

Prof.dr. J. A. Bikker

Prof.dr. V. P. Ioannidou

Contents

Summary and Curriculum Vitae

The four essays in this dissertation examine various topics related to the governance of financial institutions. The essays focus on the behavior and performance of pension funds and banks with the aim to identify suboptimal features in their institutional setup. Part I examines the management of pension funds with a focus on operating costs and investment behavior. In particular, the first essay examines the variation in operating costs of pension funds and shows that this is mainly explained by (unutilized) economies of scale and to a lesser extent by the type of fund (industry funds are most efficient). The second essay studies the variation of investment sophistication and shows that less sophisticated pension funds tend to mitigate their lack of sophistication by selecting investment policies with a lower risk profile. The third essay examines the variation of pension fund investment policies over time and shows that this is influenced by the short- and medium-term performance of the stock market. Part II focuses on a market mechanism that provides economic incentives to limit risk taking in the banking system. Specifically, the last essay shows that a variation in bank risk influences the supply of uninsured deposits. This study also shows that the introduction of explicit deposit insurance significantly reduces market discipline by depositors, thereby increasing incentives for banks to take (excessive) risks.

Jan de Dreu (1981) works in Debt Advisory at the Corporate & Investment Banking division of BBVA in Madrid. In his current role, he advises large corporates in Europe, the US and Latin America on their ratings, liquidity and capital structure. Prior to joining BBVA, he worked in the Credit Department of RBS in London and ABN AMRO in Amsterdam where he monitored and managed credit exposure to large corporates. For RBS, he also worked at the Restructuring Group in Madrid. Jan started his career in the Supervisory Policy Division of De Nederlandsche Bank where he supported the department with statistical analysis and worked on several research projects. He holds a Master Degree in Financial Economics from Tilburg University and is certified as Financial Risk Manager by the Global Association of Risk Professionals.

Acknowledgements

Writing this dissertation has taken almost ten years, with most of the work done in evenings, weekends, and holidays next to my consecutive jobs at DNB, ABN AMRO, RBS and BBVA. During this period many people have contributed to the different chapters and supported my efforts to complete it. I would like to thank all who supported me and I'll mention a few in particular.

First, I am very grateful to Jaap Bikker, my supervisor and co-author for the chapters on pensions, for giving me the opportunity to collaborate with him, and for his continuing support and encouragement throughout the project. The papers on pensions would also not have been possible without the support of De Nederlandsche Bank (DNB) and specifically I would like to mention Aerdt Houben and Klaas Knot for allowing me to work on research during the time that I worked at DNB and for their contributions and support to publish the chapters on pensions, even though some of the results were sensitive at the time and led to considerable debate in the sector. I am also grateful to Dirk Broerders for being a co-author of one of the pension chapters and for his valuable comments and suggestions on the others.

Second, I am indebted to Vasso Ioannidou, my co-supervisor and co-author of the chapter on deposit insurance and market discipline, for inspiring me to do research and for showing firsthand how to conduct high-quality empirical research and the art of writing a paper. This chapter would also not have been possible without the support of the Bank Supervisory Authority in Bolivia (SBEF), and specifically Enrique Hurtado, a valued friend, who enabled me to do research at the SBEF and supported our efforts to write the chapter on deposit insurance on market discipline. In addition, my research for this chapter has been supported by Tilburg University (my alma mater) and a travel grant from Nuffic.

Third, I would like to express my gratitude to Wolter Hassink, Clemens Kool, Fabiana Penas, Onno Steenbeek, and Wolf Wagner for being on my thesis committee.

Finally, I am grateful to Monica for her infinite patience and support, to my family and friends for their enthusiasm, and to all the other people that have encouraged me to work on this project.

Chapter 1

Introduction

One of the key functions of financial institutions is to facilitate lifetime consumption smoothing. By investing savings in long-term assets, banks, life-insurers, and pension funds aim to generate sufficient income to provide a return on the money entrusted to them and cover their operating costs. Consumers place part of their wealth (often the major part, besides an investment in a house) with these financial institutions in the expectation that they have sophisticated investment strategies, prudently manage their risk, and are cost effective. This dissertation investigates whether financial institutions meet such expectations, particularly focusing on pension funds and banks.

This dissertation consists of two parts: (I) pension fund administration and investment management, and (II) market discipline and deposit insurance for banks. In this introduction, I first present a high-level discussion of these two topics. Subsequently, I outline each of the four following chapters in greater detail.

"Investors should remember that excitement and expenses are their enemies. And if they insist on trying to time their participation in equities, they should try to be fearful when others are greedy and greedy only when others are fearful"

Warren Buffet, 2004, Letter to shareholders

Topic I: Pension fund administration and investment management

Pension funds with defined benefit plans are under pressure around the world due to a combination of unfavorable conditions: rising life expectations; volatile, and frequently negative, investment returns of equity and real estate portfolios; low interest rates in fixed income portfolios; and finally, low discount factors for the calculation of future obligations. These factors have led numerous pension funds to report persistent funding deficits in the last few years. In response, pension funds have increased pension premiums, limited or dropped price or wage indexation, and slimmed down pension plans to reduce costs and risks for employers.[1] These measures have gone some way to support the financial position of pension funds, but in many cases they have not been sufficient to solve deficits. Complicating efforts to restore the financial health of pension funds is the fact that populations are ageing in most OECD countries, both in the sense of increasing live expectations, and lower birth rates. This reduces the effectiveness of raising premiums to solve funding deficits. Consequently, given the size of pension deficits, a number of Dutch pension funds, starting in 2013, have been forced to even cut accrued (nominal) pension rights. These developments have increased interest in the performance of pension funds and raised questions about the sustainability of the current pension systems.

The performance of pension funds is determined by investment returns and operating costs. Investment returns have a dominant impact on the funding positions of pension funds, given the volatile returns of equities and other risky assets. Conversely, the long-run impact of operating costs—consisting of administrative and investment costs—may easily be underestimated, since it is less noticeable in a given year. However, over the typical long life-cycle of a pension, the accumulation of pension funds' operating costs makes an important difference as well. For example, for a typical employee, a yearly operating cost of 1 percent of total assets translates into a 27 percent lower final pension benefit (Bateman, Kingston, and Pigot, 2001). Consequently, sophisticated investment

[1] Most importantly, by changing from final salary to career average defined benefit pensions and by changing from defined benefit (DB) to defined contribution (DC) pension schemes.

management and a cost-efficient administration are of key importance to participants in pension funds, given the direct influence on their pension wealth.

Pension schemes are widely used to ensure a stable income following retirement. Pension plans can help workers to spread income over their lifetime and maintain their standard of living after retirement, in line with the life-cycle hypothesis. Chapters 2, 3, and 4 in this dissertation examine the efficacy of Dutch pension funds in performing their two key activities: administration and investment management.

The pension system in the Netherlands consists of three pillars: (i) a basic pension provided by the government for all inhabitants above sixty-five,[2] (ii) company or industry-wide pension schemes where employees build-up an additional occupational pension to maintain their standard of living; and (iii) individual tax-supported schemes provided by insurance firms to top-up pensions in the first two pillars. In this dissertation, I focus on the second pillar of occupational pensions. These pension funds are established by employers and industry associations in cooperation with labor unions. The analysis is primarily focused on defined benefit schemes since this is the overwhelming type of pension in the Netherlands, both currently and in the sample period analyzed in this dissertation.[3]

The economic importance of the pension sector in the Netherlands is immense. Over 91 percent of employees are covered by an occupational pension plan (OECD, 2011) and pensions from occupational pension plans provide the most important source of income for retired workers. Dutch pension funds managed around €845 billion of assets in 2011, representing 140 percent of GDP or over €50,000 per inhabitant. Hence, a lower investment return or higher administrative costs of 1 percent of total assets would represent an annual loss of €8.5 billion.

The research questions in Chapters 2, 3, and 4 in this dissertation are inspired by several remarkable industry characteristics of the pension sector in the Netherlands. Specifically, while defined benefit pension schemes are fairly homogenous across Dutch pension funds, there are striking differences between the management of these pension funds, both in terms of administration costs and investment strategies. Remarkable industry characteristics include:

[2] The pension age will rise gradually to sixty-seven during the next decade.
[3] While in the last few years there has been a shift from DB to DC schemes, DB schemes still continue to be the dominant system.

- The existence of a large number of pension funds, but also, a steady consolidation of the sector over time with a decrease in the number of pension funds from 1,131 in 1992 to 454 in 2011.
- Large differences in the size of pension funds, ranging from the very small (with less than one hundred participants) to the very large (over two million participants).
- Different types of pension funds, including company funds, industry funds, and professional group funds.
- Large variations in administrative and investment costs per participant, ranging from €72 (average for funds with over one million participants) to €1,061 (funds with less than one hundred participants), and from 0.2 percent to 1.3 percent as a percentage of assets under management in 2004 (further examined in Chapter 2).
- Investment allocations vary widely across pension funds (further examined in Chapter 3), including:
    - Asset allocations to equities and bonds, both ranging from 0 to 100 percent.
    - Different geographical diversification of investments (with varying home biases).
    - Varying shares (including absence) of investments in alternative, more complex assets, such as real estate, commodities, and hedge funds.
- The financial sophistication of pension fund boards diverges (also examined in Chapter 3).
- Both actual and strategic asset allocations of Dutch pension funds vary significantly over time (further examined in Chapter 4).

The variation in operating costs points to inefficiencies, given that pension funds generate fairly homogenous services (investment of pension savings and provision of a pension benefit from retirement until death). Similarly, while the differences in pension contracts and risk tolerance of participants and sponsors can justify some variation in investment strategies, it seems implausible that this can fully explain the large differences in asset allocations, and geographical and asset diversification observed above. Hence, the wide range of administrative costs and investment strategies suggest that both the efficiency of pension funds and effectiveness of their investment strategies vary considerably. The inevitable conclusion is that overall the structure and management of the pension sector is suboptimal, with some participants getting a better pension deal than others.

Factors that can potentially explain differences between pension funds and inefficiencies in the sector are: (1.a) many companies, with varying sizes and (financial) sophistication, have set up and managed their own pension fund, resulting in substantial variation between the size and efficacy of pension funds, and (1.b) behavioral biases and the complexity of investment management, which may result in suboptimal choices. In addition, several factors have allowed inefficiencies to persist over time, including: (2.a) limited transparency (i.e. the ability of stakeholders to monitor performance is restricted), (2.b) mandatory participation and restrictions on switching between pension funds for employees (i.e. market competition does not reward or punish above or below average performance),[4] and (2.c) considerable regulatory freedom for pension funds to implement portfolio strategies (i.e. the regulator has limited instruments to correct suboptimal investment strategies), although risk taking is linked to buffer requirements. Below, I further discuss each of these factors.

1. Factors that explain differences between pension funds and inefficiencies in the sector

(1.a) Set up of pension funds with varying scale and efficacy

In the Netherlands, most pension funds have been set up with the objective to provide a pension for employees following retirement and thereby enable them to maintain their standard of living. Accordingly, many companies, as well as professional groups (e.g. general practitioners, public notaries), have set up and managed their own pension funds, with varying sizes and (financial) sophistication. However, given economies of scale and the complexity of investment management, large size and financial sophistication are of key importance to optimally run a pension fund. Up to a degree, this has been reflected in the evolution of the sector, with the set up of large industry funds for multiple companies in a sector, as well as a strong consolidation in the last decade. Nonetheless, large variations in size and sophistication continue to characterize the sector, and so far, this institutional evolution has not led to convergence to an optimal model. As a result, a substantial variation between the size and efficacy of pension funds can be observed, as also discussed in Chapters 2, 3, and 4.

[4] Companies generally have the option to change the pension arrangement for their employees though in some sectors the government has declared participation in a specific collective pension agreement binding for all employers.

(1.b) Behavioral biases and complexity of investment management

Financial decisions may be influenced by social, cognitive, and emotional factors.[5] The behavioral finance literature has examined a number of behavioral biases that influence investment decisions and result in suboptimal portfolios in the context of finance theory. For example, investment decisions may be based on spurious factors, such as recent stock market returns or on gut feelings, instead of long-term optimization guided by asset-liability management studies and finance theory. Potential explanations for suboptimal behavior include limited expertise, attention, memory, and processing capabilities. Most of the empirical research related to behavioral finance is focused on retail investors, possibly since data is more generally available. Professional investors, such as pension funds, are expected to suffer less from behavioral biases since they have more resources to optimize their investment strategy. However, investment management is highly complex and state of the art finance knowledge may still be insufficient to determine the optimal investment mix. In addition, the level of sophistication varies substantially across pension funds, as indicated by our results in Chapters 3 and 4. Furthermore, a suboptimal sector configuration and limited transparency and accountability may facilitate suboptimal behavior. Consequently, behavioral biases—in combination with varying sophistication—may be a key contributor to the large variation of investment management policies.

2. Factors that explain why differences and inefficiencies can persist over time

(2.a) Limited transparency

One reason why sector inefficiencies can persist is that many pension funds do not publish full details of their administration costs, investment decisions, and returns.[6] This limits the ability of stakeholders to compare performance across the sector and assess how well pension funds are managed. In case of deficiencies, limited transparency may shield pension fund boards from pressure by stakeholders to improve their performance. Chapters

[5] This is examined in the behavioral finance literature, which has attracted increasing interest following the Nobel Prize for Daniel Kahneman, awarded in 2002. Kahneman received the Nobel Prize for having "integrated insights from psychological research into economic science, especially concerning human judgment and decision-making under uncertainty." His research includes a seminal paper with Tversky on prospect theory, which uses cognitive psychology to analyze decisions between alternatives that involve risk (Kahneman and Tversky, 1979). In addition, Kahneman and Tversky published important insights on heuristics that people use and the biases to which they are prone in various tasks of judgment under uncertainty (e.g. Tversky and Kahneman, 1974).

[6] LCP (2012) reports that many pension funds do not publish their annual accounts. In addition, not all annual accounts contain costs (or an estimate of costs) incurred by investment management and investment transactions.

2 and 3 illustrate that scale is one of the key factors for cost-efficiency and sophistication of investment management. However, potential advantages of scale may not be apparent if limited information is published by pension funds.

(2.b) Mandatory participation and restrictions on switching

Occupational pension plans in the Netherlands are negotiated between the Social Partners (employer associations and labor unions). Pension plans can be negotiated at the company level or at the sector level, depending on the preferences of companies in a given industry. Pension plans form part of collective labor agreements and participation is mandatory for all employees that fall under the agreement. Additionally, under certain conditions (e.g. if requested by companies that represent the majority of employees in a sector) the government can declare a collective pension agreement binding for all employers in a specific sector or members in a professional group.[7] As a result of this arrangement, most employees in the Netherlands face mandatory participation in the pension fund connected to their company (or sector). Employees can influence the management of pension funds through their mandatory representation at the board, but they cannot opt-out or switch between pension funds (except by switching jobs to a different company or sector). As a consequence, participants cannot impose market discipline by changing pension fund, which limits competitive pressure.[8] Advantages of these restrictions on competition are that pension funds do not face costs related to marketing and adverse selection.[9] Also the absence of a profit margin is an advantage (compared with insurance firms). Pension funds, however, need to build and maintain buffers,[10] while shareholders of insurance companies bear risk in exchange for the profit margin. The downside is, in short, that pension funds face limited market pressure to optimize the structure of the sector and improve operating efficiency and investment performance.

[7] This arrangement is commonly used in the Netherlands with around 83 percent of participants linked to compulsory industry funds and professional group funds in 2004.

[8] There is some competition between pension fund providers and insurance companies to implement pension plans for third parties, but changes rarely occurs since switching is costly and contracts are usually long-dated. See Van der Lecq (2011) for a good discussion of markets and competition in the Dutch pension sector.

[9] In a cost-comparison between private pension schemes managed by insurance companies and collective schemes managed by pension funds, Bikker and De Dreu (2007) show that the operating costs per participant of pension funds are around 18 percent of those of insurance company schemes. These differences are attributed to scale effects, adverse selection, acquisition costs (promotion, distribution, and advice), and a profit objective for insurance companies.

[10] Participants have a claim on (investment returns made on) the buffer, although in case of overfunding, the sponsor may also try to reduce premium payments (the pension contract is incomplete).

(2.c) Regulatory freedom to implement portfolio strategies

Investment strategies of Dutch pension funds need to follow the prudent-person rule, as specified in the Dutch Pension Act 2007.[11] The pension law includes a Financial Assessment Framework (FTK), which prescribes minimum financial reserve requirements for pension funds. The minimum coverage ratio of assets to pension liabilities is circa 105 percent. In addition, a pension fund must maintain buffers to be able to cope with financial setbacks and other risks. The minimum size of these buffers is linked to the risk profile of the investment portfolio. The key principle is that pension funds must maintain sufficient reserves to safeguard their ability to fulfill future obligations.[12]

The financial position of pension funds is monitored by the pension sector supervisor, the Dutch Central Bank. Funds with insufficient financial reserves must prepare a recovery plan and present this to the Dutch Central Bank.[13] The pension fund, however, remains responsible for investment decisions and Dutch pension legislation does not specify quantitative restrictions related to asset allocations, though funds with a riskier investment portfolio need to maintain a higher buffer.[14,15] Consequently, pension funds have considerable freedom to choose portfolio strategies.

[11] The prudent-person rule is not defined, but investment guidelines are specified in EU Directive 2003/41/EG. These guidelines include: (i) investments need to safeguard the risk profile, quality, liquidity, and return of the investment portfolio, (ii) assets that cover future liabilities need to be invested in line with the nature and duration of future expected liabilities, and (iii) investments need to be diversified satisfactorily.

[12] The pension law specifies that pension funds need to maintain a minimum level of financial reserves to ensure, with a 97.5 percent probability over a one-year time horizon, that sufficient funds will be available to cover their (discounted) liabilities.

[13] Recovery plans can have a term up to three years to re-establish a minimum cover ratio of 105 percent and up to fifteen years to re-establish the additional buffers linked to investment risk.

[14] An exception is that pension funds can invest at most 5 percent of their assets in the sponsor company or, in case the sponsor company belongs to a group, up to only 10 percent in companies that belong to this group.

[15] A recent court case has illustrated the limited power of the Dutch Central Bank (DNB) to prescribe quantitative restrictions on investment holdings. In February 2011, the DNB ordered the *Stichting Pensioenfonds Verenigde Glasfabrieken* to reduce its holdings in Gold from 13 percent to a maximum of 3 percent. However, in March 2012 this decision was reversed by the District Court of Rotterdam since the DNB failed to demonstrate why a 13 percent investment in gold did not comply with the prudent-person rule, whereas a 3 percent investment, taking into account the composition of the investment portfolio and the fund's specific circumstances, would be acceptable.

"*Taking away the risk from the financial sector and taking it onto the public shoulders is not the right approach. If we want to have a healthy, sound financial sector, the only way is to say: "Look, there where you take on the risks, you must deal with them. And if you can't deal with them, you shouldn't have taken them on and the consequence may be that it's end of story." That is an approach that I think we should, now that we're out of the heat of the crisis, consequently take"*

… "Maybe it's inevitable that if you push back the risks, risks will be priced. Because if I finance a bank and I know if the bank will get in trouble I will be hit and I will lose my money, I will put a price on that. I think that's a sound economic principle"

Jeroen Dijsselbloem, President of the Eurogroup, March 2013

Topic II: Market discipline and deposit insurance

The primary function of banks is to facilitate the allocation and deployment of economic resources, both spatially and temporally, in an uncertain environment (Merton, 1995). In their most elementary form, banks raise deposits and allocate these to investment projects. This enables banks to transfer economic resources through time and across regions and industries, thereby facilitating both saving and investing.

There are two dominant theories that explain the existence of banks and other financial intermediaries. The intermediation approach considers that the key task of banks is to effectively allocate financial resources to investment projects. In this theory, the existence of banks avoids replication of the selection and monitoring of investment projects and facilitates diversification for investors. Deposits are seen as inputs to produce loans and other banking assets. The production approach considers that banks offer two services: deposits and loans. In this theory, savings and loans are both seen as output factors. Banks improve liquidity and risk sharing for depositors and avoid that depositors need to invest in illiquid long-term investments.[16]

A well-functioning banking sector ensures that savings from depositors are channeled toward profitable investment projects, thereby facilitating economic activity as well as generating a return for depositors and the bank. Banks allocate large budgets to build systems and train their staff to identify projects with acceptable risk-reward profiles

[16] See Bhattacharya, Boot, and Thakor, (1998) for a good discussion of this topic.

and monitor the repayment of loans. Nonetheless, banks sometimes fail to identify systemic risk and to distinguish between profitable and loss-making projects, resulting in a misallocation of resources. Under certain conditions, such misallocation of resources can occur on a vast scale, and when exposed, result in a banking and economic crisis.

The recent financial crisis has exposed a vast misallocation of resources, resulting in unprecedented losses for banks and the economy as a whole. The IMF (2010) estimates global bank write-downs and loan loss provisions of $2.3 trillion from 2007 to 2009. Total costs for the economy are much higher due to a slowdown of the economy and a reduction of asset values.

Conditions that led up to the crisis include a long period of economic growth coupled with low default rates (leading to optimism), financial deregulation, financial innovation, fierce competition, low inflation, and loose monetary policy. In addition, excessive risk taking was encouraged by the risk-reward structure for shareholders,[17] management,[18] and employees of financial institutions,[19] while the incentives for depositors and other creditors to impose market discipline was impaired by deposit insurance and other implicit and explicit government guarantees for the financial sector.[20]

---

[17] Potential losses of shareholders are capped, but their upside is multiplied by leverage since the full balance sheet can be used to maximize potential earnings. Conversely, creditors can only expect a fixed return while their potential losses increase with leverage. Hence, equity can be seen as a call option on the bank's assets. The value of this option increases with volatility, giving shareholders an incentive to encourage risk taking. For example, investing in high-risk projects with zero expected return results in no change of the enterprise value, but the value of equity increases at the expense of the value of debt.

[18] Compensation plans for bank executives generally include equity and option awards to align their incentives with shareholders. Guay (1999) shows that equity risk is positively related to the convexity in CEO compensation plans, suggesting that managers' investment and financing decisions are influenced by their risk-taking incentives. Crawford, Ezzell, and Miles (1995) find that, following deregulation, CEO pay-performance sensitivity increased more at riskier banks. This result is interpreted as evidence of a moral hazard problem induced by deposit insurance priced with fixed premiums unrelated to bank risk positions. There is some discussion, however, on whether incentives generated by executive pay arrangements in financial institutions have in fact encouraged excessive risk-taking in the years preceding the 2008 financial crisis. Fahlenbrach and Stulz (2011) find that bank CEOs did not reduce or hedge their holdings of shares before or during the crisis, and as a consequence, suffered extremely large wealth losses as a result of the crisis. Such heavy losses by management have been used as argument to dismiss the view that pay structures caused excessive risk-taking. However, Fahlenbrach and Stulz (2011) do not analyze how much cash earnings were received by top management in the run-up to the crisis. Bebchuk, Cohen, and Spamann (2009) find that the top-five executive teams of Lehman and Bear Sterns cashed out circa $1.4 billion and $1 billion respectively from performance-based compensation during 2000-2008. These cash flows substantially exceeded the value of the executives' initial holdings in the beginning of the period, resulting in large positive net payoffs for the period. The authors conclude that the executive pay structure at these firms provided executives with incentives to seek improvements in short-term results even at the cost of maintaining an excessively elevated risk of an implosion at some point down the road.

[19] Large bonus payments are commonly used in financial institutions to align the incentives of employees with management and shareholders. In addition, employees (as well as shareholders and management) do not face liability in case of losses (except in case of fraud) and the use of deferred bonuses or claw-back options was uncommon in the run-up to the crisis. Hence, the structure of expected pay-offs encouraged risk taking.

[20] An example is the classification of large banks as being "too big to fail" (see O'Hara and Shaw, 1990).

These factors seem to have "clouded" the judgment of banks to identify systemic risks and distinguish between profitable and non-profitable investment projects. This has resulted both in an increase of leverage (making the system more vulnerable) and a misallocation of resources (resulting in losses). Recent examples of a misallocation of resources on a large scale include subprime mortgages loans in the US and large infrastructure and property investments in Ireland and Spain.[21] Unfortunately, the final economic costs of such resource misallocation can be very high as evidenced in the current crisis.[22]

The crisis has also been characterized by a tightening of liquidity in response to widespread uncertainty about the value of assets and creditworthiness of financial institutions. Trust is of key importance for banks since they are vulnerable to bank runs as a result of a maturity mismatch between assets and liabilities. In theory, bank runs can be self-fulfilling and occur after rumors, though unfounded rumors are usually easy to dismiss when banks have strong capital and liquidity positions. The current crisis, however, has eroded liquidity and capital, as well as confidence in the financial system, resulting in several bank runs. Recent examples include the depositor runs on Northern Rock in the UK and DSB bank in the Netherlands. These banks faced massive withdrawals of retail deposits following rumors of potential failure.[23] The run on Northern Rock included long queues outside branch offices, similar to old-fashioned bank runs depicted in classic movies like "It's a Wonderful Life" and "Mary Poppins."

Modern bank runs are usually silent bank runs in the sense that they mainly occur through "invisible" electronic or wire transfers. In addition, sophisticated lenders, rather than retail depositors, are generally the first to withdraw funding from the bank.[24] In this

---

[21] The Ciudad Real airport in Spain is a good example of unproductive infrastructure investments. This airport was built with a capacity of up to ten million passengers per year for a cost of over EUR 1 billion. Only a few airlines scheduled flights to the new airport, however, and these were canceled after a short operating period due to a lack of passenger demand. The airport was closed in 2012 after less than three years of operations.

[22] Oliver Wyman (2012) estimates baseline cumulative credit losses of EUR 320-340 billion from 2007 to 2014 for banks in Spain. These credit losses represent 21-23 percent of the total lending book and 30-32 percent of GDP in 2011. The estimate is based on an audit of the fourteen largest banking groups in Spain (accounting for around 90 percent of total bank assets).

[23] The bank run on DSB bank started following a call to withdraw deposits by a representative of a foundation for unsatisfied DSB customers. The call was heeded and large deposit withdrawals were made. Within two weeks over EUR 600 million was withdrawn. DSB was not able to attract alternative funding and the government was not willing to provide rescue funds. Three weeks after the start of the bank run, DSB bank was declared bankrupt.

[24] Hyon Song Shin (2009) argues that the depositor run on Northern Rock was an aftermath of the liquidity crisis faced by the bank. This liquidity crisis followed a withdrawal of short-term capital market funding and interbank lending, which triggered the need for emergency liquidity support. The depositor run only occurred after the Central Bank made an announcement that it would provide liquidity support.

context, the drying up of liquidity experienced by banks such as Bear Sterns, RBS,[25] and Fortis[26] can be characterized as silent bank runs. Following a collapse of liquidity, partly instigated by the financial crisis and partly by bank-specific concerns, these banks were forced to seek emergency support from the government.

Large losses incurred by banks, a lack of liquidity, and a dramatic loss of trust in banks forced governments to intervene with a number of support measures, including direct bailouts, emergency loans, and guarantees. In addition, the ECB and other major central banks have provided unprecedented access to short- and medium-term funding, thereby providing liquidity to banks. Finally, governments have increased deposit insurance to protect small depositors and reduce the incentives for bank runs.

Key arguments for these emergency measures include:

(i) To safeguard banks' lending operations, given their key importance to the economy.

(ii) To avoid the costs from bankruptcy (direct for the state from the pay out of deposit insurance, and indirect from destruction of jobs, systems, etc.).[27]

(iii) To avoid bank runs, which can potentially result in the failure of solvent financial institutions.

(iv) To avoid a systemic crisis, which can occur as a result of contagion from individual bank failures to the rest of the financial system.

(v) Political reasons, e.g. to protect the savings of "small" depositors.

In addition to the direct costs to society, however, these support measures increase moral hazard since bank losses are shifted from private investors to society and expectations are created that in a worst case scenario the state will provide support. Increased deposit insurance and expectations of government bailouts reduces incentives for depositors and bondholders to distinguish safe from risky banks and adjust the supply of

[25] FSA (2011) confirms that a liquidity run was the immediate driver of RBS's failure. "Potential insolvency concerns (relating both to RBS and other banks) drove that run, but it was the unwillingness of wholesale money market providers (e.g. other banks, other financial institutions and major corporates) to meet RBS's funding needs, as well as to a lesser extent retail depositors."

[26] Around EUR 5 billion of deposits were withdrawn from Fortis Bank Nederland in the third quarter of 2008 (Tweede Kamer, 2011).

[27] In the Netherlands, banks are liable for any payouts made by the government under the deposit insurance scheme. However, the sector would not be able to cover the liabilities linked to a bankruptcy of one of the largest banks. Hence, in such a scenario it seems unavoidable that the government will be forced to assume part of the losses.

funds accordingly. Consequently, government support measures and deposit insurance are likely to discourage market discipline and result in easier and cheaper funding access for risky banks, thereby encouraging risk taking.

Banking supervision and regulation aims to limit excessive risk taking and contribute to the financial soundness of the financial sector, and in theory, should mitigate perverse incentives created by deposit insurance and bailouts. However, financial crises occur despite banking supervision and regulation. The increasing complexity of financial instruments, as well as the size, diversity, and interconnectedness of financial institutions, makes it difficult to truly understand their risk profile and enforce prudent management. Moreover, bank supervisors have limited resources and financial institutions are likely to "fine-tune" the presentation of information, compounding the difficulties to effectively oversee them. Capital and liquidity requirements are based on a trade-off between safety and costs, implying the risk that the capital or liquidity position may be insufficient under extreme conditions. In addition, banks have strong incentives to minimize their capital and liquidity requirements, for example, through off-balance sheet financing. As a result, banking supervision and regulation is imperfect and not always able to prevent bank failures, as clearly illustrated in the current credit crisis.

Given the challenges faced by banking supervision and regulation, it seems sensible to reconsider the use of market discipline as an additional tool to discourage bank risk taking.[28] In theory, market discipline can be an effective tool to control bank risk taking. Compared to bank supervision, it offers a number of advantages: (i) market participants have a strong incentive to monitor the risk of their uninsured investments, (ii) the market includes the most sophisticated players, including peers, who are well placed to monitor and discipline banks, (iii) market discipline reflects the aggregation of information from numerous market participants, (iv) no costs for the supervisor, and (v) the market can be expected to react immediately following perceived changes in bank risk, which encourages management to address potential risk issues without delay. Nonetheless, market discipline is best used as a complement to bank supervision, noting it also has some shortcomings. These include: (i) cyclicality may increase, due to limited market discipline during periods of growth and potential overreaction in times of crisis, and (ii) the supply of funds may be

[28] The importance of market discipline is reflected in the Basel II capital accord, which recognizes that market discipline can be an important complement to supervisory oversight of financial institutions. To facilitate market discipline, Basel II specifies: "a set of disclosure requirements which allow market participants to assess key pieces of information related to capital, risk exposures, risk assessment processes, and hence the capital adequacy of the institution". However, the Basel II accord does not specify recommendations to ensure that depositors have sufficient incentives to impose market discipline on banks.

overly sensitive to news or rumors. In addition, bank supervisors can use on-site examinations to get access to private information, which may complement public information.

This dissertation investigates: (i) whether market discipline by depositors can be an effective tool to discipline banks, and (ii) how the introduction of explicit deposit insurance impacts market discipline. We find that depositors impose market discipline when their funds are not formally insured and that this is mostly canceled after the introduction of explicit deposit insurance.

Contribution of this dissertation

This dissertation contributes to the broad fields of financial economics and behavioral finance with the aim to deepen our understanding of how institutional characteristics (e.g. scale, governance, and sophistication) and external factors (e.g. stock market performance, deposit insurance) influence the behavior and economic performance of financial institutions (e.g. cost efficiency, investment policy, risk taking, and market discipline). The topics that are examined vary widely, but each chapter examines a specific outcome or behavior that seems inefficient or suboptimal from the perspective of economic theory.

Part I (Chapters 2, 3, and 4) examines the management of pension funds with a focus on operating costs and investment behavior. In particular, Chapter 2 examines the variation in operating costs and shows that this is mainly explained by (unutilized) economies of scale and to a lesser extent by the type of fund (industry funds are most efficient). Chapter 3 studies the variation of investment sophistication across pension funds and shows that less sophisticated pension funds tend to mitigate their lack of sophistication by choosing investment policies with a lower risk profile. Chapter 4 investigates the variation of investment policies over time and shows that this is influenced by the short- and medium-term performance of the stock market.

Part II (Chapter 5) focuses on a market mechanism that provides economic incentives to limit risk taking in the banking system. Specifically, Chapter 5 assesses how variation in bank risk influences market discipline. This chapter also shows that the introduction of explicit deposit insurance significantly reduces market discipline applied by depositors.

Below I introduce each of the four chapters with a short discussion of the research question, related literature, and key conclusions.

Chapter 2, entitled "Operating costs of pension funds: the impact of scale, governance, and plan design," considers which factors explain the variation of administrative and investment costs across pension funds.[29] Operating costs are important since they accumulate over the life-cycle of a pension and consequently either reduce final pensions or raise the cost of retirement security (or both).

[29] This chapter is based on Bikker and De Dreu (2009).

This chapter is closely related to a number of studies that investigate how pension fund characteristics affect administrative costs of both defined benefit (DB) and collective defined contribution (DC) pension schemes (e.g. Caswell (1976), Mitchell and Andrews (1981), Bateman and Mitchell (2004), and more recently, Bikker, Steenbeek, and Torrachi (2012) and Bikker (2013). These related studies present evidence for (i) significant economies of scale in the administration of pension funds, and (ii) large differences in administrative costs across countries' pension governance type and pension plans.

Our results show, for the Netherlands, that average annual operating costs amount to 1.31 percent of total assets for the smallest pension funds (with assets up to ten million euros), versus only 0.18 percent for the largest pension funds (with assets over ten billion euros) in 2004. Of course, this reflects a comparison of the highest and lowest cost levels, but large numbers of participants could profit from (somewhat) lower operating costs. In line with the literature, we find that pension fund size is a key factor in explaining the variation of both administrative and investment costs across pension funds. Other explanatory factors, including the type of pension fund (industry funds appear to be more efficient than company funds), type of plan (operating costs of DB plans are lower than DC plans), and type of participants (operating costs are highest for pensioners and lowest for inactive participants), are also statistically significant but of lesser economic importance. The results of this chapter support a consolidation of the Dutch pension sector with the aim to improve pension fund efficiency.

Our study was the first to present systematic evidence on the importance of economies of scale for pension funds in the Netherlands. Following its publication, the results have been widely discussed in the sector. This has also stimulated additional research to administrative costs of Dutch pension funds, notably by PWC (2007, based on survey data, and 2009, using annual reports for 2006 and 2007 of 150 pension funds), AFM (2011, using DNB data for 2009), Bikker, Steenbeek, and Torrachi (2012, using international data from CEM Benchmarking for 2004-2008) and LCP (2012, using data from annual reports for 2009, 2010 and 2011). Although they are based on different datasets, these studies have confirmed our key findings and provided further evidence on the importance of economies of scale in the pension sector.

It should be pointed out, however, that while PWC (2007) agrees with our main conclusions, they have argued that small company funds may provide better and more customized services which can potentially outweigh higher costs due to a lack of scale. In our study we point out that while small company pension funds may provide certain

benefits, such as more direct control and better alignment with the interest of stakeholders, this comes at high costs as a result of unused economies of scale. Using a survey among pension fund participants, PWC (2007) finds that (i) company funds score well on factors such as trust, fund expertise, and customer service, and (ii) participants consider these factors more important than costs. On this basis, PWC argues that high administrative costs of small company funds are partly compensated by better and more personalized service. However, PWC's survey only includes company funds and their study does not formally test whether better service quality by small funds mitigates higher costs. Hence, I conclude that their evidence is inconclusive. The latter question is, however, formally tested by Bikker, Steenbeek and Torrachi (2012). Using a dataset with detailed information on service quality and pension plan complexity, they find evidence for significant economies of scale for pension funds, also after controlling for service quality. In addition, they find that smaller funds tend to have less tailor-made pension plans and provide fewer services. The findings of Bikker et al. (2012) refute the claims of PWC (2007) and provide further support for sector consolidation.

Chapter 3, entitled "Investor sophistication and risk taking," examines whether the sophistication of investment policies varies across pension funds and whether it can explain differences in the risk profile of the investment portfolio.[30] Pension fund investment policy drives the expected returns and risks of pension savings and is therefore of key importance for participants and sponsor companies.

This chapter is related to a number of behavioral finance studies that have shown that the composition of investment portfolios of private investors is influenced by suboptimal investment decisions. Relevant studies include Agnew, Balduzzi and Sunden (2003), Huberman and Jiang (2006), Benartzi and Thaler (2001), Calvet, Campbell, and Sodini (2007, 2009a,b), DeMiguel, Garlappi, and Uppal (2007), Goetzmann and Kumar (2008), and Dhar and Zhu (2006). This chapter adds to the literature since there is, to the best of our knowledge, no empirical investigation in the literature on the impact of the level of sophistication of institutional investors on the risk profile of their investment policy.

Investor sophistication is measured using three indicators that point to suboptimal investment decisions: gross rounding of strategic asset allocations, home bias and

[30] This chapter is based on De Dreu and Bikker (2012).

investments in more complex asset classes, such as real estate, private equity, commodities and hedge funds. We consider gross rounding of strategic asset allocations as an indicator for the use of rules of thumb, instead of a more sophisticated optimization process underpinning the investment strategy. This is, as far as we know, the first time that gross rounding of asset allocations is used as an indicator for investor sophistication. A close comparable can be found, however, in demographic studies, which have shown that in different settings gross rounding is correlated to education, income, illiteracy, and human capital (e.g. Bachi, 1951; Myers, 1976; Budd and Guinnane, 1991; and A'Hearn, Baten, and Crayen, 2009).

For the period from 1999 – 2006, we find that over 60 percent of Dutch pension funds, particularly smaller ones, round strategic asset allocations to the nearest multiple of 5 percent for both bonds and equity. Also, we find that many funds (i) invest little or nothing at all in alternative, more complex asset classes, and (ii) favor investments in the Euro area (indicating home bias). Finally, using the indicators for investor sophistication, we show that less sophisticated pension funds tend to have investment policies with a lower risk profile. This latter result proves that our indicators have an economic impact. A possible explanation for this effect on the risk profile is that less sophisticated pension fund boards prefer a lower risk profile to compensate for less financial knowledge and weaker risk management skills. This explanation is in line with Grable (2000), who finds that the risk tolerance of individuals is negatively correlated with financial knowledge and education.

Chapter 4, entitled "Stock market performance and pension fund investment policy," examines how the asset allocation of pension funds is influenced by stock market performance.[31] The strategic asset allocation of pension funds specifies the targeted portfolio composition of the investment portfolio. However, the actual portfolio composition continually changes as a result of market movements that affect the relative value of different asset classes in the investment portfolio. Therefore, to remain close to the strategic asset allocation, frequent rebalancing is needed with offsetting purchases and sales of assets in response to market movements. Alternatively, pension funds can choose to accommodate value changes within defined bandwidths, the so-called tactical asset allocation.

[31] This chapter is based on Bikker, Broeders, and De Dreu (2010).

Intuitively, it may be expected that the asset allocations of pension funds are fairly stable over time, reflecting a long investment horizon and evidence that pension funds (just like mutual funds) are on average unsuccessful in exploiting market timing to generate excess returns. (See Brinson, Hood, and Beebower, 1986; Brinson, Singer, and Beebower, 1991; Coggin, Fabozzi, Rahman, 1993; Blake, Lehmann, and Timmermann, 1999 for pension funds, and Kon, 1983; Henriksson, 1984; Chang and Lewellen, 1984; Daniel, Grinblatt, Titman, and Wermers, 1997; Bolle and Busse, 2001; Friesen and Sap, 2007; Chen, Ferson, and Peters, 2010 for mutual funds.)

Contrary to this, however, we find that stock market performance affects the asset allocation of Dutch pension funds in two ways. In the short-term, outperformance of equities over bonds and other investment categories automatically results in a higher actual equity allocation (and vice versa), as pension funds do not continuously rebalance their investment portfolios. On average, pension funds rebalance only around 39 percent of quarterly excess equity returns (within one quarter). In the medium-term, outperformance of equities induces pension funds to increase their strategic equity allocation (and vice versa). We also find that the equity allocation of the largest pension funds fluctuate more and asymmetrically with equity returns; for the largest players positive equity market shocks even lead to equity allocation adjustments of more than 100 percent, reflecting "overshooting," or positive-feedback trading. A possible explanation is that large funds have greater risk tolerance and may suffer from overconfidence (resulting in suboptimal behavior), in line with our findings in Chapter 3.

These outcomes suggest that the investment policies of pension funds, particularly the large ones, are partially driven by the cyclical performance of the stock market. This may reflect some free floating (can be useful to limit transaction costs) and a strategy to reduce the risk profile of the investment portfolio following a loss on investments and resulting decrease of the financial buffer (and vice versa). The latter risk management strategy is rational for participants with preferences for decreasing relative risk aversion and to safeguard compliance with minimum financial buffer requirements. However, the variation of the actual equity allocation is much larger than the strategic equity allocation, suggesting that market timing plays a role as well, even though the literature shows that this is not remunerative for the average investor.

Chapter 5, entitled "The impact of explicit deposit insurance on market discipline," considers how the introduction of explicit deposit insurance influences market

discipline in the banking system.[32] Deposit insurance is widely used by governments to protect small, unsophisticated depositors and to reduce the risk of bank runs, which can result in bank failures with potential systemic consequences for the financial sector. Deposit insurance is considered as an effective tool to promote stability in the financial sector, and as a result, many governments, including the Netherlands, have increased the level of protection in the recent crisis. However, deposit insurance may have negative side effects, since it removes incentives for depositors to monitor and discipline banks, thereby increasing incentives for banks to take excessive risks.

This chapter contributes to the growing literature that investigates the impact of deposit insurance on market discipline, including Cook and Spellman (1991, 1994), Kane (1987), Park and Peristiani (1998), Martinez, Peria and Schmukler (2001), and Demirgüc-Kunt and Huizinga (2003). We improve upon previous studies by exploiting a unique detailed Bolivian dataset, which covers a period when an explicit deposit insurance system was introduced. The dataset allows us to compare the behavior of small vs. large depositors, and the specific design of the deposit insurance system enables us to investigate the impact of the coverage rate on market discipline. Finally, we have data on both marginal interest rates and volumes of deposits, allowing us to distinguish market discipline from alternative hypotheses that are demand, as opposed to supply, driven.

We find that an increase in bank risk is associated with a reduced supply of deposits as indicated by higher interest rates and lower deposits, providing evidence for market discipline. Moreover, the introduction of explicit deposit insurance causes a significant reduction in market discipline and the impact depends on the coverage rate. In addition, we find that most market discipline comes from large depositors, in line with expectations, and that they are most impacted by the introduction of deposit insurance.

[32] This chapter is based on Ioannidou and De Dreu (2006).

Chapter 2

Operating costs of pension funds: the impact of scale, governance, and plan design

"I do believe in simplicity. It is astonishing as well as sad, how many trivial affairs even the wisest thinks he must attend to in a day; how singular an affair he thinks he must omit. When the mathematician would solve a difficult problem, he first frees the equation of all incumbrances, and reduces it to its simplest terms. So simplify the problem of life, distinguish the necessary and the real. Probe the earth to see where your main roots run"

Henry David Thoreau, 1848

Administrative and investment costs per participant appear to vary widely across pension funds. These costs are important because they reduce the rate of return on the investments of pension funds and consequently raise the cost of retirement security. This chapter examines the impact of determinants of these costs, such as the size, governance, pension plan design and outsourcing decisions, using data on all Dutch pension funds across the 1992-2004 period, including more than 10,000 observations. We find that economies of scale dominate the strong dispersion in both administrative and investment costs across pension funds. Industry-wide pension funds are significantly more efficient than company funds and other funds. The operating costs of pension funds' defined contribution plans are lower than those of defined benefit plans. Higher shares of pensioners make funds more costly, whereas the reverse is true when relatively many participants are inactive.

This chapter is based on: Bikker, J. A., and De Dreu, J., 2009, Operating costs of pension funds: the impact of scale, governance, and plan design, *Journal of Pension Economics and Finance, 8* (01), 63-89.

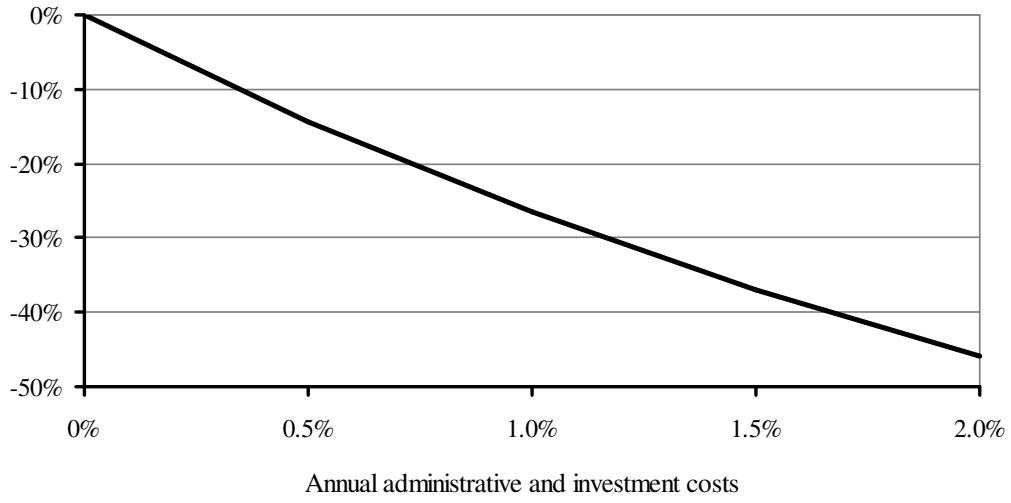
2.1 Introduction

The ageing of the population in many industrial countries, the current low bond yields, and the fall in stock market returns during 2000-2002 have focused the attention of policy makers on the cost of supplementary retirement provisions. Particularly, the low stock market returns over 2000-2002 have resulted in deficits, that is, insufficient cover ratios for many pension funds in the Netherlands and elsewhere. Consequently, the sustainability of many countries' pension systems has been called into question. In response, premiums were increased, pension schemes were made less generous, and part of the risks was shifted from companies to participants. The two major components determining the costs of pension provisioning are, of course, the quality of the pension scheme and the net rate of return on investments. However, administrative and investment costs can also substantially increase the cost of retirement security substantially (Bateman and Mitchell, 2004). Graph 2.1 illustrates how, under certain conditions, operating costs (administrative costs and investment costs) erode retirement benefits. An increase in annual operating costs of 1% of pension fund assets imply a cumulated reduction of 27% of eventual pension benefits or, equivalently, an increase of more than 37% in pension costs (see also Bateman, Kingston and Piggot, 2001). In the Netherlands, annual administrative costs typically lie between 0.1% and 1.2% of pension fund assets. This wide spread is remarkable, but the average level is low compared to that in a number of other countries (Bateman and Mitchell, 2004, Dobronogov and Murthi, 2005).

The relatively high cost level of pension plans was one of the main reasons for the closure of around 300 smaller Dutch pension funds (that is, around 25% of the funds) during 1992-2004. Nonetheless, this chapter will show that many relatively inefficient pension funds have continued to operate. During the recent pension crisis, pension funds have generally focussed on other measures, such as lower inflation or wage indexation and a move from final to average salary schemes, to reduce the overall costs of retirement security.[33] Given the significant cost differences across pension funds and the huge cumulative impact of additional costs, cost reduction should receive more attention.

[33] In 2002, 21 percent of the Dutch pension funds faced a deficit, while 41 percent of the funds failed to fulfill statutory solvency requirements. In response, Dutch pension funds have drastically increased the premiums for active members: on average, premiums increased from 8 percent of labor income in 2000 to 17 percent in 2005. In addition, the majority of funds have moved from final salary schemes to generally cheaper forms of average earnings schemes. Finally, many pension funds have cut (part of) their inflation or wage indexation.

Graph 2.1 Erosion of retirement income due to annual costs



Note: To simulate the impact of administrative and investment costs on pension payouts, we assume an annual wage growth of 3%, yearly inflation of 2%, nominal investment returns of 7%, an uninterrupted contribution history of 40 years, and a remaining 20 years in which pension benefits will be received.

This chapter examines both the administrative and investment costs of pension funds and their determinants. Using a new dataset with extensive information on all Dutch pension funds during 1992 and 2004, we find that administrative costs depend heavily on the size of pension funds and to a lesser extent on the governance structure (that is, type of pension fund), pension plan design and management choices. Economies of scale may indeed be expected in pension fund administration and investment activities, as many costs are likely to increase less than proportionally with size. Examples are the costs of policy development (especially asset and liability management), data management systems and reporting, and the expert personnel required, such as actuaries, accountants, legal staff and investment managers. Of course, pension funds can outsource fund administration and investment to specialised companies, thus gaining access to the necessary expertise at, particularly for smaller funds, relatively low costs.

This chapter is related to two streams of literature that investigate the efficiency of financial institutions.[34] First, there are a few studies that investigate how pension fund characteristics affect administrative costs of both defined benefit (DB) and collective defined contribution (DC) pension schemes. These studies focus on two countries: the US (Caswell, 1976, and Mitchell and Andrews, 1981) and Australia (Bateman and Mitchell,

[34] See Berger, Hunter and Timme (1993) for a review of the literature on the efficiency of financial institutions.

2004). In addition, there are a number of publications that examine fees and administrative costs in individual account DC pension schemes for sixteen countries around the world (*e.g.* Whitehouse, 2000, Dobronogov and Murthi, 2005, and James, Smalhout and Vittas, 2001). Two important conclusions can be drawn from the results of these studies. One is that significant economies of scale may be attained in the administration of pension funds, and the other is that there are large differences in administrative costs across countries and pension plans.[35]

Second, while little is known about the investment costs of pension funds, there is a large body of literature on the costs incurred by mutual funds.[36] The investment operations of pension funds are similar to those faced by mutual funds and many pension funds invest (part of) their funds through mutual funds.[37] Therefore, this literature can provide useful insights into the investment operations of pension funds as well.[38] Empirical evidence suggests substantial economies of scale related to costs in the mutual fund industry (*e.g.* Malhotra and McLeod, 1997). However, these scale economies turn out to decrease as the fund size increases and become zero as soon as the optimal size has been reached (*e.g.* Indro *et al.*, 1999, and Collins and Mack, 1997).

Of course, mutual funds may incur higher costs because they hunt for higher returns. A few studies suggest that mutual funds achieve superior returns, indeed offsetting higher expenses. For example, Ippolito (1989) compared the expenses and returns of mutual funds and index funds and found that mutual funds offset higher expenses with better results. Possibly, however, this outcome may be sensitive to the particular benchmark used, or could be explained by survivorship bias (*e.g.* Malkiel, 1995). Many other studies have indeed found that higher costs are not related to superior performance relative to the risk-adjusted rate of return (*e.g.* Jensen, 1968, Malkiel, 1995, and Malhotra and McLeod, 1997). Thus, the evidence suggests that, in general, higher costs incurred by mutual funds do not lead to higher returns. Since the investment operations of pension

[35] See also Mitchell (1998).

[36] Most studies do not have separate data on administrative and investment costs and instead use the total costs (*e.g.* Caswell, 1976, Bateman and Mitchell, 2004, Dobronogov and Murthi, 2005, and Mitchell and Andrews, 1981). Only James *et al.* (2001) report separate statistics on investment fees for some individual account pension schemes.

[37] James *et al.* (2001) estimate that in the US the average investment costs are 0.22% and 0.81% of total assets for, respectively, passive and active institutional investors.

[38] Mutual fund expenses and investment costs of pension funds are different. For example, marketing costs and administration costs are important cost categories in the mutual fund industry. Pension funds have hardly if any marketing costs and administration costs are reported separately. Further, pension funds have to take the duration of their investment portfolio into account, given their liabilities. Finally, mutual funds often focus on investments in one asset class (*e.g.* stocks, bonds), while pension funds generally invest in various asset classes.

funds and mutual funds are similar, it seems reasonable to expect this result also to hold for pension funds.[39] We may therefore conclude that, *ceteris paribus*, stakeholders are likely to be best served by pension funds with low investment costs.

The remainder of this chapter proceeds as follows. Section 2.2 discusses institutional details of the Dutch pension system. Section 2.3 presents summary statistics on administrative costs, size and governance of pension funds. Section 2.4 discusses the model we apply to explain administrative costs and presents the variables used in our empirical analysis, while Section 2.5 presents estimates of this model. Section 2.6 and 2.7 present similar summary statistics, model and estimation results for investment costs. Finally, Section 2.8 draws conclusions. Appendix 2.A discusses the model of total operating costs, that is, the sum of administrative costs and investment costs, and Appendix 2.B provides alternative estimation outcomes for the investment costs model.

2.2 The pension system in the Netherlands

The Dutch retirement pension system is built on three pillars. The first pillar is the basic pension for every person over 65, under the Old Age Pensions Act ('Algemene Ouderdomswet'; AOW). This benefit is funded by the government according to the pay-as-you-go method, *i.e.* current AOW pensions are paid out of current contribution income. The second pillar consists of employees' compulsory participation in company or industry-wide pension schemes, with employees saving for a pension in addition to the AOW benefit according to a funded scheme. The third pillar comprises (tax-supported) schemes which people arrange individually in addition to the first and second pillar schemes.

At the end of 2005, 800 pension funds served the Dutch market. In total they managed some €630 billion in pension capital (125% of GDP) for around 6.3 million active members, 2.4 million pensioners and 8 million inactive participants (on a population of 16 million).[40] Under Dutch law, employees must participate in the pension scheme offered by their employer. Generally, both the employer and the employee pay pension contributions, the employer bearing most of the cost. Almost all pension schemes in the Netherlands are DB schemes, meaning that the pension fund commits itself to paying benefits at a pre-defined level. This contrasts with defined contribution DC schemes in

[39] Lakonishok, Schleifer and Vishny (1992) report that the pension fund industry have consistently underperformed the market. The authors put forward that pension fund managers may trade too much, incurring large execution and transaction costs, and may be unlucky with their timing..
[40] Job-switchers may be counted more than once.

which the financial contribution is fixed and the eventual benefit depends on the return on the funds invested. Most pension contracts guarantee only a nominal benefit, but pension funds do aim to link pensions to the wage or price index, provided there is sufficient pension capital. The Dutch situation can therefore best be described as a nominal DB pension combined with a 'target benefit' index-linked pension.

Internationally, the Dutch system of old age provision is rather unique. The size of the supplementary compulsory funding system is huge and based entirely on funding. Few countries have similarly high savings for their private pensions (OECD, 2004). Moreover, under the Dutch system, most pension schemes (90% in 2004) are DB schemes. In the UK and the US, which have also built up substantial pension capital through funding schemes, DC schemes dominate the market and their proportion is increasing. In the Netherlands many of the annuity and single premium policies, a significant element of third pillar provision, fall into this category. The fully funded nature of the second and third pillars promotes adequate savings as demographic pressures rise. The number of persons over 65 as a percentage of the 20–64 age group will double over the next 25 years. Because in international terms, the post-WWII decline in the birth rate came comparatively late in the Netherlands, the ageing of its population will also peak at a later stage.

In the Netherlands, three major types of pension funds can be distinguished: company funds, industry funds, and professional group funds (including non-academic occupational groups). Company funds provide pension plans to the employees of their sponsor company. They are separate legal entities, but are run directly by the sponsor company and, often, the labour union of the employees. Industry funds provide pension plans for employees in an industry. Such pension plans are based on a collective labour agreement (CLA) between an industry's companies and the labour unions, representing the employees in this industry. There are two types of industry-wide pension funds: compulsory funds and non-compulsory funds. Compulsory funds are based on a CLA making participation mandatory for all employers and employees working in the respective industry. Non-compulsory industry funds refer to CLAs that leave employers a choice as to whether or not to participate. Finally, professional group funds offer pension schemes to specific professional groups (*e.g.* general practitioners, public notaries). In contrast to company and industry funds, professional group funds deal directly with workers and not with employers. Other types of pension funds include saving funds, but they constitute a

very small share of the industry.[41] Insurance companies also offer individual and collective pension plans, but they are not considered in this study, since separate data on the operating costs of such pension plans is not available. For more details of the Dutch pension system and, particularly, its supervisory regime, see Bikker and Vlaar (2006).

2.3 Administrative costs and size, governance, pension plan design and outsourcing

Administrative costs include all costs laid out to operate the pension fund except investment costs, that is, personnel costs, costs charged by third parties, rent, depreciation, and so on. The administration of pension funds includes record-keeping, communication with participants, policy development and compliance with reporting and supervisory requirements. Investment costs arising from asset management are discussed in Section 6. Although all pension funds are separate legal entities, many small and some medium-sized company funds use personnel and office space of their sponsor. The costs this involves are in many cases not (fully) passed on to the pension fund. For example, about 12% of company funds do not report any administrative costs at all. Obviously, these pension funds were disregarded by our respective data analyses. Small company funds in particular tend to underreport administrative costs.[42] Industry funds, by contrast, have several sponsor companies and are, therefore, unlikely to be able to (implicitly) transfer costs to sponsor companies. Furthermore, as much as 65% of company funds do not report wage costs. They may have been borne by the respective company or been booked as 'other costs'. Again, small company funds in particular tend to underreport wage costs (see Table 2.1 below). Industry funds do not underreport as, again, they cannot pass on costs to (one of) their sponsors.

We use a detailed dataset on all Dutch pension funds for the 1992-2004 period, provided by De Nederlandsche Bank, which is responsible for the prudential supervision of pension funds and their compliance with laws and regulations. The data set is an unbalanced panel, as observations for some pension funds are missing, due to new entrants, mergers, and terminations. The number of pension funds in our dataset declined gradually from 1131 in 1992 to 742 in 2004. Tables 1 to 3 are based on the 655 pension funds that, in 2004, do report administrative costs. They present summary statistics of administrative

[41] In 2004, there were five saving funds holding less than 1 percent of total assets in the pension industry.
[42] Note that, costs are not crucial for solvency supervision and are not central in reporting.

costs during 2004 for, respectively, different size classes, various categories of pension funds and types of pension plans, and, finally, for various outsourcing choices. Size has been measured by either the number of participants or total assets. The 'participants' variable includes contributing employees, inactive participants and pensioners. The tables also show sizes of pension funds and their distribution across categories. This distribution has been quite stable over time. Data from earlier years (1992-2003) lead to results similar to those found in the tables below.

The upper part of Table 2.1 shows the average administrative costs of pension funds for various size categories in terms of the number of participants. The table indicates that the (weighted) average of administrative costs per participant decrease sharply across the number of participants classes, although the average increases somewhat for participants in the highest size category. These costs vary, on average, from €927 for the smallest pension funds to around €30 for the largest two classes. Actual differences in costs across size classes are likely to be even larger, due to underreporting of costs by the smallest company funds. The average administrative costs as percentage of total assets decrease substantially across the number of participants classes, from 0.59% for the smallest funds to 0.07% for the largest class. About half of the pension funds in the smallest size category are legal vehicles for director-large shareholders and director funds for board members and supervisory board members, which explains why average total assets per participant for this size class is much higher than in the other categories.

Table 2.1 Administrative costs by size classes (2004)

Size classes based on:	Administrative costs per participant (euro)	Administrative costs / total assets (%)	Total assets per participant (1,000 euro)	Pension funds reporting zero wage costs (%)[a]	Total number of participants (1,000)	Number of pension funds
number of participants						
<100	927	0.59	157	88	2	56
100 - 1,000	302	0.46	66	82	104	225
1,000-10,000	156	0.23	68	55	809	264
10,000-100,000	86	0.17	50	18	2,774	87
100,000-1 million	28	0.24	12	30	7,146	20
>1 million	33	0.07	46	0	5,611	3
Average / total	*48*	*0.15*	*33*	*61*	*16,446*	*655*
total assets (million euro)						
0-10	159	1.23	13	85	37	105
10-100	129	0.55	23	71	508	289
100-1,000	51	0.27	18	45	3,532	209
1,000-10,000	45	0.17	27	23	4,929	44
>10,000	43	0.10	45	25	7,439	8

[a] Note that only company funds underreport wage cost.

The lower part of Table 2.1 provides the (weighted) average administrative costs for different size categories in terms of total assets. Administrative costs as a percentage of total assets are, again, negatively related to the size of the pension fund. Where the smallest pension funds run up administrative costs of, on average, 1.23% of total assets, the largest funds have costs of only 0.10% of total assets. This differences implies a potential reduction of benefits of more than 30%, or an increase of pension costs of more than 40%, see Graph 2.1. Table 2.1 shows that the provision of pension plans is characterized by large economies of scale, either expressed in number of participants or in total assets under administration.

Table 2.2 Administrative costs by governance and pension plan (2004)

	Administrative costs / total assets (%)	Administrative costs per participant (euro)	Assets per participant (1,000 euro)	Total number of participants (1,000)	Number of pension funds[a]	Average number of participants (1000)
Type of pension fund						
Industry funds (all)	0.13	33	26	14,072	95	148
- Compulsory	0.12	31	26	13,557	76	178
- Non-compulsory	0.16	66	40	515	19	27
Company funds	0.19	138	71	2,167	524	4
Professional group funds	0.10	221	221	71	11	6
Average / total	*0.15*	*48*	*33*	*16,446*	*655*	*25*
Plan type						
Mainly DB	0.14	49	34	15,546	590	26
Mainly DC	0.37	25	7	672	51	13
Other	0.33	37	11	228	14	16

[a] The type of fund is unknown for 21 pension funds; four funds are saving funds.

The upper part of Table 2.2 presents the administrative costs for different pension fund categories. At around €138, company funds' average annual administrative costs per participant are high compared to the mere €33 spent by industry funds. Again, actual differences are likely to be even larger, due to underreporting of costs by company funds. Industry funds provide relatively straightforward pension plans. Also, they face lower costs from the transfer of pension rights, whereas scale effects may play a role too. Company funds have generally higher total assets per participant than industry funds, often reflecting more generous pension plans.[43] Company funds often choose for custom-made pensions: the schemes can be tailored to the wishes of company and participants. Among the industry funds, compulsory funds face average administrative costs of only around €31 per

[43] The age structure of participants may also play a role.

participant per year, whereas non-compulsory funds are twice as expensive. The compulsory industry funds category has the largest number of participants. Professional group funds are, on average, more expensive, though less pricy than company funds. Scale effects seem to be the largest single cause of these cost differences across categories of pension funds. Differences in governance may also play a role, but, compared to the scale effects, they seem to be of minor importance. Table 2.2 shows that while most of the pension funds are company funds, they cover only a minor part of the number of participants.

The lower part of Table 2.2 provides the administrative costs for different types of pension plans. We observe significantly higher average costs for DB schemes, of €49 per participant, compared to €25 per participant for DC schemes. In contrast, the costs as a percentage of total assets are much higher for DC schemes. This is due to the much higher average total assets per participant for DB schemes compared to DC schemes, probably because many of the DC schemes are quite new. So far, the number of DC participants is limited. Again, scale effects probably play a major role.

The upper part of Table 2.3 shows the administrative costs for different behaviour with respect to outsourcing. On balance, pension funds that outsource seem to incur lower administrative costs per participant (second column), although, remarkably, somewhat higher costs in terms of total assets (first column). The costs of pension funds that do not outsource are most probably underestimated due to the underreporting of costs by the smallest company funds, mentioned above. Of course, such underreporting is impossible in the case of outsourcing.

Table 2.3 Administrative costs by outsourcing behaviour (2004)

	Administrative costs / total assets (%)	Administrative costs per participant (euro)	Total assets per participant (1,000 euro)	Total number of participants (1,000) [a]	Number of pension funds [a]	Average number of participants (1000)
Outsourcing of administration						
Less than 50%	0.10	56	58	5,689	334	17
More than 50%	0.22	44	19	10,757	321	34
Average / total	*0.15*	*48*	*33*	*16,446*	*655*	*25*
Type of reinsurance [a]						
Partly	0.36	189	53	227	79	3
Fully	0.36	60	17	463	132	4
Not at all	0.14	45	33	15,702	440	36

[a] The type of reinsurance is unknown for four pension funds.

Finally, the lower part of Table 2.3 displays administrative costs for different degrees of liability reinsurance. Fully reinsured pension funds have transferred all liability risks and (downward) investment risks of their (nominal) pension claims to an insurance company. In contrast, partly reinsured pension funds have transferred some of their liability and investment risks to an insurance company. Liability risks include longevity and disability risk. The transfer of these risks is generally coupled with the outsourcing of pension administration and asset management to the insurance company. Therefore, we use these variables also as an indicator of the outsourcing of administration and investment management.[44] Fully and partly reinsured pension funds have significantly lower cost per participant than funds without reinsurance, even where the latter category profits from large scale effects. As part of administrative costs may be related to investment activities, it is in line with expectations that this type of outsourcing reduces administrative costs as well.

This exploratory survey of possible drivers of administrative costs reveals that scale effects dominate governance characteristics, pension plan features and managerial choices with respect to outsourcing. However, a simultaneous approach, as presented below, is needed in order to determine the marginal contribution of each of these drivers more precisely.

2.4 Empirical model for administrative costs

In this chapter we distinguish two production processes: administration and investment, both of which provide services to participants. In principle, these production processes are fully separable and, in practice, they are often outsourced to different service providers. Therefore, we discuss each component separately. For the 'administration' production process we observe various inputs, such as labour, management, advice, and office premises. Production processes are often represented by their dual, the cost function, in order to test behavioural assumptions (Coelli *et al.*, 1998). We will use the cost function to estimate scale economies. In theory, the cost function should include at least output volume and input prices. Although we observe input costs, we do not observe the

[44] Unfortunately, pension funds that have outsourced investments but not reinsured their liabilities are not captured by this variable. Data that measure pension funds' outsourcing of asset management directly are not available. In addition, measuring the outsourcing of asset management is no straightforward exercise. In many cases, pension funds have contracts with several asset management companies and they have varying degrees of control over how their funds are invested.

respective input quantities and input prices. The true input prices would probably be of no use in an econometric model, because there is little or no price variation across the small country the Netherlands is. Gilligan and Smirlock (1984) and Kolari and Zardkoohi (1990) assume that efficiency wages and other factor prices are equal for all financial institutions. Price changes across the years due to inflation would not provide additional information,[45] whereas minor changes in, say, wage rate due to increased productivity would probably be insufficient to identify their true impact of this price on costs. Therefore, following the cited authors above and Swank (1996), we omit input prices for both practical and theoretical reasons. As we will explain later, this simplification is of no consequences to our purpose: measuring the impact of scale, governance and plan design on costs.

Section 3 indicates that pension funds' size, governance, plan design and outsourcing choices each have their impact on administrative costs. In order to examine the marginal contributions of these determinants, we estimate the following multiple regression model of administrative costs:

$$\ln AC_{it} = \alpha + \Sigma_{j=1,2}\, \beta_j\, (\ln \text{participants}_{it})^j + \Sigma_j\, \gamma_j \text{ governance dummies}_{ijt} + \delta \text{ pension plan design dummy}_{it} + \Sigma_j\, \zeta_j \text{ outsourcing}_{ijt} + \Sigma_j\, \eta_j \text{ control variables}_{ijt} + \varepsilon_{it} \qquad (1)$$

$AC_{i,t}$ stands for the administrative costs of pension fund i at time t. As our scale variable we use the pension fund's number of participants, focussing on service activities related to clients. An estimate for the coefficient of this scale variable, β_1, of less than 1 would indicate the presence of scale economies in pension fund administration, as observed in the data analyses above. In variants of the model we also include the square of this scale variable, to discern a possible non-linear relationship with changing economies of scale over the size classes. We use logarithms for costs and participants to reduce heteroskedasticity. The error term is represented by ε_{it}. We estimate the standard deviations with White's correction for heteroskedasticity.

The impact of governance is investigated using four dummy variables that indicate the type of pension provider: non-compulsory industry funds, compulsory industry funds, company funds and professional group funds.[46] Since industry funds have generally more straightforward pension schemes and face fewer transfers of accrued pension rights, they may incur lower costs compared to company funds. Professional group funds operate in a

[45] Note that in a panel data set all values variables should be deflated to avoid spurious correlations.
[46] The fifth category, saving funds and funds with an unknown status, serves as reference category.

more decentralised environment and have to deal with the many 'professionals', rather than with one or a few companies, for instance, in collecting premiums. Therefore, their administration is expected to be more costly than that of industry funds. Pension plan design is represented by a dummy variable 'defined contribution', which identifies DC pension funds. DC plans may be easier to manage than DB plans as long as participants have no or limited choice with respect to pension fund and investment portfolio, as is commonly the case in the Netherlands.[47] However, DC plans are likely to entail additional education costs (if participants have investment choices) and marketing costs (where individual participants may choose their DC pension fund and/or insurer).[48] Outsourcing choices include a variable 'outsourcing of administration', which indicates the percentage of activities outsourced. This coefficient will be negative if outsourcing improves efficiency, that is, if it leads to a net reduction of costs. In addition, we include two dummy variables for, respectively, fully and partly reinsured pension funds, reflecting full or partial coverage of liabilities and investment risks and outsourcing of investment management. Often, also outsourcing of administration is part of the reinsurance contract.

We also include a number of control variables, which help to explain administrative costs and may improve the estimates of the other coefficients. The ratio of total assets and participants represents the average investment per participant. Higher per capita investments may come with higher costs. The variables percentage pensioners and percentage inactive participants control for the composition of participants of the pension fund, as costs for these categories may differ from those of active participants. A dummy variable for 'investment costs reported' indicates whether or not the pension fund reports investment costs. If pension funds do not report investment costs, part of these costs may be reported under administrative costs. Hence, we expect reporting pension funds to have lower administrative costs. Finally, we aim at controlling for the number of pension rights transfers.[49] Transfers of pension rights are costly because they require the valuation of pension rights and the administration of the transfer. These costs are expected to be lower when employees switch jobs between employers that are both connected to the same industry-wide pension fund. Therefore, account transfer costs are expected to be lower for

[47] Under a DC scheme, there is less need for actuaries and no need to observe funding rate requirements.
[48] Marketing costs are generally reported to be among the most important cost categories in countries where workers are free to choose – and to switch – pension funds (*e.g.* Dobronogov and Murthi (2005); James *et al.* (2001)).
[49] The possibilities for employees to switch pension funds are limited. Generally, switching is only possible when an employee moves to an employer connected to a different pension fund. After starting in the new job, the employee has the right to have his accrued entitlements transferred to the new pension fund.

(large) industry funds – where job-switchers are likely to stay with the same industry fund – than for company funds Due to the limited data on account transfers, this variable has been dropped from the final model. In the subsample where this variable is available, its coefficient was positive, indeed indicating additional costs.

2.5 Empirical results for administrative costs

Table 2.4 presents estimation results of Equation (1) for, subsequently, the full data set (1992–2004), the latest year (2004), and for company funds and industry funds separately, both over the entire 1992–2004 period. For all data samples the linear specification of the scale variable appeared to be inferior to the quadratic form.[50] Therefore, we only present the latter model. The scale coefficient β_1 of the number of participants, at 0.64, is far removed from its constant-returns-to-scale value of 1. Apparently, very strong and significant economies of scale exist in the administration of most Dutch pension funds. An increase of the pension fund size by 1% would raise administrative costs by only 0.64%.[51] The observed 36% potential scale economies per additional unit of production are far greater for pension funds than those found for *e.g.* Dutch banks (10%) or insurance firms (21%).[52] The significant quadratic terms explain that these economies of scale for administration are not constant but decrease as the pension fund size increases. The empirical relationship between economies of scale and pension fund size is illustrated in Graph 2.2. When cost elasticity becomes equal to 1 we see constant returns to scale. At this point, the pension fund size has reached its optimal scale. Larger pension funds face diseconomies of scale. More than 90% of the pension funds in our sample are below the optimal size. This size tends to increase over the investigated years; in 2004, all funds are below the optimal size.

The governance dummy variables indicate that administrative costs differ across types of pension provider. Professional group funds are the most expensive, probably because they operate in a more decentralised environment and have to deal directly with individual professionals – instead of companies – which makes their administration more costly. Industry funds have lowest costs, which may be due to the relatively straightforward pension schemes under the corresponding collective labour agreement

[50] We have tested the restriction that the quadratic term has a zero coefficient. This restriction has been rejected on the 99 percent confidence level.
[51] Note that the scale coefficient β_1 is higher for industry-wide pension funds, indicating that they have less economies of scale.
[52] See, respectively, Bos and Kolari (2005) and Bikker and Van Leuvensteijn (2006).

(CLA) and to the fact that they need to transfer pension rights less often. Among the industry funds, compulsory funds are most efficient, possibly because they do not need to compete for clients or suffer from adverse selection. Cost levels of non-compulsory industry funds and company funds take intermediate positions. Note that the ordering of pension fund categories by costs levels (from low-cost to expensive) remains constant across the various samples and specifications, although their coefficients vary across the samples.

Table 2.4 Estimates for the administrative costs model (1992–2004)

	Full data set		2004		Company funds		Industry funds[a]	
Number of participants (in logs)	0.64	***	0.74	***	0.72	***	0.83	***
	(0.01)		(0.02)		(0.01)		(0.01)	
Ditto,[b] squared	0.04	***	0.01	***	0.03	***	0.02	***
	(0.00)		(0.00)		(0.00)		(0.00)	
Compulsory industry funds	-0.52	***	-0.69	***			-0.43	***
	(0.05)		(0.23)				(0.11)	
Non-compulsory industry funds	0.45	***	-0.21				-0.09	
	(0.07)		(0.25)				(0.11)	
Company funds	0.55	***	-0.04					
	(0.03)		(0.22)					
Professional group funds	1.18	***	0.32					
	(0.07)		(0.29)					
Defined contribution plan	-0.20	***	-0.29	*	-0.20	***	-0.40	*
	(0.04)		(0.16)		(0.06)		(0.12)	
Outsourcing of administration	1.08	***	0.75	***	1.21	***	0.26	***
	(0.03)		(0.10)		(0.04)		(0.05)	
Liabilities fully reinsured	-0.76	***	-0.39	***	-0.73	***	-1.07	***
	(0.04)		(0.11)		(0.04)		(0.14)	
Liabilities partly reinsured	-0.12	***	0.13		-0.17	***	-0.40	***
	(0.04)		(0.09)		(0.05)		(0.12)	
Total assets (in €1000) per participant	0.07	***	1.53	***	1.25	***	2.59	***
	(0.02)		(0.38)		(0.11)		(0.36)	
Percentage of pensioners	0.59	***	0.08		0.46	***	0.90	***
	(0.05)		(0.23)		(0.08)		(0.17)	
Percentage of inactive participants	-0.29	***	-0.74	***	-0.22	**	-1.14	***
	(0.07)		(0.27)		(0.10)		(0.12)	
Investment costs reported	-0.46	***	-0.29	***	-0.33	***	-0.43	***
	(0.03)		(0.10)		(0.03)		(0.07)	
Intercept	-0.39	***	0.12		-0.50	***	-0.89	***
	(0.05)		(0.29)		(0.08)		(0.18)	
Number of observations	10,119		655		6,560		1,195	
F-statistics[c]	2,307	***	157	***	1,318	***	703	***
Adjusted R^2	0.71		0.75		0.62		0.87	

Notes: ***, **, and * denote significantly different from zero at the 99%, 95%, and 90% confidence level, respectively (for the scale variables: significantly different from 1). Standard errors are corrected for heteroskedasticity and reported in parentheses. All variables are expressed in the 2004 price level. [a] The industry fund regression includes the professional group funds, which acts as a reference group; [b] Expressed as the deviation (in logs) from the average number of participants, allowing for easier interpretation of the coefficients; [c] Joint significance of coefficients.

The administration of DC plans appears to be less costly than that of DB plans, as becomes especially clear from the estimation for 2004 (when more pension funds had DC plans) and from the compulsory and industry fund estimates. Apparently, DC plans are easier to manage and – due to their limited range of options and, in the Netherlands, their collective nature – do not incur high marketing costs and costs of education in risk awareness.

Remarkably, outsourcing of the administration seems to raise costs significantly. This outcome is most probably due to underreporting of costs where pension funds keep their own administration.[53] Note that outsourcing is applied most frequently by the smallest pension funds. Full reinsurance, that is, outsourcing of liability and investment risks as well as – often – the administration appears to reduce administrative costs significantly, as expected. Where administration is included in the outsourcing contract, the administrative costs are included in the reinsurance premium. Partial reinsurance of liability and investment risks also reduces administrative costs, although generally less strongly and not significantly in the 2004 sample.

The significantly positive coefficient of total assets per participant confirms our expectation that administrative costs are higher for pension funds with relatively higher investments, since part of the administrative costs may be related to investment. Administration costs appear to be significantly higher for pension funds with relatively many pensioners and lower for funds with relatively many inactive participants. Finally, pension funds that report investment costs appear to have lower total operating costs than others. This, too, is in line with expectations: apparently, some non-reporting pension funds turn out to report (part of) their investment costs as administrative costs.

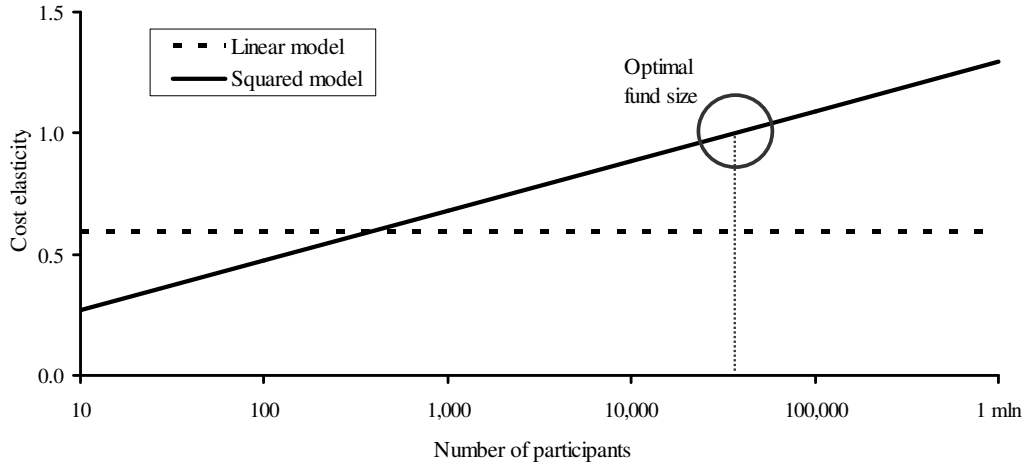
We also calculated the squared partial correlations (SPC), which indicate the marginal contribution of individual variables in explaining administrative cost differences (not reported here). The SPC's indicate that the scale variables have by far the greatest explanatory power. The reinsurance dummy, the percentage of pensioners and pension governance variables have some – although much less – explanatory power, whereas the contribution of the type of pension scheme is negligible. In addition, we calculated the variance inflation factors. These factors are below 4 for all coefficients, indicating that

[53] We have investigated possible selection bias (Heckman, 1976). Use of a so-called heuristic model approach confirms that scale effects and the effects of outsourcing are indeed affected by underreporting. The heuristic model is a probit model which estimates whether the probability of underreporting can be explained by the explanatory variables of Equation (1). The selection bias indicates that our conclusions would be enforced in the imaginary case of a world without underreporting of costs.

multicollinearity is never a problem. All in all, we find plausible and highly significant coefficients for most explanatory variables. Also, we observe similar outcomes across the various samples used, so that the results appear to be fairly robust.

We have re-estimated the model for every single year in our sample. In all thirteen years, we observe strong economies of scale, but the potential to reduce costs by increasing scale appears to decreases over time. This is in line with the fact that the average number of participants per pension fund gradually increases.[54] The coefficient of the quadratic term also decreases with time. This implies that the optimal size increases over time, which is in line with additional costs due to IT investments and requirements of legal, supervisory and accounting regimes which are likely to increase less than proportionally with size.

Graph 2.2 Economies of scale and pension fund size (1992-2004)



Note: Cost elasticities below one imply increasing returns to scale, a cost elasticity of one reflects constant returns to scale while cost elasticities above one point to decreasing returns to scale. This graph is based on the estimates for the linear model (not presented in Table 2.4) and the quadratic model (as shown in Table 2.4), both using the full data set.

2.6 Investment costs and size, governance, pension plan design and outsourcing

Investment costs include wages of portfolio managers and analysts, brokerage fees and the cost of electronic trading facilities. There are at least two possible causes for economies of scale in the investment of pension funds' assets. First, a larger fund can spread costs that increase less than proportionally with size over a larger asset base.

[54] Note that the population of funds gradually shifts to the right along the quadratic-model line of Graph 2.2.

Examples are the costs of trading facilities, asset managers, financial research, risk management, and compliance with regulatory standards and reporting requirements. Second, large pension funds are likely to have more bargaining power (*e.g.* James *et al.*, 2001).

Pension funds must report investment costs separately. In order to obtain net investment returns, these costs are deducted from gross returns. About 24% of the pension funds in our sample do not report any investment costs. There are various possible explanations for such missing observations or zero values. Sometimes these costs are included in the premium of reinsurance contracts. Also, the respective pension funds may have deducted investment costs from investment returns directly without reporting, or they may have allocated investment costs to administrative costs. This is confirmed in the empirical analysis of Section 5, showing that pension funds which do not report investment cost appear to have higher administrative costs. For this latter reason, we also examine total operating costs. The results are shown in Appendix 2.A.

Table 2.5 Investment costs by size classes (2004)

Size classes based on:	Investment costs per participant (euro)	Investment costs / total assets (%)	Total assets per participant (1,000 euro)	Total number of participants (1,000)	Funds that not report investment costs (%)	Number of pension funds
number of participants						
<100	270	0.13	208	1	52	27
100-1,000	101	0.14	72	75	33	151
1,000-10,000	97	0.14	71	672	21	209
10,000-100,000	45	0.11	41	2,469	13	76
100,000-1 million	13	0.13	10	6,847	10	18
>1 million	39	0.08	46	5,611	0	3
Average / total	*31*	*0.10*	*31*	*15,676*	*26*	*484*
total assets (million euro)						
0-10	25	0.15	17	16	53	49
10-100	31	0.14	22	418	28	209
100-1,000	25	0.14	18	3,163	14	179
1,000-10,000	24	0.10	24	4,809	7	41
>10,000	39	0.10	41	7,270	25	6

The upper part of Table 2.5 shows the average investment costs of pension funds for various size categories in terms of the number of participants. Average investment costs per participant decrease sharply across the number of participants classes, from €270 for the smallest pension funds to €13 and €31 for the largest two fund classes. Note that investment costs per participant are lowest for pension funds in the second largest class, which serves the greatest number of participants. Actual differences in costs across size

classes are even larger than according to Table 2.5, as smaller pension funds report zero investment costs substantially more frequently than larger ones. The investment costs as percentage of total assets decrease across the number of participants classes, from around 0.14% for the three smallest fund classes to 0.08% for the largest funds. The lower part of Table 2.5 provides a similar overview for various size classes based on total assets with comparable conclusions. Remarkably, investment costs per participant do not vary systematically across the total assets size classes.

2.7 Empirical model for investment costs

We assume that the size, governance, plan design and outsourcing choices of pension funds determine not only their administrative costs but also their investment costs. Since we do not have investment production input prices available, the investment costs model is very similar to the administrative costs model. Of course, the output measure differs, but the control variables are the same. In order to examine the marginal contribution of each determinant, we estimate the following multiple regression model of investment costs:

$$\ln IC_{it} = \alpha + \Sigma_{j=1,2}\, \beta_j\, (\ln \text{total investments}_{it})^j + \Sigma_j\, \gamma_j \text{ governance dummies}_{ijt} + \delta \text{ pension plan design dummy}_{it} + \Sigma_j\, \zeta_j \text{ reinsurance dummies}_{ijt} + \Sigma_j\, \eta_j \text{ control variables}_{ijt} + \varepsilon_{it} \qquad (2)$$

$IC_{i,t}$ stands for the investment costs of pension fund i at time t. As our scale variable we use the pension funds' total assets, focusing on service activities as related to returns on investment. Compared to Equation (1) we drop 'outsourcing of administration' and 'reporting of investment costs', which are not relevant here, and add 'percentage of investments in stocks', as the costs of stock management is expected to be higher than that of fixed-income securities. This latter variable controls for the risk-return trade-off the pension funds faces: more stocks imply higher risks and, hence, higher costs to manage that risk. Of course, the additional costs are expected to be compensated by higher returns.

The coefficient β_1 of the logarithm of total investment is, at 0.78, significantly different from 1, its constant-return-to-scale value (Table 2.6). This confirms that strong economies of scale exist with regard to investment costs as well. An increase of total assets by 1% would raise investment cost by only 0.78%. These economies of scale per additional unit of production (22%) are substantially less than those for administrative costs. The

significant quadratic terms show that the economies of scale with respect to investment management are also not constant, but vary with the pension fund size, indicating the existence of an optimal fund size.

The governance dummy variables indicate that investment costs differ across types of pension institutions. Compulsory industry funds have, on average, lowest investment costs, while non-compulsory industry funds are second best in this respect. Apparently, these types of pension funds are able to manage their investment more efficiently than the other categories: industry funds have lower costs. These governance dummies reflect cost level differences similar to those in the administrative cost model. Pension funds with DC plans appear to have higher investment costs than those of DB plans in the quadratic full-data set sample. For the other samples we do not observe any significant effect.

Full or partial outsourcing of liability and investment risks does not affect investment costs significantly. As reinsurance premiums are booked separately, we would have expected lower costs. Underreporting of investment costs for do-it-yourself company funds may have distorted the comparison.

The coefficient of 'percentage of investments in stocks' is significantly positive in most samples. These positive coefficients reflect that a higher share of investments in stocks is accompanied by higher costs, as stocks need more investment and risk management.[55] An exception is the industry funds sample, where a negative sign is observed. We can not explain this unexpected sign, but the coefficient is positive in an alternative model, presented in Table 9 (see Appendix B). Apparently, industry funds are able to manage their stock investments relatively efficient. The variable 'percentage pensioners' does not affect investment costs, whereas a relatively high share of inactive participants seems to raise costs.

All in all, we find plausible and (often highly) significant coefficients for many explanatory variables. Most results are similar across the various samples used, so that these estimates are fairly robust. An exception is the scale-economies coefficient in the industry model which is 1. Hence, for this category of pension funds, we observe no scale economies. As we cannot exclude the possibility that some pension funds may have

[55] Following Hughes and Mester (1993), we also included investment volatility (defined as the standard deviation of average annual returns per fund) in a variant of this investment costs model. More risk management would go with more costs, but would reduce volatility, resulting in a negative sign. Alternatively, pension funds that choose more risk (expecting more returns) face both higher investment cost (caused by more risk management activities) and higher volatility, resulting in a positive sign. The estimated coefficient is not significant.

reported investment costs as administrative costs, it might also be useful to model total costs instead of their two components, see Appendix A.

Table 2.6 Estimates for the investment costs model (1992–2004)

	Full data set		2004		Company funds		Industry funds [a]	
Total investments (in logs)	0.78	***	0.86	***	0.79	***	1.00	
	(0.02)		(0.03)		(0.01)		(0.02)	
Ditto,[b] squared	0.03	***	0.04	***	0.02	***	0.01	
	(0.00)		(0.01)		(0.00)		(0.01)	
Compulsory industry funds	-0.34	***	-0.52				-0.23	*
	(0.07)		(0.41)				(0.13)	
Non-compulsory industry funds	-0.21	**	-0.24				-0.22	*
	(0.09)		(0.46)				(0.12)	
Company funds	0.11	**	0.15					
	(0.05)		(0.37)					
Professional group funds	-0.08		0.43					
	(0.10)		(0.41)					
Defined contribution plan	0.08		-0.05		0.09		-0.36	**
	(0.07)		(0.23)		(0.08)		(0.16)	
Liabilities fully reinsured	0.01		-0.07		0.01		0.07	
	(0.05)		(0.14)		(0.05)		(0.10)	
Liabilities partly reinsured	0.00		-0.10		-0.02		0.34	*
	(0.05)		(0.16)		(0.06)		(0.20)	
Share of stock investments	0.64	***	0.28		1.14	***	-1.91	***
	(0.12)		(0.42)		(0.15)		(0.34)	
Percentage of pensioners	0.07		-0.18		-0.10		-0.22	
	(0.09)		(0.36)		(0.13)		(0.22)	
Percentage of inactive participants	0.29	***	0.82	**	0.47	***	-0.30	
	(0.09)		(0.37)		(0.12)		(0.23)	
Intercept	-4.81	***	-5.83	***	-5.03	***	-6.31	***
	(0.16)		(0.48)		(0.14)		(0.25)	
Number of observations	4,542		470		3,121		880	
F-statistics [c]	1,494	***	162	***	1,086	***	544	***
Adjusted R^2	0.75		0.71		0.70		0.81	

Notes: ***, **, and * denote significantly different from zero at the 99%, 95%, and 90% confidence level, respectively (for the scale variables: significantly different from 1). Standard errors are corrected for heteroskedasticity and reported in parentheses. All variables are expressed in the 2004 price level. [a] The industry fund regression includes the professional group funds, which acts as a reference group; [b] Expressed as the deviation (in logs) from the average total investments, allowing for easier interpretation of the coefficients; [c] Joint significance of coefficients.

2.8 Conclusions

The administrative and investments costs of private pension funds are of great importance to both employees and employers, as they potentially erode the value of wealth accrued for retirement or, alternatively, increase the costs of retirement security. This study finds a strong dispersal in administrative and investment costs across Dutch pension funds, explained mainly by their size. These effects may also been expected in other countries, as

confirmed by the literature cited above. Other pension fund characteristics play a minor role. Industry funds are significantly more efficient than company funds and other types of pension funds. The industry funds' DC plans are somewhat cheaper to manage than their DB plans. Higher shares of pensioners make pension funds more costly. Pension funds that outsource their administration appear to have higher costs than others, what we ascribe to under reporting of administrative cost of smaller funds. Finally, reinsurance, that is, the outsourcing of liabilities and investment, reduces costs, as expected.

A company's own pension fund can provide specific benefits, both to its participants and the sponsor company. In particular, such pension funds allow for more direct control, which potentially could result in superior alignment of the pension fund governance and policy with the interests of its stakeholders. These benefits may include tax gains, more discretion to adjust contributions and the option to claim (part of) pension fund surpluses (*e.g.* Broeders, 2005). However, as shown in this chapter, such benefits come at high costs when the pension fund is small, as such pension funds are unable to (fully) exploit the large economies of scale that exist in pension plan administration and asset management. In addition, accounting principles and compliance rules, new information technology, and stricter supervision have increased the complexity of pension fund management and its costs, affecting smaller funds in particular.

The market for pension provisioning may be seen as imperfect because collective pension arrangements are generally much cheaper than individual ones, due to scale and the absence of marketing and education costs, adverse selection and profits. This suggests scope for beneficial market intervention aimed at providing good pensions at low costs. For these reasons, many countries have introduced mandatory pension schemes. An example of a legal instrument that reduces costs further is, in the Netherlands, the possibility for sectors to ask the government for a mandatory status within the sector of a collective labour agreement, so that industry fund pensions become 'compulsory' for all companies in that industry. This appears to be quite efficient, as we find that operating costs are lowest for large compulsory industry funds. In fact, this structure has contributed to low average operating costs of pension funds in the Netherlands (0.16% of total assets), compared to a number of other countries where costs vary from 0.54 tot 1.36% of total assets (Bateman and Mitchell, 2004, Dobronogov and Murthi, 2005).

Given this finding, the question may arise whether the continuing presence of small pension funds with relatively high costs points to market imperfections, which prevent stakeholders from fully exploiting the economies of scale. Many companies, however,

have the choice to operate independently, to co-operate with other pension funds (but then with a common financial buffer) or to outsource all activities. Thus, since companies have different options, company funds indirectly face competition from other (financial) service providers. On the other hand, pension regulation limits the possibility for participants and firms to discipline pension funds, *e.g.* by switching pension funds, thereby eliminating competitive pressures that could potentially force (small) pension funds to lower their costs.

The results of this chapter support (policy) actions aimed to improve the efficiency of pension funds, particularly small funds, in the Netherlands, as well as in other countries.[56] Public policy could be used to promote the transparency of pension plan operating costs and to increase the incentives for small to medium-sized pension funds to merge. The latter would also reduce the costs of supervision. As industry funds are most efficient, it would also be desirable to promote further industry-wide consolidation of pension providers.

[56] The organization of the Dutch company pension funds examines the possibilities of a 'national company pension fund' to supply technical assistance to the smaller company funds or to encompass all small company pension funds to exploit unused scale effects.

APPENDIX 2.A Total operating costs

This chapter finds evidence that some pension funds may have reported investment costs as administrative costs. Therefore, we also investigate the determinants of total operating costs. Table 2.7 presents summary statistics on total operating costs for the same pension funds as in Sections 3-5, hence, also for funds that do not report investment costs. Total operating costs per participant depend also heavily on pension fund scale, falling from €1,061 to €72 across the number of participants classes. Total operating costs as percentage of total assets decreases sharply across the total assets classes from 1.31% for the smallest funds to 0.18% for the largest class. For the three classes serving the mass of participants, the average costs still vary strongly, from 0.18% to 0.39%. Again note that, the smaller pension funds tend to underreport costs**.** Note that the average operating costs of the pension funds in the Netherlands (0.16) are low compared to a number of other countries where average operating costs vary from 0.54 to 1.36% of total assets (Bateman and Mitchell, 2004, Dobronogov and Murthi, 2005).

Table 2.7 Total operating costs by size classes (2004)

Size classes based on:	Total costs per participant (euro)	Total costs / assets (%)	Total assets per participant (1,000 euro)	Total number of participants (1,000)	Number of pension funds
number of participants					
<100	1,061	0.68	157	2	56
100-1,000	375	0.57	66	104	225
1,000-10,000	237	0.35	68	809	264
10,000-100,000	126	0.25	50	2,774	87
100,000-1 million	41	0.34	12	7,146	20
>1 million	72	0.16	46	5,611	3
Average / total	*78*	*0.24*	*33*	*16,446*	*655*
total assets (million euro)					
0-10	170	1.31	13	37	105
10-100	155	0.66	23	508	289
100-1,000	72	0.39	18	3,532	209
1000-10,000	68	0.26	27	4,929	44
>10,000	81	0.18	45	7,439	8

Table 2.8 presents estimation results of Equation (1) with total operating costs as dependent variable. The results are very similar to the results for the administrative and investment costs models, shown in Tables 4 and 6, respectively. Most coefficients are significant at the 1% level and all significant coefficients have the same sign as in Table 2.4, where we observe similar mutual ordering of costs for the various fund types.

Table 2.8 Estimates for the total operating costs model (1992–2004)

	Full data set		2004		Company funds		Industry funds[a]	
Number of participants (in logs)	0.69	***	0.80	***	0.79	***	0.86	***
	(0.01)		(0.02)		(0.01)		0.01	
Ditto,[b] squared	0.05	***	0.01		0.02	***	0.02	***
	(0.00)		(0.00)		(0.00)		0.00	
Compulsory industry funds	-0.47	***	-0.63	*			-0.68	***
	(0.06)		(0.25)				0.11	
Non-compulsory industry funds	0.58	***	-0.08				-0.34	***
	(0.08)		(0.27)				0.11	
Company funds	0.82	***	0.17					
	(0.03)		(0.23)					
Professional group funds	1.55	***	0.65	**				
	(0.07)		(0.29)					
Defined contribution plan	-0.28	***	-0.34	*	-0.28	***	-0.55	***
	(0.05)		(0.18)		(0.06)		0.13	
Outsourcing of administration	0.93	***	0.49	***	0.99	***	0.09	*
	(0.03)		(0.10)		(0.04)		0.05	
Liabilities fully reinsured	-1.12	***	-0.62	***	-1.06	***	-1.40	***
	(0.04)		(0.11)		(0.04)		0.14	
Liabilities partly reinsured	-0.36	***	0.04		-0.42	***	-0.65	***
	(0.05)		(0.08)		(0.05)		0.13	
Total assets (in €1000) per participant	0.08	**	1.83	***	1.66	***	2.51	***
	(0.03)		(0.46)		(0.10)		0.36	
Percentage of pensioners	0.60	***	0.05		0.38	***	1.34	***
	(0.06)		(0.23)		(0.08)		0.17	
Percentage of inactive participants	-0.28	***	-0.85	***	-0.25	***	-1.14	***
	(0.07)		(0.29)		(0.10)		0.13	
Intercept	-0.78	***	-0.12		-0.66	***	-0.74	***
	(0.05)		(0.30)		(0.07)		0.17	
Number of observations	10,119		655		6,560		1,195	
F-statistics [c]	2,342	***	161	***	1,626	***	758	***
Adjusted R^2	0.71		0.78		0.66		0.86	

Notes: ***, **, and * denote significantly different from zero at the 99%, 95%, and 90% confidence level, respectively (for the scale variables: significantly different from 1). Standard errors are corrected for heteroskedasticity and reported in parentheses. All variables are expressed in the 2004 price level. [a] The industry fund regression includes the professional group funds, which acts as a reference group; [b] In deviation of the average number of participants (in logs), allowing for easier interpretation of the coefficients; [c] Joint significance of coefficients.

APPENDIX 2.B Alternative investment costs model

We consider 'total investments' as the most relevant scale variable for the investment costs model (see Table 2.6). Table 2.9 presents estimation results of an alternative model using the number of participants as scale variable, just as in the models of administrative costs and total operating costs. Although the outcomes have generally the same sign as in Table 2.6, the results in Table 2.9 are much better in the sense that the significance of most variables improves sharply across all samples. This suggests that, also

for investment costs**,** the number of participants better captures scale than total assets. Remarkably, the results are now very close to those of the administrative cost model in Table 2.4. Note that this dependency of total investments on the type of scale variable was also observed in Table 2.5 where investment cost per participant behaved different across number of participant classes and across total assets classes.

Table 2.9 Estimates of the alternative investment costs model (1992–2004)

	Full data set		2004		Company funds		Industry funds [a]	
Number of participants (in logs)	0.69	***	0.81	***	0.75	***	0.98	
	(0.01)		(0.04)		(0.01)		(0.03)	
Ditto,[b] squared	0.04	***	0.03	***	0.03	***	0.02	**
	(0.00)		(0.01)		(0.00)		(0.01)	
Compulsory industry funds	-1.22	***	-1.18				-2.14	***
	(0.11)		(0.79)				(0.18)	
Non-compulsory industry funds	-0.27	**	-0.25				-1.89	***
	(0.14)		(0.78)				(0.15)	
Company funds	0.43	***	0.83					
	(0.07)		(0.68)					
Professional group funds	1.09	***	1.94	***				
	(0.12)		(0.73)					
Defined contribution plan	-0.18	**	-0.65	*	-0.13		-1.09	***
	(0.09)		(0.36)		(0.10)		(0.26)	
Liabilities fully reinsured	-0.40	***	-0.53	***	-0.40	***	-0.16	
	(0.07)		(0.18)		(0.08)		(0.12)	
Liabilities partly reinsured	-0.09		-0.22		-0.14	**	0.49	**
	(0.06)		(0.18)		(0.07)		(0.22)	
Share of stock investments	1.74	***	0.94	*	2.07	***	0.11	
	(0.15)		(0.55)		(0.18)		(0.39)	
Percentage of pensioners	1.17	***	1.12	***	0.84	***	3.44	***
	(0.12)		(0.44)		(0.16)		(0.33)	
Percentage of inactive participants	-1.10	***	-0.74		-1.08	***	-2.12	***
	(0.12)		(0.47)		(0.16)		(0.33)	
Intercept	-1.45	***	-2.44	***	-1.51	***	-2.08	***
	(0.09)		(0.70)		(0.12)		(0.29)	
Number of observations	4,542		470		3,121		880	
F-statistic [c]	762	***	65	***	532	***	358	***
Adjusted R^2	0.64		0.57		0.59		0.67	

Notes: ***, **, and * denote significantly different from zero at the 99%, 95%, and 90% confidence level, respectively (for the scale variables: significantly different from 1). Standard errors are corrected for heteroskedasticity and reported in parentheses. All variables are expressed in the 2004 price level. [a] The industry fund regression includes the professional group funds, which acts as a reference group; [b] Expressed as the deviation (in logs) from the average number of participants, allowing for easier interpretation of the coefficients; [c] Joint significance of coefficients.

Chapter 3

Investor sophistication and risk taking

"People rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations. In general these heuristics are quite useful, but sometimes they lead to severe and systematic errors"

Amos Tversky and Daniel Kahneman, 1974

Using investment policy data of 857 Dutch pension funds during 1999–2006, we develop three indicators of investor sophistication. The indicators show that pension funds' strategic portfolio choices are often based on coarse and less sophisticated approaches. First, most pension funds round strategic asset allocations to the nearest multiple of 5%, similar to age heaping in demographic and historical studies. Second, many pension funds invest little or nothing in alternative, more complex asset classes, resulting in limited asset diversification. Third, many pension funds favor regional investments and as such do not fully employ the opportunities of international risk diversification. Our indicators are correlated with pension fund size, in line with the expectation that smaller pension funds are generally less sophisticated than large pension funds. Using the indicators for investor sophistication, we show that less sophisticated pension funds tend to opt for investment strategies with less risk.

This chapter is based on: De Dreu, J., and Bikker, J. A., 2012, Investor sophistication and risk taking, *Journal of Banking & Finance, 36* (7): 2145-2156.

3.1 Introduction

During the recent financial banking and sovereign debt crises pension funds sustained huge investment losses. The crash in equity prices, coupled with a dramatic decline of long-term interest rates used to discount liabilities, slashed pension funds' funding ratios (defined as total assets divided by discounted pension liabilities), with only limited relief from increased bond prices. In 2008 alone the market value of total pension assets in the Netherlands dropped by more than 17%. Together with the impact of lower discount rates, the crisis caused the funding ratio to fall in that year by no less than 49 percentage points. Strikingly, however, sustained losses varied considerably across pension funds, illustrating considerable differences among pension fund's investment policies. These losses have severe consequences since in many countries pension funds play a central role in investing pension savings and providing old age benefits. This is particularly evident in The Netherlands where the assets of pension funds exceed GDP. Most Dutch pension funds now face significant funding gaps and are forced to increase premiums, cut wage or price indexation and, in a number of cases, even to cut pension rights. Evidently, these investment losses have profound implications and have raised questions as to risk taking by pension funds and the quality and sophistication of their investment policies.

For pension funds, determining the asset allocation strategy is the most important decision in the investment process. Setting the optimal asset allocation strategy involves two decisions. First, the level of risk preference must be determined in line with the funding ratio and preferences of pension scheme participants and sponsor companies. Second, the allocation of investments to different asset classes should be chosen to maximize expected returns, given a pension fund's liabilities and its risk preference. Both tasks are highly complex and it is to be expected that the expertise and abilities of different investors in performing them will vary. We examine pension fund investors' sophistication in setting an optimal asset allocation (task 2) and how this relates to their risk preferences, expressed in terms of risky investments (task 1).

A major contribution in the finance literature on optimal asset allocation is the two-fund separation theorem, which prescribes investors to hold an optimal portfolio of risky assets in combination with the risk-free asset (Tobin, 1958). This optimal portfolio should be mean-variance efficient, implying that for a given expected return, no additional diversification can lower the portfolio's overall risk (Markowitz, 1952). These theorems are building blocks of CAPM, which states that there is only one optimal risk portfolio, that is,

the market portfolio (Sharpe, 1964). If this is the correct model, asset allocations for investors with different risk preferences should be simply different linear combinations of the riskless asset and the market portfolio. This implies that investors, including pension funds, should keep the ratio of bonds to equities and other asset classes unchanged across all portfolios and vary allocations to the risk free asset, reflecting varying risk preferences. The finding that investors hold different proportions of risky assets – including the ratio of bonds to equities – conflicts with the two-fund separation theorem and is called the Asset Allocation Puzzle (see also Canner *et al*., 1997).

While we concern ourselves with institutional investors, the literature on the sophistication of asset allocation decisions has mostly focused on private investors (individuals or households). Empirical research has shown that private investors invest in ways that are hard to reconcile with standard theory and that have been labeled investment mistakes (Campbell 2006, Calvet, Campbell and Sodini, 2007, 2009a,b). Private investors often use simple rules of thumb in allocating their wealth across asset classes, resulting in suboptimal investment portfolios. The behavioral finance literature classifies such suboptimal investment decisions as behavioral biases or cognitive errors. Individuals use heuristics, or rules of thumb, because they have limited attention, memory, education, and processing capabilities. A number of papers have shown that individual investors often rely on simple asset allocation rules. Examples of such rules are asset allocations that tend to be either zero or 100 percent in equities (Agnew, Balduzzi, and Sundén, 2003) and investor's use of the $1/n$ rule to allocate their money among the n funds they invest in (Huberman and Jiang, 2006). Benartzi and Thaler (2001) show that some private investors use the $1/n$ rule to allocate investments equally among eligible investment funds offered in pension plans and, consequently, that the equity allocation of investors is influenced by the proportion of stock funds offered. The natural conclusion is that the use of heuristics can lead to suboptimal asset allocation by private investors.[57] Other recorded investor mistakes are (i) insufficient diversification (Calvet *et al.*, 2007; Goetzmann and Kumar, 2008), (ii) inertia (Agnew *et al*. 2003; Campbell, 2006; Calvet *et al.*, 2009a) and (iii) holding of losing stocks and selling winning stocks (Dhar and Zhu, 2006; Calvet *et al.*, 2009a).

[57] While the use of the $1/n$ rule points to lower sophistication, it is disputed whether this 'naive' strategy also leads to lower returns. DeMiguel, Garlappi and Uppal (2007) show that investment strategies following 14 different models derived from modern portfolio theory generate inferior out-of-sample results relative to the use of the $1/n$ strategy. They conclude that the gain from optimal diversification for mean-variance models is more than offset by estimation error.

The tendency to round figures coarsely or to choose attractive numbers is also documented in a number of demographic and historical studies. For instance, self-reported age data in countries or periods characterized by low average levels of education often show high frequencies at attractive, 'round' numbers. This phenomenon is called age heaping. Individuals with limited knowledge about their age are found to have a higher propensity to choose a 'plausible' number. These individuals do not choose random numbers, but instead have a systematic tendency to choose attractive numbers, particularly those ending in 5 or 0. Age heaping is reported for a number of data sources, including census returns, tombstones, and tax data. Demographic studies have shown that age heaping is correlated to education (*e.g*. Bachi, 1951), income (*e.g*. Myers, 1976), illiteracy (Budd and Guinnane, 1991) and, more generally, human capital (A'Hearn, Baten, and Crayen, 2009).

While there is a growing literature documenting behavioral biases of private investors, much less is known about professional parties. Institutional investors are generally considered to be more sophisticated than private investors and are therefore assumed to invest more optimally. A number of theoretical papers argue that more sophisticated investors suffer less from cognitive biases or irrational behavior (*e.g*. Banerjee, 1992, DeLong *et al.*, 1990, Hirshleifer *et al.*, 1994, and Shleifer and Summers, 1990). However, there is little empirical evidence documenting (i) the investment behavior of institutional investors or (ii) how this behavior is influenced by their level of sophistication.

To fill this gap in the literature, we study the investment behavior of institutional investors with varying degrees of sophistication. Scale advantages should enable large pension funds to hire competent experts and consultants and spend more time and resources on optimizing their investment policies. Consequently, large pension funds should have a lower propensity to use heuristics in determining their asset allocation, but should instead use more advanced rules to guide investment policy. The more sophisticated investors are also expected to be more knowledgeable about the range of investment options available to them, and consequently to have a larger proportion of investments in other assets than bonds and equities. These factors should enable more sophisticated pension fund investors to apply better asset class allocation strategies than those of less sophisticated pension funds.

The influence of sophistication on risk taking is not self-evident. Less sophisticated investors may underestimate risks and consequently take more risk by investing in high

risk-high (expected) return assets. Alternatively, less sophisticated investors may be more risk shy, thus compensating for weaker risk management skills, *e.g.* the ability to measure and control risk and implement diversification strategies. The latter conjecture is confirmed by previous research, showing that risk tolerance in individuals is negatively correlated with financial knowledge and education (Grable, 2000). We hypothesize that, by analogy, the sophistication of institutional investors correlates also positively to risk taking.

We investigate the investment policies of 857 Dutch pension funds during the 1999–2006 period. At the end of 2010, total pension fund assets in the Netherlands amounted to some €775 billion, or 132% of GDP, ranking the Dutch pension system in terms of the asset-to-GDP ratio as the largest in the industrial world.[58] We find that pension funds' asset allocation policies often seem to be relatively simple and that they vary widely, in line with the asset allocation puzzle. This raises the question whether all pension funds implement optimal asset allocation strategies, given their specific profiles and preferences.

To investigate this, we develop three measures of sophistication. The first measure assumes that less sophisticated pension funds are less knowledgeable about their (unpublished) optimal asset allocation, or use human judgment more, and are therefore more likely to choose plausible figures rather than the outcomes of detailed calculations. For example, they may use multiples of 5% to set their strategic asset allocation. The strategic investment allocation reflects pension funds' (unpublished) investment objectives, which they report to their prudential supervisor, De Nederlandsche Bank. The strategic asset allocation must meet supervisory requirements. The actual asset allocation may depart from the objective as a result of asset price shocks, since pension funds do not continuously rebalance their portfolios (Bikker, Broeders and De Dreu, 2009). We find that most pension funds do, in fact, apply such a coarse approach in allocating wealth to investment classes. This finding is similar to age heaping found in sociological and historical studies, where it is considered an indication of limited education.

Our second measure records how much pension funds invest in alternative, more complex asset classes such as commodities and real estate (versus more simple classes such as money market and mixed asset funds), thereby improving asset diversification.[59] We find that pension funds that apply rounding to multiples of 5% tend to diversify less to

[58] Graph 5 in OECD (2011; see page 7) shows for 2010 that the asset-to-GDP ratio of the pension sector is higher in the Netherlands than in all other OECD countries.

[59] Alternative refers to all assets except bonds and equities.

such more complex asset classes. Third, we examine 'home bias' and find that many pension funds favor regional investments, thereby limiting international diversification. We also find that all three indicators are correlated to pension fund 'size', indicating that smaller pension funds are generally less sophisticated than large funds, which is in line with our expectation.

In accordance with the asset allocation puzzle, we observe for Dutch pension funds that there are large differences in asset allocation strategies across pension funds. Specifically, relative holdings of bonds and equities, investments in more complex asset classes and international diversification all vary significantly. Whereas specific conditions such as size (reflecting scale economies with respect to *e.g.* asset management and risk management), funding ratio, age distribution of participants, type of pension plans or type of pension fund contribute to this spread (Bikker, Broeders, Hollanders and Ponds, 2012), the variation remains largely unexplained. An important question is whether pension fund investors' sophistication influences risk taking. It would be a rational risk-management strategy for pension fund investors with less financial expertise to reduce exposure to risks that are not well understood. We investigate the impact of sophistication on risk taking by estimating a model for the strategic bond allocation, where our measures of sophistication are added as explanatory variables. The empirical results indicate that less sophisticated pension funds have a significantly lower risk profile, investing more in bonds and less in equities.

There are at least two reasons why the pension sector in the Netherlands provides an ideal setting to study the impact of investor sophistication on risk taking. First, 'total assets under administration', our measure of the size of pension funds, which may be related to sophistication, varies widely. Pension funds range in size from small institutions – with assets below one hundred million euro (almost two-thirds of the funds) – to very large institutions with assets of more than one hundred billion euro. The variation in terms of participants is also wide, from less than 100 participants (5% of institutions) to more than a million participants. Large institutions include industry-wide pension funds such as ABP and PFZW, which are among the biggest in the world. Small institutions are mostly company funds that provide pensions for the employees of a single company. Second, De Nederlandsche Bank collects comprehensive data on the investment policies of all these institutions, which allows us to study their asset allocation strategies.

This chapter is organized as follows. Section 3.2 describes our dataset, while Section 3.3 develops three measures of sophistication in pension funds' investment

behavior and examines their mutual connection and relationship to size and other characteristics of pension funds. Section 3.4 investigates the influence of investment sophistication on risk taking. Section 3.5 provides an update of our approach for 2007-2010 as a robustness test, while the last section concludes.

3.2 Data on pension funds

We use a detailed dataset on the investments of 857 Dutch pension funds, consisting of quarterly figures for 1999:Q1 – 2006:Q4. The data is from De Nederlandsche Bank, responsible for the prudential supervision of pension funds and their regulatory compliance. For each pension fund, data is or should be available on its strategic asset allocation, asset sales and purchases and on the market value of investments in various asset classes. Pension funds generally do not fully and continuously rebalance their actual asset allocation to match their strategic allocation policies (Bikker, Broeders and De Dreu, 2010). As a result, actual asset allocations reflect both active policy decisions by pension funds and (recent) returns on the portfolio holdings. We investigate strategic asset allocations, since these fully reflect active choices of pension funds, in contrast to actual asset allocations, which are also determined by market price shocks. The sample is an unbalanced panel, as not all pension funds are included throughout the sample period, due to new entrants, mergers, dissolutions, and reporting failures.[60] Pension funds with evident reporting errors have been excluded.[61] Over 2001-2006, the sample represents around 95% to 99% of pension funds' participants in the Netherlands. Our sample includes 664 company pension funds, 97 industry-wide pension funds, and 11 professional group pension funds; the status of 85 funds is unknown.[62]

Table 3.1 presents summary statistics after cleaning up the data. The size of pension funds in the sample ranges from small pension funds with total investments worth less than

[60] We also compare the results for a balanced sample comprising 381 pension funds that report at least seven years of data. The results are similar to the tables that are presented, suggesting that survivorship bias is not a significant issue.

[61] 2082 (10.2%) of the observations have been deleted: zero or negative number of participants (37 observations), strategic allocation not adding up to 100% (10), observations of pension funds with total investments below €100,000 which are assumed to be not representative (332), too large fluctuation in values of bonds or equity (73), too large difference between actual and strategic allocation (803), and lacking strategic bond or equity allocation (827).

[62] Company funds provide pension plans to the employees of their sponsor company. They are separate legal entities, but are run jointly by the sponsor company and employee representatives. Industry funds provide pension plans for employees working in an industry. Such pension plans are based on a collective labor agreement between an industry's companies and the labor unions, representing the employees in that industry. Finally, professional group funds offer pension schemes to groups such as general practitioners and public notaries.

€1 million, to large pension funds such as ABP, the public servants pension fund, with total investments of over €200 billion. The average size of pension fund assets is €785 million. The number of pension funds varies over the quarters between 510 and 657. Given the total number of pension funds, 857 (after data selection), this implies that each quarter a substantial number of pension funds are – in that quarter – not present in our dataset, due in part to the data clean up. To compare pension funds with different levels of sophistication we define three size classes: small (investments of up to €100 million), medium (€100 – 1000 million) and large (> €1 billion). Although large in number (63% of the institutions), the small pension funds administer only 2% of total pension fund assets. Conversely, while large pension funds represent only 8% of institutions, they administer 86% of total pension fund assets.

All investment figures are split into the respective currencies. We define home bias as more than proportional investments in the euro area. Other characteristics of pension funds, such as number of participants, funding ratio and percentage of pensioners, are available on an annual basis. Where desirable, we interpolate and extrapolate these variables to obtain quarterly values.

Table 3.1 Summary statistics for various pension fund sizes (1999:Q1–2006:Q4)

	Mean value	Standard deviation	Maximum	Minimum	Number of observations
Number of pension funds	614	38	657	510	19,174
Small funds	388	49	438	252	12,165
Medium-sized funds	171	13	188	135	5,429
Large funds	50	6	61	38	1,580
Number of participants	25,135	148,440	2,710,422	1	18,739
Small funds	2,030	11,668	299,195	1	11,801
Medium-sized funds	15,640	46,541	659,342	9	5,392
Large funds	234,613	458,625	2,710,422	3,425	1,546
Total investments, € mln	785.2	6,740.0	204,000.0	0.1	19,174
Small funds, € mln	28.4	26.8	99.9	0.1	12,165
Medium sized funds, € mln	319.6	206.9	998.6	100.0	5,429
Large funds, € mln	8,211.4	22,200.0	204,000.0	1,006.0	1,580

[a] Small pension funds have investments of €0 – 100 million, medium-sized funds €100 – 1000 million and large funds over €1 billion.

3.3 Investor sophistication

In order to assess the sophistication of pension funds' investment policies, we develop three measures of sophistication, based on the data discussed above: (i) the use of

gross rounding, (ii) investments in alternative, more complex asset classes minus investment in alternative simple assets, and (iii) home bias.

3.3.1 Gross rounding of asset allocations

We first examine the use of rounded numbers in pension funds' strategic asset allocation. The histograms in Graph 3.1 show the strategic equity and bond allocations of Dutch pension funds.[63] Two patterns stand out. First, and most remarkably, strategic allocations cluster around multiples of 5%. Table 3.2 shows that the frequencies of 5% multiples used for strategic allocations to both equities and bonds far outstrip those of other numbers. Apparently, pension funds strongly favour round percentages for strategic equity and bond allocations to the nearest 5%. The graphs further suggest that coarse rounding to the nearest 10% is more frequent than rounding to 5%. Apparently, sets of ten are even more attractive than sets of five. Just as Agnew *et al.* (2003) observes for private investors, we also notice that some pension funds take extreme positions of 0% and 100% in equities or bonds.[64] Second, the dispersion of strategic equity and bond allocation across pension funds is large. The graphs show little or no convergence around a certain strategic asset allocation indicating that (beliefs about) optimal asset allocation levels vary widely across pension funds, perhaps (partly) due to diverging conditions such as risk aversion and ageing.

Attractive numbers for rounding should be simple to remember and easy to use for calculations. Multiples of 10%, 5% and also 2% fit the bill. We classify pension funds that use these multiples for their strategic equity and bond allocations as 'using attractive numbers'. Coarse rounding may point to less sophistication in line with findings for demographic studies. Alternatively, the preference of pension funds to use attractive numbers for their strategic asset allocation may be due to the absence of compelling arguments for more 'precise' allocation figures. The latter explanation would be in line with DeMiguel, Garlappi and Uppal (2007), who find that simple heuristics such as the $1/n$ rule generate returns similar to those of more complicated portfolio choice models in the presence of estimation errors. If this alternative explanation were true, we would expect no

[63] Here, we disregard other asset categories, which represent relative small shares in total assets. For a number of (smaller) pension funds these shares are even zero, see Table 3. Section 3.2 investigates this further.

[64] This is also clear from the histograms of actual equity and bond ratios, not shown here. These figures show smooth distributions (actual allocations are influenced by market movement and hence not rounded), but with the same wide dispersion.

significant impact of coarse rounding on risk taking. However, our empirical results presented later in this chapter point elsewhere.

Graph 3.1 Frequency distribution of strategic equity and bond allocations of 857 pension funds (1999:Q1–2006:Q4)

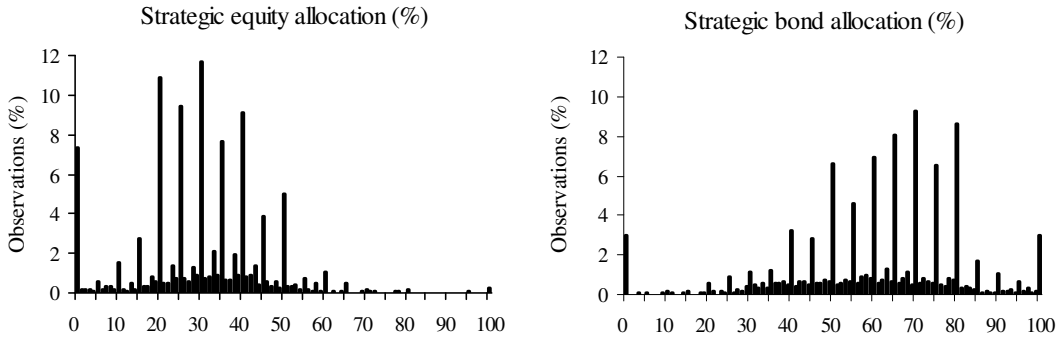


Table 3.2 shows the percentages of pension funds that use attractive numbers for their strategic allocation to both equities and bonds. The number 66% for multiples of 5% by small pension funds (first column, second row) indicates that two-thirds of these pension funds use 5% multiples for their strategic allocation to both equities and bonds, leaving only 34% of funds allocating other percentages, which may include 5% multiples to either bonds or equity. We compare this to the incidence of attractive numbers for both equity and bond allocations under a uniform distribution. As already suggested by Graph 3.1, multiples of 5% (including tens) occur most frequently. On average, 61% of pension funds use multiples of 5% for their strategic allocation to both equities and bonds, far above the 4% expected in a uniform distribution of integers between 0% and 100%. Multiples of 10% are reported at slightly more than half the frequency for multiples of 5% indicating that, on average, pension funds slightly prefer even over odd multiples of 5%. The difference between multiples of 10% and multiples of 2% is only marginal indicating low preference for percentages ending in 2, 4, 6 and 8. We only consider integers to calculate the uniform distribution, while in the dataset we only consider multiples of 10.0%, 5.0% and/or 2.0% to be attractive numbers. In fact, however, almost one fifth of the pension funds report their asset allocations in decimals. So in reality, the expected use of attractive numbers under the uniform distribution would be even lower than assumed here.

We test whether multiples of, respectively, 10%, 5%, and 2% for investments in equities and bonds occur more frequently (H_1) than under a uniform distribution of integers

between 0% and 100% (H_0), using Pearson's chi-squared test on observed *versus* expected percentages under a uniform distribution (A'Hearn, Baten, and Crayen, 2009). The uniform distribution is rejected at the 1% significance level for all three multiples, across all three size classes of pension funds,[65] except the use of even numbers for large pension funds.

Table 3.2 Attractive numbers used for strategic allocation to both equities and bonds (in %; 1999:Q1–2006:Q4)

Attractive numbers	Small funds[a]	Medium-sized funds	Large funds	All funds	Uniform distribution
Multiples of 10%	37	28	11	33	1
Multiples of 5%	66	57	29	61	4
Multiples of 2%	41	33	19	37	25

[a] Size classes are defined in Table 3.1

Table 3.2 also shows that small pension funds use attractive numbers significantly more frequently than medium-sized pension funds, while large pension funds use attractive numbers least frequently. We test whether the frequencies of certain multiples are equal (H_0) *or different* (H_1), using the *t*-test on the equality of means, respectively, between small and medium-sized funds, and between medium-sized and large funds.[66] We find that the different frequencies between small, medium and large pension funds, across all types of multiples, are significant at the 1% level.[67]

Table 3.3 shows the frequency distribution of combinations of strategic equity and bond allocations when they are both rounded to 5%. Each non-zero cell presents the frequency of a combination linked to (i) a bond allocation with a percentage as in the upper row, and (ii) an equity allocation with a percentage as in the left-hand column. The bottom row gives aggregations for the frequencies corresponding to the respective bond allocations, and the right-hand column gives summations for the frequencies related to the respective equity allocations.

[65] As well as the combination of both 2% and 5%, not shown in Table 2. The test is based on the assumption that pension funds round their asset allocation to integers.

[66] Note that if the equality of means between (i) small and medium-sized funds, and (ii) medium-sized and large funds has been rejected, the rejection of the equality of means between small and large funds follows automatically. An alternative is the binomial probability test. This test gives virtually the same results.

[67] These test results may have been influenced by the fact that large pension funds tend to invest more in alternative assets. Though rounding plays an important role for other assets too, investment allocations with percentages below the rounding multiple would reduce the probability of rounding for equity and bond allocations. This would affect the last test, but not the rest of the analysis.

In line with Graph 3.1, the table confirms that there is a wide variety of investment policies with little convergence to a certain average or median strategy. The most common strategic allocations are between 20% and 50% for equities and between 50% and 80% for bonds (see shaded cells). The diagonal reflects the frequencies of pension funds where the allocations to equities and bonds add up to 100%, hence without investments in other assets (see *e.g.* shaded cells). These diagonal cells add up to 36.8%.

Table 3.3 Frequency distribution of 5% multiples in strategic equity and bond allocations (in % of observations; 1999:Q1–2006:Q4)

(%)	Bonds																					
Equities	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	Sum
0	1.8										0.1				0.1	0.1	0.1		0.2	0.3	2.9	5.9
5							0.1												0.1	0.2		0.5
10						0.1				0.1	0.1							0.4	0.7			1.5
15															0.1	0.1	0.9	1.0				2.1
20	0.1								0.2				0.1	0.4	0.6	0.8	7.2					9.3
25	0.1				0.1					0.1			0.2	1.2	1.5	5.1						8.3
30	0.1						0.1		0.2	0.1	0.1	0.4	1.0	1.7	6.3							10.0
35								0.1	0.1	0.2	0.4	0.8	1.1	3.7								6.4
40							0.1	0.1	0.5	0.4	1.8	0.8	3.3									6.9
45			0.1						0.1	0.6	0.4	1.8										3.0
50	0.1				0.1	0.1			0.9	0.4	2.8											4.4
55							0.1	0.1	0.1	0.3												0.6
60						0.1	0.1	0.2	0.5													1.0
65						0.1	0.1															0.3
70							0.1															0.1
75																						0.0
80					0.2																	0.2
85																						0.0
90																						0.0
95	0.1																					0.1
100	0.3																					0.3
Sum	2.6	0.0	0.1	0.1	0.4	0.6	0.8	0.6	2.5	2.3	5.7	3.8	6.0	7.1	8.7	6.2	8.2	1.4	1.0	0.6	2.9	**60.8**

Note: Cells in the upper triangular with values below 0.05% are shown as blanks.

The hypothetical optimal asset allocation of pension funds depends on risk preferences of participants and sponsors (determined by *e.g.* the age structure of participants), expected risks and returns of the different asset classes, the funding ratios and macroeconomic variables such as wage growth, inflation and real interest rates. Typically, Asset-Liability Management (ALM) studies take these factors into account. Such studies could be used to obtain supposed optimal asset allocation estimates, using

Monte Carlo simulations based on preferences (such as the risk-return trade off) and on market return and volatility assumptions. However, in practice, ALM studies are not used directly to optimize portfolio investments across asset classes. Rather, they are used as input for a human appraisal process. The widespread use of multiples of 5% indicates that the determination of strategic asset allocations is often based on rough estimates rather than precise measures.

Table 3.4 Multiples of 5% used for strategic asset allocation over time and across size classes (1999–2006; in %)

Year	Small [a]	Medium-sized	Large	Total
1999	60	48	22	54
2000	64	51	25	57
2001	66	57	26	61
2002	70	64	29	65
2003	70	60	32	64
2004	70	61	30	64
2005	66	57	31	59
2006	65	52	32	56
Unweighted average	*66*	*56*	*29*	*60*

[a] Size classes are defined in Table 3.1

Table 3.4 presents the use of attractive strategic asset allocation numbers by small, medium-sized and large pension funds over time. The statistics confirm that small funds are more likely than large funds to choose multiples of 5% for their investment strategies. On average, 66% of small pension funds choose a multiple of 5% for their strategic equity and bond allocations compared to only 56% of medium-sized funds and 29% of large funds. There is some variation over time: the use of 5% multiples increases until 2002 (for large funds: 2003) and decreases afterwards. This may be an indication that the use of ALM models in determining the strategic allocation has increased since 2002/2003. However, the finding that the use of 5% multiples is inversely related to size is consistent over the years. Based on a *t*-test, we find that differences in the use of 5% multiples between small, medium-sized and large pension funds are significant at the 1% level for each year. These findings suggest that small pension funds use less sophisticated asset allocation rules more often than large funds.

3.3.2 Allocation to alternative asset classes

We investigate how pension funds allocate investments across different asset classes. Our dataset distinguishes the following asset classes: equities, bonds, real estate, mortgages and loans, commodities, mixed mutual funds, and money market instruments.[68] More than 50% of pension funds base their strategic asset allocation on bonds and equities only and do not consider alternative asset classes such as real estate or commodities. This suggests that these pension funds limit their scope for higher expected returns and/or further risk diversification.

Table 3.5 Average strategic asset allocation by size class (1999:Q1–2006:Q4)

		Equities	Bonds	Alternative simple investments [b]	Alternative complex investments [c]	Average investments (mln euro)
Size classes pension funds[a]		*In %*				
0 – 100	(small)	27	64	4	5	28
100 – 1,000	(medium sized)	36	56	1	7	320
>1,000	(large)	41	45	1	13	8,211

Note: All allocation numbers are simple averages in percentages.
[a] Based on total investments (in € millions). [b] Simple alternative investments include money market funds and mixed mutual funds. [c] Complex alternative investments include real estate, commodities and loans.

Table 3.5 presents the allocation of pension funds' wealth across asset classes for pension funds of various size categories. It shows that larger pension funds allocate higher proportions of their investments to equities and lower proportions to bonds, compared to smaller pension funds. Medium-sized funds take an intermediate position. Larger pension funds, seeking better risk diversification and/or higher returns, also invest more in alternative investments than small and medium-sized funds. We split alternative investments into two categories: relatively simple assets (money market funds and mixed mutual funds) and more complex assets (real estate, commodities and loans). This split shows that larger pension funds invest significantly more in alternative complex assets, but less in alternative simple assets, compared to small funds. This behavior is probably driven in part by supervisory regulations, which require a more sophisticated risk management for institutions that invest in more complex alternative investments. Differences between small, medium-sized and large pension funds for all asset categories distinguished are significant at the 1% level (based on a *t*-test on the equality of means as used in Table 3.2),

[68] Mixed mutual funds are investment funds that combine investments in both debt and equity instruments. Money market instruments are short-term debt investments such as certificates of deposits and commercial paper. Our data do not include information regarding underlying investments in these funds. Note that investment assets do not include liquidity for *e.g.* ongoing payments.

except for simple alternative investments between medium-sized and large pension funds. Over time, diversification to alternative investments has been quite stable, on average, with a slight downward trend for all size classes.

Table 3.6 provides further insight in the relationship between investments in complex alternative assets and pension fund sizes. The upper panel of this table shows that 83% of small pension funds invest less than 10% of their assets in alternative, complex assets *vs.* 69% for medium-sized funds and 34% for large funds. Only 18% of small funds invest more than 10% in sophisticated assets whereas 66% of the large funds do so. The lower panel of Table 3.6 shows that pension funds that round to 5% multiples invest significantly less in alternative complex assets. The outcomes of this table confirm the finding that large funds diversify their investments more. Furthermore, this behaviour turns out to be inversely correlated with heaping.

Table 3.6 Pension funds that invest in alternative complex assets[a] (in % of all pension funds; 1999:Q1–2006:Q4)

		Investments in alternative complex assets			
Size classes pension funds[b]		*0%*	*0 – 10%*	*10 – 20%*	*>20%*
0 – 100	(small)	62	21	11	7
100 – 1,000	(medium sized)	44	25	22	10
>1,000	(large)	10	24	44	22
Use of 'attractive numbers' for strategic asset allocation					
Pension funds that round to 5%		67	14	14	5
Funds that do not round to 5%		31	35	20	14

Note: All statistics are simple averages in %.
[a] Alternative complex asset classes include real estate, commodities and loans. [b] Based on total investments (million euro).

For a pension fund whose risk management is not sophisticated, it may make sense to invest more in simple alternative investments, as opposed to complex alternative investments that are not fully understood. However, this approach implies less diversification: *a priori* lower investment returns (at given risk levels) so that sophistication remains 'better'. Nonetheless, it may be relatively costly for small funds to invest in complex alternative investments. It is difficult to distinguish between unsophisticated or 'suboptimal investment policies and the most appropriate (but less rewarding) investments for small funds. Nevertheless, we can do this by controlling for the size effect, which reflects the scale of the risk management unit, so that we observe pension fund investment behavior in deviation from its fund size. This is what happens

indirectly when, in Section 4, we use the sophistication measures together with size as explanatory variables in the risk aversion or bond allocation model of Equation (3).

3.3.3 Home bias

We investigate in what degree pension funds diversify their investments geographically. International diversification can provide significant benefits by reducing risk for a given level of expected returns. However, not all investors exploit these diversification benefits to the full, as evidenced by their limited ownership of foreign shares. This phenomenon has been documented using macro-economic data (*e.g.* French and Poterba, 1991), firm-specific data (*e.g.* Kang and Stulz, 1997), as well as investor-specific data (*e.g.* Karlsson and Norden, 2007). The main explanations point to explicit and implicit barriers to international investments. Other explanations include the use of domestic assets to hedge against unexpected changes in inflation and cognitive biases. However, these explanations have not been able to fully account for the lack of international diversification by domestic and foreign investors, despite significant risk-return benefits. Therefore, this phenomenon is known as the home-bias puzzle.

Table 3.7 Home bias of equity investments[a] (1999:Q1–2006:Q4)

		Investments within the euro area (in%)		
Size classes pension funds[b]		*All*	*Funds using 5% multiples*	*Funds not using 5% multiples*
0–100	(small)	53	59	42
100–1,000	(medium sized)	42	40	44
>1,000	(large)	34	39	32
All funds		*43*	*47*	*39*

Note: All percentages are simple averages.
[a] Including exposure from derivatives; [b] Based on total investments (in € millions).

Home bias usually refers to a preference by investors to hold domestic assets. Here we refer to more than proportional investments of Dutch pension funds in the euro area, as the data do not present greater detail. International diversification provides substantial risk-return benefits and hence home bias indicates a certain degree of shortsightedness that suggests less sophistication. Table 3.7 shows that, on average, large pension funds invest 34% of their assets within the euro area, while investments of small pension funds in the

euro zone average 53% of assets.[69] The home preference for assets from the euro area is at 47% stronger in less sophisticated pension funds (which round to 5%) than in sophisticated ones (39%). This finding is consistent with a study by Karlsson and Norden (2007), who report a higher likelihood of home bias for less sophisticated investors with lower education levels and no previous experience with investments in risky assets. Remarkably though, the home bias is stronger for sophisticated small and medium-sized funds compared to unsophisticated funds of these size classes (which is unexpected), whereas it is much smaller for sophisticated large funds compared to unsophisticated large funds, in line with 'theory'. On average, home bias fell from 50% to 42% during 1999-2001 (a similar fall is observed in all size classes), with a slight upward bound in 2006.

We also observe home bias in total investments of pension funds, where small and medium-sized funds hold around 85% of their investments in assets located in the euro area against 63% for large funds. This total-investment euro-area bias confirms the equity euro-area bias of Table 3.7. Incidentally, pension funds tend to hedge their currency risk with derivatives, reducing their net non-euro exposure to only 4% for small funds and 8% for large funds. Note that currency risk insurance does not wipe out the euro-area bias above, as the lack of international diversification remains.

3.3.4 An overall index of sophistication

Following Calvet, Campbell and Sodini (2009b) we investigate the relationship of each of the three sophistication measures with a number of pension fund characteristics in order to explain which features of pension funds determine the developed measures. The relationship we use is:

$$y^{k}_{i,t} = \Sigma_j \beta^{k}_{j} x_{i,j,t} + e^{k}_{i,t} \qquad (1)$$

where y refers to the three measures of sophistication (k = 1, 2, 3), x to the j considered pension fund characteristics listed in Table 3.8, β to the respective coefficients, e to the error terms, i to the pension funds and t to time. The first three columns of Table 3.8 present the estimation results.

Each of the three measures correlates significantly with size, expressed as the logarithm of total assets, and the signs of the estimated coefficients are in line with

[69] The current share of EMU assets in the worldwide total is just below 28% (IMF Global Financial Stability report, April 2009).

expectations that larger size is associated with higher sophistication. This is what we also observed earlier and it is in line with the idea that size and risk management go hand in hand. Note that gross rounding and home bias point to less sophistication, whereas diversification into alternative assets indicates more sophistication, see the first row of Table 3.8. Pension funds with larger investments per participant tend to round less and diversify more in alternative assets. Apparently, funds paying higher individual pension benefits are more sophisticated. Funds offering defined-contribution plans are also more sophisticated, possibly related to the fact that most of these funds in the Netherlands were established more recently and at that time introduced the current state of knowledge. The measures vary across pension fund type: particularly the industry funds have less rounding and more diversification, indicating more sophistication, which is as expected. The low R-squares point to the fact that these pension fund characteristics only explain a minor part of the variation in the measures: sophistication varies widely across pension funds, even within size classes, et cetera.

Table 3.8 Measures of sophistication and pension fund characteristics (1999:Q1–2006:Q4)

	Gross rounding		**Diversification in alternative assets**		**Home bias**		**Overall index**	
Correlation with sophistication	–		+		–		–	
Size (logarithm of total assets)	-0.043	***	0.013	***	-0.045	***	-0.044	***
Investments per participant	-0.210	***	0.002		-0.005		-0.196	***
Percentage pensioners	0.014		-0.005		0.084	*	0.024	***
Funding ratio	-0.019	*	0.012	***	0.109	***	-0.017	**
Industry funds	-0.243	***	0.073	***	0.100	***	-0.241	***
Professional group funds	-0.063	**	0.015	*	-0.091	***	-0.068	***
Defined contribution plan	-0.174	***	0.012		0.110	***	-0.154	***
Gross rounding intercept	-0.043	***					1.167	***
Asset diversification intercept			0.013	***			-0.113	***
Home bias intercept					0.013	***	0.697	***
Gamma2							-0.281	***
Gamma3							0.437	***
Number of observations	16,937		16,937		2,092		35,966	
F-statistics	267		253		57			
R-squared, adjusted	8.6		9.8		14.0		62.9	

Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Further following Calvet, Campbell and Sodini (2009b), we construct an overall index of sophistication by regressing the vector of measures of sophistication on (vectors of) pension fund characteristics:

$$\begin{bmatrix} y^1_{i,t} \\ y^2_{i,t} \\ y^3_{i,t} \end{bmatrix} = \begin{bmatrix} \Sigma_j \beta_j x_{i,j,t} \\ \gamma_2 \Sigma_j \beta_j x_{i,j,t} \\ \gamma_3 \Sigma_j \beta_j x_{i,j,t} \end{bmatrix} + \begin{bmatrix} e^1_{i,t} \\ e^2_{i,t} \\ e^3_{i,t} \end{bmatrix} \tag{2}$$

Equation (2) combines the three Equations (1) – for k = 1, 2, 3 – into one vector, and imposes a set of restrictions $\beta^1_j = \gamma_2 \beta^2_j = \gamma_3 \beta^3_j$ (= β_j by definition) for each j. These restrictions force the impact of the pension funds characteristics on the three measures of sophistication to be identical, apart from scaling factors γ_2 *and* γ_3. This construction of an overall index is based on the assumption that the three measures have a common component, interpreted as (lack of) sophistication. This common component, $\Sigma_j \beta_j x_{i,j,t}$, is the overall index. The last column of Table 3.8 presents the estimates of Equation (2). The values of the two gammas lower than 1 (in absolute terms) reflect that the first measure, 'gross rounding', is more strongly correlated with this underlying common factor than the other two measures. The negative sign of γ_2 indicates that 'diversification into alternative assets' is correlated positively with sophistication while the other two are correlated with *lack of* sophistication, hence negatively. Table 3.9 shows the mutual correlations between the measures.

Table 3.9 Mutual correlations between measures of sophistication and pension fund size (1999:Q1–2006:Q4)

	Gross rounding	Diversification	Home bias	Overall index	Total investments
Gross rounding	1.00				
Diversification	-0.14	1.00			
Home bias	0.15	0.24	1.00		
Overall index	0.29	-0.17	0.22	1.00	
Total investments	-0.29	0.08	-0.30	-0.86	1.00

The correlations reflect the fact that gross rounding, home bias, the overall index and total investments are negatively associated with sophistication, while diversification is positively correlated. The correlations are quite low, indicating that the measures reflect various dimensions of sophistication. The overall index reflects gross rounding and home bias more closely than diversification. This index is highly (but inversely) correlated with pension fund size. In part, this is due to the construction of the index: it reflects the model $\Sigma_j \beta_j x_{i,j,t}$, including size, which covers the sophistication measures only poorly, and ignores

their residuals. The next section will show that the measures explain the risk appetite of pension funds, even when controlling for size.

3.4 Investor sophistication and risk taking

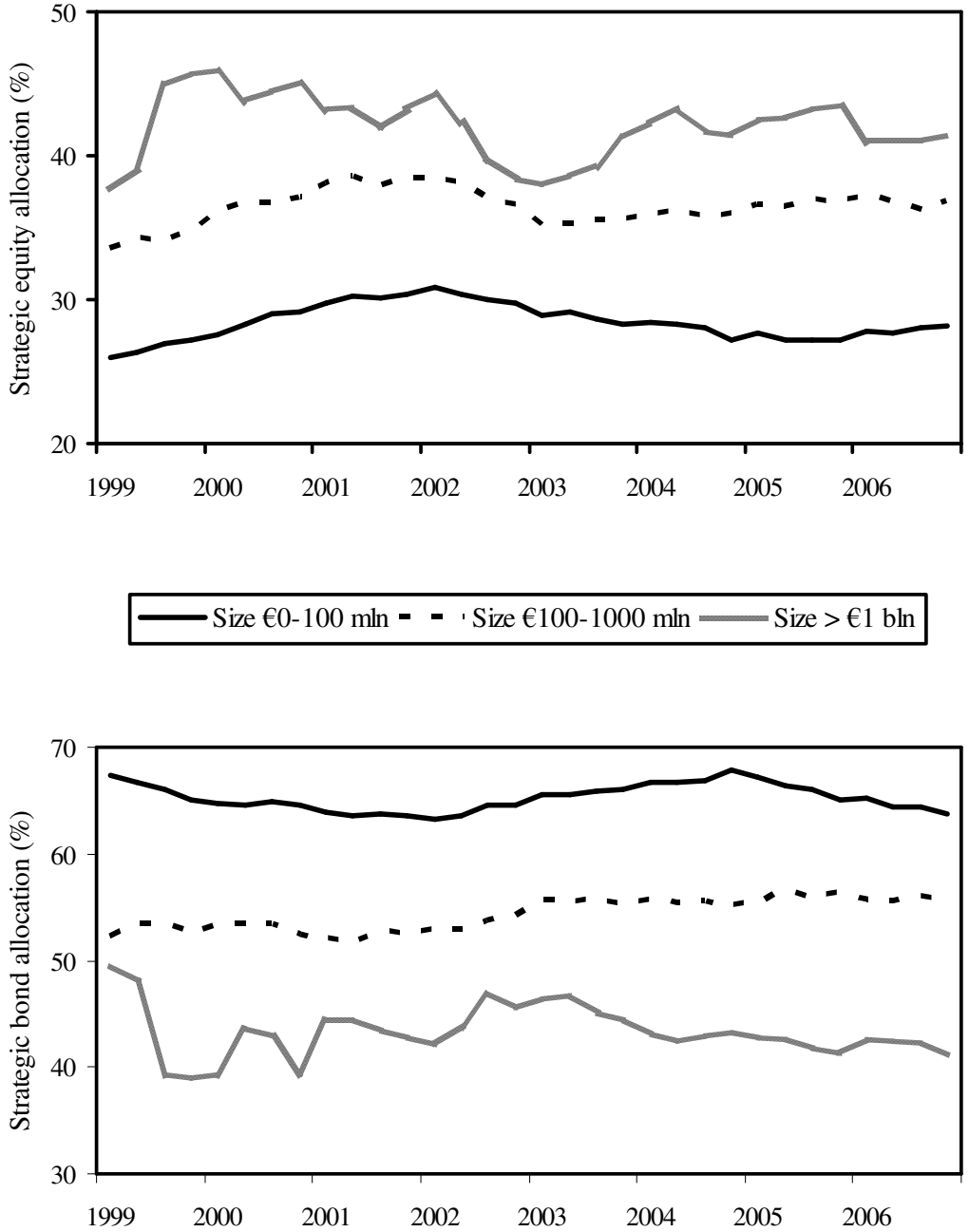
We investigate a possible relationship between the measures of investor sophistication and risk taking. We hypothesize that pension funds with less investment expertise are generally more risk-averse. Assuming that they are less knowledgeable about how to invest assets optimally, less sophisticated funds may deliberately choose a lower risk profile for their asset allocation. This strategy makes sense intuitively, as small funds with limited sophistication and expertise are likely to feel less comfortable with these risks. Conversely, sophisticated pension funds are more likely to have significant in-house expertise and to use sophisticated modelling techniques, which may make them less averse to risk taking. Sophisticated funds may also suffer from overconfidence because they put too much trust in the theories and models they have developed (Griffin and Tversky, 1992). As the recent credit crisis shows, risk taking is not always a rewarding strategy since: over the last decade, investments in bonds have yielded higher rewards than equities in most countries.

Graph 3.2 presents the average strategic equity and bond allocations over time for pension funds in different size categories. On average, large pension funds invest a greater share of their assets in equities and less in bonds, as also observed in Table 3.5. The graphs show that this finding is persistent across the sample period.

Investing more in bonds, as small funds do, reduces the mismatch between the duration of assets and liabilities, and reduces the exposure to volatile equity markets.[70] Hence, the graphs indicate that small and less sophisticated funds tend to choose a lower risk exposure. Graph 3.2 further shows that strategic asset allocations vary significantly over time, reflecting the dynamic nature of investment policies. Over time, large pension funds have most volatile strategic asset allocation over time. This suggests that they update their investment policy more frequently but may also reflects the fact that the average of large funds is based on a lower number of pension funds (see Table 3.1).

[70] Nominal defined-benefit pension liabilities are best resembled by nominal government bonds. Instead, defined-benefit pension liabilities that are fully indexed to prices are best resembled by inflation linked bonds. In many Dutch defined benefit-pension deals, indexation is contingent on the funding ratio of the pension fund. The market value of this contingent indexation can be derived using option pricing theory. In this case it might be optimal to have considerable equity exposure, see *e.g.* Broeders (2010).

Graph 3.2 Strategic equity and bond allocations by pension fund size over time (1999:Q1–2006:Q4)



To examine the impact of investor sophistication, or the lack of it, on risk taking, we estimate the following equation:

$$Bond°allocation_{i,t} = \alpha + \beta\ Heaping_{i,t} + \gamma\ Diversification_{i,t} + \delta\ Home°bias_{i,t-1} + \varepsilon\ Size_{i,t-1}$$
$$+\zeta\ Risk°preferences_{i,t-1} + \eta\ Governance_i + \theta\ Pension°plan_i + e_{i,t} \qquad (3)$$

The dependent variable $Bond°allocation_{i,t}$ is the strategic bond allocation of pension fund i (i = $1,\ldots,$N) at quarter t (t = $1,\ldots,$T). The explanatory variables *Heaping* and *Diversification* are variables indicating sophistication in asset allocation. *Heaping* equals one if the strategic equity and bond allocation are multiples of 5% and zero otherwise. *Diversification* stands for sophisticated diversification and is defined as 'the strategic allocation to alternative complex assets' minus 'the strategic investment in alternative simple assets', each presented as a percentage of total assets. *Home°bias* is the percentage of investments in the EMU. Positive estimates for β and δ, and a negative estimate for γ would indicate that pension funds with less developed strategies choose a lower risk profile for their portfolio by investing a higher share of their wealth in bonds.

The other explanatory variables are standard elements in bond (or equity) allocation models for pension funds (Alestalo and Puttonen, 2006; Gerber and Weber, 2007; Lucas and Zeldes, 2006, 2009). The variable *Size*, measured as the log of total investments, is included to estimate the impact of scale on the risk profile of pension funds. This variable is included with a lag to avoid possible endogeneity problems, even though such problems are unlikely. Bond price shocks may lead to an increase in both the actual bond allocation and total investments during the same period, but equity price shocks would have opposite effects on actual bond allocation and total investments. More importantly, we explain the strategic and not the actual allocation. But the strategic allocation may gradually over time be influenced by asset price shocks (Bikker, Broeders and De Dreu, 2010).[71] A negative estimate for ε would indicate that the investments of larger pension funds tend to be riskier. Scale advantages should enable large pension funds to apply a more highly developed allocation policy and, therefore, this variable may also pick up some of the variation that is not explained by the first two variables (*Heaping* and *Diversification*), which are used as indicators for the level of sophistication of asset allocation.

[71] Nevertheless we also estimate this equation with 2SLS or replace total assets by number of participants, see footnote 20.

Risk°preferences is a vector of three variables that control for risk preferences of participants and sponsors. The variable 'assets per participant' is included to control for the impact of higher average pension assets on risk preferences. A negative coefficient would indicate that participants with higher pension fund investments are less risk averse. The age variable 'percentage of pensioners' is included to control for the duration of liabilities (Lucas and Zeldes, 2009).[72] A positive coefficient for this variable would indicate that pension funds where relatively many participants have a short investment horizon will choose a lower risk profile (see Bikker, Broeders, Hollanders and Ponds, 2012). The variable 'funding ratio', calculated as total investments divided by discounted pension liabilities, is included because, from a risk management perspective, a bigger buffer provides room to invest more in risky assets.[73] A negative coefficient could also indicate decreasing relative risk aversion in line with *e.g.* Cohn *et al.* (1975). This variable is included with a one-quarter time lag because it may take some time for changes in a fund's funding ratio to affect its strategic bond allocation.

Governance is a vector of three dummy variables that control for differences in the governance of pension funds. The variable 'industry-wide pension funds' equals one if the pension fund provides pension plans for employees in an industry and zero otherwise, whereas the variable 'professional group pension funds' equals one if the pension fund provides a pension scheme to a specific professional group (*e.g*. medical profession, public notaries) and zero otherwise. Note that 'company pension funds' is the reference group. Finally, the variable 'defined-contribution plan' equals one if a defined-contribution pension scheme is offered, as opposed to a defined-benefit plan (zero).

Columns 1, 3 and 4 of Table 3.10 reports estimation results for Equation (3), though excluding the home-bias variable, both for all pension funds and for company and industry funds separately.[74] Inclusion of 'home bias' would reduce the number of observations from 13,517 to 2,007.[75] All key variables enter with the expected signs and

[72] Our dataset for 1999-2006 does not contain the average age of participants, as used in Alestalo and Puttonen (2006) and Gerber and Weber (2007).

[73] This is also according to the Dutch regulatory regime, which requires that the probability of a funding ratio falling below 100% within one year must be less than 2.5% (Broeders and Pröpper, 2010) and pension funds must always hold a minimum buffer of 5%. For risky portfolios a higher buffer is required. The Netherlands does not have a pension benefit guarantee fund.

[74] We estimate with pooled OLS and correct the standard errors for heteroskedasticity, using the Huber-White sandwich estimators.

[75] We estimate also Equation (3) including 'home bias'. This variable enters significantly and with the expected sign (more home bias implies higher investments in bonds). The other two measures of (a lack of) sophistication show up with the expected sign when they are significant, that is, for diversification (all

are significant at the 1% significance level in all three specifications, except the DC dummy for industry funds, which is significant at the 10% confidence level only. The results provide strong evidence that small pension funds with less than optimal allocation policies are more likely to choose low risk asset allocation strategies. Specifically, the heaping variable's coefficient has a significant positive sign, showing that pension funds with less advanced asset allocation policies invest more in bonds. The coefficient indicates that pension funds using multiples of 5% for their asset allocation invest, on average, 3.2 percentage points more in bonds (first column). The coefficient is even higher for *Diversification*, indicating that pension funds investing 10% of total assets more in alternative complex assets or less in alternative simple assets, invest 2.9% of total assets less in bonds. Note that in this multiple-regression model (which includes size as explanatory variable) the coefficients of the two sophistication variables reflect the sophistication effect corrected for the size effect. Finally, the size variable enters with a negative sign, indicating that large pension funds raise their risk profiles by investing relatively less in bonds. An alternative size measure, that is, number of participants instead of total assets, leads to virtually identical estimation results.[76]

Table 3.10 The strategic bond ratio and indicators of sophistication for various pension fund types (1999:Q1–2006:Q4)

	All pension funds		**Company pension funds**	**Industry pension funds**
Column	*1*	*2*	*3*	*4*
Heaping (gross rounding)	0.031***		0.021***	0.079***
Diversification in alternative assets	-0.212***		-0.153***	-0.554***
Overall index		0.465***		
Pension fund size (t-1)	-0.025***		-0.027***	-0.016***
Investments per participant (t-1)	-0.039***		-0.044***	-0.820***
Percentage pensioners	-0.044***		-0.043***	0.088***
Funding ratio (t-1)	-0.048***		-0.048***	-0.026***
Industry pension funds	-0.040***			
Professional group pension funds	0.054***			
Defined contribution plan	-0.064***		-0.048***	-0.026*
Intercept	0.962***	0.871***	-0.080***	-0.099***
Number of observations	16,260	16,937	13,484	2,436
F-statistics	377	2,499	226	220
R-squared, adjusted	19.9	13.8	13.9	42.7

Note: One and three asterisks denote significance at the 10% and 1% levels, respectively.

variants) and heaping (industry funds). The results are available upon request from the authors, but have not been not reported, since the number of observations for 'home bias' is relatively low.

[76] The results are available upon request from the authors. We also estimate Equation (3) with 2SLS where the instrument for total assets is number of participants (all in logs). The results are virtually identical.

Two of the three included risk preference variables carry their expected sign for all three samples: a higher funding ratio and more investments per participant each imply relatively lower allocation to bonds, in line with Bikker, Broeders, Hollanders and Ponds (2012). A higher percentage of pensioners should result in a lower risk profile with relatively more bonds, but this is observed for industry funds only. Studies which use average age (not available in our dataset) instead of percentage of pensioners found a similar negative impact of age (Alestalo and Puttonen, 2006; Gerber and Weber, 2007). Compared to company pension funds, industry funds hold relatively less in bonds, while the reverse is true for professional group funds. The latter is explained in Bikker, Broeders, and De Dreu (2010). Defined contribution plans, which have no nominal pension benefit target, tend to hold lower investments in bonds. The goodness of fit (R^2) in Table 3.10 for 'all pension funds' is, at 19.9, rather low, indicating that many other determinants of the bond ratio are not captured by Equation (3). This indicates a heavy impact of non-observed preferences, risk aversion and human judgment on strategic allocation. Note that the model fits much better for the – generally larger – industry pension funds, see adjusted R^2 of 42.7 versus 19.9 for all funds.

Column 2 of Table 3.10 presents the coefficient of the 'overall index of (lack of) sophistication', estimated in Section 3.4. This index is defined as $\Sigma_j \beta_j x_{i,j,t}$ with $x_{i,j,t}$ the variables already occurring in Equation (3) and β_j the corresponding coefficients, estimated under restrictions. Inclusion of both this index and the indicators as explanatory variables would by definition cause (full) multicollinearity,[77] so that we estimate the coefficient of this index only. As expected, the *t*-value of this coefficient is higher than each of the *t*-values of the two separate measures of sophistication, which are now combined in the index. This outcome confirms that the overall index is a useful proxy for the underlying measures of (lack of) sophistication and that less sophisticated pension funds invest more in bonds.

3.5 An update for 2007-2010 as a robustness check

In 2007, a new regulatory regime for pension funds in the Netherlands came into force. At the same time, the prudential supervisor updated the reporting system for pension funds and adjusted the definition of asset classes. One essential change was that hedge

[77] Full multicollinearity if we had the same lags in Equation (1) and (3). Hence, near multicollinearity, as Equation (1) does not include lags.

fund investments must henceforth be reported as a separate category, apart from equity. Another change was that mixed funds were split into their constituting components and merged with bonds, equities, *et cetera*. These changes have a significant impact on our diversification measure 'alternative assets' and on the dependent variable 'bonds' in our risk-taking model of Equation (3). This is why we cannot append the 2007 and later data to our basic sample period 1999-2006 and apply our approach for the entire period at once.

Our dataset extends from 2007:I to 2010:IV, so that we have another 16 quarters of observations available. We use this second dataset to check whether the financial sophistication characteristics of pension funds that we find over 1999-2006 also hold for the successive years. Note that this period is short, compared to the 32 quarters of our sample period 1999-2006, and that we use different definitions of asset classes in accordance with the new reporting standards. We duplicate all calculations of this chapter for 2007-2010 and briefly discuss the results (available on request). Typical trends in the summary statistics of this later period (as in Table 3.1) are a reduction in the number of smaller pension funds from, on average, 368 to 126, and, consequently, larger (remaining) pension funds. Average total assets increased as a result of both consolidation and overall growth. The updated frequency distribution of strategic equity and bond allocations (as in Graph 3.1) looks similar, with the same remarkable spikes at multiples of 5%. The share of bonds is lower now and zero allocations for equity are no longer reported. Rounding to multiples of 5% declined during 2007-2010 from 62% to 43%, the reduction being stronger in both relative and absolute terms for medium-sized and larger funds (compare Tables 2 and 3). The reduction in heaping appears suddenly in early 2007, which is probably related to the new reporting system, adding force to the argument that the two considered periods cannot be analyzed jointly. Therefore, we do not interpret the decrease in heaping as an increase in sophistication. The use of complex investments has increased somewhat in all size classes, but remains the highest by far for larger pension funds. The use of simple assets is now low in all pension fund size classes. Over time, the proportions of equities and bonds for larger pension funds have come to differ less from those for smaller funds, due in part to the lower number of smaller funds (compare Tables 4 and 5). Differences in home bias across size classes remain unchanged (compare Table 3.7). The general picture is that the difference between large and small pension funds increases for one indicator (diversification) and decreases for the two others (heaping and home bias).

In explaining the strategic allocation to bonds over 2007-2010, the coefficient of the measure 'diversification in alternative assets' is larger and more significant than before,

due to the improved definition of alternative assets (compare Table 3.10). While heaping was the most statistically significant measure during 1999-2006, it is less prominent in later years and, in fact, not significantly different from zero for the industry-wide pension funds, probably due to its lower frequency. The estimated overall index of (lack of) sophistication, defined by Equation (2), is also a highly significant explanatory variable in explaining the strategic allocation to bonds: less sophistication goes hand in hand with lower bond investments.

We conclude that the measures of sophistication continue to work well during 2007-2010, but with less emphasis on heaping and a more prominent role for diversification into alternative assets. Furthermore we find that two out of three measures point to increasing sophistication over time.

3.6 Conclusions

We examine the impact of investor sophistication on risk taking. We focus on pension funds since their size and other characteristics vary widely and comprehensive data is available. To measure investor sophistication, we construct three measures of the sophistication of pension funds' investment policies. The first indicator gauges the use of attractive, but imprecise, numbers for the strategic allocation of assets to both equities and bonds. Most pension funds in the Netherlands apply such rule of thumb, using particularly multiples of 5%. This supports the observation that in current practice, asset allocation does not follow directly from optimization of ALM models. Rather, it is determined by human judgment, given results from ALM studies. The second indicator is the use of alternative, complex investments other than equities and bonds, as an instrument to diversify the investment portfolio. We observe that many pension funds invest little in alternative, more complex asset classes, suggesting suboptimal portfolio diversification. The third indicator is home bias in the equity investment portfolio. We show large differences in terms of relative investments in the euro area, suggesting suboptimal international diversification in many pension funds. We find that these three measures correlate with pension fund size indicating that smaller pension funds tend to be less sophisticated than larger ones. Nevertheless, investment sophistication contributes independently to the explanation of risk aversion, showing that investment expertise also varies among pension funds in the same size class. These results suggest that the asset allocation policies of many pension funds, particularly small ones, are suboptimal.

A notable finding is the huge variation in asset allocation practices across pension funds, in a broader context also referred to as the asset allocation puzzle. Part of this variation can be explained by the pension fund's size, its type of pension plan, its preference indicators, such as assets per participant, participant age distribution and the funding ratio and, finally, its governance type. In addition, we find that all our indicators of investor sophistication are highly statistically significant.

Even when controlling for size, sophistication and other fund-specific variables, pension funds make significantly diverging portfolio choices. We believe that this reflects widely varying views regarding the optimal investment mix. It seems likely that differences in risk-return assumptions for the various asset classes, in the level of expertise of pension fund investment managers and in personal preferences of pension boards also play an important role. The analysis of this latter phenomenon is outside the scope of this chapter, but is suggested as an interesting topic for future research.

Our findings suggest that further consolidation of the Dutch pension sector, by mergers or increased cooperation (*e.g.* in so-called general pension institutions, which can administer pensions plans for several companies or industries) may contribute to improve the sophistication of pension funds' investment policies. Such benefits of consolidation are in line with previous studies, in which we find a negative correlation between the size of pension funds and the administrative and investment costs per participant (Bikker and De Dreu, 2009; Bikker, Steenbeek, and Torracchi, 2012).

Chapter 4

Stock Market Performance and Pension Fund Investment Policy

"If there are many analysts who are pretty good at this sort of thing ... they help narrow discrepancies between actual prices and intrinsic values and cause actual prices, on the average, to adjust "instantaneously" to changes in intrinsic values... Although the returns to these sophisticated analysts may be quite high, they establish a market in which fundamental analysis is a fairly useless procedure both for the average analyst and the average investor"

Eugene Fama, 1965, Random walks in stock prices

This chapter examines the impact of stock market performance on the investment policy of pension funds. We find that stock market prices performance the asset allocation of Dutch pension funds in two ways. In the short-term, outperformance of equities over bonds and other investment categories automatically results in a higher actual equity allocation (and vice versa), as pension funds do not continuously rebalance their investment portfolios. Each quarter, pension funds rebalance, on average, around 39 percent of excess equity returns, leaving 61 percent for free floating. In the medium-term, outperformance of equities induces pension funds to increase their strategic equity allocation (and vice versa). These findings suggest that the investment policies of pension funds are partially driven by the cyclical performance of the stock market. We also find that rebalancing is much stronger after negative equity returns indicating that pension funds respond asymmetrically to stock market shocks.. Furthermore, investment policies of large funds deviate from that of small funds: they hold more equity and their equity allocations are more strongly affected by actual equity returns, reflecting less rebalancing. The largest funds react highly asymmetrically to equity returns. Their positive excess equity returns lead to adjustments in equity portfolios of more than 100%, reflecting 'overshooting' of free floating, or

positive feedback trading. Apparently, managers of large funds have greater risk tolerance, particularly in bull markets.

This chapter is based on: Bikker, J. A., Broeders, D. W. G. A., and De Dreu, J., 2010, Stock market performance and pension fund investment policy: rebalancing, free float, or market timing, *International Journal of Central Banking, 6* (2): 53-79.

4.1 Introduction

The optimal equity allocation of pension funds is subject to considerable debate. A high percentage of assets invested in equities results in significant exposure of pension wealth to fluctuations in stock market prices. While nominal defined-benefit pension liabilities are best resembled by bond returns, considerable equity holdings may be optimal when indexation of benefits is contingent on the funding ratio of the pension fund.[78] During the nineties abundant equity returns led to premium reductions and even contribution holidays for pension plan sponsors. However, the risks of equity holdings surfaced after the collapse of the stock market in 2000-2002, which resulted in large losses for pension funds. In reaction, pension benefits were curtailed and contributions steeply increased. This episode motivated raised a debate on the investment strategies of Dutch pension funds and, particularly, on their exposure to equity markets.

The investment strategy of Dutch pension funds is of key importance to society, as it involves more than €600 billion in assets, or over €37,500 per inhabitant. The way in which these assets are invested has a significant influence on the level of required premiums or final benefits. A one percent lower annual return over the lifecycle of a typical worker translates into 27 percent lower accumulated pension assets.[79] Consequently, one of the most important responsibilities of pension funds' trustees is to

[78] Nominal defined benefit pension liabilities are best resembled by nominal government bonds. Instead, defined benefit pension liabilities that are fully indexed to prices are best resembled by inflation linked bonds. In many Dutch defined benefit pension deals, indexation is contingent on the funding ratio of the pension fund. The market value of this contingent indexation can be derived using option pricing theory. In this case it might be optimal to have considerable equity exposure, see *e.g.* Broeders (2006).

[79] The three main components determining the costs of pensions are the quality of the pension scheme, the rate of return on investments and administrative and investment costs (see also Bikker and De Dreu, 2009).

maximize the expected return on assets at an acceptable level of risk, *e.g.* measured in terms of the probability of underfunding.

This study investigates whether stock market performance influences pension funds' investment policies. In particular, we examine two ways in which stock market performance impacts the equity allocation of pension funds: (i) in the short-term, as a result of market timing or imperfect rebalancing, and (ii) in the medium-term, as a result of adjustments to the strategic asset allocation.

Table 4.1 presents the asset allocation of Dutch pension funds over the following five broad classes: Equities, Bonds, Real Estate, Cash, and Other Assets. Pension fund investment policy includes the strategic asset allocation decision, which refers to choosing the investment percentages in each asset class. Of the aforementioned asset classes, equities have the highest expected return but also the highest volatility. For most pension funds it is the largest asset category. Consequently, equity allocation is one of the key policy variables determining the risk-return profile of a given pension fund.

Table 4.1 Pension fund strategic and actual asset allocation 1999:I – 2006:IV (%)

Asset classes	Average strategic asset allocation	Standard deviation	Average actual asset allocation	Standard deviation
Equities	42	15	41	15
Bonds	39	20	45	19
Real Estate	10	6	10	6
Cash	1	11	1	10
Other	8	11	3	11
Total	*100*		*100*	

Note: The asset shares are averages over Dutch pension funds, weighted by total investments.
Source: De Nederlandsche Bank.

Pension funds generally determine their strategic asset allocation policies using asset and liability management studies, in which they consider long-term expected returns, return variances and covariances of broad asset classes, given the size and characteristics of their pension liabilities, see *e.g.* Campbell and Viceira (2002).[80] The strategic asset allocation is typically set on a three to five year horizon. For many pension funds, the strategic asset allocation includes bandwidths for the actual asset allocation to drift. For this purpose a tactical risk budget can be made available. These bandwidths are chosen in such a way that the maximum *ex ante* tracking error does not exceed a given threshold.

[80] Shefrin and Statman (1997) use behavioral finance theory to explain the asset allocation of pension funds. They argue that investors build portfolios as pyramids of assets, layer by layer. In contrast to mean-variance theory, covariance between asset classes are generally ignored resulting in suboptimal portfolios.

This tracking error (*TE*) is usually defined as $TE = w'\Sigma w$, where w is the vector of actual portfolio weights minus the vector of strategic portfolio allocation and Σ is the variance-covariance matrix. In this chapter, rebalancing is interpreted as a return to the midpoint of these bandwidths.

As investment opportunities change over time, deviations in expected returns from their long-term averages may warrant changes in the investment mix.[81] Choosing actual portfolio weights that deviate from the strategic asset allocation is known as 'tactical asset allocation' or 'market timing'. Market timing refers to taking short-term (informed) bets on relative asset class returns. It can be implemented through actually buying and selling the underlying securities, although in practice, derivatives are also commonly used as an efficient manner to change a fund's asset allocation. However, the potential extra return through market timing is limited, as indicated also by the so-called fundamental law of active management, see Grinold and Kahn (1999).[82]

This study examines the impact that higher or lower returns on stocks compared to the other asset categories have on the equity allocation of pension funds. To the best of our knowledge this is the first study that examines this relationship. Graph 4.1 shows the various factors that influence the equity allocation of pension funds. Over the long-term, equity allocation is determined by a fund's strategic asset allocation. However, several factors influence asset allocation in the short to medium-term. We distinguish the following three equity investment strategies that pension funds may use to respond to positive or negative stock market returns: rebalancing, free float, and market timing.

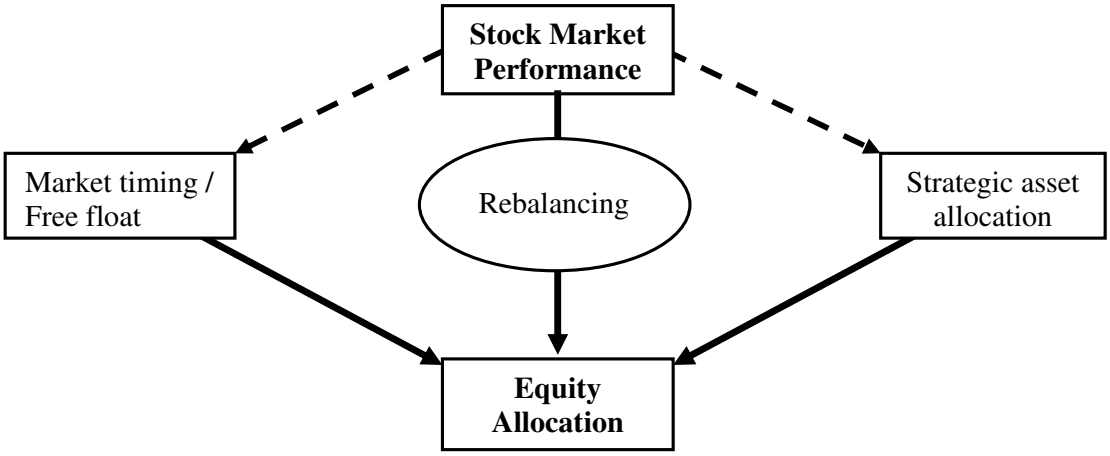
Rebalancing refers to the investment process applied to ensure that a fund's actual equity allocation continuously equals its strategic equity allocation, which implies selling equities after relative high stock market returns and buying after relative low equity returns. This might also be indicated as a form of negative-feedback trading referring to buying past losers and selling past winners, see *e.g*. Lakonishok *et al.* (1992). This form of

[81] Predictability in expected asset returns may affect the optimal portfolio choice of investors with long horizons (see *e.g*. Barberis, 2000; Pastor and Stambaugh, 2001).

[82] This law states that the information ratio equals the information coefficient times the square root of the number of independent investment decisions. The information ratio is the risk-adjusted excess return over a passive investment strategy. An information ratio of 0.5, which is considered high, requires that asset managers earn a 50 basis points excess return ('alpha') per 1 percent of residual risk on a yearly basis. The information coefficient measures the skill of the asset manager, and is defined as the correlation between his forecasts on investment returns and the actual outcomes. The number of independent investment decisions is four, if the pension fund makes quarterly market timing decisions. To generate a market timing information ratio of 0.5 requires, in that case, an information coefficient of 0.25, which is considered extremely high. It would require the asset manager to forecast the direction of the stock market correctly 63 out of 100 times and adjust his portfolio likewise. Therefore, the potential added value of market timing is limited. In addition, such a strategy would involve (substantial) transaction costs.

trading is commonly a part of the argument that institutional investors stabilize asset prices. By contrast, we use *free float* to indicate a passive investment strategy, in which pension funds allow their equity allocation to drift with market developments.[83] Finally, as mentioned above, *market timing* refers to a temporary higher or lower weighting of equities (or other asset classes) relative to the pension fund's strategic asset allocation, motivated by short-term return expectations. Note that where no equity trades are made, it is difficult to distinguish between free float (passive management) and market timing (active management), as allowing the asset allocation to drift could be seen as an active investment decision.

Graph 4.1 The impact of stock market performance on equity allocation



A number of studies show that strategic asset allocation dominates portfolio performance. In particular, strategic asset allocation is shown to explain more than 90 percent of the variability in pension fund returns over time, while the additional variation explained by market timing is less than 5 percent (Brinson, Hood, and Beebower, 1986, 1991; Blake, Lehmann and Timmermann, 1999; Ibbotson and Kaplan, 2000). Moreover, in line with the efficient market theory, empirical evidence shows that on average, pension funds, as well as mutual funds, are unsuccessful in exploiting market timing to generate excess risk-adjusted returns. (See Brinson, Hood, and Beebower, 1986; Brinson, Singer,

[83] Pension funds can rebalance continuously, thereby ensuring that their asset allocation always matches their strategic asset allocation. However, pension funds are known to use rebalancing strategies, which have some free float component. Examples include *calendar* rebalancing, whereby pension funds rebalance their portfolio back to its strategic weights at regular intervals, and *band rebalancing* whereby pension funds create bands around each asset class and rebalance their portfolio as soon as one asset class breaches its band.

and Beebower, 1991; Coggin, Fabozzi, Rahman, 1993; Blake, Lehmann, and Timmermann, 1999 for pension funds and Kon, 1983; Henriksson, 1984; Chang and Lewellen, 1984; Daniel, Grinblatt, Titman, and Wermers, 1997; Bolle and Busse, 2001; Friesen and Sap, 2007; Chen, Ferson, and Peters, 2010 for mutual funds.) An exception is the study by Jiang, Yao, and Yu (2007), who find evidence consistent with positive market timing ability at 3- and 6-month (but not at 1- or 12-month) forecasting horizons.

While a number of empirical studies examine the impact of investment policy on returns,[84] very few papers investigate the impact of market developments on investment policy. Blake *et al*. (1999) and Kakes (2006) report a negative correlation between asset class returns and net cash flows to the corresponding asset class, which points to rebalancing. However, Blake *et al.* (1999) also find that the asset allocation for UK pension funds drifts toward asset classes that performed relatively well, in line with a free-float strategy. Apparently, UK pension funds only partly rebalanced their investments in response to different returns across asset categories. Hence, the degree of rebalancing versus free float in pension fund asset allocation remains an open question.

This chapter uses quarterly data from Dutch pension funds over 1999:I–2006:IV. Although this period is relatively short, it contains a significant stock market bubble as well as a burst. Graph 4.2 presents a preview of the empirical results, depicting the strategic and the actual equity allocation for Dutch pension funds, as well as the MSCI World Index. Three patterns stand out from this figure. *First*, the actual equity allocation tends to have a pattern similar to the MSCI World Index, but with some reversion to the strategic asset allocation. Generally, actual equity allocation increases when the stock market goes up, and *vice versa*. The main explanation for this pattern is that pension funds tend to rebalance their asset allocation only partly in response to changes in the value of their equity portfolio.

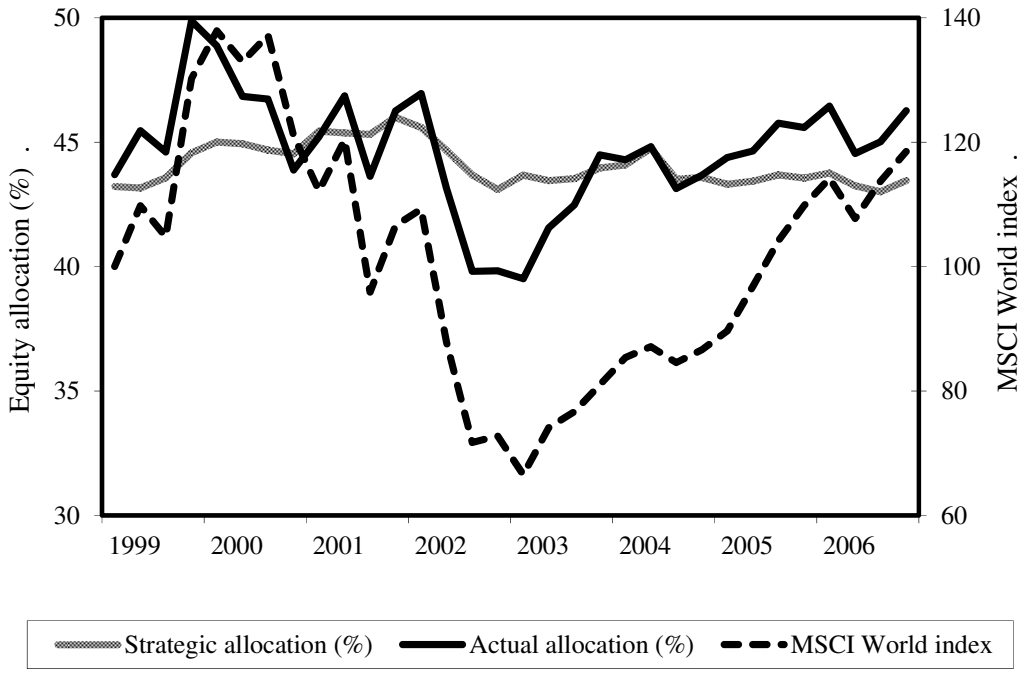
Second, Graph 4.2 points to interaction between stock market performance and strategic asset allocation. The strategic equity allocation appears to follow the performance of the equity market, although only gradually and with a time lag. Following the stock market boom in the second half of the 1990s, the strategic equity allocation increased until

[84] The literature investigating the effectiveness of stock picking and market timing in improving investment performance is extensive. Most studies focus on US mutual funds and find that fund managers are not able to exploit selectivity and timing to generate excess returns (*e.g.* Fama (1972), Henriksson and Merton (1981), Kon and Jen (1979) and Kon (1983)). Agnew *et al.* (2003) report that equity allocations of participants in 401(k) plans are positively related to the previous day's equity return (feedback trading). However, no significant correlation is found between changes in equity allocations and returns over the following three days suggesting the absence of market-timing abilities.

the end of 2001, but decreased from 2002 to 2003 in response to the fall of the stock market that started in 2000. A possible explanation is that pension funds adjust their investment policies based on recent stock market performance. Positive excess returns increase the pension fund's buffer, so that, as a consequence, regulatory rules also allow for a higher proportion of the more risky equity investments. Apparently, pension funds make use of this opportunity and adjust their strategic asset allocation accordingly.

Third, the figure suggests that pension funds may have lost money from market timing over the business cycle. They seem to have gradually increased their equity allocation until the downturn of the stock market was well under way, confronting them with relatively large losses. Conversely, pension funds did not significantly increase their equity allocation portfolio investments to reap the full benefit of the subsequent upward stock market trend.

Graph 4.2 Stock market returns and equity investments (1999:I–2006:IV)



The structure of this chapter is as follows. Section 4.2 presents the data used in the analyses. Section 4.3 investigates the influence of market movements on asset allocation, whereas rebalancing is more closely examined in Section 4.4. The next section analyses

the relationship between stock market returns and strategic asset allocation. Finally, the last section summarizes and concludes.

4.2 Description of the data

We use a detailed dataset with quarterly information on all Dutch pension funds for the 1999:I–2006:VI period. The data is from De Nederlandsche Bank, responsible for the prudential supervision of the 748 pension funds. For each pension fund data is available on strategic asset allocation, asset sales and purchases, the market value of investments in different asset classes and their time-weighted returns. We use self-reported returns, as well as the MSCI World total return index denominated in euros, to assess the impact of equity returns on actual and strategic equity allocation. The sample is an unbalanced panel, as not all pension funds reported data for the entire sample period due to new entrants, mergers, terminations, and reporting failures. Since our aim is to study asset allocation over time, we exclude pension funds with less than two years of data. Finally, we exclude inconsistent observations and observations with clear reporting errors.

Our final sample includes data on 748 pension funds from 1999:I – 2006:IV, representing around 85% percent of total pension fund assets in the Netherlands. Table 4.2 presents summary statistics on the investment portfolios of pension funds in our sample. The size of pension funds in the sample is hugely divergent: the smallest pension funds have assets worth less than €1 million, while the largest fund has assets of more than €200 billion. The average and median sizes of pension fund assets equal €799 million and €53 million, respectively. We distinguish between size classes and types of pension funds and between types of pension plans. Small funds tend to invest relatively less in equity compared to larger funds, and more in bonds, reflecting lower risk appetite. Although large in number (70% of the sample), small funds administer only a minor share (less than 3%) of all pension fund investments.

Our sample includes 631 company funds, 95 industry funds, and 10 professional group funds.[85] Compulsory industry funds are largest in terms of investments. All pension fund categories invest between 41 and 45 percent in equity. Company funds and

[85] Company funds provide pension plans to the employees of their sponsor company. They are separate legal entities, but are run by the sponsor company and employee representatives. Industry funds provide pension plans for employees working in an industry. Such pension plans are based on a collective labor agreement between an industry's companies and the labor unions, representing the employees in this industry. Finally, professional group funds offer pension schemes to specific professional groups (*e.g.* general practitioners, public notaries).

professional group funds invest relatively more in bonds than other types of funds, reflecting their stronger risk aversion. Industry funds invest substantially more in real estate. On average, defined benefit (DB) funds have higher equity and lower bond investments than defined contribution (DC) funds, suggesting that DB funds may take higher risks since they can benefit from intergenerational risk sharing.

Table 4.2 Investments across pension fund type and size classes (1999:I –2006:IV)

Size classes based on total investments (mln euro)	Number of pension funds	Average total investments (mln euro)	Average bond investments (%)	Average equity investments (%)	Max - min equity investments over time (%)	Max - min equity policy over time (%)	Invest-ment gap (%) [a]
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
0-100 (Small)	524	29	62	29	18	12	0.4
100-1000(Medium)	177	320	51	37	18	13	0.2
>1000 (Large)	47	8,276	37	43	16	13	0.8
Total/average	*748*	*799*	*39*	*42*	*16*	*13*	*0.8*
Type of fund[b, c]							
Industry (all)	95	3,798	35	41	14	12	1.1
- Compulsory	76	4,412	36	41	14	12	1.1
- Non-compulsory	19	1,099	35	45	16	15	1.7
Company	631	280	45	43	20	13	0.1
Professional group	10	2,292	51	42	18	12	0.5
Plan type[c]							
DB	592	926	39	42	16	13	0.8
DC	56	78	51	37	19	14	0.3

Note: All statistics are averages weighted by total investments except for the first two columns (Number of pension funds and Average total investments).
[a] Investment gap is the absolute difference between the strategic equity allocation and the actual percentage of equity portfolio investments; [b] Ten pension funds belong to other categories; [c] For some pension funds, type of pension fund or dominant plan type are unknown.

Columns 5 and 6 indicate how, respectively, the actual and strategic equity allocation vary over time. For the average pension fund, the range of the actual equity allocation is 16% and that of the strategic equity allocation is 13%. Thus, both actual and strategic equity allocation move significantly over time. The last column shows that the difference between strategic and actual equity allocation is, on average, 0.8 percentage point.

Table 4.3 shows that the strategic and actual equity allocation differs significantly across pension funds. A small majority of funds invest 20-40 percent of their assets in equities. A quarter of the funds invest more than 40 percent in equities, while around one-fifth of the funds invest less than 20 percent in equities.

Table 4.3 Frequency distribution of equity allocation across pension funds (1999:I – 2006:IV; in %)

Investment-in-equity classes	Frequency distribution of pension funds, based on their:	
	equity allocation strategy	*actual equity allocation*
0 – 20	15.2	20.4
20 – 40	55.6	53.6
40 – 60	26.3	23.8
60 – 80	2.4	1.9
80 – 100	0.4	0.3
Total	100.0	100.0

4.3 Relative stock-market returns and short-term changes in equity allocation

To start our empirical analysis, this section examines the short-term impact of stock market performance on equity allocation. Over time, actual equity allocation may change either (i) due to excess returns on equities compared to other asset classes (free floating) or (ii) due to net purchases or net sales of equities (rebalancing and market timing). To investigate the impact of relative stock market returns on pension funds' equity allocation, we estimate the following equation:

$$w_{i,t} = \alpha_1 + \Sigma_{j=0}^{k} \beta_j \left(r_{t-j}^{E} - r_{i,t-j}^{T} \right) + \gamma_1 Policy_{i,t-1} + \delta_1 Size_{i,t-1} + \lambda_1 funding_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

The dependent variable $w_{i,t}$ is the actual percentage of the portfolio invested in equities of pension fund i ($i = 1,\ldots,N$) at quarter t ($t = 1,\ldots,T$). The variable ($r^E - r^T$) is used to measure excess stock market returns compared to other investment categories on a quarterly basis. For stock market return (r^E) we use either the return on the MSCI World equity index or the pension funds' self-reported equity performance. For the average return on the pension fund portfolio's other asset categories (r^T) we multiply the strategic asset allocation of four key asset classes by either the pension funds' own reported returns or representative broad market indexes.[86] Again, the alternative is to use the pension funds'

[86] We consider five investment categories: equities, bonds, real estate, money market instruments and other assets. For bonds we use the JP Morgan EMU bond index, for real estate we use the FTSE EPRA Netherlands real estate index and for money-market investments we use the 3-month Euribor interest rate. We assume that the fifth category 'other assets' is proportionally invested in the previous four investment categories (or has a similar return). We calculate excess returns as follows: excess return = return MSCI – [(return on bonds * bond investments + return on real estate * real estate investments + 3-months Euribor * money market investments) / (bond investments + real estate investments + money market investments)].

self-reported performance on the respective asset classes. We consider two variants of Equation (1). The base model is without lagged stock market returns (k = 0), whereas alternatively, we include excess stock market returns with time lags (k = 5) to investigate the influence of past returns on pension funds' equity investments. The strategic equity allocation (*Policy)* also expressed as a percentage, is included to control for pension fund investment policy. *Size*, which is measured as the logarithm of the total investment portfolio, controls for the tendency of larger funds to invest relatively more in equities. *Funding*, calculated as total investments / discounted pension liabilities, is included because funds with a higher buffer are allowed to invest more in equities. *Policy, Size* and *Funding* are included with one time lag to avoid endogeneity problems and since it may take some time before changes in these variables lead to changes in the equity portfolio investment. As stated before the panel is unbalanced, which implies that the number of observations varies across pension funds.

4.3.1 Empirical results of the impact of stock returns on actual equity allocation

Table 4.4 presents estimates of the impact of short-term excess stock returns on the percentage of equity portfolio investments, using Equation (1). The measure of excess stock returns in this table is based on the pension fund's self-reported asset returns. A one-percentage point outperformance of the pension funds' equities leads to a significant increase in equity allocation of 0.12 percentage point in the subsequent quarter (first column). The second column shows that excess equity returns also have a (highly) significant impact on the equity allocation up to five quarters later. The impact decreases over time, indicating that pension funds rebalance gradually or infrequently. If a pension fund invests 40 percent in equity, a one percent rise of stock prices would imply an increase of the weight of stocks by 0.24 percentage point (being 40.4/100.4 minus 40/100), that is, as long as no adjustments are made. In this example, the observed 0.12 percentage point effect of excess returns on pension funds' equity implies that only half the excess is rebalanced and that the other half of the equity weight moves in tandem with stock prices.

Table 4.4 reveals also that a one percentage point increase in the strategic equity allocation causes a significant rise of around 0.90 percentage point in actual equity portfolio investments in the next period. As one would expect,, pension fund investment managers adjust their equity portfolio investments almost fully in response to changes in the strategic equity allocation. The positive sign for the size of investments affirms that larger funds invest relatively more in equities (see also Table 4.1), except within the

medium-sized funds class where the sign becomes negative. A possible explanation is that large pension funds tend to be less risk averse than small pension funds, which also holds within the classes of small and large funds. Finally, in line with expectations, the funding ratio has a highly significant positive coefficient, indicating that funds with larger buffers invest more in equities. As equities are more risky, regulation requires larger buffers for this asset class.

Table 4.4 Estimates of the equity investments model (1999:II – 2006:IV)

	All funds		Small funds	Medium sized funds	Large funds
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Excess return	0.118***	0.103***	0.094***	0.109***	0.125***
Idem, lagged 1 quarter		0.067***	0.068***	0.069***	0.056***
Idem, lagged 2 quarters		0.053***	0.055***	0.052***	0.054***
Idem, lagged 3 quarters		0.031***	0.023***	0.037***	0.042***
Idem, lagged 4 quarters		0.023***	0.020***	0.024***	0.037***
Idem, lagged 5 quarters		0.018***	0.014**	0.020***	0.028**
Investment policy (t-1)	0.900***	0.910***	0.931***	0.900***	0.884***
Size (t-1)	0.001***	0.001**	0.002***	-0.004***	0.005***
Funding ratio (t-1)	0.025***	0.016***	0.011***	0.025***	0.011***
Intercept	-0.009***	0.009***	-0.009	0.058***	-0.043**
Number of observations	11045	9358	4308	3855	1195
R^2, adjusted	0.86	0.87	0.85	0.85	0.86

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% significance levels, respectively. The standard errors have been corrected for possible heteroskedasticity or lack of normality using the Huber-White sandwich estimators. Estimates for excess returns are based on data reported by pension funds.

If we consider the investment behavior across size classes (last three columns), where size classes are defined as in Table 4.2, we observe that the impact of excess stock market returns on equity allocation increases with the pension fund size, both immediately and in the long run. Apparently, large funds allow more free floating, whereas smaller funds rebalance more. In line with this result, larger funds react less to changes in the investment policy, compared to smaller funds.

4.4 Excess stock market returns and rebalancing

The positive impact of excess equity returns on equity allocation in the previous section may be (partly) due to imperfect rebalancing by pension funds. Excess equity performance will automatically lead to changes in equity allocation if pension funds do not actively rebalance their investment portfolios fully. This section presents an empirical

rebalancing model, which is used to estimate to what extent pension funds rebalance, that is, re-adjust their asset allocation in response to excess equity returns.[87] This model is derived as follows, starting from the definition of the actual equity allocation:

$$w_{i,t} = E_{i,t} / TA_{i,t} \tag{2}$$

where $E_{i,t}$ represents the equity investments of pension fund i at time t, and TA stands for total assets. Taking first differences of Equation (2), we obtain:

$$\begin{aligned} w_{i,t} - w_{i,t-1} &= \frac{E_{i,t}}{TA_{i,t}} - \frac{E_{i,t-1}}{TA_{i,t-1}} = \frac{E_{i,t-1}(1 + r_{i,t}^{E} + NCF_{i,t}^{E})}{TA_{i,t-1}(1 + r_{i,t}^{T} + NCF_{i,t}^{T})} - \frac{E_{i,t-1}}{TA_{i,t-1}} \\ &= w_{i,t-1} \frac{(1 + r_{i,t}^{E} + NCF_{i,t}^{E})}{(1 + r_{i,t}^{T} + NCF_{i,t}^{T})} - w_{i,t-1} \frac{(1 + r_{i,t}^{T} + NCF_{i,t}^{T})}{(1 + r_{i,t}^{T} + NCF_{i,t}^{T})} \\ &= w_{i,t-1} \frac{(r_{i,t}^{E} - r_{i,t}^{T} + NCF_{i,t}^{E} - NCF_{i,t}^{T})}{(1 + r_{i,t}^{T} + NCF_{i,t}^{T})}, \end{aligned} \tag{3}$$

where NCF^T is short for Net Class Flows converted into new investments as a fraction of total investments, NCF^E for new equity investments also as a fraction of equity investments, r^E for the return on equities over the last quarter, and r^T for the return on total assets (all for fund i and quarter t). Dividing both sides by $w_{i,t-1}$ results in:

$$\frac{w_{i,t} - w_{i,t-1}}{w_{i,t-1}} = \frac{r_{i,t}^{E} - r_{i,t}^{T}}{1 + r_{i,t}^{T} + NCF_{i,t}^{T}} + \frac{NCF_{i,t}^{E} - NCF_{i,t}^{T}}{1 + r_{i,t}^{T} + NCF_{i,t}^{T}} \tag{4}$$

This equation explains the percentage change in equity allocation by: (i) excess equity returns, and (ii) net cash flows to equities, where both variables are scaled by the change in the total portfolio size. The first right-hand term is exogenous, since excess returns are determined by market developments and net cash flows into the pension fund are based on (previously made) decisions by employers and employees rather than on equity allocation. Given the small size of pension fund investments relative to total stock market capitalization, we can safely assume that changes in equity allocation do not affect

[87] An alternative approach to measure rebalancing based on pension' funds equity sales and purchases is presented in the appendix.

stock market returns. The second right-hand term, however, is endogenous. While net cash flows to equity investments directly influence the equity allocation of pension funds, the reverse can also be true: changes in the equity allocation may sway pension funds to adjust their net cash flows to equity investments. Thus, there is mutual causality between changes in equity allocation and net cash flows to equity investments. To estimate the impact of excess equity returns on equity allocation, we apply the above decomposition, ignoring the endogenous second right hand term. This results in the following empirical regression model:

$$\frac{w_{i,t} - w_{i,t-1}}{w_{i,t-1}} = \alpha_2 + \beta_2 \left(\frac{r_{i,t}^E - r_{i,t}^T}{1 + r_{i,t}^T + NCF_{i,t}^T} \right) + \gamma_2 \left(\frac{\Delta Policy_{i,t-1}}{Policy_{i,t-2}} \right) + \varepsilon_{i,t} \tag{5}$$

The percentage change or growth in the strategic equity allocation (*Policy*) is included to control for changes in investment policy. This variable is included with a time lag of one quarter, since it may take some time before changes in policy lead to adjustments in the actual equity portfolio investments. In Equation (5), β_2 estimates the degree of free float or market timing so that $1\text{-}\beta_2$ assesses the rebalancing percentage. As an alternative model we split the excess equity return variable into positive and negative equity returns. This allows us to observe possible asymmetric effects in response to changes in excess equity returns.

4.4.1 Empirical results of rebalancing

Table 4.5 presents the estimated impact of excess equity returns on equity allocation. The results show that pension funds rebalance, on average, around 39 percent of excess equity returns, leaving 61 percent for free floating. Thus 61 percent of excess equity returns translate into increases of the equity allocation in the next period. This is roughly in line with what we have observed in Table 4.4. Column (2) shows that pension funds rebalance differently in response to positive and negative equity returns. Only 13 percent of positive equity returns are rebalanced, against 49 percent of negative equity returns. Apparently, whereas pension funds do not automatically sell equities in bull markets, they do tend to buy additional equities in bear markets. In line with expectations, changes in policy affect the actual allocation positively (significant at the 1% significance level), with a lag of one quarter.

Table 4.5 Estimates of the equity allocation model: rebalancing versus free float (1999:II – 2006:IV)

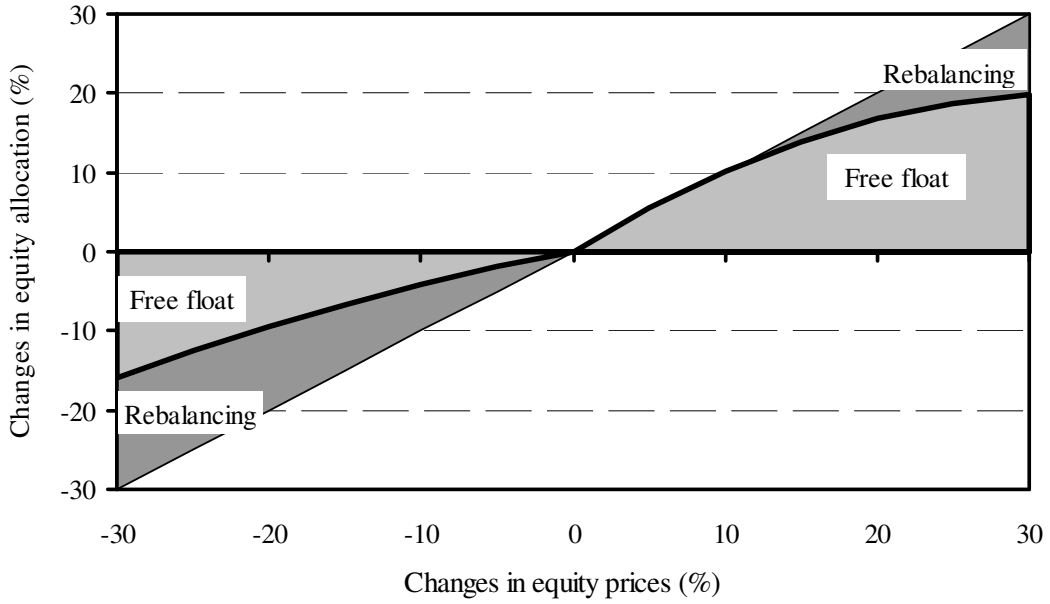
	All funds		Small funds		Medium sized funds		Large funds	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Excess equity returns	0.613		0.621		0.586		0.680	
Pos. excess equity returns		0.872		0.839		0.842		1.209
Neg. excess equity returns		0.508		0.532		0.482		0.483
Change in policy (t-1)	0.075	0.076	0.109	0.109	0.020	0.022	-0.018	-0.015
Intercept	0.012	0.003	0.014	0.007	0.010	0.001	0.007	-0.008
Number of observations	12010	12010	5889	5889	4705	4705	1416	1416
R^2, adjusted	0.19	0.20	0.17	0.18	0.22	0.23	0.29	0.32

Notes: All symmetric and asymmetric excess equity returns effects are significant at the 1% significance level. The standard errors have been corrected for possible heteroskedasticity or lack of normality using the Huber-White sandwich estimators. Estimates for excess returns are based on data reported by pension funds.

Columns (3) to (8) present the model estimates for the various size classes. In line with the results of Section 3.1, we observe that, in the symmetric model variant, large funds, at 32 percent, rebalance less than the small and medium-sized funds (around 40 percent). Consequently, large funds leave 68 percent for free floating. Changes in the one quarter lagged strategic equity allocation (*Policy*) affect actual allocation significantly (at the 1% significance level) for the small funds only. If we turn to the asymmetric effects on excess equity returns, we observe that the positive effects increase significantly with pension fund size, while the negative effects are similar across the size classes. The positive returns coefficient for the largest funds is, at 1.21, even above 1, indicating that large funds invest additional funds in equities in response to positive excess returns in the last month. This suggests that excess equity returns are perceived by large pension funds to provide a positive signal for future returns, leading pension funds to increase their stakes. This is in line with results in Table 4.4, which indicate that large funds respond more strongly to excess equity returns than small ones. A possible explanation is that managers of large funds have more freedom to use market timing strategies in response to market developments. Quite remarkable, we observe that the strategic equity allocation (although increasing for small and medium-sized pension funds) is not increasing for large pension funds, *e.g.* compare 1999 to 2006. This holds also for the actual equity allocation. Hence, the overshooting for large funds, as we have estimated in this chapter, is apparently not due to an increase in the strategic asset allocation over time.

Graph 4.3 presents the asymmetric relation between excess equity returns and rebalancing discussed above.[88] If pension funds used a free float strategy and did not rebalance at all, excess equity returns would go in full to proportionate increases in equity allocation. This is represented by the diagonal line. Instead, with full rebalancing, excess equity returns would have no impact on equity allocation, marked off on the x-axis. The curvature dividing the free float and rebalancing areas reflects the actual rebalancing behavior of Dutch pension funds. Strikingly, rebalancing by pension funds depends on both the sign and size of excess equity returns. Small positive equity returns (of around 0-5%) are not rebalanced at all, but the degree of rebalancing increases with the size of excess equity returns. Instead, small negative returns (of around 0 to -10%) are rebalanced for the largest part, but the degree of rebalancing decreases with the size of negative excess returns.

Graph 4.3 How funds react to excess equity returns: rebalancing and free float



[88] To estimate this figure we adjusted Equation 5 by adding three additional terms: squared excess equity returns and excess and squared equity returns multiplied with 0-1 dummies indicating positive and negative returns.

4.5 Excess stock market returns and medium-term changes in strategic equity allocation

The previous two sections described the effects of excess equity returns on actual equity allocation. This section investigates the impact of (annual) stock market performance (ar^E - ar^T) on pension funds' strategic equity allocation (*Policy)*. Therefore, we estimate the following equation:

$$Policy_{i,t} = \alpha_3 + \beta_3\left(ar_{i,t}^E - ar_{i,t}^T\right) + \gamma_3 Policy_{i,t-1} + \delta_3 Size_{i,t-1} + \varepsilon_{i,t} \qquad (6)$$

The excess stock market performance has been taken on an annual basis, indicated by (ar^E – ar^T), where *a* refers to annual. We assume that the pension fund trustees base their policy on longer-term measures of performance, as also reflected by the empirical results. As above, *Size* controls for the tendency of larger funds to invest relatively more in equity portfolios. We also include a lag of the dependent variable *Policy*, as we expect only gradual changes in policy over time. Hence, the equation describes the quarterly adjustments in policy.[89]

While this equation shows how investment policy is influenced by market developments, it does not provide a model of the underlying investment policy decisions, which are generally based on asset liability management studies.

4.5.1 Empirical results of the impact of stock market returns on strategic equity allocation

Table 4.6 shows the impact of excess stock market returns on strategic equity allocation. The investment policy is adjusted significantly in response to changes in equity returns, irrespective of whether they are measured by the MSCI or by the actual investment returns earned by pension funds. This shows that investment policy is not constant over time but, to some extent, follows market developments. The coefficient of the lagged dependent variable, 0.97 in the first column, indicates that the strategic equity allocation reacts only to a small extend to changes in the quarterly returns. These market developments, captured by the yearly excess return, have a small but very significant impact, both based on the MSCI and on the actual equity return of the pension fund. The

[89] An alternative model, with first differences of Policy as the dependent variable, instead of gradual adjustment, leads to similar estimation results (not reported here).

size effect is also small but significant. Finally, the results are similar across pension fund size classes.

Table 4.6 Estimates of the strategic equity allocation model (1999:II – 2006:IV)

	All funds			Small funds	Medium - sized funds	Large funds
	(1) OLS	*(2)* A&B	*(3)* OLS	*(4)* OLS	*(5)* OLS	*(6)* OLS
Equity investment policy (t-1)	0.972 ***	0.801 ***	0.972 ***	0.970 ***	0.971 ***	0.978 ***
Yearly excess MSCI equity return	0.007 ***	0.006 ***				
Yearly excess psf equity return			0.005 ***	0.005 ***	0.004 ***	0.005 *
Size (t-1)	0.001 ***	0.005 ***	0.001 ***	0.001	0.001	0.001
Intercept	0.001 ***	0.006	0.003 ***	0.002	0.004	-0.001
Number of observations	16156	16156	11273	5425	4488	1360
R^2, adjusted	0.95		0.954	0.941	0.952	0.955

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% significance levels, respectively. The standard errors have been corrected for heteroskedasticity using the Huber-White sandwich estimators. Estimates for excess returns are based on data reported by pension funds. Column (2) reports Arellano and Bond (A&B) estimators.

Column (2) in table 4.6 reports Arellano and Bond (1991) estimators, in contrast to pooled OLS results that are reported in the other columns. The Arellano and Bond estimators are added since they avoid potential biases as a result of two econometric problems associated with equation (6): (i) Time-invariant pension fund characteristics may be correlated with the explanatory variables, and (ii) the inclusion of the lagged variable $Policy_{i,t-1}$ may result in autocorrelation. The Arellano and Bond estimators are close to the original results and the main variables remain significant, indicating that the bias from aforementioned factors is limited.[90]

We used three alternative approaches to check the robustness of our results.[91] First, we estimated all equations employing the alternative measure of excess equity returns based on market indices. Results were very close to the reported estimates based on self-reported returns, indicating that, on average, actual asset returns followed the same pattern as index returns. Second, we also ran regressions for a balanced sample of a subset of 382 pension funds that reported at least seven years of data. The regression results were similar to those reported in Tables 4-7, suggesting that survivorship bias is not a significant issue.

[90] For the Arellano and Bond estimators, I have assumed that the variables *Yearly excess MSCI return* and *Size* are exogenous. Conversely, I have instrumented *Equity investment policy (t-1)*. In addition, I have included year dummies (not reported). The table reports one-step results but two-steps results are very similar.

[91] The tables of alternative estimates have not been reported here but are available upon request by the authors.

Third, we re-estimated all regressions using fixed effects for pension funds and years. The Hausman test rejected random effects. The results are again fairly similar, except for Table 4.6.[92] Overall, these results confirm that our outcomes are robust.

4.6 Conclusions

This chapter finds that stock market performance influences the asset allocation of pension funds in two ways. In the short-term, the outperformance of equities over bonds and other investment categories automatically results in higher equity allocation (and *vice versa*), as pension funds do not continuously rebalance their asset allocation. Each quarter, pension funds rebalance on average around 39 percent of excess equity returns. The remaining 61 percent leads to higher or lower equity allocation as a result of free floating, which are further rebalanced in subsequent quarters. In the medium-term, outperformance of equities induces pension funds to increase their strategic equity allocation (and *vice versa*). Overall, our estimates indicate that the investment policy of pension funds is partially driven by the (cyclical) performance of the stock market. Apparently, pension funds suffer from myopic investment behavior: they tend to base investment decisions on recent stock market performance, rather than on long-term trends.

We also find that pension funds react asymmetrically to stock market shocks. Equity reallocation is higher after underperformance of equity investments then after outperformance. In particular, only 13 percent of positive excess equity returns is rebalanced, while 49 percent of negative shocks results in rebalancing. The former can be indicated as a 'buy on the dip' strategy and the latter as a 'the trend is your friend' approach. Thus, pension funds limit any decline in equity allocation in response to underperformance but they allow higher exposures to equities when these outperform other investments. Apparently, equity portfolio managers are able to convince pension funds both to replenish their funds in bear markets (to profit from low asset prices) and to increase the equity allocation in bull markets (to take advantage of rising markets).

Large funds' investment behavior is different from that of small funds. They invest more in equity and their equity allocation is affected much more strongly by actual equity returns. The latter implies that large funds rebalance less, possibly because managers enjoy more freedom in implementing market timing strategies. We find asymmetric effects on

[92] In Table 4.6, the coefficients levels of significance are substantially lower. Apparently, the pension funds' fixed effects picked up a part of the variation in the explanatory variables.

excess equity returns, where the positive effects increase significantly with pension fund size. The coefficient of positive returns of the largest funds is, in fact, significantly above 1, reflecting 'overshooting' of free floating, or 'positive feedback trading'. A possible explanation is that managers of large funds have more freedom to respond to market developments and, particularly in bull markets, demonstrate great risk tolerance.

APPENDIX 4.A Pension funds' equity purchases and sales

An alternative procedure to estimate rebalancing is to use the purchases and sales of equity investments as the dependent variable. Equation (7) estimates the impact of excess equity returns on net equity purchases or sales.

$$Equity\ purchases_{i,t} = \alpha_4 + \beta_4 (r_{i,t}^E - r_{i,t}^T) + \gamma_4 \Delta Policy_{i,t-1} + \delta_4 (Policy_{i,t-1} - w_{i,t-1}) + \lambda_1 funding_{i,t-1} + \varepsilon_{i,t} \quad (7)$$

Equity purchases$_{i,t}$ is defined as net equity purchases (+) or sales (-) of fund *i* at quarter *t* as a percentage of total equity. The explanatory variables are the same as before: $(r^E - r^T)$ measures excess stock market returns compared to other investment categories, $w_{i,t}$ is the percentage of pension fund equity investments, while *Policy* is the strategic equity allocation. Additionally, we consider asymmetric effects of excess equity returns on equity transactions. We control for changes in the strategic equity allocation ($\Delta Policy$),for differences between the strategic equity allocation (*Policy* – *w*) and actual equity investments (the 'investment gap') and for the funding ratio, all lagged one quarter.

Table 4.7 Estimates of the equity purchases and sales model (1999:II – 2006:IV)

	All funds			Small funds	Medium-sized funds	Large funds
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Excess equity returns	-0.19***	-0.19***		-0.21***	-0.20***	-0.13***
Pos. excess equity returns			-0.07**			
Neg. excess equity returns			-0.23***			
Change in strategic equity allocation (t-1)		0.10**	0.10***	0.10	0.11**	-0.03
Investment gap (t-1)		0.34***	0.33***	0.40***	0.32***	0.24***
Funding ratio (t-1)	-0.03***	-0.02***	-0.02***	-0.02***	-0.02***	-0.01
Intercept	0.05***	0.04***	0.04***	0.05***	0.04***	0.02***
Number of observations	10.895	10.652	10.652	5.044	4.304	1.304
R^2, adjusted	0.04	0.07	0.07	0.06	0.08	0.06

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% significance levels, respectively. The standard errors have been corrected for heteroskedasticity, using the Huber-White sandwich estimators. Estimates for excess returns are based on data reported by pension funds.

Table 4.7 presents evidence on rebalancing, as the percentage of equity portfolio purchases and sales are significantly affected by excess equity returns. Negative equity returns are the main force behind this phenomenon (see Column 3). The investment gap is also a significant driver of equity portfolio sales and purchases. Although the rebalancing

and investment gap effects are significant, only a tiny portion of the variation in equity portfolio sales and purchases is explained by our model (see adjusted R^2).

Turning to the size class estimates, we find less rebalancing behavior of the larger funds compared to small funds. This is further emphasized by the observation that larger funds also react less than small funds to changes in the policy and investment gap.

Chapter 5

The impact of explicit deposit insurance on market discipline

"In the long tradition of the United States, free banking, even wildcat banking, was the rule. Anyone could start a bank, and many did. Risks were large, banker turnover rapid. A guarantee of bankers' deposits would have constituted a license to speculate, if not embezzle, and would have removed the major check on banker irresponsibility, the threat of withdrawal of deposits"

Charles Kindleberger, 1978, Maniacs, Panics and Crashes

This chapter studies the impact of explicit deposit insurance on market discipline in a framework that resembles a natural experiment. We improve upon previous studies by exploiting a unique combination of country-specific circumstances, design features, and data availability that allows us to distinguish between demand and supply effects. We show that deposit insurance causes a significant reduction in market discipline. We also show that the effect of deposit insurance depends on the coverage rate: the higher the coverage rate, the larger the decrease in market discipline. When the coverage rate is 100 percent, market discipline is completely eliminated. Our results also suggest that most market discipline comes from large depositors and that the introduction of deposit insurance affected mainly those who were already active in imposing discipline. Our findings emphasize the need for binding coverage limits per depositor, high degrees of co-insurance, and "tailor made" deposit insurance systems that preserve the incentives of a critical mass of depositors that are willing and able to perform this function.

This chapter is based on: Ioannidou, V. P., and De Dreu, J., 2006, The impact of explicit deposit insurance on market discipline, CentER discussion paper No. 2006–05.

5.1 Introduction

The provision and design of deposit insurance systems presents governments with an unprecedented set of challenges. Deposit insurance systems typically are motivated by a desire to decrease the risk of systemic bank runs (e.g., Diamond and Dybvig, 1983) and to protect small, uninformed depositors (e.g., Dewatripont and Tirole, 1994). Often, however, they are blamed for increasing the incentives of banks to take excessive risk because such systems weaken, or remove entirely, the link between a bank's risk of default and its funding costs (e.g., Kane, 1989; Calomiris, 1999).

Policymakers face a major challenge: how to design a deposit insurance scheme that protects the financial system from systemic bank runs without unduly reducing market discipline. A major concern is that deposit insurance reduces the incentives of depositors to monitor and discipline their banks, either through requiring higher interest rates, withdrawing their deposits when bank risk increases, or both, with "overly generous" deposit insurance systems or open-ended implicit guarantees having the potential to completely eliminate market discipline. Coupled with weak regulatory and supervisory systems, this could lead to huge costs, both for taxpayers and for the economy more generally, from exacerbating and prolonging crises. The U.S. Savings and Loan (S&Ls) debacle in the mid-1980s is a classic example of such situations (e.g., Kane, 1989).

While most studies of market discipline provide evidence consistent with the hypothesis that market discipline is at work, to date, there is little *direct* evidence on the effect of explicit or implicit deposit insurance on market discipline by depositors.[93] The evidence on how various design features of a deposit insurance system might affect market discipline is particularly sparse.[94] In part, these weaknesses in the existing literature reflect data limitations. For example, a comparison of the behavior of small with large depositors is used to draw conclusions about the effect of the coverage rate on market discipline because most deposit insurance systems provide full coverage up to a certain amount per depositor or account (e.g., Martinez Peria and Schmukler, 2001). However, small and large depositors differ across many dimensions for which controls are not included (e.g., degree

[93] Most of the empirical literature on market discipline uses U.S. data and provides evidence consistent with market discipline in three markets: large certificates of deposit (e.g., Baer and Brewer, 1986; Hannan and Hanweck, 1988; and Ellis and Flannery, 1992), subordinate notes and debentures (e.g., Flannery and Sorescu, 1996), and the overnight inter-bank market (e.g., Furfine, 2001). On the interaction between market discipline and deposit insurance, see Kane (1987), Cook and Spellman (1991) and (1994), Park and Peristiani (1998), Martinez Peria and Schmukler (2001), and Demirgüç-Kunt and Huizinga (2003).
[94] See Demirgüç-Kunt and Huizinga (2003).

of sophistication, absolute or relative risk-aversion). A second data limitation concerns the calculation of a measure of a bank's current cost of funds (i.e., the current cost of existing funds or the cost of new funds). For most countries, the only available information is an implicit interest rate, calculated as the ratio of interest expenses to total deposits, which reflects an average, rather than marginal, measure that averages over various types of deposits and contractual interest rates that reflect market conditions at different points in time.

This study attempts to overcome the weaknesses in the existing literature by exploiting a unique, detailed Bolivian dataset that covers the 1998 to 2003 period. However, the value of this dataset comes not only from the detailed measures available, but also from the country-specific circumstances during this period and the characteristics of the Bolivian deposit insurance system that provides a "natural experiment" setting for the analysis. In particular, the sample period is characterized by a severe recession that weakened significantly the health of the banking sector, providing depositors with reasons to worry about the safety of their deposits. More importantly, the deposit insurance system was introduced part way through our sample in December 2001, with no other major regulatory reforms during the sample period. This makes it possible to construct consistent time-series and to compare the behavior of depositors before and after the new system was introduced.

Moreover, the Bolivian deposit insurance system presents a unique opportunity to investigate the effect of the coverage rate on market discipline without having to compare the behavior of small and large depositors. With full coverage up to a certain amount per depositor (or per account), typical of most deposit insurance systems, depositors (or accounts) above this limit are only partially insured, and the degree of coverage decreases as the value of deposits increases above this limit.[95] The Bolivian system differs by having a coverage limit per bank, which effectively translates into a flat coverage rate per depositor (or per account). This makes it easier to examine the relationship between the coverage rate and market discipline, including the ability to investigate whether small and large depositors are indeed different for reasons other than their degree of deposit insurance coverage.

[95] For example, the United States has a coverage limit of $100,000 per account. This implies that any account with $100,000, or less, enjoys a 100 percent coverage rate, while any account above this limit is only partially insured (e.g., accounts with $300,000 have only a 33.3 percent coverage rate).

The Bolivian data provide further benefits from providing more detail than is typical. In particular, the interest rate on deposits is constructed by the Central Bank as a weighted average of the interest rate on all deposits outstanding at the end of each month and is constructed separately by type of deposits and by currency denomination. With interest rates available by deposit account type and currency of denomination, we can construct a measure of banks' current cost of funds that represents a substantial improvement over that typically used. Finally, with such detailed data, we are able to obtain evidence of market discipline in both the price and quantity dimensions. As emphasized by Park (1995)—and explained later in the section on methodology— finding evidence on both prices and quantities is crucial in order to distinguish market discipline from alternative hypotheses that are demand, as opposed to supply, driven (e.g., regulatory discipline, gambling for resurrection, etc.).

Our results are consistent with the hypothesis that market discipline is at work. We find that an increase in bank risk leads to higher interest rates on deposits and lower deposit volumes. More importantly, we find that the introduction of explicit deposit insurance caused a significant reduction in market discipline. The coefficients of the indicators that capture market discipline are 50 to 90 percent smaller after the introduction of deposit insurance. We also find that the effect of deposit insurance depends on the coverage rate: the higher the coverage rate, the larger the decrease in market discipline. As the coverage rate increases above 60 percent, many of our coefficients start to become insignificant and none of them remains significant when the coverage rate reaches 100 percent. These results suggest the need for much higher degrees of co-insurance than those employed by most deposit insurance systems around the world. To the best of our knowledge, this study is the first to provide such direct evidence on the effect of deposit insurance on market discipline.

Given that we have some information by size we also try to infer whether small and large depositors behave differently. Our results are consistent with the hypothesis that most market discipline comes from large depositors and that the introduction of explicit deposit insurance affected mainly those who were active in the first place. As shown in the sensitivity analysis, this is true even if we take into account a "pollution bias," resulting from the possible migration of accounts across size categories— a problem that has been completely overlooked by the existing literature (e.g., Martinez Peria and Schmukler, 2001).

This study contributes to a small but growing literature that investigates empirically the effects of deposit insurance on market discipline. In particular, drawing from the U.S. S&Ls crisis, the evidence shows that even fully insured depositors would discipline their banks if the deposit insurer faces serious financial difficulties (e.g., Cook and Spellman, 1991 and 1994; Kane, 1987; and Park and Peristiani, 1998).[96] More recently, Martinez Peria and Schmukler (2001) find that depositors in Argentina, Chile, and Mexico punish risky banks by withdrawing their deposits and requiring higher interest rates, but do not find any statistically significant effect of deposit insurance on their behavior. They argue that their findings highlight the lack of credibility of deposit insurance in developing countries. Our results, instead, do not support this interpretation. In fact, our results are much closer to the findings of Demirgüç-Kunt and Huizinga (2003). Using data from more than 30 developed and developing countries, Demirgüç-Kunt and Huizinga find that bank interest expenses are lower and less sensitive to indicators of bank risk in countries with an explicit deposit insurance system. They also find that these effects are more pronounced for countries with more generous deposit insurance systems (e.g., systems without co-insurance, high coverage limits, etc.). Although these results are consistent with the hypothesis that market discipline is lower in countries with an explicit deposit system in place, they are only based on estimates from the price equation, and thus do not eliminate alternative hypotheses.

The remainder of this chapter is organized as follows. Section 5.2 describes the deposit insurance system in Bolivia and contrasts it to deposit insurance systems in the rest of the world. Section 5.3 discusses our methodology. Section 5.4 describes the data and variables used in the empirical analysis. Section 5.5 presents and evaluates the paper's main results. Section 5.6 provides sensitivity analysis, and Section 5.7 concludes.

5.2 Background

Bolivia introduced an explicit deposit insurance system on December 20, 2001, with the passage of Law 2297. Before that, there were some implicit guarantees. For example, when two commercial banks failed in 1994, the Bolivian Central Bank covered 100 percent of their deposits to the private sector. More recently, these bailout policies

[96] When the deposit insurer faces serious financial difficulties, there are reasons to believe that deposit insurance could be repudiated (in whole or in part) or that insured depositors could incur indirect costs if their bank fails (e.g., wait for a long time to collect their funds). Hence, in this case, even fully insured depositors might find it optimal to withdraw their funds from risky banks or to require higher risk premiums.

tended to favor "small" depositors. For example, when a savings and loan cooperative failed in 1996, the Central Bank covered only up to $5,000 per account. Instead, when a commercial bank failed in 1997, the coverage limit was $200,000 per account.[97]

With the passage of Law 2297, the "Fund for Financial Restructuring" (thereafter the Fund) was created in order to protect the "preferred obligations" of failing financial institutions. All financial institutions operating in Bolivia are required to contribute to the Fund. The insurance premiums are proportional to the institution's private sector deposits. When fully capitalized, the Fund will be 5 percent of the total deposits in the system. Until then, the Bolivian Central Bank is the responsible party. However, even after full capitalization is reached, if the resources of the Fund are insufficient, the Bolivian Central Bank is required by law to supply the lacking resources by debiting against future contributions of the financial intermediaries to the Fund.[98] Clearly, this back-up support by the Central Bank aims at strengthening the credibility of the newly established system.

Deposit insurance coverage is limited. Before 2005, the Fund covered only up to 50 percent of a bank's "total preferred obligations" (TPOs), while after 2005 it covers only up to 30 percent. The TPOs are divided into first and second order obligations, where second order obligations are subordinate to first order obligations. The first order obligations include obligations to the private sector, which consist primarily of deposits to the private sector. Given that the Bolivian economy is highly dollarized, the Law makes no distinction between foreign denominated deposits and deposits in Bolivianos.[99] The second order obligations include obligations to the public sector, the Central Bank, and foreign financial entities. Finally, the Law states specifically that interbank deposits are not insured.

The first part of Table 5.1 provides some information regarding the *effective coverage* of the deposit insurance system. There are two distinct patterns: i) both before and after deposit insurance, first order obligations are almost always more than 50 percent of TPOs, and ii) the ratio of first order obligations to TPOs increased after the introduction of deposit insurance. The first pattern implies that first order obligations are only *partially*

---

[97] Although there is a trend in limiting coverage to small depositors, the definition of small seems quite ambiguous. Part of the difference between the two limits, is probably due to differences in the distribution of deposits between the two types of banks. Commercial banks have on average larger accounts than savings and loan cooperatives. Hence, although the coverage limits per account are very different between the banks, the total coverage per bank could be similar (e.g., the percentage of accounts or deposits covered).

[98] See third paragraph of Article 127, Law 2297.

[99] More than 90 percent of deposits and credits are in U.S. dollars. This high degree of dollarization is one of the longer lasting effects of the hyperinflation of the 1980s. Because the economy is highly dollarized, the exchange rate policy follows a crawling peg with the U.S. dollar. During the sample period, the exchange rate has been depreciating at a roughly constant rate of 6.5 percent per annum, with a peak of 9.7 percent in 2002.

insured, while all second-order obligations are effectively *uninsured* after 2001. Given that first order obligations are on average 84.4 percent of TPOs, on average only 60 percent of first order obligations are insured.[100] Since there is no priority within the group of first order obligations, this implies that on average only 60 percent of private sector deposits is effectively insured. This percentage varies across banks and time, depending on their ratio of first order obligations to TPOs, but it does not vary between accounts of different size within a given bank. Hence, in the event of bankruptcy, small and large depositors within a given bank will receive the same percentage of their deposits. The second pattern suggests that after the introduction of deposit insurance, first order obligations became more attractive than second order obligations. This increase could be due to a supply effect (i.e., a decrease in market discipline after the introduction of deposit insurance), a demand effect (i.e., an increase in the demand for insured, as opposed to uninsured, funds), or both.[101]

The second part of Table 5.1 compares the deposit insurance system in Bolivia with the deposit insurance systems in the rest of the world. For the most part, the Bolivian system is in line with the rest of the world. The only difference is the absence of full insurance up to a certain amount per depositor (or per account). In particular, 90 percent of the systems in the rest of the world provide full insurance up to a certain amount per depositor (or per account). Depositors that are above this limit are only partially covered and the degree of coverage decreases as the value of the deposits increases above this limit. The Bolivian scheme, instead, has a coverage limit per bank, which effectively translates in a flat and partial coverage rate per depositor (or per account). Hence, compared to the rest of the world, the Bolivian scheme is more generous to large depositors than it is to small depositors. This rather unusual feature of the Bolivian system was the result of pressure from financial institutions against the first draft of the deposit insurance law that included a coverage limit of $10,000 per account. This first draft was submitted to the Congress in 1999, but failed to pass given the strong opposition from the country's "business elite."[102]

---

[100] The coverage rate is equal to 50*(TPOs/First Order Obligations) if first order obligations is more than 50 percent of TPOs and is equal to 100 percent otherwise.

[101] Billet, Garfinkel, and O'Neal (1998) argue that if the costs of regulatory discipline are lower than the costs of market discipline, banks should replace uninsured funds with insured funds. Using U.S. data, the authors show that banks that have been downgraded by Moody's, experience smaller declines in equity value and increase their absolute and relative reliance on insured deposits, indicating that bank managers perceive the cost of insured deposits to have increased less than the cost of uninsured deposits.

[102] A number of recent papers have been emphasizing the role of private interest groups on the design of deposit insurance systems around the world. Kroszner and Strahan (2001) find that the voting behavior in the U.S. House of Representatives on the limitation of deposit insurance to a single account per bank is consistent with private interest theories of regulation. More recently, Laeven (2004) finds that cross-country differences in deposit insurance coverage can also be explained by private interest theories.

Table 5.1: The Bolivian deposit insurance system in perspective (in %)

Part 1: Effective coverage in Bolivia	Before	After	Difference
First order obligations to total preferred obligations (TPOs)	79.2	84.4	5.2***
Observations for which first order obligations are fully insured		1.9	
Coverage rate			
Mean		60.0	
Standard deviation		10.3	
Min		50.6	
Max		100.0	

Part 2: Characteristics of deposit insurance systems around the world	Bolivia	All Countries	High & Upper Middle Income	Lower Middle & Low Income
Participation is compulsory	√	91.5	95.7	86.1
There is a permanent fund	√	83.1	73.9	94.6
Insurance premiums are risk-adjusted	×	24.4	19.6	30.6
Interbank deposits are covered	×	17.3	6.7	30.6
Foreign currency deposits are covered	√	76.5	75.6	77.8
Full insurance up to a certain amount per account/depositor	×	90.9	97.9	82.9
Percentage of deposit value (fully or partially) insured	60	52.4	54.8	49.7
Percentage of deposit accounts (fully or partially) insured	100	92.0	92.3	91.9

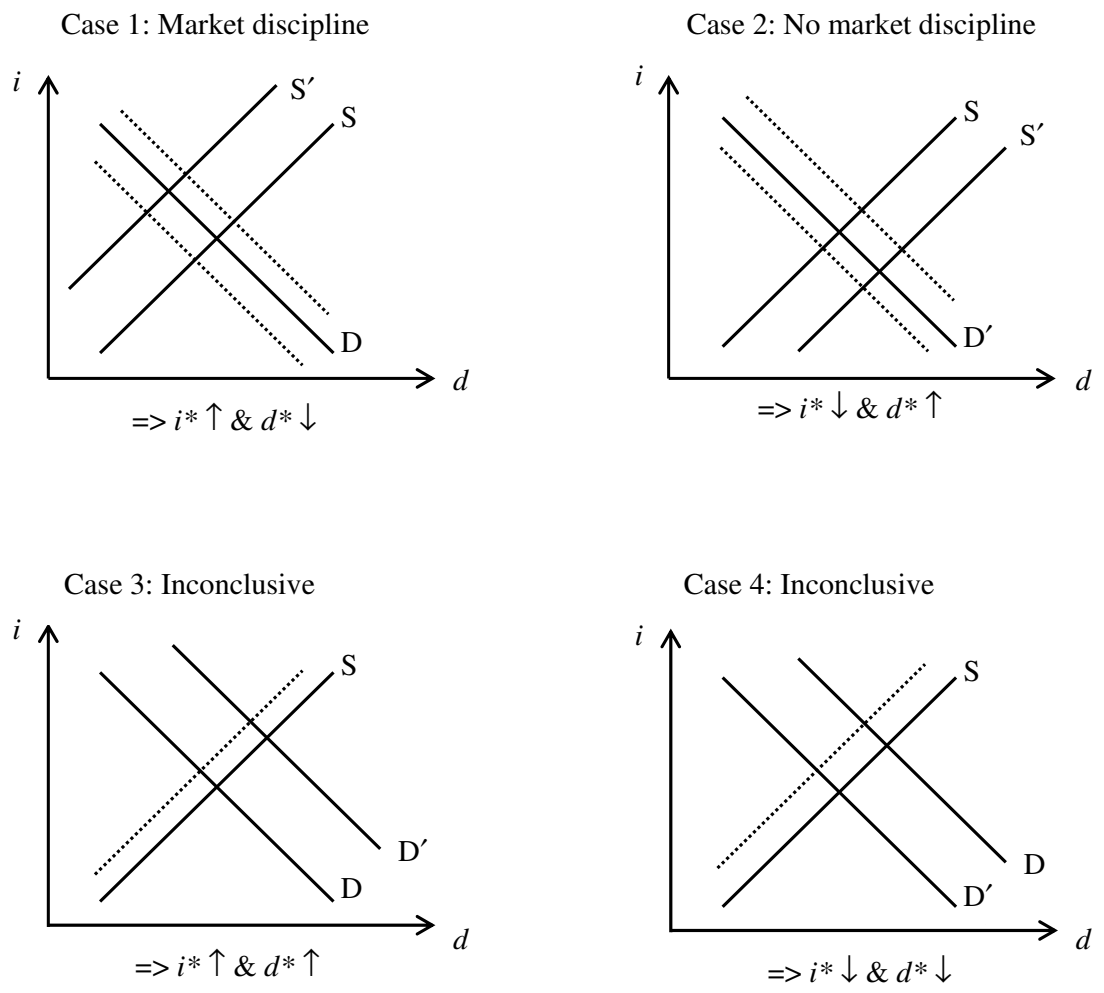
Notes: The coverage rate is equal to 50*(TPOs/First Order Obligations) if first order obligations are more than 50 percent of TPOs and is equal to 100 percent otherwise. The percentages in Part 2 are calculated using data reported in Demirgüç-Kunt et al. (2005), with the exception of the last row that uses data from Garcia (1999). "All Countries": reports the percentage of all explicit deposit insurance systems with a certain characteristic. According to Demirgüç-Kunt et al. (2005), as of 2003 there are 88 countries with an explicit deposit insurance system, 47 of which are classified as high and upper-middle income countries. "High & Upper Middle Income": reports the percentage of deposit insurance systems in high and upper middle-income countries that have a certain characteristic. Similarly "Lower Middle & Low Income": reports the percentage of deposit insurance systems in lower middle and low middle-income countries that have a certain characteristic.
*** The difference in the ratio of first order obligations before and after the introduction of deposit insurance is statistically significant at 1 percent

5.3 Methodology

To examine whether depositors respond to increases in bank risk by reducing their supply of deposits, ideally one should estimate a simultaneous equations model specifying demand and supply equations. In practice, however, this is very difficult, since it is hard to find exogenous variables that strongly affect either the supply or the demand equation. Hence, the empirical literature has tried to infer whether market discipline is present using reduced-form equations for the equilibrium interest rates and/or deposits. In particular, market discipline implies that an increase in bank-risk leads to a decrease in the supply of deposits. Thus, everything else equal, it leads to higher interest rates and lower deposits.[103] Using reduced-form equations, however, is more complicated than it may seem at first sight, since the demand function could also depend on bank risk. For example, an increase in bank risk could be associated with an increase in the demand for deposits, if risky banks are expanding more aggressively. At the same time, an increase in bank risk could be associated with a decrease in the demand for deposits, if banks respond to regulatory discipline by shrinking their operations. For example, banks may respond to regulatory pressures on their capital ratios by reducing their assets and, consequently, their liabilities. Thus, risky banks may lower their interest rates to reduce their deposits.

[103] Whether an increase in bank risk leads to a change in interest rates *and* deposits depends on the elasticities of the two curves (e.g., if the demand curve is perfectly inelastic we should expect only a change in interest rates, while if it is perfectly elastic, we should expect only a change in deposits). However, it is more likely that the demand curve is downward sloping and the supply curve is upward sloping. In general, a bank's demand for deposits is determined by its loan supply. If a bank has finite lending opportunities, due to geographic and regulatory restrictions or limited expertise with certain types of loans, its marginal revenue curve for loans is downward sloping, which implies that its demand for deposits will be downward sloping (Klein, 1971). Similarly, an upward sloping supply curve is consistent with a limit on the amount of deposits per depositor and a finite number of potential depositors or, alternatively, with higher search costs for deposits outside the bank's local market (Flannery, 1982).

Graph 5.1: Market discipline and reduced-form models



Notes: The graphs above show four different scenarios for shifts in the demand and supply of deposits after an increase in bank risk. On the axes: *i* denotes the interest rate on deposits and *d* the volume of deposits.

Since both the demand and the supply functions could depend on bank risk, it is possible that market discipline occurs, but is not strong enough (compared to the demand effect) to be reflected in the equilibrium interest rates and deposits. Graph 5.1 illustrates this argument graphically. Assuming that the supply curve is upward sloping and the demand curve is downward sloping, an increase in bank risk could lead to four possible cases. In general, the presence of market discipline is most convincing in the first case, most doubtful in the second case, and inconclusive in the third and fourth case (Park, 1995). Graph 5.1 also highlights that a positive relationship between interest rates and bank risk *and* a negative relationship between deposits and bank risk is a sufficient, but not a necessary, condition for market discipline. We argue, however, that finding both effects would provide the most convincing evidence. Hence, to examine whether there is any market discipline in Bolivia during the sample period we estimate the following reduced-form equations:

$$InterestRate_{i,t} = \alpha_1 + \beta_1 BankRisk_{i,t-k} + \gamma_1 Controls_{i,t-k} + \varepsilon_{i,t} \qquad (1)$$

$$\Delta Deposits_{i,t} = \alpha_2 + \beta_2 BankRisk_{i,t-k} + \gamma_2 Controls_{i,t-k} + \eta_{i,t} \qquad (2)$$

where $i = 1,\ldots,N$ and $t = 1,\ldots,T$, and N is the number of banks and T is the number of observations per bank. The panel is unbalanced, which implies that T varies across banks. $InterestRate_{i,t}$ is the interest rate on deposits in bank i at time t, while $\Delta Deposits_{i,t}$ is the growth rate of deposits in bank i at time t.[104] $BankRisk_{i,t-k}$ is a vector of publicly observable bank risk characteristics and $Controls_{i,t-k}$ is a vector of control variables. These vectors are included with a lag since it takes some time before changes in the independent variables lead to changes in the dependent variables and because the credit-risk indicators are publicly available with a lag, ranging from 20 to 30 days. The specific variables used in these vectors are discussed extensively in the next section.

A positive estimate for β_1 and a negative estimate for β_2 would indicate the

[104] Following the literature, the growth rate of deposits is used instead of the level because the latter depends more on bank characteristics (e.g., bank size and business orientation) than on supply and demand conditions in a given month. However, using growth rates instead of levels makes it a lot more difficult to find statistically significant coefficients for the bank risk indicators. Even if bank risk affects the level of deposits, it may not affect its growth rate. Moreover, the growth rate series has a lot more noise than the level series. To reduce this problem we use quarterly average growth rates instead of monthly growth rates. Hence, to ensure that our independent variables are predetermined, in the quantity equation we use k = 3 (i.e., the independent variables are determined one period before the last period used to calculate the dependent variable).

existence of market discipline. However, in terms of their economic interpretation, $\hat{\beta}_1$ and $\hat{\beta}_2$ should be viewed as either a *lower* or *an upper bound* of the degree to which depositors penalize their banks. In particular, when one of the two estimates is an upper bound the other will be a lower bound. If the demand for deposits depends positively on bank risk, $\hat{\beta}_1$ would overestimate the degree of market discipline, while $\hat{\beta}_2$ would underestimate it. The opposite is true if the demand for deposits depends negatively on bank risk.

To examine whether the introduction of an explicit deposit insurance system affects market discipline, we estimate the following model:

$$InterestRate_{i,t} = \alpha_1 + \beta_1 BankRisk_{i,t-k} + \gamma_1 Controls_{i,t-k} + \delta_1 DI_{t-k} + \theta_1 BankRisk_{i,t-k} DI_{t-k} + \varepsilon_{i,t} \quad (3)$$

$$\Delta Deposits_{i,t} = \alpha_2 + \beta_2 BankRisk_{i,t-k} + \gamma_2 Controls_{i,t-k} + \delta_2 DI_{t-k} + \theta_2 BankRisk_{i,t-k} DI_{t-k} + \eta_{i,t} \quad (4)$$

where DI_{t-k} is a dummy variable that equals one when there is explicit deposit insurance, and equals zero otherwise. A negative estimate for θ_1 and a positive estimate for θ_2 would indicate that the introduction of explicit deposit insurance reduces market discipline. In addition, a positive estimate for $\beta_1 + \theta_1$ and a negative estimate for $\beta_2 + \theta_2$ would indicate that deposit insurance reduces, but does not eliminate, market discipline.

Given that the deposit insurance coverage varies across banks depending on their ratio of first order obligations to TPOs, we also estimate:

$$InterestRate_{i,t} = \alpha_1 + \beta_1 BankRisk_{i,t-k} + \gamma_1 Controls_{i,t-k} + \delta_1 C_{i,t-k} + \lambda_1 BankRisk_{i,t-k} C_{i,t-k} + \varepsilon_{i,t} \quad (5)$$

$$\Delta Deposits_{i,t} = \alpha_2 + \beta_2 BankRisk_{i,t-k} + \gamma_2 Controls_{i,t-k} + \delta_2 C_{i,t-k} + \lambda_2 BankRisk_{i,t-k} C_{i,t-k} + \eta_{i,t} \quad (6)$$

where $C_{i,t-k}$ is equal to the deposit insurance coverage. Before the introduction of explicit deposit insurance, $C_{i,t-k}$ is equal to zero. After the introduction of deposit insurance, $C_{i,t-k}$ is equal to 0.5*(TPOs/First Order Obligations) if first order obligations are more than 50 percent of the TPOs and is equal to one otherwise. Hence, a positive estimate for β_1 and a negative estimate for β_2 would indicate the existence of market discipline before deposit insurance (i.e., when $C_{i,t-k} = 0$). Instead, a negative estimate for λ_1 and a positive estimate for λ_2 would indicate that the reduction of market discipline from deposit insurance depends positively on $C_{i,t-k}$. Finally, the combined coefficients $\hat{\beta}_1 + \hat{\lambda}_1 C_{i,t-k}$ and

$\hat{\beta}_2 + \hat{\lambda}_2 C_{i,t-k}$ are used to estimate the degree of market discipline for different values of $C_{i,t-k}$.

5.4 Data and variables

This study makes use of a detailed and reliable dataset on the Bolivian banking sector from 1998:1 to 2003:12. The data and all information that were necessary to create consistent time series (e.g., definitions of variables, changes in laws and regulations, etc.) were provided by the Bolivian Superintendence of Banks and Financial Entities (SBEF).
To ensure comparability of the financial institutions in our sample, we focus our analysis on commercial banks. This does not involve any significant loss, since commercial banks capture a dominant part of the market (e.g., 86 percent of total loans). Table 5.2 provides an overview of all banks that were active in Bolivia during the sample period. At the beginning, there are sixteen banks, while at end there are twelve banks. During the sample period, one bank failed, another bank was taken over, a foreign bank left the Bolivian market, and one bank was sold after intervention by the SBEF. The five largest banks have a market share of 70 percent of total assets, and two of these banks are foreign. During the sample period, there are no government-owned or de novo banks.[105] As of December 2003, six out of twelve banks are foreign, accounting for 33 percent of the market.[106] Since 1993, foreign banks have the same rights as domestic banks (i.e., they are subject to the same regulation), and as of December 2001, both foreign and domestic banks are covered by the deposit insurance system in Bolivia. Moreover, as mentioned in Table 5.2, none of the foreign banks in our sample is subject to explicit deposit insurance from its home country.[107]

[105] The last government-owned bank (Banco del Estato) was liquidated in 1994.
[106] A bank is defined as foreign if more than 50 percent of its shares are owned by foreigners. However, we consider Banco BISA as an exception to this rule, since a Bolivian investor has majority ownership in the foreign companies that own this bank.
[107] This information was obtained from direct contact with the supervisory authority in each country.

Table 5.2: Overview of commercial banks in Bolivia during the period 1998:1-2003:12

Bank Name	Market Share[a] January, 1998	Market Share[a] December, 2003	Ownership[b]	Country of Parent Bank	Explicit Deposit Insurance from the Home Country
Banco Santa Cruz	22.1	11.2	Foreign Subsidiary (17-07-98)	Spain	No
Banco Nacional de Bolivia	12.9	16.2	Domestic		
Banco Industrial[c]	11.2	16.0	Domestic		
Banco Mercantil	11.2	15.1	Domestic		
Banco de la Unión	9.5	8.3	Domestic		
Banco de Crédito de Bolivia	7.7	11.7	Foreign Subsidiary (30-12-92)	Peru	No
Banco Boliviano Americano	5.8		Domestic		
Banco Económico	5.5	6.3	Domestic		
BHN Multibanco	4.3		Domestic		
Banco de La Paz	3.7		Domestic		
Banco Ganadero	2.0	4.9	Domestic		
Banco Solidario[d]	1.5	3.0	Foreign Owned (15-03-99)	Mix[d]	No
Citibank	1.3	5.8	Foreign Branch (10-10-66)	United States	No
Banco de la Nación Argentina	0.8	0.4	Foreign Branch (28-04-58)	Argentina	No
Banco Real / ABN Amro	0.4		Foreign Branch	Brazil/Netherlands	No
Banco do Brasil	0.2	1.2	Foreign Branch (01-07-61)	Brazil	No

[a] Market Share is calculated in terms of total assets.
[b] Foreign subsidiary: a bank operating in Bolivia for which more than 50 percent of its shares is owned by a foreign company; Foreign owned: a bank operating in Bolivia for which more than 50 percent of its shares are owned by foreign companies; Foreign branch: a bank operating in Bolivia that is an integral part of a foreign bank (i.e., it is not a separate legal entity). The dates in parentheses indicate when a bank changed from domestic to foreign or the date a foreign branch started its operations in Bolivia.
[c] Banco Industrial is not considered a foreign bank although, more than 50 percent of this bank is owned by foreign companies. It is viewed as a domestic bank because a Bolivian investor has a majority share in some of these foreign companies.
[d] Banco Solidario has the legal status of a bank, but it focuses mainly on micro-credit lending. Hence, this bank is more comparable to micro-credit institutions rather than commercial banks. In terms of ownership, 24 percent of the shares of this bank is owned by a Costa Rican company, 22 percent is owned by a British company, and 22 percent is owned by an American company.

To estimate the model, we use *savings deposits denominated in U.S. dollars*. Focusing on U.S. dollar denominated deposits is not restrictive, since they represent more than 90 percent of total deposits. Focusing on savings deposits, instead of time deposits, allows us to better capture a bank's marginal cost of funds. In particular, time deposits are grouped into various "maturity buckets" (e.g., 90 days, 180 days, etc). Within each bucket, there are deposits issued at different points in time, with the interest rate being determined when the deposits are issued. Hence, like the implicit interest rate, the interest rate on time deposits is only a rough measure of current economic conditions. On the contrary, the interest rate on savings deposits can adjust at any point in time, depending on the current economic conditions, and does not depend on the time of initiation.

The independent variables can be grouped into two categories: indicators of bank risk and control variables. For bank risk we use a number of accounting ratios that are publicly available and have been previously used to capture a bank's financial condition (e.g., equity to total assets, nonperforming loans to total assets, loan loss reserves to total assets, overhead expenses to total assets, returns to total assets, and liquid assets to total assets). We also include two additional indicators that may or may not capture bank risk: bank size (measured as the log of total assets) and a foreign bank dummy variable.[108]

To control for general macroeconomic conditions we include the growth rate of real GDP in Bolivia and the U.S. inflation rate to deflate the interest rate on U.S. dollar denominated deposits.[109] Finally, we have constructed a (0,1) dummy variable to capture episodes of political instability during the sample period. We control for two events: i) violent confrontations between the police and the public because of the coca eradication policy introduced after pressure from the United States and international organizations, and ii) the severe uncertainty in the financial markets during the elections of July 2002.[110]

[108] Bank size could be capturing a bank's market power and reputation, but it could also be capturing a lower probability of failure due to too-big-to-fail policies, better access to funds, better diversification of risk, etc. The foreign bank dummy variable is used to control for possible fixed-effect differences between domestic and foreign banks. In the sensitivity analysis, this variable is interacted with bank risk indicators to examine whether foreign banks are subject to less market discipline than domestic banks.

[109] Including the inflation rate in the equation, instead of using real interest rates, allows for the estimated coefficient on the inflation rate to be different than one, indicating the degree to which banks compensate depositors for the inflation tax.

[110] Before the elections of July 2002, there was severe uncertainty in the financial markets since Evo Morales—the leader of the coca growers, a congressman, and a candidate for the presidential elections— was gaining popularity. His victory, which did not materialize by a small margin, would have meant a major change in the political and economic system towards socialism.

5.5 Results

5.5.1 Do depositors penalize their banks for risk taking?

The first panel of Table 5.3 reports estimation results for equations (1) and (2) using a benchmark specification. It includes bank-level indicators of bank risk and a number of control variables, such as bank size, a foreign bank dummy, the growth rate of real GDP in Bolivia, the U.S. inflation rate, and the political instability dummy variable.

The results provide strong evidence that market discipline is at work. Four out of six indicators of bank risk indicators are statistically significant in both equations and have signs that are consistent with market discipline. Specifically, the leverage capital ratio, measured as equity to total assets, enters with a negative sign in the interest rate equation and a positive sign in the deposits equation, suggesting that depositors are willing to supply more deposits to better-capitalized banks. The ratio of nonperforming loans to total assets, which is used to capture credit risk problems, has a positive sign in the interest rate equation and a negative sign in the deposits equation, indicating a decrease in the supply of deposits. The ratio of loan loss reserves to total assets, which captures the degree to which an institution is reserving against credit risk, enters with the opposite signs of nonperforming loans. This implies that everything else equal, including credit risk, depositors are willing to supply more funds to institutions with higher reserves. Similarly, the ratio of overhead expenses to total assets, which is often used to capture bank or managerial inefficiency, suggests that depositors are less willing to supply funds to inefficient banks.[111] The return to total assets ratio enters with signs that are consistent with a positive supply effect, but is statistically insignificant in both equations. The only variable that does not show any signs of market discipline is the ratio of liquid assets to total assets; it enters with negative signs in both equations, suggesting that banks with high liquidity demand less deposits.

Most control variables enter with the expected signs. In particular, the log of total assets has a negative sign in both equations, indicating that bigger banks demand less deposits, either because they have access to other sources of funds or because they are expanding less than smaller banks. The foreign bank dummy variable enters with a negative sign in both equations indicating that, everything else equal, foreign banks

[111] This ratio could also be capturing differences in business orientation or the level of extra services they may offer. For example, banks with high overhead ratios could be offering more personal attention to their customers. Hence, everything else equal, depositors would be willing to supply more deposits to these banks. Our results, however, do not support this alternative hypothesis.

demand less deposits than domestic banks. The U.S. inflation rate and the growth rate of real GDP in Bolivia have positive and statistically significant coefficients in the interest rate equation, but they are highly insignificant in the quantity equation (i.e., their p-values are around 0.9). Since the coefficients of these variables are so imprecisely estimated, it is hard to say whether they are capturing supply or demand effects based on their signs.

Finally, the dummy variable for political instability is statistically significant in both equations and has a positive sign in the interest rate equation and a negative sign in the deposits equation. This result implies that political instability makes depositors worry about the safety of their deposits and thus, everything else equal, they reduce their supply of deposits, regardless of the health of an individual institution.[112] These findings are in line with a recent paper by Levy-Yeyati, Martinez Peria, and Schmukler (2004) that emphasizes the importance of systemic risk factors for developing countries.

In the second panel of Table 5.3, we re-estimate equations (1) and (2) using quarterly time dummies instead of the macroeconomic control variables. Our main results with respect to market discipline are the same. In particular, the four indicators that were previously found to capture market discipline (i.e., leverage ratio, nonperforming loans to total assets, loan loss reserves, and overhead expenses) enter again with signs that are consistent with market discipline and they are statistically significant in both equations. Moreover, their estimated coefficients are very similar to those reported in the first panel of Table 5.3.

Finally, to evaluate the economic significance of our results, in the third panel of Table 5.3, we report the marginal effects of a one-standard deviation increase in each explanatory variable, using the benchmark specification from the first panel. The marginal effect of a dummy variable is calculated as the discrete change in the dependent variable as the dummy variable changes from zero to one. With respect to the interest rate equation, the marginal effects of the four key indicators vary between 30 to 90 basis points. In the deposits equation, the marginal effects of these variables are between 5.3 and 11.5 percent. Although, the marginal effects in the interest rate equation may seem small at first glance, they are actually quite large if we take into account that the average interest rate during the sample period is 3.7 percent, with a standard deviation equal to 2.1 percent.

[112] Since the role of political instability is not a central point to our analysis, we only present results using one dummy variable for all episodes. However, we also experimented with separate dummies for each event. While our main results with respect to bank risk do not change, this exercise highlighted that the most important event of political instability was the uncertainty before and during the elections of 2002.

Table 5.3: Do depositors discipline their banks?

	Panel 1		Panel 2		Panel 3	
	Interest Rates	Deposits	Interest Rates	Deposits	Interest Rates	Deposits
Leverage capital ratio (t-k)	-0.04***	1.30**	-0.06***	1.12**	-0.34***	11.52**
	(0.01)	(0.66)	(0.01)	(0.56)	(0.09)	(5.85)
Nonperforming loans to total assets (t-k)	0.05***	-1.78***	0.03***	-1.98***	0.31***	-11.18***
	(0.01)	(0.40)	(0.01)	(0.47)	(0.07)	(2.51)
Loan loss reserves to total assets (t-k)	-0.24***	1.55***	-0.21***	1.96*	-0.88***	5.26***
	(0.03)	(0.54)	(0.03)	(1.07)	(0.10)	(1.83)
Overhead expenses to total assets (t-k)	1.77***	-24.84***	1.65***	-27.04***	0.42***	-5.91***
	(0.31)	(5.96)	(0.30)	(8.08)	(0.08)	(1.42)
Return to total assets (t-k)	-0.002	0.17	0.001	0.16	-0.01	1.13
	(0.01)	(0.13)	(0.01)	(0.12)	(0.05)	(0.91)
Liquid assets to total assets (t-k)	-0.02***	-0.49	0.001	-0.41	-0.12***	-2.40
	(0.01)	(0.51)	(0.01)	(0.45)	(0.05)	(2.51)
Log of total assets (t-k)	-0.46***	-6.25***	-0.62***	-7.40***	-0.59***	-7.88***
	(0.07)	(2.21)	(0.08)	(2.34)	(0.10)	(2.79)
Foreign Bank Dummy	-0.47***	-1.38	-0.57***	-1.22	-0.47***	-1.38
	(0.09)	(2.31)	(0.09)	(2.98)	(0.09)	(2.31)
U.S. inflation rate (t-k)	0.66***	0.22			0.49***	0.16
	(0.06)	(1.19)			(0.05)	(0.89)
Growth rate of real GDP in Bolivia (t-k)	0.18***	-0.04			0.23***	-0.06
	(0.02)	(1.01)			(0.03)	(1.55)
Political instability dummy	0.34**	-5.97**			0.34**	-5.97**
	(0.16)	(2.82)			(0.16)	(2.82)
Quarterly dummies	Not Included	Not Included	Included	Included	Not Included	Not Included
Observations	842	863	842	863	842	863
R-Square	0.74	0.14	0.74	0.17	0.74	0.14

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Robust standard errors in parentheses. For the interest rate equation k equals 1, while for the deposits equation k equals 3.

5.5.2 Did the introduction of deposit insurance affect the behavior of depositors?

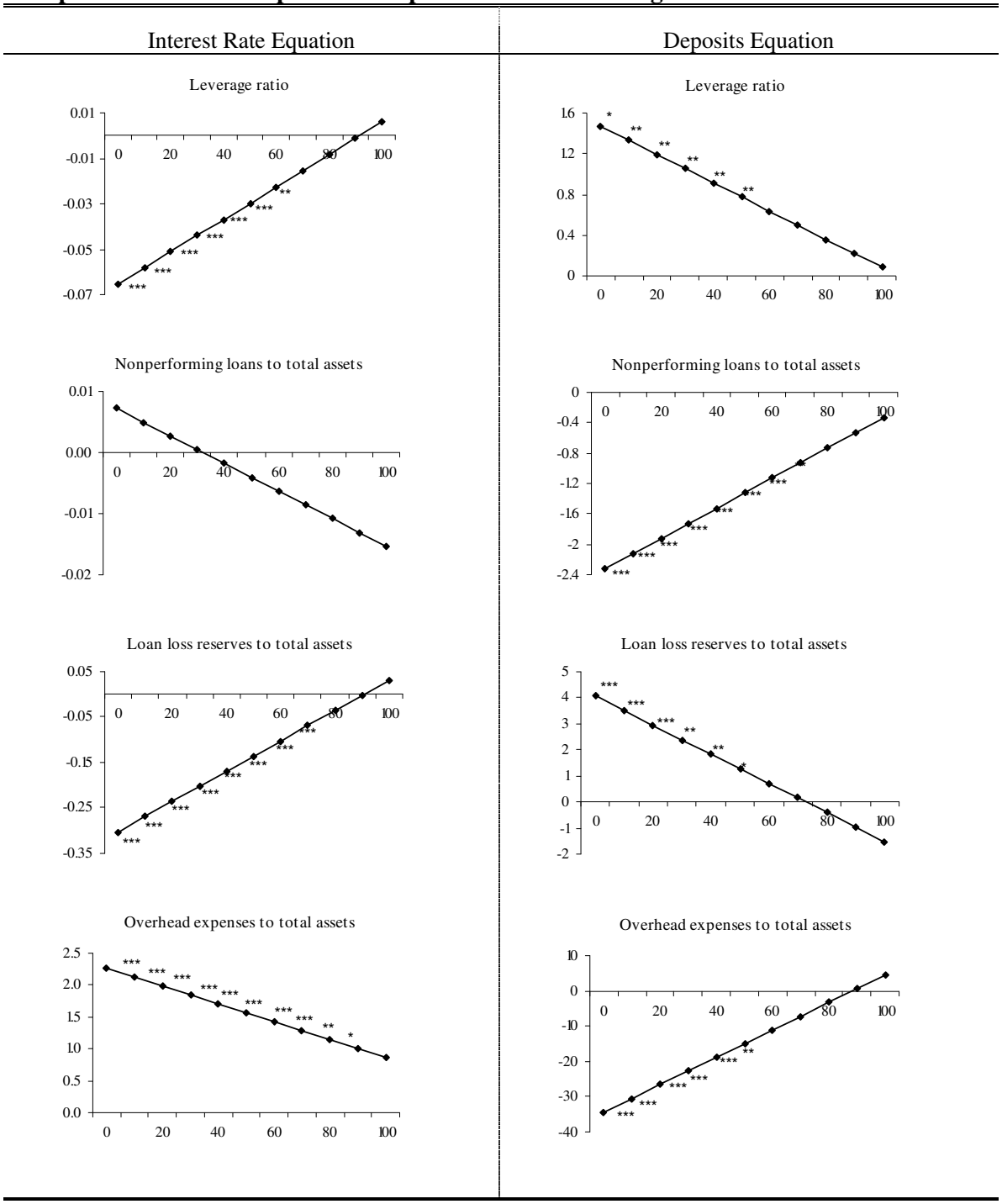
To examine whether the introduction of explicit deposit insurance affected the extent to which depositors penalize their banks, we estimate equations (3) and (4) using the benchmark specification that was presented in the first panel of Table 5.3.[113]

The results, presented in the first panel of Table 5.4, indicate that the introduction of explicit deposit insurance caused a significant reduction in market discipline. The four indicators that were previously found to capture market discipline enter again with signs that are consistent with market discipline (i.e., $\hat{\beta}_1 > 0$ and $\hat{\beta}_2 < 0$), while their interaction terms with DI_{t-k} enter with the opposite signs (i.e., $\hat{\theta}_1 < 0$ and $\hat{\theta}_2 > 0$), causing sizable reductions to the original coefficients. The combined coefficients, $\hat{\beta}_1 + \hat{\theta}_1$ and $\hat{\beta}_2 + \hat{\theta}_2$, are 50 to 90 percent smaller than the original coefficients. Nevertheless, some of the combined coefficients are statistically significant, suggesting that the introduction of deposit insurance did not completely eliminate market discipline. In particular, the leverage ratio and the ratio of nonperforming loans to total assets are statistically significant in both equations, while the ratio of overhead expenses to total assets is significant only in the interest rate equation.

To examine whether the effect of deposit insurance depends on the coverage rate, we also estimate equations (5) and (6), exploiting the variation in the coverage rate across banks. The results, presented in the second panel of Table 5.4, show that the reduction in market discipline depends positively on the coverage rate (i.e., the higher the coverage rate, the larger the reduction in market discipline). In Graph 5.2 we report the values and the statistical significance of the combined coefficients, $\hat{\beta}_1 + \hat{\lambda}_1 C_{i,t-k}$ and $\hat{\beta}_2 + \hat{\lambda}_2 C_{i,t-k}$, for different values of $C_{i,t-k}$. Graph 5.2 clearly shows that as the coverage rate increases above 60 percent, many of the coefficients start to become insignificant. More importantly, when the coverage rate is 100 percent, none of the coefficients remains statistically significant.

[113] In this case, the deposit insurance dummy is equal to one as of January 2002. In the sensitivity analysis, we show that our results are robust to alternative timings.

Graph 5.2: Market discipline and deposit insurance coverage levels



Notes: ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively. The vertical axes show the values of the combined coefficients: $\hat{\beta}_1 + \hat{\lambda}_1 C_{i,t-k}$ for the interest rate equation and $\hat{\beta}_2 + \hat{\lambda}_2 C_{i,t-k}$ for the deposits equation. The horizontal axes show the values of the coverage rate $C_{i,t-k}$.

Table 5.4: Did the introduction of explicit deposit insurance affect the extent to which depositors impose market discipline?

	Panel 1				Panel 2			
	Interest Rates		Deposits		Interest Rates		Deposits	
		DI effect		DI effect		Coverage		Coverage
Leverage capital ratio (t-k)	-0.07***	0.05***	1.50*	-0.74	-0.07***	0.07***	1.47*	-1.39
	(0.01)	(0.01)	(0.84)	(0.73)	(0.01)	(0.02)	(0.80)	(1.27)
Nonperforming loans to total assets (t-k)	0.03	-0.06***	-2.69***	1.61***	0.01	-0.02	-2.32***	1.99*
	(0.02)	(0.02)	(0.76)	(0.66)	(0.02)	(0.03)	(0.69)	(1.08)
Loan loss reserves to total assets (t-k)	-0.36***	0.33***	4.60**	-4.22**	-0.30***	0.33***	4.06**	-5.57**
	(0.04)	(0.05)	(1.99)	(1.84)	(0.04)	(0.06)	(1.71)	(2.56)
Overhead expenses to total assets (t-k)	2.44***	-1.36***	-35.77***	27.96*	2.26***	-1.40*	-34.35***	38.80*
	(0.34)	(0.50)	(11.60)	(15.69)	(0.32)	(0.79)	(10.54)	(21.13)
Return to total assets (t-k)	0.03**	-0.04***	0.56	-0.49	0.02	-0.03*	0.53	-0.63
	(0.01)	(0.01)	(0.45)	(0.46)	(0.01)	(0.02)	(0.42)	(0.51)
Liquid assets to total assets (t-k)	-0.05***	0.05***	-0.11	-0.17	-0.04***	0.06***	-0.14	0.09
	(0.01)	(0.01)	(0.51)	(0.67)	(0.01)	(0.02)	(0.51)	(0.96)
Log of total assets (t-k)	-0.42***		-6.50***		-0.45***		-6.93***	
	(0.09)		(2.31)		(0.09)		(2.28)	
Foreign bank dummy	-0.43***		-2.79		-0.45***		-3.78	
	(0.09)		(3.55)		(0.09)		(3.42)	
U.S. inflation rate (t-k)	-0.28***		-2.39		-0.32***		-2.14	
	(0.05)		(2.18)		(0.06)		(1.88)	
Growth rate of real GDP in Bolivia (t-k)	-0.01		-1.06		0.03		-1.00	
	(0.03)		(1.22)		(0.03)		(1.20)	
Political instability dummy	0.45***		-6.79***		0.22		-8.16**	
	(0.15)		(2.69)		(0.18)		(3.67)	
Observations	842		863		842		863	
R-Square	0.81		0.15		0.78		0.15	

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Robust standard errors in parentheses. For the interest rate equation k equals 1, while for the deposits equation k equals 3. The "DI effect" ("Coverage") columns show the coefficients of the interaction terms between the deposit insurance dummy variable (coverage rate, $C_{i,t-k}$) and indicators of bank risk.

These results indicate that the reason for which deposit insurance did not completely eliminate market discipline, as suggested by the results in the first panel of Table 5.4, is due to the partial coverage, as opposed to issues of credibility of the deposit insurance system or indirect costs associated with the recovery of deposits from a failed bank. Perhaps more importantly, these results emphasize the need for much higher degrees of co-insurance than those employed by most deposit insurance system around the world. According to Demirgüç-Kunt et al. (2005) only 26 percent of deposit insurance systems around the world have co-insurance, with the average co-insurance percentage being only 16 percent.

5.5.3 Do small depositors behave differently than large depositors?

Deposit insurance systems are often motivated or designed to protect small unsophisticated depositors that are either not able, or find it too expensive, to monitor and discipline their banks. Given that we have some information by size of accounts we try to infer whether small and large depositors behave differently with respect to market discipline. In particular, the data that are used to construct the growth rate of deposits are available by size, which allows us to estimate the quantity equation separately for small and large depositors.[114]

Table 5.5 reports estimation results for equation (2) using alternative thresholds for small and large depositors. The results suggest that the transition between responding or not to bank risk occurs somewhere between $1,000 and $5,000. In particular, depositors with at most $1,000 are not found to respond to risk. When the threshold is increased to $5,000, small depositors start to respond in a fashion consistent with market discipline. These effects become even stronger, in terms of size and significance, when the threshold is increased to $10,000 or above. In Table 5.5 we report estimates using a $10,000 threshold, but larger and more significant coefficients can be obtained using higher thresholds. This upward trend can also be seen from the estimates of large depositors. For example, accounts with at least $10,000 are more responsive than accounts with at most $10,000; the differences between the coefficients of small and large depositors are significant at 1 percent.[115]

[114] The value of deposits is broken down in 14 categories: up to $500, between $501-$1,000, between $1,001-$5,000, etc. The largest size category includes accounts with more than $2,000,000.

[115] To examine whether the differences in the betas are statistically different, we re-estimated equation (2) using interaction terms between the indicators of bank risk and a dummy variable that equals 1 when an account has $10,000 or less. These results are not reported in the paper but are available upon request.

Table 5.5: Do small and large depositors behave differently?

	Small Depositors			Large Depositors		
	≤ $1,000	≤ $5,000	≤ $10,000	> $10,000	> $20,000	> $30,000
Leverage capital ratio (t-k)	0.26	0.27***	0.27***	1.29**	1.62**	1.63**
	(0.21)	(0.09)	(0.09)	(0.68)	(0.83)	(0.82)
Nonperforming loans to total assets (t-k)	-0.32	-0.19*	-0.15**	-2.11***	-2.34***	-2.38***
	(0.22)	(0.10)	(0.07)	(0.50)	(0.57)	(0.57)
Loan loss reserves to total assets (t-k)	-0.25	-0.08	0.03	2.14***	2.36***	2.41***
	(0.28)	(0.13)	(0.12)	(0.69)	(0.80)	(0.80)
Overhead expenses to total assets (t-k)	-7.22***	-1.69	-2.08**	-27.14***	-29.55***	-29.25***
	(2.84)	(1.29)	(0.99)	(7.07)	(8.24)	(8.29)
Return to total assets (t-k)	-0.07	-0.05	-0.01	0.23	0.28	0.29
	(0.09)	(0.07)	(0.04)	(0.15)	(0.18)	(0.19)
Liquid assets to total assets (t-k)	-0.27	-0.12	-0.02	-0.68	-0.89	-0.93
	(0.20)	(0.09)	(0.08)	(0.55)	(0.65)	(0.64)
Log of total assets (t-k)	-2.88**	-0.09	0.18	-7.39***	-7.88***	-8.00***
	(1.47)	(0.60)	(0.43)	(2.40)	(2.65)	(2.64)
Foreign Bank Dummy	1.11	-0.43	-0.78**	-1.64	-2.50	-2.36
	(0.99)	(0.44)	(0.39)	(2.47)	(2.95)	(2.94)
U.S. inflation rate (t-k)	-1.79***	-1.04**	0.23	-0.56	-0.71	-0.81
	(0.63)	(0.44)	(0.31)	(1.22)	(1.36)	(1.38)
Growth rate of real GDP in Bolivia (t-k)	0.48	0.23	0.18	-1.45	-1.79	-1.83
	(0.47)	(0.23)	(0.20)	(1.36)	(1.60)	(1.60)
Political instability dummy	-0.48	0.95	-1.09	-7.63***	-8.90***	-8.42**
	(1.50)	(1.21)	(0.76)	(3.09)	(3.58)	(3.57)
Observations	834	839	839	844	844	844
R-Square	0.10	0.09	0.10	0.13	0.13	0.13

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Robust standard errors in parentheses. k equals 3.

Table 5.6: Did the introduction of explicit deposit insurance affect small and large depositors differently?

	Small Depositors				Large Depositors			
	≤ $10,000		≤ $20,000		> $20,000		> $30,000	
		DI effect		DI effect		DI effect		DI effect
Leverage capital ratio (t-k)	0.30***	-0.08	0.43***	-0.30***	2.06*	-1.20	2.07*	-1.15
	(0.11)	(0.11)	(0.11)	(0.10)	(1.12)	(0.97)	(1.11)	(0.96)
Nonperforming loans to total assets (t-k)	-0.25**	0.22*	-0.36***	0.35***	-3.54***	2.30***	-3.49***	2.18***
	(0.13)	(0.12)	(0.14)	(0.14)	(1.01)	(0.90)	(1.01)	(0.90)
Loan loss reserves to total assets (t-k)	-0.08	-0.28	0.60*	-0.76**	6.90***	-6.43***	6.80***	-6.35***
	(0.29)	(0.30)	(0.33)	(0.34)	(2.73)	(2.52)	(2.70)	(2.50)
Overhead expenses to total assets (t-k)	-2.41*	4.70**	-5.39***	10.01***	-45.39***	39.32**	-44.64***	40.48**
	(1.38)	(2.03)	(1.80)	(2.74)	(15.95)	(20.76)	(15.77)	(20.71)
Return to total assets (t-k)	-0.04	0.04	0.11	-0.13	0.86	-0.79	0.94*	-0.89
	(0.08)	(0.09)	(0.10)	(0.10)	(0.59)	(0.60)	(0.57)	(0.59)
Liquid assets to total assets (t-k)	-0.04	0.05	0.10	-0.05	-0.54	0.17	-0.59	0.18
	(0.10)	(0.13)	(0.12)	(0.16)	(0.67)	(0.83)	(0.67)	(0.83)
Log of total assets (t-k)	0.37		0.25		-7.41***		-7.43***	
	(0.46)		(0.42)		(2.86)		(2.84)	
Foreign bank dummy	-0.45		-1.33***		-4.27		-4.16	
	(0.46)		(0.52)		(4.31)		(4.26)	
U.S. inflation rate (t-k)	0.59*		0.12		-3.61		-3.52	
	(0.35)		(0.37)		(2.83)		(2.81)	
Growth rate of real GDP in Bolivia (t-k)	0.25		0.07		-1.67		-1.68	
	(0.20)		(0.19)		(1.60)		(1.60)	
Political instability dummy	-1.39*		-1.41*		-9.48***		-9.05***	
	(0.76)		(0.78)		(3.34)		(3.35)	
Observations	839		839		844		844	
R-Square	0.11		0.18		0.14		0.15	

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Robust standard errors reported in parentheses. k equals 3. The "DI effect" columns show the coefficients of the interaction terms between the deposit insurance dummy variable and indicators of bank risk.

Similarly, equation (4) is estimated separately for small and large depositors to examine whether deposit insurance affected these groups differently. The results, presented in Table 5.6, indicate that deposit insurance significantly reduced the sensitivity of large depositors to bank risk, but did not affect the behavior of small depositors, unless accounts above $10,000 are included in the definition of small. In Table 5.6 we report results using the $10,000 and $20,000 thresholds for small depositors. The results using the $15,000 threshold, which are not reported, are somewhere in between those of $10,000 and $20,000.

All in all, our results are consistent with the hypothesis that most market discipline comes from large depositors and that the introduction of explicit deposit insurance affected mainly those who were active in the first place. However, this interpretation should be viewed with caution since it only relies on estimates from the quantity equation, as the interest rate series are not available by size. In the sensitivity analysis, we discuss how a possible "pollution bias," resulting from the migration of accounts across size categories, affects our estimates and the interpretation of our results with respect to size.

5.6 Sensitivity analysis

5.6.1 Fixed Effects

As a first robustness check we re-estimate equations (1) and (2) using bank fixed effects. Fixed effects estimators highlight the variation of deposits over time, using deviations from each bank's mean. The estimation results, presented in the first panel of Table 5.7, are similar to the pooled estimates, presented in Table 5.3. The only notable difference is that two of the relevant coefficients, the leverage ratio in the interest rate equation and the overhead expenses in the deposits equation, are less significant than their counterparts in Table 5.3.

Similarly, we also re-estimated equations (3) and (4) using bank fixed effects. The results, presented in the second Panel of Table 5.7, are similar to those presented earlier; they are only slightly weaker in terms of statistical significance.

5.6.2 Pollution bias

Our results with respect to small and large depositors are subject to a possible "pollution" bias. If there is market discipline, depositors withdraw their funds when a

bank's financial condition deteriorates. They can withdraw all or part of their funds. The latter case is problematic. If the amount left in the account falls into the small size category, large accounts will record a fall larger that the amount withdrawn, while small accounts will record a smaller drop or even an increase. This implies that our estimates in Table 5.5 tend to overestimate market discipline for large depositors and underestimate it for small depositors.

To examine the potential size of this bias, we collected data on the number of accounts. Using the $10,000 threshold, we find that on average, across banks and time, there are 45,671 small accounts and 880 large accounts. Since the number of large accounts is only 2 percent of the small accounts, one could argue that the bias is likely to be small. However, if all large depositors were to drop into the small accounts, the maximum amount they could transfer would be 42 percent of the small deposits, which is quite large.[116] To examine the possible effects of this bias on our results, we reconstruct our series for small and large deposits by removing the maximum possible "pollution" from the original series:

$$Large\ Deposits\_Adjusted_{i,t} = Large\ Deposits\ \_Original_{i,t} - \$10{,}000(N^{L}_{i,t-1} - N^{L}_{i,t}) \qquad (5)$$

$$Small\ Deposits\_Adjusted_{i,t} = Small\ Deposits\_Original_{i,t} + \$10{,}000(N^{L}_{i,t-1} - N^{L}_{i,t}) \qquad (6)$$

where $N^{L}_{i,t}$ and $N^{S}_{i,t}$ are the number of large and small accounts, respectively.

Using the adjusted series, we re-estimate equation (2). The results, presented in the third panel of Table 5.7, show that both large and small depositors discipline their banks, but small depositors impose less market discipline. As expected, the difference between small and large depositors is smaller using the adjusted series than with the original series (see Table 5.5 for comparison). It should be pointed out that these estimates do not measure the actual degree of market discipline, but simply provide a *lower bound* for large depositors and an *upper bound* for small depositors. Given that we still find that small depositors impose less market discipline, we can conclude that regardless of the actual degree of market discipline, small depositors impose less market discipline than large depositors.

[116] The average dollar value of small savings deposits is $20.90 million (40 percent of savings deposits) and the maximum amount that each large depositor could transfer in the small size category is $10,000.

5.6.3 Foreign vs. Domestic Banks

Although the results, presented in Table 5.4, are consistent with the hypothesis that the introduction of deposit insurance reduced market discipline, they are also consistent with an alternative hypothesis. In particular, the ratio of foreign banks to domestic banks increased during the sample period. Hence, to the extent that foreign banks are subject to less market discipline, our results could be due to the increase of foreign banks in the sample.[117] To examine this possibility, we estimated equations (3) and (4) using a sub-period for which the number of foreign banks in the sample is equal to the number of domestic banks.[118] The results, presented in the first panel of Table 5.8, are very similar to those presented earlier in Table 5.4, which implies that the deposit insurance dummy variable is not picking up the relative increase of foreign banks in the sample.

Finally, we also examine whether foreign and domestic banks are indeed subject to different degrees of market discipline. To do that, we interacted the indicators of bank risk in equations (1) and (2) with the foreign bank dummy variable. The estimation results, presented in the second panel of Table 5.8, show that foreign banks are indeed subject to less market discipline. We also tried to investigate whether there is a difference between foreign branches and foreign subsidiaries, but found no statistically significant difference.[119]

5.6.4 Timing of Deposit Insurance

We also examine the sensitivity of the results with respect to the timing of deposit insurance (i.e., we re-estimate equations (3) and (4) using alternative definitions of DI_{t-k}).[27] First, we start by setting the introduction of deposit insurance earlier than January 2001 by one month at a time. At the beginning, the results improve. We reach the peak of improvement in October 2001, i.e., three months before the effective date. Before October 2001, the results start to deteriorate, and they break down completely if deposit insurance is timed six months before the law was passed or at any time earlier than six months (i.e., we do not find any statistically significant difference between before and after deposit insurance). We also examine how the results change if we introduce deposit insurance later than January 2002. In this case, the results start to deteriorate right away. In fact, they

[117] A growing literature on foreign bank entry argues that foreign banks in developing countries might be more efficient and less corrupted than domestic banks. Hence, depositors might trust foreign banks more than domestic banks. Foreign banks may also enjoy implicit deposit insurance from the home country, and thus they may be subject to less market discipline.
[118] From April 1999 until the end of the sample.
[119] These results are not presented in the paper, but are available upon request.

completely break down if deposit insurance is introduced three months after the effective date or later.

Overall, these results suggest that the reduction in market discipline during the sample period is due to a structural break around the date that the deposit insurance system was introduced, and not to a constant reduction in market discipline during the sample period. In addition, it seems that there was an anticipation effect i.e., market participants starting to adjust three months before the law was implemented.

5.7 Conclusions

This chapter examines the effect of explicit deposit insurance on market discipline in a setup that resembles a natural experiment, using the experiences of Bolivia between 1998 and 2003. The sample period is characterized by a severe recession that weakened significantly the health of the banking sector. Hence, depositors have reasons to worry about the safety of their deposits. More importantly, during the sample period, there are no major regulatory reforms apart from the introduction of a deposit insurance system in December 2001. This makes it possible to investigate the effect of explicit deposit insurance on market discipline by comparing the behavior of depositors before and after the introduction of deposit insurance. Moreover, the characteristics of the Bolivian system allow us to examine whether the effect of deposit insurance depends on the coverage rate, without having to compare the behavior of small and large depositors; a more difficult exercise.

The data and the methodology employed improve upon previous studies in at least two ways. First, the data availability with respect to interest rates and our focus on savings deposits provide us with a much more accurate indicator of a bank's current cost of funds than those employed by previous studies. Second, we provide evidence both on prices and quantities, which is important in order to distinguish market discipline from alternative hypotheses (e.g., regulatory discipline, gambling for resurrection, etc.).

In contrast to other studies on developing countries we find a strong link between bank fundamentals and the supply of deposits, consistent with the hypothesis that market discipline is at work. We find that an increase in bank risk leads to higher interest rates and lower deposits. The results also suggest that most of the market discipline comes from large depositors. Nevertheless, small depositors (with at least $5,000 to $10,000 in their account) are also found to respond to bank risk. As shown in the sensitivity analysis, these

results are not due to a possible "pollution bias" across the two size categories.

More importantly, we find that the introduction of explicit deposit insurance caused a significant reduction in market discipline. After the introduction of deposit insurance, the coefficients of the variables that capture market discipline are 50 to 90 percent smaller than before the introduction of deposit insurance. Moreover, by exploiting the variation in the coverage rate across banks, we find that the effect of deposit insurance on market discipline depends on the coverage rate. The higher the coverage rate, the larger the decrease in market discipline after the introduction of deposit insurance. We find that as the coverage rate increases above 60 percent, many of our coefficients start to become insignificant and none of them remains significant when the coverage rate reaches 100 percent.

This implies that the deposit insurance system in Bolivia is credible and that indirect costs, associated with the recovery of deposits from a failed bank, are not important enough for depositors to continue monitoring and disciplining their banks. More generally, however, these findings emphasize the need for serious degrees of co-insurance and "tailored made" deposit insurance systems that would preserve the incentives of a critical mass of depositors that are willing and able to monitor their banks. In this case, the deposit insurance system covered a significant part of the deposits of those who were active in the first place and thus caused an almost complete elimination of market discipline. In this sense, our results also emphasize the need for a "meaningful" coverage limit per depositor.

Finally, our findings also suggest that the degree of market discipline differs between domestic and foreign banks. Foreign banks are subject to less market discipline than domestic banks. In addition, we find that depositors "run" more from domestic banks than from foreign banks whenever there are episodes of political instability. These results are consistent with the hypothesis that foreign banks are trusted more than domestic banks, either because they are more efficient or because they are perceived to have implicit guarantees from their home country or their parent company.

Table 5.7: Sensitivity analysis

	Panel 1		Panel 2				Panel 3	
	Interest Rates	Deposits	Interest Rates		Deposits		Small	Large
				DI effect		DI effect	≤ $15,000	> $15,000
Leverage capital ratio (t-k)	-0.02**	0.98**	-0.12***	0.11***	1.21**	-0.41	-0.09	1.31**
	(0.01)	(0.49)	(0.01)	(0.02)	(0.54)	(0.53)	(0.11)	(0.67)
Nonperforming loans to total assets (t-k)	0.05***	-2.62***	-0.02	-0.03	-4.02***	2.20*	-0.51***	-2.09***
	(0.01)	(0.58)	(0.02)	(0.02)	(1.06)	(1.15)	(0.16)	(0.50)
Loan loss reserves to total assets (t-k)	-0.25***	3.10***	-0.27***	0.24***	7.21***	-6.41***	0.38*	1.98***
	(0.03)	(1.14)	(0.03)	(0.05)	(1.98)	(2.14)	(0.20)	(0.69)
Overhead expenses to total assets (t-k)	1.79***	-20.02*	1.82***	-0.98**	-24.77*	28.42	-8.09***	-26.41***
	(0.21)	(12.16)	(0.20)	(0.45)	(13.37)	(22.11)	(2.49)	(6.97)
Returns to total assets (t-k)	-0.003	0.26	0.03***	-0.04***	0.96*	-0.89	-0.03	0.20
	(0.01)	(0.26)	(0.01)	(0.01)	(0.53)	(0.61)	(0.04)	(0.15)
Liquid assets to total assets (t-k)	-0.03***	-0.65*	-0.06***	0.04**	-0.24	-0.92	0.23	-0.62
	(0.01)	(0.37)	(0.01)	(0.02)	(0.44)	(0.90)	(0.17)	(0.55)
Log of total assets (t-k)	-0.44***	-10.41***	-0.76***		-10.09***		-3.35***	-7.09***
	(0.07)	(3.38)	(0.08)		(3.55)		(1.00)	(2.35)
Foreign Bank Dummy	-0.74***	-14.00	-0.77***		-18.96		1.02	-2.31
	(0.26)	(11.83)	(0.23)		(12.45)		(0.66)	(2.42)
U.S. inflation rate (t-k)	0.66***	-0.77	-0.26***		-1.43		-0.78	-0.78
	(0.06)	(2.34)	(0.05)		(2.83)		(0.61)	(1.21)
Growth rate of real GDP in Bolivia (t-k)	0.18***	-2.04	-0.07**		-1.92		0.01	-1.52
	(0.03)	(1.37)	(0.03)		(1.44)		(0.33)	(1.42)
Political instability dummy	0.32**	-6.02	0.39***		-8.37		0.02	-6.75**
	(0.14)	(5.49)	(0.12)		(5.59)		(1.67)	(3.03)
Observations	842	863	842		863		801	831
R-Square	0.76	0.15	0.83		0.17		0.11	0.13

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Robust standard errors reported in parentheses. k equals 3. The "DI effect" columns show the coefficients of the interaction terms between the deposit insurance dummy variable and indicators of bank risk.

Table 5.8: Sensitivity analysis

	Panel 1				Panel 2			
	Interest Rates		Deposits		Interest Rates		Deposits	
		DI effect		DI effect		Foreign		Foreign
Leverage ratio (t-k)	-0.12***	0.09***	2.75**	-1.45	-0.14***	0.10***	1.60**	-1.61
	(0.01)	(0.01)	(1.34)	(1.12)	(0.02)	(0.02)	(0.79)	(1.07)
Nonperforming loans to total assets (t-k)	0.01	-0.02	-5.23***	4.37***	0.03	0.02	-2.39***	2.01***
	(0.03)	(0.03)	(1.76)	(1.70)	(0.03)	(0.03)	(0.57)	(0.44)
Loan loss reserves to total assets (t-k)	-0.38***	0.33***	8.86***	-8.54***	-0.46***	0.25***	1.80**	-1.18**
	(0.05)	(0.05)	(3.01)	(2.76)	(0.05)	(0.05)	(0.79)	(0.59)
Overhead expenses to total assets (t-k)	2.53***	-1.58***	-55.66***	53.54***	2.98***	-1.48***	-30.26***	23.69*
	(0.43)	(0.48)	(18.12)	(21.82)	(0.30)	(0.38)	(9.44)	(14.40)
Return to total assets (t-k)	0.03	-0.04**	0.82	-0.81	-0.03	0.03	0.19	-0.19
	(0.02)	(0.02)	(0.76)	(0.77)	(0.02)	(0.02)	(0.20)	(0.25)
Liquid assets to total assets (t-k)	-0.07***	0.07***	-1.21	0.90	-0.01	-0.02	-0.81	1.26
	(0.01)	(0.01)	(1.04)	(1.20)	(0.01)	(0.01)	(0.71)	(0.91)
Foreign bank dummy	-0.17*		-4.75		-1.83***		-10.04*	
	(0.10)		(3.12)		(0.29)		(5.75)	
Log of total assets (t-k)	-0.81***		-1.98		-0.52***		-5.14**	
	(0.08)		(2.89)		(0.69)		(2.44)	
U.S. inflation rate (t-k)	-0.23		1.48		0.54***		0.17	
	(0.09)		(2.24)		(0.06)		(1.15)	
Growth rate of real GDP in Bolivia (t-k)	0.01		-4.10		0.06*		-1.56	
	(0.06)		(3.15)		(0.03)		(1.65)	
Political instability dummy	0.47***		-8.44***		0.22		-6.78***	
	(0.15)		(3.12)		(0.16)		(2.68)	
Observations	594		587		842		863	
R-Square	0.82		0.19		0.78		0.13	

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Robust standard errors in parentheses. For the interest rate equation k equals 1. For the deposit equation k equals 3. The columns "DI effect" ("Foreign") show the coefficients of the interaction terms between the deposit insurance dummy variable (foreign bank dummy variable) and indicators of bank risk.

Chapter 6

Policy recommendations and further research

"Education: that which reveals to the wise, and conceals from the stupid, the vast limits of their knowledge"

Mark Twain

6.1. Policy recommendations

The four essays in this dissertation examine various topics related to the governance of financial institutions. The essays focus on the behavior and performance of pension funds and banks with the aim to identify suboptimal features in their institutional setup. Analyzed topics include operating costs and investment management of pension funds and the interaction between deposit insurance and market discipline for banks.

Based on the findings in this dissertation, I propose a number of suggestions to reduce the administrative and investment costs of pension funds, enhance the investment policy of pension funds, and adjust deposit insurance systems to mitigate their negative effect on market discipline of banks. My key conclusions and policy recommendations for the four subsequent topics are:

- It is important to reduce the operating costs of pension funds, where possible, since they either raise the cost of retirement security or result in lower final pensions. We find that operating costs vary significantly across pension funds in the Netherlands, mainly explained by (unutilized) economies of scale. In addition, Bikker, Steenbeek, and Torracchi (2012) show that higher service quality and complexity of pension plans raise costs (the effect is small but statistically significant). Collective pension arrangements are generally five times cheaper than private arrangements at insurance companies, due to scale, the absence of marketing and education costs, adverse selection and profits (Bikker and De Dreu, 2007). In this context, I note that in the last

decade substantial consolidation has taken place in the collective pension sector. Nonetheless, recent studies continue to find large cost differences across pension funds (AFM, 2011; LCP, 2012; and Bikker, 2013). My conclusion is that further consolidation of the pension sector, particularly of small and medium-size pension funds, complemented by a simplification of overly complex pension plans, has the potential to unlock unutilized economies of scale and result in significant cost savings. Hence, our results support policy measures that stimulate further consolidation of the pension sector and facilitate collective pension arrangements.

To stimulate further cost savings, I recommend the implementation of measures to ensure full transparency of operating and investment costs of pension funds. Increased transparency can enable pension funds, employers, and participants to monitor and compare costs. This can help stakeholders to identify potential for cost savings and make cost-benefit analyses to evaluate service levels. Suggested policy measures to promote transparency include a legal obligation for pension funds to: (i) publish annual accounts, and (ii) provide full insight in operating and investment costs. In this context, management fees, operational expenses, and trading costs should be fully transparent and not hidden in net returns or net asset values of investments. It is acknowledged that so far, not all investment funds report all costs and it may be difficult for small pension funds to enforce full transparency. However, potential exclusion from investment mandates will give investment managers a strong incentive to report all costs, given the large amount of investments by Dutch pension funds. The introduction of a legal obligation to provide full cost-transparency for all investment funds with a Dutch license would similarly facilitate investment decisions by pension funds and other investors.[120]

- Choosing an optimal asset allocation is of key importance for pension funds since it has a dominant impact on expected returns and portfolio risks. In theory, the optimal asset allocation is not correlated with the sophistication of pension funds. We find, however, that less sophisticated pension funds maintain a lower risk profile, with higher investments in bonds and less in equities. A possible explanation is that limited knowledge of less sophisticated investors makes them feel less comfortable to take risks. A risk-management strategy that limits exposure to risks that are not well

[120] International coordination (for example at EU level) for such legal obligation may be useful to ensure that funds with a Dutch license do not have a competitive disadvantage compared to their international peers.

understood seems sensible. However, our indicators for pension fund sophistication also suggest that the asset allocations of many pension funds are suboptimal. Specifically, we find that: (i) most pension funds round their asset allocations to multiples of 5 percent, suggesting that asset allocation figures are rough estimates based, in part, on human judgment as opposed to optimization of ALM models, and (ii) many pension funds invest little in alternative "complex" investments other than bonds and equities and/or little outside the Euro area. These findings may indicate suboptimal diversification. We also find that these indicators are significantly correlated with size, suggesting that smaller pension funds are generally less sophisticated than large funds. Nevertheless, in explaining risk taking, both size and sophistication are significant, suggesting they reflect different dimensions.

Overall, this indicates that financial sophistication varies across pension funds and that this influences investment decisions. Measures that improve financial sophistication would likely enable pension funds to improve the risk-return characteristics of their investment portfolio. For example, our findings support stricter requirements of investment expertise of pension fund board members to ensure a sufficient level of financial expertise. Additionally, the correlation of investment sophistication with size supports measures that stimulate further consolidation of the pension sector. The latter is in line with the recommendation to reduce operating costs, as discussed before.

- The investment strategy of Dutch pension funds is of key importance to society, since it directly influences pension wealth, which is the main source of income following retirement. In theory, the risk-return profile of pension funds' investment portfolios should reflect the preferences of participants and employers as well as the length of the investment period. We find, however, that the asset allocation and risk profile are influenced by the short- and medium-term performance of the stock market (apart from the level of sophistication, as discussed above). Average equity allocations decrease following a decline of stock prices and vice versa. In addition, changes of equity allocations following positive or negative stock market returns are asymmetric and differ between small and large pension funds.

The variations in asset allocations reflect a combination of free floating, partial rebalancing and market timing.[121] Free floating, for example within certain bandwidths, may be efficient to save transaction costs. However, only a relatively limited number of transactions are needed to maintain asset allocations close to the strategic mix and transaction costs are usually low for institutional investors. Hence, this is unlikely to explain more than a small part of the substantial variations that we observe in our quarterly dataset. Partial rebalancing may be influenced by the impact of investment returns on the financial buffer. This can reflect a strategy to reduce the risk profile of the investment portfolio following a loss on investments and resulting decrease of the financial buffer (and vice versa).[122] Such risk management strategy is rational for participants with preferences with decreasing relative risk aversion and to safeguard compliance with minimum financial buffer requirements. Our results indeed show that the strategic equity allocation is reduced following losses on the equity portfolio (and vice versa). However, we also find that the variation of the actual equity allocation is much larger than the strategic equity allocation. Hence, I conclude that market timing – i.e. taking positions in deviation of the policy mix with the aim to profit from anticipated market developments, play a role as well. The literature shows, however, that investors are generally unsuccessful in exploiting market timing to generate excess returns. Consequently, I recommend pension fund boards to: (i) determine their optimal investment mix, and (ii) design an investment policy that includes rules on rebalancing to stay close to the optimal investment mix. The rules on rebalancing should take into account potential variations of the optimal investment mix with the financial buffer. In addition, the benefits from returning to the strategic investment mix should be weighed against related transaction costs. Market timing, however, is best avoided by most pension funds, except, perhaps, for the most sophisticated players, noting the evidence in the literature that for the average pension fund this is not remunerative.[123]

[121] Unfortunately, our dataset does not allow us to identify how much each factor contributes to the variation of equity allocations.

[122] Besides adjusting the asset mix, pension funds can use various other instruments to limit downside risk and maintain adequate funding ratios. Bikker, Knaap, and Romp (2011) find, for example, that that the increase of nominal pension rights is linked to the financial buffer

[123] A number of studies show that a minority of equity fund managers have been able to deliver positive excess returns from market timing, even though, on average, market timing resulted in negative excess returns for the sector. This result has been shown for pension funds (See Coggin, Fabozzi, and Rahman, 1993) and mutual funds (See Kon, 1983; Chang and Lewellen, 1984; Bolle and Busse, 2001). In this context, I note that it is difficult to predict the future better than the market, especially if you have to compete against the most sophisticated and largest pension funds and other professional investors such as hedge funds.

- The design of deposit insurance schemes should take into account the tradeoff between (i) encouraging market discipline, which can be an effective tool to discourage risk taking by banks, and (ii) discouraging potential bank runs, which can have high social costs and lead to a systemic crisis.[124] Deposit insurance can be an effective tool to avoid bank runs and potentially systemic crises but it reduces the incentives of depositors to select safe banks for their deposits. As a result, the introduction of deposit insurance may have the unintended consequence to reduce incentives for banks to limit their risk profile. We find evidence for this in the banking sector in Bolivia, where we observe a significant decrease of market discipline following the introduction of explicit deposit insurance. Our results also indicate, however, that several "tailor made" design features of deposit insurance can be used to limit the reduction of market discipline, including binding coverage limits per depositor and high degrees of co-insurance. Our results support the findings in a cross-sectional study for over thirty developed and developing countries by Demirgüç-Kunt and Huizinga (2004). This study shows that bank interest expenses are lower and less sensitive to indicators of bank risk in countries with an explicit deposit insurance system. In contrast to Demirgüç-Kunt and Huizinga, however, we find evidence for the supply of deposits, as well as interest rates, allowing us to eliminate alternative hypotheses. In view of these findings, I suggest to reconsider the configuration of deposit insurance systems, to encourage market discipline.[125,126]

---

[124] To ensure the integrity of the system it is important that: (i) the system as a whole is sound, limiting the risk of system-wide bank runs, and (ii) the size of any individual institution is limited, such that its failure does not cause systemic instability.

[125] Reneging on deposit insurance and applying a direct tax to deposits, as was recently (end March 2013) proposed in Cyprus, will also likely encourage market discipline but this may lead to bank runs and have political and legal risks for the government.

[126] Alternatively, governments can consider the mandatory issuance of subordinated debt to encourage market discipline. The use of subordinated debt has the advantage that these instruments are highly risk-sensitive and generally held by professional investors, who can be expected to have the skills and resources to assess and monitor bank risk. A requirement for frequent issuance (e.g. monthly or quarterly) can ensure that an increase in bank risk immediately leads to higher interest rates. Such an arrangement would link banks' funding costs to their risk profiles, giving them an additional incentive to control their risk positions. This can be complemented by covenants to skip interest payments and/or write-down the value of subordinated debt in case of distress, which would further encourage market discipline and provide an automatic mechanism to absorb losses and strengthen bank capital in case of distress. Additionally, the inability of banks to issue new subordinated debt at reasonable rates can be used as a trigger for intervention by bank supervisors. Furthermore, the interest rates required by investors may be used by bank supervisors as a measure of bank risk, which could be considered in setting deposit insurance premiums and/or in triggering supervisory actions. It is important to note though, that a key condition for the mandatory issuance of subordinated debt is that there is sufficient demand for these instruments. Market liquidity is important to ensure that interest rate margins accurately reflect bank risk and to allow frequent issues by banks. This

6.2 Suggestions for future research

Looking forward, the topics researched in this dissertation reveal several gaps in our knowledge about how to improve the design of pension funds, optimize investment policy, and balance the need for market discipline and the need for deposit insurance. I have identified the following questions for future research:

- Pension costs: Despite a consolidation of the sector, there are still a huge number of pension funds in the Netherlands (454 in 2011). This number seems far too high in view of large economies of scale in administration and investment management. A counterargument could be that pension funds provide varying pension plans, service levels, and investment strategies that cater to different needs of participants and sponsor companies. In this context, I suggest the following research question: Do different (average) preferences of participants in pension funds justify a variety of pension funds with different pension plan designs and service levels? Or, conversely, are preferences of participants similar across pension funds with limited value attributed to variety? These are relevant research questions, since uniform pension schemes would facilitate sector consolidation and increase potential benefits of economies of scale. For policymakers, employers, and pension funds it would be useful to know: (1) which design features (e.g. potential benefits for spouse) and service levels (e.g. communication) are preferred by pension participants and how much value is attributed to specific items, (2) whether preferences differ significantly across pension plans and whether this justifies differences in service levels and pension plan design, and (3) whether actual plan design and service levels of pension funds indeed reflect these preferences. A survey of participants of different pension funds and an examination of their pension plan design, service levels, and cost characteristics can potentially provide an answer to these questions and could contribute to a better design of the pension sector.

---

should not be an issue for large banks, which already issue many types of debt instruments, including subordinated debt, but market liquidity may be insufficient for small banks. See Federal Reserve System (1999) for a good discussion of this topic.

- Variation of investment policies across funds: one can observe huge variation of asset allocation policies across pension funds, including investments in stocks and bonds. Our study finds that a minor part of this variation is explained by differences in sophistication, as well as by a number of control variables. Nonetheless, most of the variation remains unexplained, even after controlling for these variables. A key question is whether the unexplained variations in assets allocation and risk levels are justified by different characteristics of pension funds (e.g. risk preference of participants, average age, sponsor support arrangements) or by insufficiently underpinned choices. In this context, it would be interesting to better understand the ALM studies (and underlying key assumptions), and the influence of individual views of pension fund managers and consultants. Furthermore, it would be important to compare the risk-return preferences of the pension fund board and sponsor companies with those of participants. In this context, it is noted that much literature exists that reveals the lack of financial awareness of participants (e.g. see Van Rooij, Kool and Prast, 2007; and Van Rooij, Lusardi, and Alessie, 2012).

- Variation of investment policies over time: Which factors drive the change of the strategic asset allocation of pension funds? This is a relevant question since our study shows that pension fund strategic investment policies move with the cyclical performance of the stock market. Possible explanations for the change of investment policies include: (i) decreasing relative risk aversion (i.e. pension funds become more risk averse following a decrease of pension assets, and vice versa), (ii) a change of risk and return expectations of asset classes, (iii) an attempt to time the market, or (iv) the aim to comply with pension regulation (FTK), which links the minimum amount of buffer to the risk profile of the investment portfolio.

- Market discipline: Our results show that deposit insurance reduces market discipline, which may increase the incentives for banks to take risks. However, there is little evidence on the direct impact of market discipline and deposit insurance on risk taking by banks. Specifically, as a follow-up research question, I suggest examining the direct link between a change in market discipline, instigated for example by the introduction of deposit insurance, and bank risk taking.

References

A'Hearn, B., Baten, J., Crayen, D., 2009, Quantifying quantitative literacy: Age heaping and the history of human capital, *The Journal of Economic History 69*: 783–808.

AFM, 2011, Kosten pensioenfondsen verdienen meer aandacht.

Agnew, J., Balduzzi, P., Sundén, A., 2003, Portfolio Choice and Trading in a Large 401(k) Plan, *American Economic Review 93* (1): 193-215.

Alestalo, N., Puttonen, V., 2006, Asset allocation in Finnish pension funds, *Journal of Pension Economics and Finance 5*: 27–44.

Arellano, M., Bond, S., 1991, Some tests of specification for panel data: Monte carlo evidence and an application to employment equations, *Review of Economic Studies 58*, 277–297.

Bachi, R., 1951, The tendency to round off age returns: Measurement and correction, *Bulletin of the International Statistical Institute 33*: 195–221.

Baer, H., Brewer, E., 1986, Uninsured deposits as a source of market discipline: Some new evidence, *Economic Perspectives,* Federal Reserve Bank of Chicago: 23-31.

Banerjee, A.V., 1992, A simple model of herd behavior, *Quarterly Journal of Economics 107*: 797–817.

Barberis, N., 2000, Investing for the long run when returns are predictable, *Journal of Finance 55* (1): 225-264.

Bateman, H., Kingston, G., Piggot, J., 2001, *Forced saving: Mandating private retirement incomes,* Cambridge: Cambridge University Press.

Bateman, H., Mitchell, O.S., 2004, New evidence on pension plan design and administrative expenses: the Australian experience, *Journal of Pension Economics and Finance 3*: 63-76.

Bebchuk, L.A., Cohen, A., Spamann, H., 2009, The wages of failure: Executive compensation at Bear Stearns and Lehman 2000-2008, *Yale Journal on Regulation, 27* (2): 257-282.

Benartzi, S., Thaler, T., 2001, Naïve diversification strategies in defined contribution saving plans, *American Economic Review 91*: 79–98.

Berger, A., Hunter, W., Timme, S., 1993, The efficiency of financial institutions: A review and preview of research past, present and future, *Journal of Banking and Finance 17*: 221-249.

Bhattacharya, S., Boot, A.W., Thakor, A.V., 1998, The economics of bank regulation, *Journal of Money, Credit and Banking 30* (4): 745-770.

Bikker, J.A., 2013, Is there an optimal pension fund size? An analysis of administrative and investment costs, DNB Working Paper, No. 376.

Bikker, J.A., Broeders, D.W.G.A., De Dreu, J., 2010, Stock market performance and pension fund investment policy: rebalancing, free float, or market timing, *International Journal of Central Banking, 6* (2): 53-79.

Bikker, J.A., Broeders, D.W.G.A., Hollanders, D.A., Ponds, E.H.M, 2012, Pension funds' asset allocation and participant age: A test of the life-cycle model, *Journal of Risk & Insurance 73* (3): 595-618.

Bikker, J.A., De Dreu, J., 2007, Operating costs of pension schemes, in: Steenbeek, O.W.; Van Der Lecq, F. S. G. (Eds.), *Costs and benefits of collective pension systems,* Springer, Berlin, pp. 51-74.

Bikker, J.A., De Dreu, J., 2009, Operating costs of pension funds: the impact of scale, governance, and plan design, *Journal of Pension Economics and Finance, 8* (01): 63-89.

Bikker, J.A., Knaap T., Romp, W., 2011, Real Pension Rights as a Control Mechanism for Pension Fund Solvency, DNB working paper 311.

Bikker, J.A., Steenbeek, O.W., Torracchi, F., 2012, The impact of scale, complexity, and service quality on the administrative costs of pension funds: A cross-country comparison, *Journal of Risk and Insurance 79* (2): 477-514.

Bikker, J.A., Van Leuvensteijn, M., 2008, Competition and efficiency in the Dutch life insurance industry, *Applied Economics 40*: 2063–2084 .

Bikker, J.A., Vlaar, P.J.G., 2007, Conditional indexation in defined benefit pension plans, *Geneva Papers on Risk and Insurance – Issues and Practice 32*: 494-515

Billet, M.T., Garfinkel, J.A., O'Neal, E.S., 1998, The cost of market versus regulatory discipline in banking, *Journal of Financial Economics 48*: 333-358.

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

Bolle, N.P.B., Busse, J.A., 2001, On the timing ability of mutual fund managers, *Journal of Finance 56* (3): 1075-1094.

Bos, J.W., Kolari, J.W., 2005, Large bank efficiency in Europe and the US: are there economic motivations for geographic expansion in financial services? *Journal of Business 78*: 1-39.

Brinson, G.P., Hood, R., Beebower, G.L., 1986, Determinants of portfolio performance, *Financial Analysts Journal 42* (4): 39-48.

Brinson, G.P., Singer, B.D., Beebower, G.L., 1991, Determinants of portfolio performance II: An update, *Financial Analysts Journal 47* (3): 40-48.

Broeders, D.W.G.A., 2005, Sponsor vulnerability and pension fund risk management, *DNB Working Paper* nr. 82, De Nederlandsche Bank, Amsterdam.

Broeders, D.W.G.A., 2010, Valuation of contingent pension liabilities and guarantees under

sponsor default risk, *Journal of Risk and Insurance 77*: 911–934.

Broeders, D.W.G.A., Pröpper, M.H., 2010, Risk-based supervision of pension funds in the Netherlands, In: Micocci, M., Gregoriou, G.N., Masala, G.B. (Eds.), *Pension Fund Risk Management: Financial and Actuarial Modelling*, Chapman & Hall: Boca Raton, US.

Budd, J.W., Guinnane, T., 1991, Intentional age misreporting, age heaping and 1908 old age pensions act in Ireland, *Population Studies 45*: 497–518.

Calomiris C.W., 1999, Building an incentive-compatible safety net, *Journal of Banking and Finance 23*, (10): 1499-1519

Calvet, L.E., Campbell, J.Y., Sodini, P., 2007, Down or out: Assessing the welfare costs of household investment mistakes, *Journal of Political Economy 115*: 707-747.

Calvet, L.E., Campbell, J.Y., Sodini, P., 2009a, Fight or flight? Portfolio rebalancing by individual investors, *Quarterly Journal of Economics 124*: 309–348.

Calvet, L.E., Campbell, J.Y., Sodini, P., 2009b, Measuring the financial sophistication of households, *American Economic Review 99*: 393–398.

Campbell, J.Y., Viceira, L.M., 2002, *Strategic Asset Allocation: Portfolio Choice for Long-Term Investors*, Oxford University Press.

Campbell, J.Y., 2006, Household finance. Journal of Finance 61, 1553–1604.

Canner, N.N., Mankiw, G., Weil, D.N., 1997. An asset allocation puzzle, *American Economic Review 87*: 181–191.

Caswell, J.W., 1976, Economic efficiency in pension plan administration: A study of the construction Industry, *Journal of Risk and Insurance 4*: 257-273.

Chang, E.C., Lewellen, W.G., 1984, Market timing and mutual fund investment performance,

Journal of Business 57 (1): 57-72.

Chen, Y., Ferson, W., Peters, H., 2010, Measuring the timing ability and performance of bond mutual funds, *Journal of Financial Economics 98* (1): 72-89.

Coelli, T.J., Prasada Rao, D.S., Battese, G.E., 1998, *An Introduction to Efficiency and Productivity Analysis,* Kluwer Academic Publishers, Boston.

Coggin, D.T., Fabozzi, F.J., Rahman, S., 1993, The investment performance of U.S. equity pension fund managers: An empirical investigation, Journal of Finance 48(3): 1039-1055.

Cohn, R.A., Lease, R.C., Lewellen, W.G., Schlarbaum, G.G., 1975, Individual investor risk aversion and investment portfolio composition, *Journal of Finance 30*: 605–620.

Collins, S., Mack, P.H., 1997, The optimal amount of assets under management in the mutual fund industry, *Financial Analyst Journal 53*: 67-73.

Cook, D.O., Spellman, L.J., 1991, Federal financial guarantees and the occasional market pricing of default risk: Evidence from insured deposits, *Journal of Banking & Finance 15* (6): 1113-1130.

Cook, D.O., Spellman, L.J., 1994, Repudiation risk and restitution costs: toward understanding premiums on insured deposits, *Journal of Money, Credit, and Banking 26* (3): 439-459.

Crawford, A.J., Ezzell, J.R., Miles, J.A., 1995, Bank CEO pay-performance relations and the effects of deregulation, *Journal of Business 68*: 231-256.

Daniel, K., Grinblatt, M., Titman, S., Wermers, R., 1997, Measuring mutual fund performance with characteristic-based benchmarks, *Journal of Finance 52* (3): 1035-1058.

De Dreu, J., Bikker, J.A., 2012, Investor sophistication and risk taking, *Journal of Banking & Finance, 36* (7): 2145-2156.

DeMiguel, V., Garlappi, L., Uppal, R., 2007, Optimal versus naive diversification: How inefficient is the 1/N portfolio strategy?, *The Review of Financial Studies 22*: 1915–1953.

Demirgüç-Kunt, A., Huizinga, H., 2004, Market discipline and deposit insurance, *Journal of Monetary Economics 51* (2): 375-399.

Demirgüç-Kunt, A., Karacaovali, B., Laeven, L., 2005, *Deposit insurance around the World: A comprehensive database,* Working Paper 3628, World Bank, Washington DC.

Dewatripont, M., Tirole, J., 1994, *The prudential regulation of banks*, MIT Press, Cambridge, MA.

Dhar, R., Zhu, N., 2006, Up close and personal: Investor sophistication and the disposition effect, *Management Science 52*: 726-740.

Diamond, D.W., Dybvig, P.H., 1983, Bank runs, deposit insurance, and liquidity, *Journal of Political Economy 91* (3): 401-419.

Dobronogov, A., Murthi, M., 2005, Administrative fees and costs of mandatory private pensions in transition economies, *Journal of Pension Economics and Finance 4*: 31-55.

Ellis, D.M., Flannery, M.J., 1992, Does the debt market assess large banks' risk? Time series evidence from money center CDS, *Journal of Monetary Economics 30* (3): 481-502.

Fahlenbrach, R., Stulz, R.M., 2011, Bank CEO incentives and the credit crisis, *Journal of Financial Economics, 99* (1): 11-26.

Fama, E.F., 1965, Random walks in stock prices, *Journal of Business 27* (1): 55-59

Fama, E. F., 1972, Components of investment performance, *Journal of Finance 27* (3): 551-567.

Federal Reserve System Study Group on Subordinated Notes and Debentures, 1999, Using

subordinated debt as an instrument of market discipline.

Flannery, M.J., 1982, Retail bank deposits as quasi-fixed factors of production, *American Economic Review 72* (3): 527-536.

Flannery, M.J., Sorescu, S.M., 1996, Evidence of market discipline in subordinated debenture yields: 1983-1991, *Journal of Finance 51* (4): 1347-1377.

French, K.R., Poterba, J.M., 1991, Investor diversification and international equity markets, *American Economic Review 81*: 222–226.

Friesen, G.C., and Sap, T.R.A., 2007, Mutual fund flows and investor returns: An empirical examination of fund investor timing ability, *Journal of Banking & Finance 31* (9): 2796–2816.

FSA, 2011, The failure of the Royal Bank of Scotland: FSA Board Report.

Furfine, C., 2001, Banks as Monitors of Other Banks: Evidence from the overnight federal funds market, *Journal of Business*, *74*, (1): 33-57.

Garcia, G., 1999, *Deposit Insurance: Actual and Best Practices*, IMF Working Paper 99/54, Washington DC: International Monetary Fund.

Gerber, D. S., Weber, R., 2007, Demography and investment behaviour of pension funds: Evidence for Switzerland, *Journal of Pension Economics and Finance 6*: 313–337.

Gilligan, T.W., Smirlock, M.L., 1984, An empirical study og joint production and scale economies in commercial banking, *Journal of Banking and Finance 8*: 67-77.

Goetzmann, W.N., Kumar, A., 2008, Equity portfolio diversification, *Review of Finance 12*: 433-463.

Grable, J.E., 2000, Financial risk tolerance and additional factors that affect risk taking in everyday money matters, *Journal of Business and Psychology 14*: 625–630.

Griffin, D., Tversky, A., 1992, The weighing of evidence and the determinants of confidence, *Cognitive Psychology 24*: 411–435.

Grinblatt, M., Titman, S., 1993, Performance measurement without benchmarks: An Examination of Mutual Fund Returns, *Journal of Business 66* (1): 47-68.

Guay, W., 1999, Compensation, convexity, and the incentives to manage risk: An empirical analysis, *Journal of Financial Economics 53*: 43-71.

Hannan, T.H., Hanweck, G.A., 1988, Bank insolvency risk and the market for large certificates of deposit, *Journal of Money, Credit, and Banking 20* (2): 203-211.

Heckman, J. J., 1976, The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimator for such models. *Annals of Economic and Social Measurement 5*: 475-492.

Henriksson, R.D., 1984, Market timing and mutual fund performance: An empirical investigation, *Journal of Business 57*, (1): 73-96.

Henriksson, R.D. Merton, R.C., 1981, On market timing and investment performance. II. Statistical procedures for evaluating forecasting skills, *Journal of Business 54* (4): 513-533.

Hirshleifer, D., Subrahmanyam, A., Titman, S., 1994, Security analysis and trading patterns when some investors receive information before others, *Journal of Finance 49*: 1665–1698.

Hsin, P.L., Mitchell, O.S., 1997, Public pension plan efficiency. In: Gordon, M., Mitchell, O.S., Twinney, M. (eds.), *Positioning Pensions for the 21st Century*. Pension Research Council. Philadelphia, PA: Univ. of Pennsylvania Press, 187-208.

Huberman, G., Jiang, W., 2006, Offering versus choice in 401(k) plans: Equity exposure and number of funds, *Journal of Finance 61*: 763–801.

Hughes, J.P., Mester, L.J., 1993, A quality and risk adjusted cost function for banks: Evidence on the 'too-big-to-fail' doctrine, *Journal of Productivity Analysis 4*: 292-315.

Ibbotson, R.G., Kaplan, P.D., 2000, Does asset allocation policy explain 40, 90, or 100 percent of performance? *Financial Analysts Journal 56*: 26-33.

IMF, 2010, Global Financial Stability Report (April).

Indro, D.C., Jiang, C.X., Hu, M.Y., Lee, W.Y., 1999, Mutual fund performance: Does fund size matter?, *Financial Analysts Journal 55*: 74-87.

Ioannidou, V.P., De Dreu, J., 2006, The impact of explicit deposit insurance on market discipline, CentER discussion paper No. 2006–05.

Ippolito, R.A., 1989, Efficiency with costly information: A study of mutual fund performance, 1965-1984, *Quarterly Journal of Economics 54*: 1-23.

James, E., Smalhout, J., Vittas, D., 2001, Administrative costs and the organization of individual retirement account systems: A comparative perspective, in: Holzmann, R., Stiglitz, J.E. (eds.), *New ideas about old age security: Toward sustainable pension systems in the twenty-first century*, Washington, D.C.: World Bank: 254-307.

Jensen, M.C., 1968, The performance of mutual funds in the period 1945-1964, *The Journal of Finance 23*: 389-416.

Jiang, G.J., Yao, T., Yu, T., 2007, Do mutual funds time the market? Evidence from portfolio holdings, *Journal of Financial Economics 86*: 724-758.

Kahneman, D. Tversky, A., 1979, Prospect Theory: An analysis of decisions under risk, *Econometrica, 47*(2): 263-91.

Kakes, J., 2006, Financial behaviour of Dutch pension funds: a disaggregated approach, DNB Working Paper nr. 108, De Nederlandsche Bank, Amsterdam.

Kane, E.J., 1987, Who should learn what from the failure and delayed bailout of the ODGF?, *Proceedings of a Conference on Bank Structure and Competition*, Federal Reserve Bank of Chicago, 306-326.

Kane, E.J., 1989, The S&L insurance mess: How did it happen?, Washington: Urban Institute Press.

Kang, J.K., Stulz, R.M., 1997, Why is there a home bias? An analysis of foreign portfolio equity ownership in Japan, *Journal of Financial Economics 46*: 3–28.

Karlsson, A., Norden, L.L., 2007, Home Sweet Home: Home Bias and International Diversification among Individual Investors, *Journal of Banking and Finance 31*: 317–333.

Kindleberger, C.P., 1978, Maniacs, panics, and crashes: A history of financial crises, John Wiley & Sons, Inc

Klein, M.A., 1971, A theory of the banking firm, *Journal of Money, Credit, and Banking 3* (2): 205-218.

Kolari, J., Zardkoohi, A., 1990, Economies of scale and scope in thrift institutions: the case of Finnish cooperative and saving banks, *Scandinavian Journal of Economics 92*: 437-451.

Kon, S.J., 1983, The Market-timing performance of mutual fund managers, *Journal of Business 56* (3): 323-347.

Kon, S.J., Jen, F.C., 1979, The investment performance of mutual funds: An empirical investigation of timing, selectivity, and market efficiency, *Journal of Business 52* (2): 263-289.

Kroszner, R.S., Strahan, P.E., 2001, Obstacles to optimal policy: The interplay of politics and economics in shaping bank supervision and regulation reforms, In: Frederic S. Mishkin, ed., *Prudential supervision: What works and what doesn't*, Chicago: University of Chicago Press, pp. 233-273.

Laeven, L., 2004, The political economy of deposit insurance, *Journal of Financial Services Research 26* (3): 201 – 224.

Lakonishok, J., Schleifer, A., Vishny, R.W., 1992, The impact of institutional trading on stock prices, *Journal of Financial Economics 32*: 23-43.

Lakonishok, J., Schleifer, A., Vishny, R.W., 1992, The structure and performance of the money management industry, *Brookings Papers on Economic Activity: Microeconomics,* 339-391.

LCP (Lane Clark & Peacock), 2012, Inzicht in de uitvoeringskosten en vermogensbeheerkosten van Nederlandse pensioenfondsen.

Levy-Yeyati, E., Martinez Peria, M.S., Schmukler, S.L., 2004, Market Discipline in Emerging Economies: Beyond Bank Fundamentals, unpublished transcript.

Lucas, D.J., Zeldes, S.P., 2009, How should public pension plans invest?, *American Economic Review*: Papers & Proceedings 99: 527–532.

Lucas, D.J., Zeldes, S.P., 2006, Valuing and hedging defined benefit pensions obligations: The role of stocks revisited, Working Paper, Columbia University.

Malhotra, D.K., Mcleod, R.W., 1997, An empirical analysis of mutual fund expenses, *The Journal of Financial Research 20*: 175-190.

Malkiel, B.G., 1995, Returns from investing in equity mutual funds 1971 to 1991, *The Journal of Finance 50*: 549-572.

Markowitz, H., 1952, Portfolio Selection, *Journal of Finance 6*: 77–91.

Martinez Peria, M.S., Schmukler, S.L., 2001, Do depositors punish banks for bad behavior? Market discipline, deposit insurance, and banking crises, *Journal of Finance 56*: 1029-1051.

Merton, R.C., 1995, A functional perspective of financial intermediation, *Financial Management 24* (2): 23-41.

Mitchell, O.S., 1998, Administrative costs of public and private pension plans. In: Feldstein, M. ed., *Privatizing Social Security*, NBER. Chicago: University of Chicago Press: 403-456.

Mitchell, O.S., Andrews, E.S., 1981, Scale economies in private multi-employer pension systems, *Industrial and Labor Relations Review 34*: 522-530.

Myers, R.J., 1976, An instance of reverse heaping of ages, *Demography 13*: 577–580.

OECD, 2004, Global Pension Statistics; Insurance Statistics Yearbook.

OECD, 2011, Pension Markets in Focus, Issue 8. OECD, Paris.

O'Hara, M., Shaw, W., 1990, Deposit Insurance and Wealth Effects: The Value of Being "Too Big to Fail", *Journal of Finance 45* (5): 1587-1600.

Oliver Wyman, 2012, Bank of Spain stress testing exercise.

Park, S., 1995, Market discipline by depositors: evidence from reduced form equations, *Quarterly Review of Economics and Finance 35*, 497-514.

Park, S., Peristiani, S., 1998, Market discipline by thrift depositors, *Journal of Money, Credit, and Banking 30* (3): 347-364.

Pástor, L., Stambaugh, R.F., 2001, The equity premium and structural breaks, *Journal of Finance 56* (4): 1207-1239.

PricewaterhouseCoopers, 2007, Kosten en baten van ondernemings-pensioenfondsen.

Sharpe, W.F., 1964, Capital asset prices: A theory of market equilibrium under conditions of

risk, *Journal of Finance 19*: 425–442.

Shefrin, H., Statman, M., 2000, Behavioral Portfolio Theory, *The Journal of Financial and Quantitative Analysis 35* (2): 127-151.

Shin, H.S., 2009, Reflections on Northern Rock: The bank run that heralded the global financial crisis, *Journal of Economic Perspectives 23* (1): 101-119.

Shleifer, A., Summers, L.H., 1990. The noise trader approach to finance, *Journal of Economic Perspectives 4*: 19–33.

Swank, J., 1996, 'How stable is the multiproduct translog cost function? Evidence from the Dutch banking industry', *Kredit und Kapital 29*: 153–172.

Tobin, J., 1958, Liquidity preference as behaviour towards risk, *Review of Economic Studies 25*: 65–85.

Tversky, A., Kahneman, D., 1974, Judgment under Uncertainty: Heuristics and Biases, *Science 185* (4157): 1124-31.

Tweede Kamer, 2011, Verloren krediet II – De balans opgemaakt, Eindrapport van parlementaire enquête financieel stelsel.

Van der Lecq, S.G., 2011, Markten en mededinging in de Nederlandse pensioensector, *Het Verzekerings-Archief 2*: 63-74.

Van Rooij, M.C.J., Kool, C.J.M, Prast, H.M., 2006, Risk-return preferences in the pension domain: Are people able to choose?, *Journal of Public Economics 91*: 701–722.

Whitehouse, E., 2000, Administrative charges for funded pensions: An international comparison and assessment, pension reform primer series, *Social Protection Discussion Paper* No. 16, The World Bank, Washington.

Summary in Dutch

Nederlandse Samenvatting

Dit proefschrift behandelt twee belangrijke thema's uit de financiële economie en de gedragseconomie. Het eerste thema betreft het beleid van pensioenfondsen en is specifiek gericht op administratieve kosten en het beleggingsbeleid. Dit thema wordt behandeld in de hoofdstukken 2, 3 en 4. Het tweede thema betreft de risicodiscipline die spaarders uitoefenen op banken en de invloed van een depositogarantieregeling op dit marktmechanisme. Dit thema komt aan de orde in hoofdstuk 5. **Hoofdstuk 1** introduceert de twee thema's van dit proefschrift en plaatst ze in de context van enerzijds de typische kenmerken van en lopende ontwikkelingen in de pensioensector (thema 1) en anderzijds de voortdurende financiële crisis en discussies over de staatssteun aan en regulering van banken (thema 2). Hieronder introduceer ik de andere hoofdstukken en geef ik korte samenvattingen van de onderzoeksvragen en de belangrijkste uitkomsten.

Thema I: Pensioenadministratie en beleggingsbeleid

Er is doorgaans weinig aandacht voor de bedrijfskosten van pensioenfondsen omdat deze kosten, als gevolg van volatiele beleggingsresultaten, maar een beperkte invloed hebben op de jaarlijkse fluctuatie van pensioenvermogen. Het cumulatieve effect van bedrijfskosten over de volledige pensioenopbouw- en uitkeringsperiode kan echter grote invloed hebben op de hoogte van pensioenen. Ter illustratie: hogere jaarlijkse kosten van 1 procent over de levensloop van pensioenen leiden tot een geschatte 27 procent lagere uitkering, of een 37 procent hogere premie.

Hoofdstuk 2 laat voor Nederland zien dat de bedrijfskosten van pensioenvoorzieningen per deelnemer sterk variëren tussen pensioenfondsen en dat dit voor een belangrijk deel wordt verklaard door onbenutte schaalvoordelen. De gemiddelde bedrijfskosten per deelnemer variëren van gemiddeld 927 euro voor de kleinste fondsen met minder dan 100 deelnemers tot ongeveer 30 euro voor de grootste fondsen met meer dan 100.000 deelnemers in 2004. Als percentage van de totale activa variëren de bedrijfskosten gemiddeld van 1,31 procent voor de kleinste fondsen (met totale activa van

minder dan 10 miljoen euro) tot 0,18 procent voor de grootste pensioenfondsen (met totale activa van meer dan 10 miljard euro). De schatting van een multivariaat regressiemodel laat zien dat schaalvoordelen de belangrijkste verklarende factor zijn voor deze verschillen. De regressie laat zien dat een toename van het aantal deelnemers met 1 procent resulteert in een gemiddelde kostenstijging van slechts 0,64 procent.

Deze resultaten tonen aan dat er grote onbenutte schaalvoordelen zijn in het beheer van kleine en middelgrote pensioenfondsen. Consolidatie van (kleine) pensioenfondsen zou de efficiëntie ten goede komen. Hierbij wordt opgemerkt dat er wellicht fondsen zijn die bewust kiezen voor een beperkte grootte om maatwerk te kunnen bieden aan werkgevers en werknemers. Daarbij is het dan echter wel de vraag of er voldoende besef is van de extra uitvoeringskosten die hiermee gepaard gaan. Dit hoofdstuk geeft meer inzicht in de kostenvoordelen die kunnen worden behaald met schaalvergroting. In combinatie met transparantie over uitvoeringskosten kunnen pensioenfondsen, werkgevers en deelnemers de resultaten gebruiken om een betere afweging te maken tussen maatwerk en schaalvoordelen.

Een tweede resultaat is dat verplichte bedrijfstakpensioenfondsen gemiddeld lagere uitvoeringskosten per deelnemer hebben dan ondernemings- en beroepsgroeppensioen-fondsen. Deze verschillen zijn ook significant nadat rekening is gehouden met schaalvoordelen en andere factoren. Deze uitkomsten zijn gebaseerd op dummies of fixed effects zodat bij de interpretatie enige voorzichtigheid moet worden betracht. Mogelijk wordt dit mede verklaard door relatief lage kosten van waardeoverdrachten omdat werknemers die van baan veranderen veelal bij het zelfde bedrijfstakpensioenfonds aangesloten blijven. Al met al pleiten deze resultaten voor de verdere uitbreiding van bedrijfstakpensioenfondsen.

De gepresenteerde resultaten geven het eerste systematische bewijs van grote onbenutte schaalvoordelen van pensioenfondsen in Nederland. De uitkomsten hebben bijgedragen aan een brede discussie in de pensioensector en geleid tot een aantal vervolgonderzoeken (PWC 2007, 2009; AFM, 2011; Bikker, Steenbeek en Torrachi, 2012; en LCP, 2012). Gebruikmakend van verschillende datasets vinden deze vervolgstudies additioneel bewijs voor het belang van schaalvoordelen voor de bedrijfskosten van pensioenfondsen. Aan de andere kant heeft PWC (2007) beargumenteerd dat de schaalvoordelen mogelijk zijn overschat omdat verschillen in dienstverlening en maatwerk niet expliciet zijn meegenomen in de regressies. Volgens deze studie kan meer maatwerk en een beter serviceniveau van kleine ondernemingspensioenfondsen mogelijk hun hogere

kosten compenseren. De bevinding van PWC is echter alleen gebaseerd op een survey onder ondernemingspensioenfondsen en de hypothese wordt niet formeel getoetst. Naar aanleiding van deze studie hebben Bikker et al. (2012) onderzocht hoe bedrijfskosten worden beïnvloed door de kwaliteit van de dienstverlening en de complexiteit van de aangeboden pensioenproducten (als maatstaf van maatwerk). De resultaten laten zien dat schaalvoordelen belangrijk blijven in het verklaren van verschillen in bedrijfskosten, ook als wordt gecontroleerd voor het serviceniveau en de complexiteit van pensioenproducten. Daarnaast blijken kleine pensioenfondsen gemiddeld minder complexe pensioenproducten (in plaats van meer maatwerk) en een lager (niet hoger) serviceniveau aan te bieden. Deze bevindingen ontkrachten de conclusies van PWC (2007) en geven additionele argumenten voor de consolidatie van de pensioensector.

Hoofdstuk 3 laat zien dat verschillen in financiële geavanceerdheid invloed hebben op het risicoprofiel van het beleggingsbeleid van pensioenfondsen. Minder geavanceerde fondsen blijken minder risico te nemen, mogelijk omdat ze zich door onvoldoende financiële expertise minder comfortabel voelen met meer riskante beleggingen. Omgekeerd hebben meer geavanceerde fondsen waarschijnlijk minder risicoaversie als gevolg van hun grotere beleggingsexpertise. Geavanceerde fondsen kunnen ook een overmatig zelfvertrouwen hebben indien zij te veel vertrouwen in eigen theorieën en ontwikkelde modellen (Griffin en Tversky, 1992). Hierbij is het risicoprofiel van pensioenfondsen gemeten aan de hand van het portefeuillegewicht van obligaties in de totale beleggingen.

Drie maatstaven zijn gebruikt om onderscheid te maken tussen financieel geavanceerde en minder geavanceerde pensioenfondsen: grove afronding op 5 procent of 10 procent van de strategische portefeuillegewichten in aandelen en obligaties (maatstaf I) en de mate van beleggingsdiversificatie over verschillende beleggingscategorieën (maatstaf II) en over landen (maatstaf III). Een grove afronding van het beleggingsbeleid kan duiden op een intuïtieve bepaling van het beleggingsbeleid, in plaats van het gebruik van meer geavanceerde methodes zoals een ALM-studie en Monte-Carlo-simulaties. Een soortgelijke maatstaf is ook veelvuldig gebruikt in geschiedkundige en sociale studies. Uit deze studies blijkt dat mensen die hun leeftijd niet precies weten veelal een aannemelijk getal noemen dat is afgerond op vijftallen. Daarbij is aangetoond dat deze grove afronding is gecorreleerd met onderwijs, inkomen, ongeletterdheid en human capital. De twee andere maatstaven hangen samen met optimale diversificatie. Hierbij kan de risicodiversificatie

geoptimaliseerd worden door beleggingen te spreiden over verschillende beleggingscategorieën (maatstaf II) en over verschillende landen en regio's (maatstaf III).

De statistieken laten zien dat maar liefst 60 procent van alle fondsen een veelvoud van 5 procent kiest voor de strategische portefeuillegewichten in zowel aandelen als obligaties. Dit is veel meer dan de verwachte 4 procent bij een uniforme of willekeurige verdeling van gehele getallen tussen 0 procent en 100 procent. Daarnaast blijkt dat veelvouden van 5 procent vaker voorkomen voor kleine fondsen (66 procent) dan voor grote fondsen (29 procent). Kleine fondsen spreiden hun fondsen ook veel minder over alternatieve beleggingscategorieën (naast obligaties en aandelen) en ze beleggen veel meer in het eurogebied dan grote fondsen (home bias).

De schatting van een multivariaat regressiemodel van het percentage obligaties in de beleggingsportefeuille als proxy van risico nemen laat zien dat zowel de drie maatstaven voor financiële geavanceerdheid als de grootte van pensioenfondsen een positieve correlatie hebben met het risicoprofiel van het beleggingsbeleid. Daaruit blijkt dat de drie geconstrueerde maatstaven van financiële expertise een statistisch significante rol spelen in het nemen van risico (apart van grootte) waarmee bewezen is dat deze een eigen economische betekenis hebben. De uitkomsten suggereren dat het beleggingsbeleid bij veel pensioenfondsen, met name de kleine, verbeterd kan worden. Daarbij wordt wel aangetekend dat meer geavanceerde fondsen mogelijk te veel risico hebben genomen en dat het in principe een gezonde strategie is om risicovolle producten te vermijden als je financiële kennis minder geavanceerd is.

Een belangrijk onderdeel van het beleggingsbeleid van pensioenfondsen is het vaststellen van de strategische beleggingsportefeuille, oftewel de verdeling van het vermogen over de beleggingscategoriën. Daarnaast bepaalt het beleggingsbeleid ook in hoeverre de feitelijke beleggingsportefeuille mag afwijken van de strategische beleggingsportefeuille, bijvoorbeeld als gevolg van verschillen in rendement tussen categorieën (passieve beleggingsbeslissing) of market timing (actieve beleggingsbeslissing). Intuïtief kan worden verwacht dat zowel de strategische als feitelijke portefeuilleverdeling redelijk stabiel is, gegeven de lange tijdshorizon en het wetenschappelijk bewijs dat pensioenfondsen (net als andere beleggingsfondsen) gemiddeld gezien niet in staat zijn om hun rendement na correctie van risico met behulp van market timing te verbeteren. **Hoofdstuk 4** laat echter zien dat het gewicht van

aandelen in de beleggingsportefeuille van Nederlandse pensioenfondsen zowel op korte als middellange termijn wordt beïnvloed door de ontwikkeling van aandelenkoersen.

Op korte termijn beweegt het feitelijke gewicht van aandelen in de portefeuille mee met het rendement van aandelen ten opzichte van andere beleggingscategorieën. Dit impliceert dat pensioenfondsen hun portefeuille niet volledig door de tijd heen herschikken. Elk kwartaal herschikken pensioenfondsen gemiddeld 39 procent van het overrendement op aandelen, zodat de overige 61 procent leidt tot een (al dan niet tijdelijke) aanpassing van het feitelijke portefeuillegewicht. Daarnaast is de toegepaste herschikking asymmetrisch: bij dalende aandelenkoersen kopen pensioenfondsen relatief veel bij, in een stijgende markt reageren ze minder sterk. Opvallend is ook dat het gedrag verschilt tussen grote en kleine pensioenfondsen. Grote fondsen beleggen meer in aandelen en herschikken hun portefeuille minder intensief. Als gevolg wordt de compositie van hun portefeuille meer beïnvloed door korte termijn beursontwikkelingen. In een stijgende markt blijken grote pensioenfondsen zelfs aandelen bij te kopen (overshooting), mogelijk omdat ze een hogere risicotolerantie hebben. Op middellange termijn leidt overrendement van aandelen tot een beperkte verhoging van de strategische allocatie naar aandelen in het beleggingsbeleid (en vice versa).

Deze uitkomsten laten zien dat het beleggingsbeleid van pensioenfondsen, met name de grote, wordt beïnvloed door cyclische ontwikkelingen op de aandelenmarkt. Dit gedrag maakt pensioenfondsen kwetsbaar voor verliezen. Als de aandelenkoersen stijgen, houden ze op korte termijn meer aandelen aan dan volgens hun strategisch beleggingsbeleid gewenst is en op middellange termijn verhogen ze beleidsmatig het gewicht van aandelen in de beleggingsportefeuille. Als de trend omslaat lijden ze daardoor verlies over een groter deel van hun portefeuille. Anderzijds kopen pensioenfondsen na een daling van de aandelenkoersen bij, ook al zijn hun reserves door de verliezen aangetast waardoor ze minder nieuwe klappen kunnen opvangen.

Thema II: Marktdiscipline en de garantie van deposito's

Een depositogarantieregeling wordt gebruikt door overheden om (kleine) spaarders te beschermen en het risico op een bankrun te verminderen. Bij een bankrun nemen depositohouders massaal hun geld op, hetgeen kan leiden tot het faillissement van de betrokken bank. Daarbij kan de stabiliteit van de financiële sector in gevaar komen, hetgeen hoge economische en sociale kosten met zich mee kan brengen. Een

depositogarantieregeling wordt veelal gezien als een effectief instrument om een bankrun te voorkomen en om de stabiliteit van de financiële sector te bevorderen. Dit wordt ook geïllustreerd in de verhoging van de Nederlandse depositogarantieregeling van 40.000 naar 100.000 euro in 2008, mede als reactie op een uitstroom van deposito's bij Fortis en ING.

Een negatief neveneffect is echter dat een depositogarantiestelsel de prikkel wegneemt voor spaarders om het risico van hun bank te beoordelen en op basis hiervan hun spaargedrag aan te passen. Omdat spaargeld een belangrijke vorm van funding is voor banken, kan deze vorm van marktdiscipline een effectieve prikkel geven aan banken om hun risico te beperken.

Hoofdstuk 5 laat voor Bolivia zien dat spaarders marktdiscipline uitoefenen op banken door na een toename van het risicoprofiel het aanbod van hun deposito's te verminderen (en vice versa). De meeste marktdiscipline wordt uitgeoefend door spaarders met grote deposito's, waarschijnlijk omdat zij beter in staat zijn en een sterker motief hebben om het risicoprofiel van banken te beoordelen. De invoering van een expliciete depositogarantieregeling heeft een substantieel negatief effect op de risicodiscipline die wordt uitgeoefend door spaarders en het effect varieert met het dekkingspercentage. Bij een dekkingspercentage van 100 procent wordt marktdiscipline volledig geëlimineerd. De bevindingen ondersteunen een beperking van het dekkingsplafond en het dekkingspercentage van depositogarantieregelingen met als doel om een kritische hoeveelheid spaarders de prikkel te geven om marktdiscipline uit te oefenen op banken.

In **Hoofdstuk 6** geef ik een aantal beleidsaanbevelingen op basis van de belangrijkste bevindingen in dit proefschrift. Daarnaast beschrijft dit hoofdstuk mijn suggesties voor vervolgonderzoek.

TKI dissertation series

USE 001 **Bastian Westbrock** (2010): Inter-firm networks: economic and sociological perspectives

USE 002 **Yi Zhang** (2011): Institutions and International Investments: Evidence from China and Other Emerging Markets

USE 003 **Ryan van Lamoen** (2011): The Relationship between Competition and Innovation: Measuring Innovation and Causality

USE 004 **Martijn Dröes** (2011): House Price Uncertainty in the Dutch Owner-Occupied Housing Market

USE 005 **Thomas van Huizen** (2012): Behavioural Assumptions in Labour Economics: Analysing Social Security Reforms and Labour Market Transitions

USE 006 **Martijn Boermans** (2012): International Entrepreneurship and Enterprise Development

USE 007 **Joras Ferwerda** (2012): The Multidisciplinary Economics of Money Laundering

USE 008 **Federico D'Onofrio** (2013): Observing the country: a history of Italian agricultural economics, 1900-1930

USE 009 **Saraï Sapulete** (2013): Works Council Effectiveness: Determinants and Outcomes

USE 010 **Britta Hoyer** (2013): Network Formation under the Threat of Disruption

USE 011 **Coen Rigtering** (2013): Entrepreneurial Orientation: Multilevel Analysis and Consequenses

USE 012 **Beate Cesinger** (2013): Context and Complexity of International Entrepreneurship as a Field of Research

USE 013 **Jan de Dreu** (2013): Empirical essays on the governance of financial institutions