MASTER

Liability-hedging real estate
the development and application of a decision support model for Dutch pension funds

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Award date: 2007

Link to publication
Liability-Hedging Real Estate

The development and application of a decision support model for Dutch pension funds
Master thesis
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Abstract

This report presents the results of a research on real estate as a potential liability-hedge for Dutch pension funds. An analysis is made on the operating environment of Dutch pension funds as well as their current investment process. The analysis showed that regulations (nFTK) cause the need for pension funds to implement Liability Driven Investment and to find liability-hedging investment strategies. Therefore a quantitative support model is developed to help professionals making a solid and thorough decision when it comes to real estate as a liability-hedging investment. To find liability-hedging real estate for Dutch pension investors, the model measures mismatch risk of 430 different (non-) listed real estate indices from the 25 most mature real estate countries with the pension liabilities. The model also measures mismatch risk from some other asset classes, like equities, fixed income and commodities. To verify the practical appropriateness of the model, the mismatch of some investment case studies is measured. The settings of the model can be adjusted to reflect the preferences of pension fund management.

Keywords
Pension fund, funding ratio, nFTK, Liability Driven Investment, liability-hedge, real estate, duration, inflation, mismatch risk.
Preface

This Master thesis presents my research on liability-hedging real estate. It also represents the end result of the last part of my academic education at the Eindhoven University of Technology. I am now fully prepared to start my professional career in real estate and I can't wait to further develop myself as a professional.

With this report I hope to have helped ABP Investments explaining what real estate investments have to offer to pension funds. Besides that, I hope that this quantitative research provides fellow academics a useful starting point to further research this innovative topic, generating even more new insights in real estate as an asset class to invest in.

I would like to thank my supervisors from my University, Robert Weisz and Kees Kokke, for their enthusiasm and support. In addition, I would like to thank Olaf Houben who helped me to get the internship position at ABP Investments. Furthermore, I would like to thank both my supervisors from ABP Investments, Patrick Kanters and Rob van den Goorbergh. They provided me this unique opportunity to research the subject from a pension fund point of view as well as from a real estate point of view. In addition, they created a solid basis for my research at ABP Investments, resulting in the support from ABP professionals whenever I needed it. I really appreciated the extensive amounts of time Rob has put in the research by helping to build the model and discussing the subject with me. Overall, the whole graduation committee helped me to stay focussed on delivering an academic worthy, yet practically relevant research.

Last but not least, I would like to thank all the people who supported me during my study. Special thanks go out to my parents for their continuous help, support and patience.

Enjoy reading the report and please do not hesitate to contact me for any enquiries regarding this research.

Niels Coolen
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Amsterdam, July 2007
Executive summary

This report presents the results of a research on real estate as a potential liability-hedge for Dutch pension funds. The research is conducted at ABP Investments, one of the largest pension funds in the world.

Dutch pension funds have the mission to maintain a sustainable pension system by providing reasonable, preferably inflation protected pensions for all their participants against an acceptable and stable price. An analysis is made on the operating environment of Dutch pension funds as well as their current investment process and related developments. The analysis showed that according to new regulations (nFTK) both assets and liabilities now have to be valued on a marked to market (fair value) basis. Consequently, nFTK links the liabilities with the investments and, as a consequence of this, indirectly with the investment strategy of pension funds. It causes the need for pension funds to implement Liability Driven Investment (LDI). LDI is a relative investment framework, which has the objective of controlling the volatility of the funding ratio. The funding ratio is defined as the sum of the assets divided by the sum of the liabilities. Therefore, instead of taking a peer group benchmark, the benchmark will now be the liabilities itself as they are considered to be the risk free investment. LDI also introduces two instead of one portfolio:

- Liability-hedging portfolio (LHP): contains assets that have minimum relative risk
- Risk optimizing portfolio (ROP): contains assets that generate absolute return

One of the new key focal points of pension funds is to define and find liability-hedging investment strategies for in the LHP. Such strategies must have similar risk return characteristics as the pension liabilities. Only in this way the funding ratio volatility can be controlled. A perfect liability-hedge is an investment strategy which total return perfectly mimics, or co-moves with, the return of the liabilities. Current Liability Driven Solutions offered in the market all have their drawbacks; either they are too costly or not yet available on a large scale.

To find liability-hedging strategies one has to measure mismatch risk. Mismatch risk is defined as the volatility of the excess return. In other words, it is the standard deviation of the difference between the returns on the actual strategy and the returns on the liabilities.

A quantitative support model is developed to provide an answer to the research question. The model helps professionals to make a solid and thorough decision when it comes to real estate as a liability-hedging investment. To find liability-hedging real estate for Dutch pension investors, the model measures mismatch risk of 430 different real estate indices from the 25 most mature real estate countries with the pension liabilities. To verify the practical appropriateness of the model, the mismatch of some real estate investment case studies is measured. Furthermore, the model has incorporated the outcome of a theoretical analysis and semi-structured interviews with research-, finance- and property professionals. With this model, an investor has a good way to gain insight into the liability-hedging qualities of real estate. The variables of the model can be set to reflect the preferences of pension fund management. By adjusting the settings, one can see the effect of each variable on the mismatch risk of the real estate indices. The model also increases insight as it uses some other asset classes like equities, fixed income and commodities as well. In this way, the mismatch performance of the real estate indices is related to the mismatch performance of the other asset classes.

One of the main results is that real estate has potential as a liability-hedge. The model outcome has shown that a lot of specific real estate indices can be labelled liability-hedge. The sector retail however, has the best potential as a liability-hedge. In general, the following most important conclusion can be made regarding the mismatch risk and thus the liability-hedging ability:

RETAIL < RESIDENTIAL < INDUSTRIAL < OFFICE
This conclusion is based on several useful indices from different countries where a mature real estate market exists. The conclusion even holds stand after adjusting the model settings such as the duration profile of the liabilities and hedging for currency risk. However adjusting the variables naturally does have its effect on mismatch risk.

Other uses of the model are possible. The calculation model is an instrument which can be used to measure the mismatch risk of numerous indices of other asset classes as well. A first step was already been taken by measuring MSCI, GSCI and a few other indices.

The model allows other investors to use it, such as insurance companies or foreign pension funds. As insurance companies do not have to pay out inflation linked claims, the liabilities do not have to be linked to inflation, but can be replaced by the insurers' own relevant benchmark. Foreign pension funds can also use this model to find real estate that is a hedge for their liabilities. In that case the liabilities have to be replaced by the representative liabilities of the foreign fund. This includes the rate of inflation of the specific country.

In short, the model is flexible, updatable and allows other users and uses as well. Furthermore, the model provides a new way of measuring (real estate) risk based on an innovative concept.

The theoretical relevance of the research is that it has created new knowledge on real estate investments. This research is the first in its kind to discuss and find liability-hedging real estate using a quantitative model for measuring mismatch risk of numerous indices. The model has practical relevance as well. It provides a starting point across the 25 countries and main real estate sectors to further search within the identified indices for liability-hedging real estate. Practical uses of the model are:

- Support decisions on potential investments
- Further negotiate on an identified liability-hedging candidate
- Define new real estate investment strategies
- Formulate a new investment mandate
- Find liability-hedges within other asset classes

The research model has proved its value. It has already been used in practice to support the real estate department and the innovation committee from ABP Investments in its decision to label a specific real estate investment of €400 million as an innovative strategy. ABP Investments decided to invest €180 million in the real estate objects, adding it as one of the first innovative liability-hedging products into ABP's liability-hedging portfolio.

The final goal of liability driven investment is to improve the well-known efficient frontier, ultimately generating a better risk / return reward and thus better pensions for the participants of the pension fund. However, to really be able to do this, more research is inevitable and necessary. This research is one of the many approaches to decide on the liability-hedging capacities of real estate. Examples of further research are a bottom-up research using a qualitative approach or a forward-looking model taking into account the portfolio context.
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1 Research set-up

1.1 Introduction

Chapter 1 discusses the set-up of the research and is divided into six sections. The next section elucidates on the main objective of this research and the theoretical and practical relevance. The third section states research question and sub questions. To get a focussed answer to all the questions, a clear structure and delineation are given in the two sections thereafter. The chapter concludes with a summary.

1.2 Relevance

At the moment the real estate market as well as pension funds draw a lot of media attention. The real estate market draws this attention due to declining yields and rocketed returns compared to other assets like bonds and shares. Last but not least, real estate has increasingly been recognised as a portfolio diversifier. All in all, there is growing consensus that real estate has been repositioned as an asset class [see among other sources Vastgoedmarkt, May 2006; PropertyNL, June 2006]. This contention is supported by the continuing increase in strategic institutional target weightings and capital in real estate. However, the supply of qualitative real estate is limited as prices are going up. One of the important investor lessons learned in history is ‘what goes up must come down.’ So, is it wise for investors to run that race, all aiming at the same benchmark? Investing is not a goal itself; however it rather is a way to reach a goal. For every investor, this goal can be different.

Financial institutions and pension funds draw media attention as their focus is more often on their core business and corresponding risks that come with their business. Pension funds have the mission to maintain a sustainable pension system by providing reasonable, preferably inflation protected pensions for all their participants against an acceptable and stable price [see among other sources Dutch Central Bank, Wikipedia]. Therefore sound financial management is essential. Social-economical developments are affecting the pension system [ABP, 2006]. However, to maintain this sustainable system and given a new regulatory financial framework that has come into effect, most pension funds have reconsidered and redefined their strategic investment framework.

The new financial regulatory framework is called the ‘Nieuw Financieel Toetsingskader’ (nFTK) and is inspired by the International Financial Reporting Standards (IFRS) [Dutch Central Bank]. In short, both assets and liabilities now have to be valued on a marking to market (fair value) basis. Consequently, nFTK links the liabilities with the investments and, as a subsequence of this, indirectly with the investment strategy of pension funds.

One of the new key focal points of pension funds is to define and find investment strategies which have similar risk return characteristics as the liabilities [see among other sources UBS, ORTEC and IPE]. In this way, a pension fund has the liabilities as its risk free investment which is quite a different role from ‘just’ being a general investment manager outperforming a benchmark.

This new strategic focus is also relevant for ABP Investments, the company where this research is conducted. Their initial request for research is reformulated into an objective, which is the following:

Find and identify liability-hedging real estate candidates for Dutch pension funds by analysing the changes in value of pension liabilities and the returns of real estate indices and measuring the mismatch between them. The deliverable is a useful support model for strategic management decisions.

The theoretical relevance of this research is to contribute to current academic knowledge on the subject of real estate investments in a pension context [Baarda and de Goede, 2001]. The practical relevance is to develop and apply a practical decision support model for Dutch pension funds which management can use as a starting point.

1 Main developments affecting the pension system are a withdrawing government, ageing and individualism and a new financial regulatory framework (nFTK) that has come into effect.

2 ABP Investment is the internal fund manager of ABP pension fund, which stands for ‘Algemeen Burgerlijk Pensioenfonds’. It is a pension fund for the government and educational sector. A detailed profile of ABP and ABP Investments is enclosed in appendix 1.
point for liability-hedging strategies. The deliverable should give pension funds considerable new insights in the identification of real estate investments as a liability hedge. The findings of this research hopefully will lead to a first attempt of defining new real estate strategies.

Figure 1.1 shows the interface of the financial- and the real estate market, which can be seen as the context of this research. The analysis on liability-hedging real estate will take place from the point of view of the strategic real estate market, while the model is going to be used for decision makers in the financial market.

1.3 Research question

The description and objective of the previous paragraph leads to the following research question:

Which real estate investments are a candidate for Dutch pension funds to offer a hedge against the changes in value of corresponding liabilities?

An answer to the research question will be formulated by using the strategic investment plan and relevant criteria for liability-hedging (ABP, 2007). To give a solid well-founded answer to the research question, it is subdivided into several sub questions. The questions are stated below:
1. What is a liability-hedge?
2. How should a liability-hedge be measured?
3. Which real estate investments are a liability-hedging candidate?

1.4 Structure

A research model has been set up to answer the sub questions in a structured way. The purpose of the model is to stipulate the structure of the complete research. Figure 1.2 shows the research model, comprising the set up of the research, the chapters and the data collection methods.

Chapter 2 can be conceived as a description of the context and concepts of the research. The chapter elaborates on the principles and practice of pension funds and developments affecting this. The research describes the investment practice of pension funds in more detail, which is the outcome of the investment policy of a pension fund. The chapter also discusses the important reconsideration of investment strategy as a result of social-economical and regulatory developments. As a result of the shift towards Liability Driven

The semi-structured interviews are with real estate portfolio managers and other related professionals like real estate analysts and researchers to gather quantitative as well as information.
Investment (LDI), more emphasis is on the funding ratio, making mismatch risk a key measure. Current liability-hedging solutions offered in the market are discussed as well. Lastly, the chapter concludes with a summary.

The thesis moves on with chapter 3 by giving an overview of relevant theory on real estate as an investment. The chapter is written to give the reader a better understanding of what real estate investing exactly entails. Section two summarizes the different ways of investing in this asset class and provides other real estate investment basic knowledge. Section three elucidates on the acclaimed characteristics of real estate investments which are relevant for this research. The chapter concludes with a summary.

Subsequently, chapter 4 describes the quantitative model. The model tries to find real estate that can serve as a liability-hedge. Methodology and the assumptions of the model are explained. Asset- and liability data that are used as model input are discussed. The chapter explains the set-up of the model, including the different variables that can be set in accordance to the preferences of a pension fund. The outcome of the model is discussed along with some general conclusions. Chapter concludes with a summary.

Finally, chapter 5 examines if the original problem statement and research questions have been answered and comes with the main conclusions and some recommendations for further research.

1.5 Delineation

Assets
Direct real estate indices as well as total return indices for indirect real estate are used. The indices cover several real estate sectors and geographical regions. The research also uses some indices from specific investment cases. Other asset classes like stock, bond, mortgage and commodity indices are used as well. It gives a better idea of the mismatch of the real estate indices with the pension liabilities, compared to other asset classes. The mismatch measurement of combined asset portfolios is not taken into account.

Liabilities
As mentioned in the problem statement, this research will only focus on Dutch pension funds with corresponding liabilities and which have Dutch inflation obligations. Younger as well as older liability profiles of Dutch pension funds are taken into account. However, the model assumes a 'steady-state' pension funds, with no changes in the liability profile from actuarial changes during the evaluation period.

Process
In order to use and interpret the model properly, this thesis assumes that a pension fund has enough in-house expertise and experience with real estate investments. This assumption is quite essential, as investing in complex real estate portfolios requires know-how.

Information
The essence of the link between the liabilities and the assets is in quantitative as well as qualitative information. Furthermore, for a heterogeneous asset class like real estate, a combination of both sets of information support the strategic portfolio management decision best. However, this research has its focus solely on quantitative analysis. What is more, the quantitative information only contains historical data meaning the research is backward looking. The research model does not do any forecast modelling. Naturally, enough data need to be available to measure real estate indices and pension liabilities. Again, correct interpretation of the information and the model require specific professional knowledge.

Strategic model
Method and model are designed to support decisions for Dutch pension funds on a strategic level. It means that all real estate return indices outside the Netherlands are recalculated to reflect true total return a Dutch investor could have made. It includes the currency effect. However, the model has the possibility of hedging foreign exchange risks (FX). Neither organisational aspects nor the implementation phase will be discussed. These aspects lie outside the scope of the thesis.

1.6 Summary

In this first chapter the relevance of the research as well as the main objective and problem statement are discussed. In addition, research questions are stated. Furthermore, a clear structure and delineation are given in order to get a focussed answer to the problem statement and underlying research questions.

In the next two chapters the context and concepts used in this research are explained.

---

1 Liability profiles are discussed in more detail in chapter two and four.
2 Foreign currencies are recalculated to Euros or guilders, before the introduction of the Euro currency.
2 Context: the Dutch pension sector

2.1 Introduction

Chapter 2 can be conceived as a description of the context and concepts of the research. It forms the starting point from which the research will proceed. The chapter elaborates on the principles and practice of pension funds and developments affecting this. The Dutch pension system is described from the point of view of a participant as well as from a pension fund. Furthermore, the research describes the investment practice of pension funds in more detail, which is the outcome of the investment policy of a pension fund. The chapter also discusses the important reconsideration of investment strategy as a result of social-economical and regulatory developments. As a result of the shift towards Liability Driven Investment (LDI), more emphasis is on the funding ratio. Current liability-hedging solutions are discussed. Lastly, the chapter concludes with a summary.

2.2 Principles

2.2.1 Dutch pension system

Ever since the Dutch East Indies Company became the first organization to float tradable shares on a public market in 1602, followed by a speculative tulip bubble a quarter century later, the Netherlands has been synonymous with financial sophistication [Brounen, 2007]. Today, the well organized pension system is a high profile example of Dutch sophistication.

The current Dutch pension system is composed out of three pillars, as shown in figure 2.1 [See among other sources Schais-van Oppen et al, 2004; ABN AMRO, 2006; Petersen, 2005]. The first pillar is the Dutch state pension, a national insurance which does not depend on the amount of earned income and can be seen as a basic facility to prevent poverty amongst the elderly. It facilitates a minimum allowance for the majority of the population in the Netherlands. It is a pay-as-you-go system, which means that these state pensions are paid directly by current pension contributions, without funding them. The Dutch example is the 'Algemene Ouderdomswet' (AOW).

The second pillar provides a pension for employees. Contributions are paid by the employer or by both the employer and the employee. It supplements the first pillar and consists of company pension plans or compulsory collective sector pension plans. Compulsory collective sector pension plans consist of participations of smaller companies who do not have a pension plan on their own. The second pillar is based on solidarity and thus on collective risk sharing, providing services for pension, death and disability. Solidarity comes in many forms [SZW]. Dutch pension funds have the so called ‘doorsneepremie’. This is the pension premium that must be paid by the whole pension population and which is the same for the whole population. However, certain sectors are more expensive than others and within each of these sectors there are relatively cheap or expensive groups of participants.

As will be discussed in subsection 2.2.2, the second pillar is based on a funded system instead of a pay-as-you-go system. It means that participants save for their own pension. Pension entitlements are built up during employment and are related to salary and time of employment. A funded system is therefore not as sensitive for demographic changes (e.g. ageing) as the pay-as-you-go system as seen in the first pillar.

The funded system can be divided into three categories [see among other sources Schols-van Oppen et al, 2004; Wikipedia; Investopedia; SZW]:

- Defined benefit (DB)
- Defined contribution (DC)

6 KLM, Shell and Akzo Nobel are examples of company/concern pension funds. ABP and PGGM are examples of compulsory sector/branch pension funds [Haaren, 2003].
7 Some examples of solidarity within groups of participants are young vs. old, women vs. men, healthy vs. less healthy and single vs. married.
8 Also known as ‘kapitaaldekkingstelsel’.
9 Some critics label the unfunded pensions as known as the pay-as-you-go system (‘omslagstelsel’) as some sort of a pyramid scheme, which collapses when there are not enough new contributors to pay pension contributions to current pensioners.
The defined contribution system has a fixed amount of contribution for employees. However, there is no way to know how much the plan will ultimately give the employees upon retiring. In other words the benefit is not guaranteed and is based on available funds. In this system, all risk is passed onto the employee.

- Collective defined contribution (CDC)
  The collective defined contribution is similar to a defined benefit (DB) system. It only limits the risk of a pension deficit for the employer and transposes it to the employee.

The third pillar consists of voluntary individual pension facilities, like life insurance or savings, to minimize pension gaps [Nijman, 2005]. The average income position of a Dutch pensioner consists of 50% AOW, 40% employee related pensions and 10% private pension facilities.

![Dutch pension system](Figure 2.1 Composition Dutch pension system [See among other sources Schol-van Oppen et al, 2004; ABN AMRO, 2006; Petersen, 2005 and authors contribution])

This research concentrates on the second pillar. The estimated Dutch market size of this second pillar is US$873.3 billion\(^{10}\) for 2006 [Watson Wyatt, 2007]. When looked at the pension assets as a percentage of Gross Domestic Product (GDP), the Netherlands is one of the front-runners with 132%\(^{11}\). The Netherlands had a total of 800 pension funds in 2005 [CBS].

### 2.2.2 Participants’ perspective

Participants of the second pillar pay premiums during their working lives and receive payments until death after retirement. Corporate sponsors (employers) add premium to the pension fund of the employees as well. A pension fund contributes to the amount of money available by investing these premiums. This is called funding. The reason for this is that participants want to maintain their wealth after retirement, which effectively means that inflation protection is needed. The payment scheme is shown in Figure 2.2. Active participants are employees that pay premiums. Inactive participants are members that no longer actively contribute to the pension scheme but receive their pension payments\(^{12}\). Around four fifth of total pension fund assets come from the investment performance of the pension fund, whereas only one fifth comes from pension premiums paid to the pension fund. Therefore, it is vital that the assets are invested in a sound way.

![Pension payment scheme](Figure 2.2 Pension payment scheme: funded system [ABN AMRO, 2006 and authors contribution])

The relationship between participants and a pension fund changes, depending on the age of the participant. This relationship can be illustrated by the concept of ‘life span capital’, which is shown in figure 2.3. ‘Life span capital’ consists of human capital (discounted value of future wages) and the accumulated financial capital (e.g. pension rights). At a young age an employee still has a long career to go and therefore his human capital is big. However, his financial capital is probably negative (e.g. study loans). Because of the relative small importance of his financial capital and the certainty of the size of the human capital, the young employee prefers the pension fund to invest her/his financial capital more risky. A potential loss of investments is easy to compensate with future income from wages.

\(^{10}\) Of this estimated market size, ABP has €209 billion assets under management [ABP, 2007a].

\(^{11}\) Appendix 2 has a more detailed overview of the pension assets across the most significant countries.

\(^{12}\) Inactive participants that are not yet retired, but still work and affiliated to another pension fund are excluded in this perspective. However, these deferred members have built up some pension rights at their previous pension fund.
This relationship is different for an older employee as the accumulated financial capital is high, while her/his human capital is low. This participant prefers the pension fund to invest less risky. An inactive participant/pensioner prefers even higher security of the financial capital as this capital is a pensioners’ only source of income.

![Figure 2.3 'Life span capital': human- and financial capital during the life span [ABP, 2006]](image)

### 2.2.3 Pension funds’ perspective

The point of view of a pension fund, instead of a single participant, is different and more complex. This complexity is due to the different stakeholders and corresponding diverging objectives a pension fund has to deal with. All stakeholders and their objectives are mentioned in figure 2.4.

![Figure 2.4 Pension fund stakeholders [Wiersma, 2006; ABN AMRO, 2006; Kleynen, 1996]](image)

As mentioned in chapter 1, pension funds have the mission to maintain a sustainable pension system by providing reasonable, preferably inflation protected pensions for all their participants against an acceptable and stable price [see among other sources Dutch Central Bank; Wikipedia]. A sustainable pension system can only be maintained when all stakeholders, including all participants are satisfied and when the fund is managed in a financially sound way.

For that reason a pension fund has to make the trade-off between these diverging interests. In short, a pension fund needs to find the optimal balance between low premiums for current active participants and sponsors and high pension benefits for current- and prospective inactive participants. In addition, sponsors do not want to pay shortfall covering premiums as they want to minimize the risk on their assets. Apart from that, the pension fund needs to comply with the financial regulatory requirements as set by the Dutch Central Bank. To make things even more complicated, a pension fund has to make the trade-off based on estimations on both pension assets and liabilities. This trade-off based on estimations is called Asset Liability Management (ALM). Section 2.3 will discuss how this is done. The section will also discuss the policies in figure 2.4, which are the outcome of the Asset Liability Management. As the reader will discover later, the investment policy is the only relevant policy for this research.
2.3 Practice

To best way to explain Asset Liability Management\footnote{Asset Liability Management is also called balance sheet management.} in more detail is to start with the balance sheet of a pension fund. As explained by subsection 2.2.2, a pension fund is similar to a household or company with money flowing in and money flowing out [ABP, May 2006]. As you can see in figure 2.4, a (pension fund) balance sheet has a liability- and an asset side. The liabilities represent the built-up pension benefits of the participants. The liabilities are built up by expected cash outflows which are spread over time from now until the last participant is expected to die. A typical aggregate liability payment scheme, or cash flow structure, is illustrated in figure 2.5. The expected cash flows are calculated using actuarial analysis and statistical methods. Generally a pension fund liability profile has a very long-term character of up to 80 years. The total current value of the liabilities is calculated by discounting all the cash flows, using a discount rate\footnote{Appendix 3 gives an example of a discounted cash flow calculation.}

![Typical Aggregate Liability Profile](image)

The asset side consists of pension premiums paid by participants and are invested in numerous assets. The goal of the assets is to cover future liability cash flows. Possible assets to invest in can range from equities and fixed income to alternative investments\footnote{Examples are stocks, bonds, private equity, hedge funds, commodities and, last but not least, real estate.}. Modern Portfolio Theory (MPT) helps to find the most optimal investment portfolio in terms of risk and return.\footnote{Appendix 4 contains a detailed overview of the Modern Portfolio Theory (MPT) and related theories.}

The funding ratio is the most important and best measure of a plan’s ability to pay participants [Goldman Sachs, 2006]. It sets the assets in relation to the liabilities and measures if a pension fund fulfills the solvency requirements as set by the regulatory authorities. The funding ratio is calculated as follows:

\[
F = \frac{\sum A}{\sum L} \times 100 \% \tag{2.1}
\]

Where:

\[
F = \text{Funding (coverage) ratio}
\]

\[
A = \text{Total amount of assets of a pension fund}
\]

\[
L = \text{Total amount of liabilities of a pension fund}
\]

The excess amount of assets compared to the liabilities is put on the balance sheet as 'surplus'. Surplus can be seen as the equity buffer of a pension fund against shocks on the financial markets or other future setbacks [Dutch Central Bank, May 2006]. Of course it is not desirable if the funding ratio will be less than 100%.

Asset Liability Management brings the pension strategy in line with the pattern of future pension liabilities. The ALM tool helps to understand how different policies can influence the balance sheet. In essence the tool captures how the balance sheet is affected over time by policy decisions (as stated in figure 2.4), given the
financial market outlook and the actuarial development\textsuperscript{17} of the pension fund. With the current balance sheet as a reference point, Asset Liability Management gives quantitative insight into the future development of assets, liabilities and the surplus and funding ratio. Figure 2.6 shows the influence of these variables [Bauer, Hoevenaars and Steenkamp, 2006; ABP, 2007].

\[
\Delta \text{(Surplus)} = \Delta \text{(Assets)} - \Delta \text{(Liabilities)}
\]

<table>
<thead>
<tr>
<th>Contribution policy</th>
<th>Contributions (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indexation policy</td>
<td>Pension benefits (-)</td>
</tr>
<tr>
<td>Investment policy</td>
<td>Investment return (+/-)</td>
</tr>
<tr>
<td>Exogeneous actuarial and economical factors</td>
<td>Actuarial factors (+/-)</td>
</tr>
<tr>
<td></td>
<td>Interest rate (+/-)</td>
</tr>
<tr>
<td></td>
<td>Inflation (+)</td>
</tr>
</tbody>
</table>

Figure 2.6 Influence of variables on future development of the balance sheet

Asset Liability Management calculates a very large number of macro-economic scenarios and reproduces the development of the funding ratio and the financial situation for each of these scenarios. The outcome of these stress test calculations is the basis for the decision makers to decide on the four policies as can be seen in figure 2.4. Some example questions of the decision makers could be:

- Do we need to renegotiate the current pension scheme with the sponsors and participants?\textsuperscript{18}
- What will be our policy with regards to pension inflation indexation and pension contributions?
- How does the investment portfolio need to look like and what are the expected returns for different portfolios?

The investment policy of pension funds is discussed in this section in more detail, as it is related to the returns of the investments. The next section states certain developments that have an impact on both the liabilities as well as on the investment policy eventually.

The idea is to gain excess (active) return per asset in excess of the benchmark set by the strategic portfolio allocation by actively deviating from this benchmark\textsuperscript{20}. This for risk corrected excess return, or alpha, is the added value of a pension fund [Kuné, 2002].

The next section discusses the social-economical and regulatory developments that have an impact on the liabilities and eventually also on the investment strategy of Dutch pension funds. This impact leads to a reconsideration of this strategy at many funds, which will be discussed in section 2.5. The influence of this reconsideration on pension fund real estate investing is also the starting point of this research.

\textsuperscript{17} Actuarial developments include risk. Examples are longevity risk, health risk, population growth risk, et cetera. E.g. increasing life expectancy can result in payout levels that are higher than what a pension fund originally accounts for. However, as discussed in section 1.5, the research assumes a 'steady-state' pension funds, with no changes in the liability profile from actuarial changes during the evaluation period.

\textsuperscript{18} E.g. build up a pension scheme based on end-wages or middle-wages.

\textsuperscript{19} Constraints can be: which benchmark to use, which countries to avoid, what target return to aim at, how much risk budget there is, the use of leverage to in- or decrease exposure or not, et cetera.

\textsuperscript{20} Appendix 5 contains a figure with an example to give the reader a better idea of active strategies.
There are some developments that lead to a reconsideration of the pension investment strategy of pension funds. The following social-economical and regulatory developments are discussed in this section [ABP, 2006; Dutch Central Bank]:

- **Ageing**\(^{21}\) and individualism
  Individualism leads to an increasing demand of flexible social arrangements\(^ {22}\) and more customized solutions, putting pressure on collective pensions and solidarity [ABP, August 2006]. Ageing creates tensions on pensions as well. It effectively means that less people have to pay for the benefits of more and more inactive participants. Recall from subsection 2.2.2 that older people ought to invest in less risky assets to limit the risk of not getting an inflation protected pension. In contrast to this, younger people could take considerable more risk as they need relatively high investment returns. To keep the Dutch pension system healthy, it is important to have an answer to these developments.

- **Withdrawing government**
  The Dutch government has planned to curtail on pensions\(^ {23}\), meaning that people have to set aside more money for their (own) pension. Moreover, as a result of the European Union, the Dutch pension system could be reorganised, meaning that compulsory pension payments could eventually come to an end. Both developments would lead to a decrease in solidarity.

- **The new financial regulatory framework (nFTK)**
  In 2006/2007, a new supervisory framework has come into effect for pension funds. The framework introduced more restrictive legislation with more emphasis on reporting, audit and control. The relevant legislation for pension funds is the new financial regulatory framework (nFTK), which is inspired by the international financial reporting standards (IFRS). One of the reasons for the regulator (Dutch Central Bank) to introduce nFTK is to create transparency in the market and for the participants of pension funds. The main challenges of nFTK are [See among other sources: Dutch Central Bank, May 2006; Intermediair, 2006, ABPa]\(^ {24}\):
  1. the stricter solvency requirements and corresponding regulations
  2. the fair value, or marked to market (MTM) valuation of both assets and liabilities

Both aspects of the third development need to be discussed in more detail. As can be seen in figure 2.8, nFTK requires pension funds to be solvent. In case of a funding shortage, nFTK only allows a short recovery period of three years. Funding coverage ratios (F) need to be at least 105%, calculating 5% for general risks. However, pension funds need a ratio of 140% to fulfill their ambition of giving participants an inflation protected pension. Corresponding regulations to the funding coverage ratios are also illustrated in figure 2.8.

---

\(^ {21}\) Appendix 6 contains a short overview of Europe's demographic outlook [Brounen, 2007].

\(^ {22}\) E.g. part-time pension plans or pensions with a flexible age of retirement.

\(^ {23}\) E.g. abolishment of, or economize on the 'AOW' (Algemene Ouderdomswet) and the 'WIA' (wet Werk en Inkomens naar Arbeidsvermogen) and the 'WW' (werkloosheidswet).

\(^ {24}\) Pension funds now also have to take into account the expected increasing longevity as predicted by the Central Bureau of Statistics (CBS).
Apart from the stricter solvency requirements, nFTK also introduces the fair value, or marked to market valuation of both assets and liabilities. This is the second aspect. 'Marked to market valuation is recording the value on a daily basis, to reflect the current market value rather than its book value.' The method is used to confirm that margins, like the funding ratio (F), are being met [Investorwords, Investopedia]. Instead of calculating the present value of the liabilities at a proscribed static 4% interest rate, which was common practice before the introduction of nFTK, pension liabilities now have to be discounted conform the yield curve (figure 2.9). The yield curve is a line that plots the interest rates of differing maturity dates at a certain point in time. It represents the market quotes of interest rates corresponding to different tenors. It basically shows the term structure of interest rates. 'The curve is used to predict changes in economic output and growth and as a benchmark for debt in the market' [Investopedia].

![Yield Curve](image)

The effect of the change in valuation has major consequences for the volatility of the liabilities and, more importantly, for the funding ratio. The consequence of this change is discussed in more detail and illustrated in the figures 2.10 to 2.12.

The sensitivity of the present value of pension liabilities (or assets) to changes in the yield curve is called duration. It is defined as the present value's change due to a parallel shift of the yield curve and thus it is a measurement for interest rate risk. The higher the duration of an asset, the greater the sensitivity of this asset for changes in interest rate. Duration of an asset is expressed in number of years and determined by the weighted average time until all its cash flows are paid or received [25]. The change in value due to changes in interest rates is formulated by the modified duration [See among other sources: Theebe, 2005; Hoorenman et al., 2006; Geltner and Miller, 2001]. The modified duration calculated for fixed-income securities or pension liabilities is as follows:

\[
\Delta V = -D \times \Delta r \quad (2.2)
\]

Where:

- \(\Delta V\) = Percentage change in value
- \(D\) = Duration (in number of years)
- \(\Delta r\) = Change in interest (discount) rate in percentage points

It can be concluded from formula 2.2 that more distant cash flows, which have a higher duration, are more sensitive to changes in interest rate. A numerical example is given in the following figure, to show this relation:

---

25 A tenor is the amount of time left for the repayment of a loan or contract or the initial term length of a loan.

26 There are three main types of yield curve shapes: normal, inverted and flat. A normal yield curve (as seen in the picture) is one in which longer maturity bonds have a higher yield compared to shorter-term bonds due to the risks associated with time. The slope of the yield curve is also seen as important: the greater the slope, the greater the gap between short- and long term rates [Investopedia].

27 A long term bond will therefore have a higher duration than a short term bond. A special case is the duration of a zero coupon bond which equals its maturity, as the only cash flow is the repayment of the bond itself at the end of maturity.

28 Formula 2.2 assumes a linear relation between the interest rate and the market value of a fixed income security. However, their actual relation is convex. This means that an increase of the interest rate of 1% has less impact on the liabilities at a high interest rate than at a low interest rate. Appendix 7 gives a short explanation of convexity.
The duration of a pension fund portfolio equals the weighted average of its components' durations. This is the way it is calculated for both the asset and liability side. The duration of a typical pension fund asset portfolio is around 5 to 8 years. However, this is under the assumption from the Dutch Central Bank and the pension industry that equity and other real assets such as real estate have no duration at all. The duration of the liabilities changed due to the introduction of nFTK.

Before nFTK, when the yield curve showed an upward shift, interest rates increased and overall pension assets decreased. However, the duration of the pension liabilities was artificially set at zero as they were valued at a static 4% and thus insensitive for the yield curve. In short, there was a duration mismatch of six. The funding ratio was mainly influenced by the investment portfolio. The liabilities only had a marginal influence. The only influence of the liabilities on the funding ratio was because of changes in the composition or number of participants. This influence only involved gradual changes and no shocks, as demographic changes can be predicted accurately.

After nFTK, the duration of the liabilities is calculated using the yield curve. The duration of a typical aggregate liability profile is 12 to 20 years depending on the composition of the participants of the pension fund. This means the liabilities now have a higher duration than the assets. As can be seen in figure 2.11, the duration-mismatch did not only invert, its size increased as well. It means that the effect of a change in interest rates has much more influence on the liabilities then it has on the assets. The assets still act the same to changes in the yield curve as they did before the introduction of nFTK. However, the liabilities now react heavily to shifts in the yield curve.

---

29 Chapter 3 has more detailed information on the duration of real estate.
30 E.g. due to the increased interest rate, new bonds that come to the market now give a higher rate of return than the ones the investor already owns. This effectively means that the value of the bonds the investor currently owns will decrease.
31 Appendix 8 contains a figure with an example of a 'younger' and an 'older' pension fund composition.
In short, the introduction of nFTK's marking to market valuation effectively means that funding ratios now have become much more volatile. Combined with nFTK's higher funding standards and shorter time for recovery, this increased funding volatility can be seen as a risk. Managing this (duration-mismatch) risk is a central question for pension funds. It causes the need for a new investment strategy, in which the yield becomes an important factor. Ideally, assets and liabilities react similarly to changes in interest rates with a constant funding ratio as a result. In this way, the funding ratio stays immune for changes in interest rates. In other words, nFTK has linked the liabilities with the assets and as a consequence of this, indirectly with the investment strategy of pension funds.

This section has discussed three main developments that lead to a reconsideration of the pension investment strategy. Apart from the first two developments, the combination of a more volatile funding ratio and stricter solvency requirements create the need for a new investment strategy with a focus on a lower funding ratio risk. This new investment strategy is labelled Liability Driven Investment (LDI).

2.5 Demystifying Liability Driven Investment (LDI)

The impact of the developments on the funding ratio leads to a reconsideration of the investment strategy at many pension funds. The reconsideration of the new strategy can be labelled Liability Driven Investing (LDI). Current section discusses what this reconsideration exactly entails. It also provides the starting point for this research on liability-hedging real estate.

According to Investopedia: 'Liability Driven Investment is a form of investing in which the main goal is to gain sufficient assets to meet all liabilities, both current and future'.

Liability Driven Investment is most prominent in the funding schemes of defined benefit (DB) pension plans, which are designed to provide a predetermined pension upon retirement. According to the following quote Liability Driven Investment is not only applicable to Dutch pension funds but also in the US and the UK.

'Liability Driven Investment now has become a buzzword for pension funds, investment banks or investment consultancies in many countries... A survey last year by JP Morgan Asset Management found that half of US retirement plans view the need to hedge against swings in liabilities as a reason to change investment strategies... 'Mercer Investment Consulting estimates that '...one in 10 UK pension funds consider introducing some kind of liability benchmarked strategy...'[Financial Times].

In essence, Liability Driven Investment is an investment framework that seeks to match pension fund assets to the promises made to the pension participants. It tries to bring the investment strategy more in line with the liabilities. Liability Driven Investment has the objective of controlling the funding ratio volatility, while still outperforming the liabilities in the long run. In contrast to the traditional 'asset-only' investment scheme, the pension liabilities take centre stage in the new investment strategy. Liability Driven Investing starts with the liabilities as its benchmark instead of using a peer benchmark (e.g. an IPD index for real estate). As mentioned in section 1.2, one of the new key focal points of pension funds is to define and find investment strategies which have at least similar risk return characteristics as the pension liabilities [see among other sources UBS and ORTEC]. In this way, a pension fund has the liabilities as its risk free investment which is quite a different role from 'just' being an investment manager outperforming a benchmark. The following table gives a short overview of the differences between the traditional asset-only approach and the funding ratio approach [See among other sources: ABP, 2007; ORTEC; UBS; Goldman Sachs, 2006], while figure 2.13 graphically shows the transition of a pension funds' balance sheet as a result of this new approach.

<table>
<thead>
<tr>
<th></th>
<th>Traditional: starts with assets (asset-only)</th>
<th>Funding ratio: starts with liabilities (LDI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>Generate high long-term returns that outperform liabilities over long term</td>
<td>Control funding ratio volatility and outperform liabilities over long term</td>
</tr>
<tr>
<td><strong>Risk measure</strong></td>
<td>Volatility of assets</td>
<td>Volatility of funding ratio (A/L)</td>
</tr>
<tr>
<td><strong>Performance benchmark</strong></td>
<td>Peers</td>
<td>Liabilities</td>
</tr>
<tr>
<td><strong>Low risk investment</strong></td>
<td>Low volatile assets</td>
<td>Liability mimicking assets</td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>Asset-only efficient portfolio</td>
<td>Combination of LHP and ROP</td>
</tr>
</tbody>
</table>
Rather than grouping investments by asset class, Liability Driven Investment groups assets by their risk compared to the liabilities. LDI introduces two portfolios, each having their own function. A distinction is made between assets that fit in a risk optimizing portfolio (ROP) and assets that fit in a liability-hedging portfolio (LHP). A liability-hedging portfolio includes assets which resemble, mimic or track the value changes of the liabilities as good as possible, while a risk optimizing portfolio 'just' tries to generate return. The structure of both portfolios is as follows:

Risk optimizing portfolio (ROP)
- Aimed at generating extra return for indexation or a reduction in premiums
- Are considered as risky investment strategies
- Consists of a lot of different products and strategies

Liability-hedging Portfolio (LHP)
- The basis are the pension liabilities
- Aimed at decreasing interest/ inflation risk
- In theory, are considered risk-free (compared to the liabilities)
- Consists of Liability Driven Solutions (LDS32)

For this research the liability-hedging portfolio is relevant. Liability-hedging investments ought to be a hedge against the value changes of the pension liabilities. The fluctuations of the market value of the pension liabilities will serve as a benchmark against which the performance of the investment strategy is compared. Therefore, the return characteristics of assets should be better aligned with the development of the value of the pension liabilities. As discussed in sections 1.5 and 2.3, the value of pension liabilities is only influenced by changes in the interest rate and the inflation. This is under the assumption of a 'steady-state' pension fund, excluding changes in pension contributions and benefits by changing actuarial assumptions. These two influences are also responsible for the majority of the changes in the liabilities of pension funds. Hence, an investment is a good liability-hedge if its returns move with the rate of inflation and the interest rate. If it is a perfect liability hedge, the investment perfectly tracks the liabilities and is therefore considered to be risk free. In other words, there is no mismatch or tracking error between the performance of the investment and the changes in value of the pension liabilities.

Mismatch risk (MMR), or tracking error, is the volatility of the (excess) mismatch return. Excess return is the return on the assets minus the return on the liabilities. In other words, MMR is measured as the standard deviation of the difference between the return on the assets and the return on the liabilities. The lower the mismatch risk the better the liability-hedge is. In formula:

\[ MMR = \sigma \left[ r_a - r_l \right] \]  \hspace{1cm} (2.3)

Where:
- \( MMR \) = Mismatch risk (tracking error)
- \( \sigma \) = Standard deviation (volatility)
- \( r_a \) = Total return of the assets
- \( r_l \) = Total return of the liabilities33

32 Liability Driven Solutions, such as Inflation-Linked Bonds and inflation- or interest-rate swaps are discussed in the next section.
33 Total return of the liabilities can be seen as the change in value of the liabilities. Chapter four uses a proxy for the return of the liabilities.
A mismatch arises if, for example during period \( t \) the value of the pension liabilities has increased with \( x\% \), while the return on a certain real estate investment has increased with \( 2x\% \) during that same period. According to this principle it also does not matter if an asset has performed \( -y\% \) when the value of the liabilities has decreased with \( y\% \) as well. In this case there is exact co-movement and thus, no mismatch risk occurs.

Liability-hedging and its measure mismatch risk are the most important concepts used in this research. The quantitative model in chapter four uses the measure mismatch risk, along with some other supporting measures.

As mentioned in the last table, the new portfolio will be a weighted combination of a liability-hedging portfolio and a risk optimizing portfolio, depending on amount of risk the pension fund is willing to take. This can be seen in the theoretical figure 2.14, where \( \text{LHP} \) and \( \text{ROP} \) are set in relation to the efficient frontier. In this graph, modern portfolio theory is still used. However, different things are being measured. On the \( x\)-axis mismatch risk instead of asset-only risk is stated. The \( y\)-axis states the (excess) return compared to the liabilities, with a 'risk free rate' using a theoretical liability-hedging portfolio instead of the traditional risk free rate, such as cash or government bonds. In essence, figure 2.14 features three parameters that define the context within which pension fund investors have to operate:

- The liabilities as the relative risk-free portfolio and benchmark, in theory perfectly tracked by \( \text{LHP} \)
- Target return requirement of the pension fund
- Maximum mismatch risk, restricted by the risk budget of the pension fund

The aim of Liability Driven Investment is to improve the risk/return characteristics of the investment portfolio and to stimulate innovative strategies which will move the efficient frontier. Eventually, the (asset-only) efficient frontier will move further to the left, coming close to the theoretically risk free liability-hedging portfolio. The move of the efficient frontier will take place if this research finds and identifies liability-hedging real estate that can be added to the investment portfolio.

Applying this new strategic framework in practice requires a different mindset from investors. Instead of just generating returns, investors now have to start with the liabilities before embarking on a specific investment. The positives of this framework are obvious though. Liability Driven Investment offers a solution for the marked to market valuation and the stricter solvency requirements introduced by nFTK. Furthermore, introducing two different portfolios, each having its own focus is far more flexible then just having one portfolio. With this split up, the social-economical developments from the previous section can now be adressed. The new investment framework increases the ability of pension funds to decrease solidarity between participants and to meet possible future changes in the demands of the participants. For example, if younger people want to take more risk in their investment portfolio, this is possible by investing a bigger share in the \( \text{ROP} \). If they want to decrease the risk of their pension portfolio during their career, a shift can be made more towards the \( \text{LHP} \). Different groups of people could be made, which effectively means that solidarity decreases.

This section has argued that as a result of nFTK, pension fund investors should implement LDI which looks at mismatch risk/ excess return compared to the liabilities instead of traditional stand-alone risk/return. The next section discusses currently available Liability Driven Solutions (LDS) for the liability-hedging portfolio as well as potential new solutions where this research tries to come up with.
2.6 Current Liability Driven Solutions (LDS)

This section discusses currently available Liability Driven Solutions for the liability-hedging portfolio as well as potential new solutions where this research tries to come up with.

Without LDS the duration mismatch between assets and liabilities causes the funding ratio to be very volatile. After applying an liability driven solution, the funding ratio’s volatility is greatly reduced. Access to LDI products and services start to become available. Currently available liability driven solutions available are offered by investments banks and other financial parties. In most cases it involves the use of derivatives, in particular swaps. In general, derivatives can be used to alter the risk profile of a portfolio: they can either reduce risk or increase it, depending on the objective for using them. More specifically, a swap is an over-the-counter product. A swap is a contract between two parties, who agree to exchange returns from different sorts of cash flows\(^34\). The idea behind it is to manage risk. Three different approaches can be differentiated [Financial Times (a, b, c, d); AXA; Investment Week]:

1. **Interest rate protection**

   Long duration fixed income securities (conventional approach):
   
   Increase the duration of assets by investing in long term fixed income securities, such as bonds. Unfortunately, the availability of these long term securities is limited and scarce. In addition, it is argued that nominal bonds are not necessarily a good match for inflation-indexed liabilities, since expected inflation that is priced into nominal bonds may differ from the actual inflation that occurs after the investment date (unexpected inflation).

   **Interest rate swap:**
   
   A pension fund exchanges a fixed rate of interest for a floating rate over a specified period of time. Aside from reducing the fund’s sensitivity to interest rates, one of the key benefits of interest rate swaps is that they can extend the duration of its assets synthetically. The swaps can be used in addition to bond strategies (as an overlay strategy) or as a replacement of the bond strategies.

2. **Inflation protection**

   **Inflation swap:**
   
   A pension fund exchanges a fixed rate of interest for one linked to an inflation measurement (e.g. Dutch Consumer Price Index). Inflation swaps enable a fund to match its liabilities, which are commonly linked to the same index. The swaps can be used in addition to bond strategies (as an overlay strategy) or as a replacement of the bond strategies.

   **Inflation-linked bonds:**
   
   Bonds that pay out a real coupon return\(^35\) and a principal return. As inflation-linked bonds are a liability-hedge in real terms, it makes them much less uncertain than long duration nominal bonds. More on inflation linked bonds in chapter four, as they are used as a proxy for the value changes of the liabilities of pension funds.

3. **Cashflow matching**

   **Portfolio swap:**
   
   A pension fund exchanges the coupons and principal repayments from its existing bond portfolio for a schedule of defined payments that match the pension liabilities precisely.

Investment banks can tailor swaps to the specific needs of a pension fund. The creation of a Goldman Sachs’ tailored derivatives solution for pension fund WH Smith is one of the few examples available in the market. LDS pioneer WH Smith chose to use 94% of its fund’s assets in a safety-first liability driven structure. However, it is easier and more flexible for pension funds to buy units in a range pooled swap funds. Pooled swap funds have easier implementation and do not need such extensive due diligence and management. Like many other Dutch pension funds, the pensionfund Metalektro (PME) is an example of a pension fund that uses swaps and other derivative instruments to manage the interest rate mismatch risk [IPE Real Estate, January/February 2006]. The ultimate choice is pension fund specific, depending on a lot of different variables. This decision falls outside the scope of this research.

Up until now the strategies offered by investments banks and other financial parties all have their own drawbacks. A general drawback is that the market for inflation hedges is not yet as large and liquid. However, it is growing and becoming more liquid. Another drawback is that long term (inflation-linked) bonds only offer

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\(^{34}\) E.g. based on London Inter-Bank Offered Rate plus risk premium (LIBOR + spread). Libor is the rate charged by one bank when it lends money to another bank.

\(^{35}\) The model in chapter four will use Dutch CPI. However, ABP's ambition is to pay out a pension indexed to the Dutch wage inflation.
very low returns, while the use of swaps - a highly liquid market- is very expensive. Some other examples of swaps are:

- Credit default swaps: provides a payment in the event of corporate default.
- Property swaps: exchange a property benchmark return in exchange for an interest rate return.
- Currency swaps: hedge currency risk by exchanging the return on one currency for another.

Another innovative solution is to identify other investments, apart from bonds, that have liability-hedging characteristics. This research tries to find real estate from the asset class alternatives - real estate that can serve as a liability-hedge. Finding them is done by measuring the mismatch between several real estate returns and the marked to market value changes of the liabilities. The research is represented by the following figure. It represents the pension fund balance sheet before and after the implementation of LDI as a result of the introduction of nFTK. It is the same figure as figure 2.13, but now only the relevant parts are colored. When the model in chapter four finds liability-hedging real estate, its allocation could take place by mismatch risk instead of asset class. This research is helpful for - and in line with - the strategy of ABP Investments, which looks for other solutions than the existing ones.

2.7 Summary

Chapter 2 can be conceived as a description of the context and concepts of the research. The chapter has elaborated on the principles and practice of pension funds and developments affecting this. Interest rate, inflation and actuarial changes are mentioned as the three main factors that have an influence on the value of pension liabilities. In addition, asset liability management (ALM)/balance sheet management is explained as well as the funding ratio (F) as the main indicator of pension funds. Social, economical and regulatory developments lead to a reconsideration of the pension investment strategy. nFTK is the most important one, introducing the marking to market valuation and the stricter solvency requirements. It effectively makes the funding ratio more volatile and it only allows a shorter recovery time in case of a funding shortage.

The innovative pension investment strategy explicitly links assets to pension liabilities. Rather than grouping investments traditionally by asset class, Liability Driven Investment (LDI) tries to group assets by the level of 'relative' risk, compared to the pension liabilities. This reshuffle is done with the introduction of a Risk Optimizing Portfolio (ROP) and a Liability-hedging Portfolio (LHP). Both portfolios each have their own focus. Liability-hedging strategies try to track or mimic the value changes of pension liabilities, and thus, minimize the mismatch risk. Up until now the strategies offered by investments banks and other financial parties are long-term (inflation-linked) bonds or synthetic solutions like swaps. All offerings have their own drawbacks. This research tries to find new products within the asset category real estate that can serve as a liability-hedge. The next chapter describes and analyzes the relevant theory of real estate as an investment. The chapter after that will start with the same figure as this chapter has ended with. The figure is the starting point of describing what the research model measures.

Appendix 9 contains an article that explains in what way ABP Investments wants to deal with liability-hedging (JPE).
3 Theory: real estate as an investment

3.1 Introduction

This research tries to find real estate that can serve as a liability-hedge. Finding it is done by measuring the mismatch between several real estate returns and the marked to market value changes of the liabilities. But before this, it is important to have a better understanding of what real estate as an investment exactly entails. Chapter three will give an overview of relevant theory on real estate as an investment. It is important to bear in mind that most real estate theory is written from an asset-only perspective. Section two describes what real estate investing entails. It summarizes the different ways of investing in this asset class and provides other real estate investment basic knowledge. Section three elucidates on the acclaimed characteristics of real estate investments which are relevant for this research. The chapter concludes with a summary.

3.2 Real estate investment basics

3.2.1 Investment constraints

Investing is not a goal itself, but a purpose to reach a certain goal. This goal, however, can be different for each investor. This has an effect on how the preferences of the investor. The following list summarizes the major constraints and concerns that affect most investors, particularly in the real estate market [Geltner and Miller, 2001]:

- Risk
- Liquidity
- Time horizon
- Investor expertise
- Size
- Capital constraint

Real estate investors are not in love with brick-and-mortar itself. Real estate assets consist of claims to future cash flows and seen from that economic perspective, real estate investing is all about the risk/return trade-off. In other words, it is about the total return stream that comes from the lease contracts and the growth in property value in relation to the risk the investor takes. As such, these tangible assets can be compared and compete in the capital market with other forms of capital assets. The total return of a real estate investment is calculated as follows:

\[ TR = IR + CG \]  

(3.1)

Where:

\[ TR = \text{Total return on real estate} \]
\[ IR = \text{Income return on real estate (leases)} \]
\[ CG = \text{Capital growth (appraisals or buying/selling)} \]

A graphical example is given in figure 3.1. It is interesting to see that the income return from leases is much more stable than the capital growth. Leases are actual contracts whereas capital growth is based on market supply and demand and thus much more volatile. Therefore almost all volatility of the total return comes from the capital growth.

![Figure 3.1 Example of stable income return and less stable capital growth](image-url)
3.2.2 Classification of investments

There are several ways to get exposure to real estate, each having its advantages and disadvantages. The difference between public and private funds is that public funds have underlying stocks that are publicly traded at a centralized market exchange, while private funds are bought and sold via direct negotiations between buyers and sellers. Instead of coming to a daily price, the value of private real estate is determined using appraisals. In most cases, appraisals are only done once a year. In short, the trading mechanisms of private and public real estate differ, but the underlying properties are the same. The following table shows the possibilities of real estate investing [Brounen, 2007]:

<table>
<thead>
<tr>
<th>Equity</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private</td>
<td>Mortgaging</td>
</tr>
<tr>
<td>Real estate objects Non-listed real estate</td>
<td>Real estate stocks REITs Securitization MBS</td>
</tr>
<tr>
<td>Public</td>
<td></td>
</tr>
</tbody>
</table>

Another way to classify real estate investments is to see if it is a direct or an indirect investment. When an investor has a majority position in the underlying real estate asset and is in control of the management, it can be labelled as a direct investment [van Gool, Jager en Weisz, 2001]. In all other cases it is an indirect investment. ABP investments does not invest in direct properties anymore. Other Dutch pension funds are also increasing there exposure to indirect real estate. The following table shows the percentages of the total asset allocation of Dutch pension funds to direct and indirect real estate [PropertyNL, October 2006]:

<table>
<thead>
<tr>
<th></th>
<th>direct (%)</th>
<th>indirect (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>5.7</td>
<td>5.4</td>
</tr>
<tr>
<td>2002</td>
<td>5.4</td>
<td>5.3</td>
</tr>
<tr>
<td>2003</td>
<td>4.7</td>
<td>5.4</td>
</tr>
<tr>
<td>2004</td>
<td>4.4</td>
<td>5.7</td>
</tr>
<tr>
<td>2005</td>
<td>3.8</td>
<td>6.2</td>
</tr>
</tbody>
</table>

The following figure graphically shows how indirect investing in real estate works. It is clearly an easier way of getting a more international and diversified exposure to real estate.

---

37 Appendix 10 has a short overview of the appraisal methods used in the real estate market.
38 Appendix 1 contains a detailed overview of ABP's real estate investment strategy.
There is one more way to get exposure to real estate. This exposure is synthetically using property derivatives such as all property swaps or sector swaps. Using derivatives is also a relatively cheap and easy way to manage existing exposures in the direct and indirect markets. It enables the management of market risk by gaining or reducing exposure to property without dealing in the physical asset or through indirect vehicles [DTZ, January 2006]. It saves time and money instead of buying an actual portfolio of real estate to increase a certain exposure. The basic idea of a property swap is already explained in section 2.6.

3.2.3 Real estate investment process
When the process of (indirect) real estate equity investments is evaluated, three things need to be determined to come to the model portfolio at a certain point of time 39:

- Market preference
- Asset preference
- (Manager preference) 40

These three preferences can be determined using quantitative as well as qualitative criteria. The market preference is the outcome of an analysis of potential countries and sectors. The top-down outcome will tell the investor which real estate markets she/he should target when composing the model portfolio. The asset preference is the result of an analysis of potential companies or funds and, if available, their underlying property portfolios. First, well-performing vehicles are selected by using performance benchmarking. After this first filter, a more in-depth analysis begins, looking at the set-up of the vehicle and the quality of the underlying portfolio. Vehicle set-up analysis looks at the legal and fiscal set-up, corporate governance and management fees, and investment style. The whole point of indirect investing is to leave the picking to professionals. Therefore, the manager preference determination is one of the most important factors to consider. The real estate investment process of (indirect) real estate equity investments is shown in the following figure [semi-structured interviews]:

![Real estate investment process diagram](image)

3.2.4 Investment styles
Three management investment styles can be identified. They often form the basis for risk measurement. However, there are no clear-cut definitions of these styles, leaving a lot of margin. The three styles are usually classified according to the use of leverage 41. Leverage can be defined as the funding of investments with borrowed securities, such as external financing or exposure created by the use of derivatives.

- Core: Low leverage
- Core plus/ enhanced return: Intermediate leverage
- Opportunistic: High leverage

39 This model is the outcome of semi-structured interviews with real estate investment staff from ABP and the use of literature [van Aert, 2006]. It should also be clear what the investors' objective and risk budget/ limitations is [van Gool, Jager en Weisz, 2001].

40 Direct investing does not necessarily take into account the manager preference.

41 Appendix 11 contains an overview of the concept leverage.
A core style is characterised by its stable income return and capital growth commensurate with a low level of risk. A small proportion of the total return is generated from appreciation; a large part of the return is derived from stable rents. Corresponding with the low risk profile, typical core investments have a low leverage and target internal rate of return. An opportunistic style focuses on real estate investments with risky long-term prospects. It explores more risky strategies (e.g. distressed sellers or emerging property sectors). The style is mostly based on capital growth instead of current income return. The leverage is usually relative high. Real estate management skills are highly important as those will make the difference. A value added style basically fall in between the previous two investment styles. The three investment styles are shown in the following figure [Inrev]:

![Figure 3.4 Real estate investment styles](image)

### 3.3 A view on real estate as a liability-hedge

Liability-hedging strategies try to track or mimic the value changes of pension liabilities. Under the 'steady-state' assumption, the only two factors that influence the pension liabilities are inflation and the interest rate. Pension liabilities are said to be similar to inflation-linked bonds in nature as they are also only influenced by changes in the interest rate or the inflation. This is mentioned in chapter two and will be discussed in more detail in chapter four. Ultimately, it means that liability-hedging real estate strategies need to be more 'bond-like' being influenced by interest rates and inflation in the same way as these factors influence the liabilities. It also means that other factors that influence the total returns of real estate should be minimized.

Each investment is evaluated by its risk/return trade-off. The evaluation of investments can be identified by the discount rate. A discount rate consists of a few components and is build up as follows:

\[
\text{Discount rate} = \text{risk free rate} (r_f) + \text{risk premium} (r_p)
\]

Where:

- **Risk free rate:**
  - Real yield (compensation for deferred consumption and for default risk)
  - Inflation expectancy

- **Risk premium:**
  - specific risks of investments

Investors require a higher return if they take more risk. If for example a real estate investment has specific risks, such as vacancy or a bad location, an additional premium will come on top of the risk free rate.

In the light of liability-hedging, risk premiums should be avoided as much as possible as they imply additional and unwanted risk. If liability-hedging real estate investments need to be more 'bond-like', its cash flow payment scheme should reflect this. A few differences between real estate payment schemes and fixed income schemes can be demonstrated graphically:
A bond has fixed coupon payments whereas real estate rents have an additional risk of vacancy in it when lease contracts expire. Therefore the 'coupon-payments' of a real estate investment are semi-fixed. The more vacancy risk can be mitigated, the better the rent payments resemble the fixed coupon payments of a bond. Real estate objects that have low vacancy risk have a good liability-hedging feature. Low vacancy risk can be the result of a high object quality or scarcity in the market/ a highly regulated market. The higher the scarcity or the more regulated a real estate market is, the less risk an investor has that the capital growth will be negative. In other words, the investor is more certain that the capital growth actually will be a positive cash flow of high quality, just as the principal payment of a fixed income security.

Another difference is that the principal of bonds is a fixed repayment. The capital growth of real estate is based on supply and demand for real estate. As seen in the previous section, most volatility comes from the capital growth part of real estate returns. It can be argued that the income component behaves like a fixed-income asset, while the capital growth behaves more like equity. Therefore, the less weight the capital growth part has in the total return, the better its liability-hedging characteristics will probably be. The use of leverage shifts the relative importance from the income return towards the capital growth part of the total return. It means that leverage should be minimized for liability-hedging real estate. Core strategies have lower use of leverage.

The higher the interest rates the lower real estate values are as it is more costly to buy real estate (assuming an investor uses debt financing as well). This reasoning is in line with the change of a bonds’ value in case of an increase in the interest rate. The last difference is that real estate is ‘going-concern’, while a bond has a fixed lifetime.

The modified duration formula can be used for all fixed-income securities and pension liabilities. The reason for this is that the size of these cash flows as well as the moment when they take place can be estimated well. However, it is harder to calculate the duration for real estate. Main reasons are that real estate has a less secure cash flow payment (and moment) as it is influenced by more factors than the interest rate alone. What can be said though is that the longer the length of a lease, the higher the duration of that specific real estate object is. Often, the retail sector has longer lease contracts as well as a higher percentage of the total return comes from the income return. Therefore retail will probably show a lower mismatch risk than offices.

Most Dutch pension funds have the ambition to provide an inflation protected pension. Some real estate leases offer a hedge against inflation. In other words, some leases are upward-only (UK) while other leases are connected to an ‘inflation-plus’ link (Australia).
3.4 Summary

This chapter explained some real estate investment basics and as well as a view on real estate as a liability-hedge. The chapter has tried to reason what kind of characteristics a specific real estate investment ought to have to be more interesting from a liability-hedging point of view. The next chapter tries to find suitable liability-hedging real estate assets, using a quantitative approach.
4 Model: liability-hedging real estate

4.1 Introduction

The quantitative model discussed in this chapter tries to find real estate that can serve as a liability-hedge. Finding it is done by measuring the historical mismatch risk between several real estate total return indices and the marked to market value changes of the liabilities. Firstly, section two describes the methodology and the assumptions of the model. Along with mismatch risk, the section will take notice on a few other supporting measures. Section three will expand on the asset- and liability data that are used in the model. Section four explains the model set-up step by step, including the different variables that can be set in accordance to the preferences of a pension fund. Section five discusses the outcomes of the model. It discusses a specific example as well as some more general conclusions. The chapter concludes with a summary.

4.2 Methodology

For this research the liability-hedging portfolio (LHP) is relevant. As discussed before, in a 'steady-state' pension fund the value of the pension liabilities is only influenced by changes in the interest rate and the inflation. An investment is a good liability-hedge if its returns co-move with the rate of inflation and interest. In other words, there is no mismatch between the performance of the investment and the changes in value of the pension liabilities. In that case, a pension fund can then keep its funding ratio steady regulated by nFTK.

As mentioned in chapter two, mismatch risk (MMR), is the volatility of the excess mismatch return. Excess return is the return on the assets minus the return on the liabilities. In other words, MMR is measured as the standard deviation of the difference between the return on the assets and the return on the liabilities. The lower the mismatch risk the better the liability-hedge is. In formula:

\[ MMR = \sigma[r_a - r_L] \]  

(4.1)

Where:

- \( MMR \) = Mismatch risk (tracking error)
- \( \sigma \) = Standard deviation (volatility)

Recall this figure from chapter two. As discussed in chapter two, liability driven investment (LDI) entails allocation to risk factors instead of to asset classes. Now, only the relevant parts of the figure are shown in color instead of grey.

For this research the liability-hedging portfolio (LHP) is relevant. As discussed before, in a 'steady-state' pension fund the value of the pension liabilities is only influenced by changes in the interest rate and the inflation. An investment is a good liability-hedge if its returns co-move with the rate of inflation and interest. In other words, there is no mismatch between the performance of the investment and the changes in value of the pension liabilities. In that case, a pension fund can then keep its funding ratio steady regulated by nFTK.
\[ r_a = \] Total return of the assets
\[ r_l = \] Total return of the liabilities

The model measures mismatch between real estate investments and the marked to market valued pension liabilities. A drawdown of using mismatch risk as a measure is that positive as well as negative deviations are taken into account, while positive deviations can be seen as an opportunity rather than a risk. However as liability-hedging criteria are unclear and still to be set by pension fund managers, all deviations from the mean are here seen as risk.

Other, more supporting, measures are used in the model as well. The idea is that the supporting measures help pension funds to make a better decision, instead of basing decisions on only one number. The other measures are:

- **Average excess return** = average out performance
- **Information ratio** = average excess return / mismatch risk
  It is a risk adjusted ratio that measures the average excess performance per unit mismatch risk. A ratio of \(0.28\) means that the specific index has an average of \(28\%\) out performance per unit mismatch risk taken.
- **Minimum excess return** = minimum value of real estate returns compared to the liabilities (%)  
- **Maximum excess return** = maximum value of real estate returns compared to the liabilities %
- **Probability < 0** = probability that asset returns < changes in the liabilities

The following assumptions were made when the model was constructed:

- The model is build from the point of view of a Dutch pension fund investor. The model uses total returns and corrects for Dutch inflation (CPI).
- Real estate indices are used as a proxy of real estate investment returns.
- Returns on inflation linked bonds are used as a proxy of the value changes of pension liabilities.
- The model only measures historical returns in nominal terms and is not forward-looking.
- The model is based on a steady state pension fund. It does not take into account a changing liability profile due to changed actuarial estimates.
- The model only takes into account parallel yield shifts. Non-parallel shifts like twists (increasing/decreasing steepness of the yield curve) or butterflies (greater or lesser concavity of the yield curve) are not taken into account (ABPC; Investopedia).
- There are no criteria or ‘best practices’ known in the market to judge if a certain asset is suitable to be taken into the liability-hedging portfolio (LHP). A pension fund needs to decide how closely it wants to match the liabilities. For example, a minimum criterion could be the expected excess return on the strategically determined LHP-portfolio divided by the mismatch risk of the strategically determined LHP\(^{42}\).

### 4.3 Data

#### 4.3.1 Introduction

The best way to measure the mismatch on a global scale and across several sectors, is by using indices. Here, the assumption is made that the used real estate indices are representative for the institutional real estate investment market. It is also the most practical solution, as there are no alternatives available. In total 430 indices are collected with historical data that serve as an input for the mismatch model. However, due to data problems only 60\%, or 240 indices, are actually usable. Only those indices are usable which have more than approximately 15 years of data. This is also given by the fact that real estate cycles are around eight to ten years. But more importantly, less data points is not desirable from a statistical point of view.

Most of the 240 indices are real estate indices. The 240 indices also contain a few other asset classes like equities and commodities, represented by respectively the Morgan Stanley Capital International World Index (MSCI World)\(^{43}\) and the Goldman Sachs Commodity Index (GSCI)\(^{44}\). In addition, the IPD UK Forestry index and

---

\(^{42}\) This is under the assumption that the strategically determined LHP still has some mismatch.

\(^{43}\) The MSCI World is a stock market index of world stocks. The index includes a selection of stocks of all the developed markets in the world. The index includes securities from 23 countries' [Wikipedia]. MSCI Global Standard Indices can assist to research the risk return profile of equity markets over time and to make asset allocation decisions and carry out back-testing of various investment strategies and product ideas using the industry standard benchmark’ [MSCIbarra]
the IPD UK let land index are used as an input. Furthermore, some assets which are currently included in the liability-hedging portfolio are measured as well. Those assets are represented by several indices from Lehman Brothers which are treasury and credit indices. In short, the represented other asset classes can range from LHP assets to more ROP-like assets. The reason to include these assets is to compare the mismatch performance of the real estate indices with the mismatch of the other asset classes. It creates a better understanding of the concept mismatch risk and places the real estate mismatch risk performance in perspective.

The pension liabilities and the real estate indices are discussed here in more detail.

4.3.2 Pension liabilities

The fluctuations of the market value of the pension liabilities serve as a benchmark against which the performance of the investment strategy is compared. To fully reflect the more volatile liabilities after nFTK, a portfolio of Inflation-Linked Bonds (ILB's or 'linkers') is used. If interest rates go down or inflation goes up, the pension liabilities increase in value. An ILB has a similar reaction to changes in interest rates and inflation as the pension liabilities with no other factors that influence the real bond. Inflation-linked bonds are designed with only one specific objective in mind, which is to protect investors from inflation. They provide a fixed real return stream, while its nominal return fluctuates with the yield curve. As inflation-linked bonds are a liability-hedge in real terms, it makes them much less uncertain than long duration nominal bonds. It is already mentioned in section 2.6 that the value changes of the pension liabilities can be reconstructed by a portfolio of ILB returns.

The nominal pension liabilities are constructed using real yield series of (price) inflation linked bonds [Bridgewater], and added to this, the Dutch inflation based on the consumer price index (CPI) [DataStream]. In formula:

\[ nrr_t = rrr_t - D \times (ry_t - ry_{t-1}) \] \hspace{1cm} (4.2)

\[ nr_t = rrr_t + \pi_t \] \hspace{1cm} (4.3)

\[ nr_t = rrr_t + \pi_t - D \times (ry_t - ry_{t-1}) \] \hspace{1cm} (4.4)

Where:

\[ rrr_t = \text{Real return in period } t \]

\[ rrr_t = \text{Real yield in period } t, \text{ which comes from the yield curve} \]

\[ D = \text{Duration} \]

\[ \pi_t = \text{Total inflation in period } t \]

For this research it does not make a difference to use either the nominal return or the real return as the behaviour to the yield curve is similar.

This is the payment scheme of one ILB of which the duration decreases in time. The model however uses a portfolio of ILB's with a fixed duration.

---

44 The Goldman Sachs Commodity Index (GSCI) is a world-production weighted index composed of 24 commodity futures contracts. Commodity sector returns, representing an unlevered, long-only investment in commodity futures that is broadly diversified across the spectrum of commodities...The combination of these attributes provides investors with a representative and realistic picture of realizable returns attainable in the commodities markets [ABP; Wikipedia]

45 The Lehman Brothers indices currently used in LHP are the following: Lehman US aggregate, Lehman US aggregate government, Lehman Euro-aggregate Treasury, Lehman US aggregate government/credit and Lehman global aggregate.
A perfect hedged pension asset portfolio consists of one hundred percent index linked bonds. Still, the reason to accept a mismatch risk is because index linked bonds generate a relatively low return. A low fund return means that pension premiums paid by active participants would have to rise to be able to pay out the pension benefits for pensioners. In addition, there are no ILB’s in the market that perfectly match the liabilities of ABP. There is for example a difference in duration and bonds are also not linked to the Dutch wage inflation index.

To fully reflect the pension liabilities, the inflation linked bond portfolio needs the same duration as the actual liability portfolio. Recall, from section 2.4 that the duration is expressed in number of years and determined by the weighted average time until all its cash flows are paid or received. Furthermore, section 2.4 mentioned that the duration of a pension fund portfolio equals the weighted average of its components’ durations. Thus, the replacement of the liabilities of a pension fund by a portfolio of ILB’s with the same duration can be graphically expressed as follows:

The first known inflation-indexed bond was issued by the Massachusetts Bay Company in 1780. The market has grown dramatically since the British government began issuing inflation-linked gilts in 1981. As of 2004 and according to Barclays Capital’s estimates, the asset class comprises over $600 billion of the international debt market. Currently the largest ILB market is the US, issuing Treasury inflation protected securities (TIPS). Besides the US, major issuers of inflation-linked bonds are the UK, France, Sweden, Canada, Australia, Japan and Italy [State Street Global Advisors; wikipedia; PIMCO, 2005]. Still, the Netherlands does not issue such real return bonds.

4.3.3 Real estate indices
This subsection briefly discusses the real estate indices used for the model. The real estate total return data are from listed as well as non-listed real estate markets. As shown in figure 4.4, the 430 indices that are used cover the 25 most mature and transparent real estate countries. The transparency of a real estate market is
based on a yearly study conducted by Jones Lang LaSalle. Most important real estate sectors are covered as well. Most important sectors are offices, retail, residential and industrial. As mentioned before, the assumption is made that the used real estate indices are representative for the institutional real estate investment market. It is also the most practical solution, as there are no alternatives available. Only 240 indices are usable which have more than approximately 15 years of data. Backward-looking standard deviation (mismatch risk) can be affected by the chosen time interval. If the analysis covers a short time interval, it may be a period during which no extreme market conditions occurred. This may lead to an underestimation of mismatch risk.

4.4 Model set-up

The model measures mismatch risk between the liabilities and numerous assets. The liabilities are represented by a portfolio of inflation linked bonds, while the assets are represented by real estate indices from different sources and other asset class' indices. Inflation-linked bonds grow by market interest rates and inflation, while (real estate) assets grow by the given portfolio's market return.

The model is made from the point of view of a Dutch pension fund investor who wants to find and identify liability-hedging real estate indices. The investor invests in international real estate and compares the real estate total returns with the total return of the inflation linked bond portfolio. The Dutch pension fund needs to fulfill its pension obligations to the fund's participants in real terms and in euros. The basic idea of the model is shown in figure 4.5, including the four variables currency hedging, horizon, delagging and duration. The model is explained in more detail in the text thereafter:

Figure 4.4 Regional data coverage of the real estate indices (given in dark blue)

4.4 Model set-up

The model measures mismatch risk between the liabilities and numerous assets. The liabilities are represented by a portfolio of inflation linked bonds, while the assets are represented by real estate indices from different sources and other asset class' indices. Inflation-linked bonds grow by market interest rates and inflation, while (real estate) assets grow by the given portfolio's market return.

The model is made from the point of view of a Dutch pension fund investor who wants to find and identify liability-hedging real estate indices. The investor invests in international real estate and compares the real estate total returns with the total return of the inflation linked bond portfolio. The Dutch pension fund needs to fulfill its pension obligations to the fund's participants in real terms and in euros. The basic idea of the model is shown in figure 4.5, including the four variables currency hedging, horizon, delagging and duration. The model is explained in more detail in the text thereafter:

Figure 4.5 Basic scheme of the research model

44 Appendix 12 contains a short overview of this study. The model in this research uses tier 1 and tier 2 countries. Furthermore Poland and Greece are included in the model as well.
Data is collected and transformed into indices for both the assets and the liabilities, using different sources. Added to the real ILB yield is the Dutch CPI inflation. The ILB index can be adjusted to reflect the liability profile of a specific pension fund. In other words, this model is flexible and not only usable for ABP Investments. This adjustment is done by changing the duration to the value of the liabilities of the specific pension fund. The real estate indices do not only cover the Netherlands. This means that a return of a foreign real estate object is not the return the Dutch pension fund investor ultimately makes. It is the real estate return for the local investor. To calculate the return relevant for the Dutch pension investor, historical spot exchange rates of several currencies (FX) is used. As can be seen in figure 4.6, due to a change in spot exchange rates the same real estate returns can be very different for a local investor than for a Dutch investor. Either this can be positive or negative, depending on the change in the spot rate between the moment of stepping in the real estate investment and stepping out the real estate investment. The return a Dutch investor gets is calculated as follows:

\[
(1 + r_{\text{Unhedged}}) = (1 + r_{\text{Local}}) \times \frac{S_1}{S_0}
\]

Where:

- \(r_{\text{Unhedged}}\) = Return for the Dutch investor, not hedged for currency risk
- \(r_{\text{Local}}\) = Return for the local investor
- \(S_0\) = Spot or current exchange rate of the two currencies in the beginning of investment
- \(S_1\) = Spot or current exchange rate of the two currencies at the moment of exit

**Figure 4.6 Recalculating local real estate returns into returns which can be made by a Dutch pension investor**

The model has the possibility or flexibility to hedge for this currency risk. The Dutch investor can buy forwards to lock in an agreed price at which the investor can sell the specific foreign currency for euros at a certain time. This calculation involves the use of interest rate parity. Parity stands for equality or the ratio of the value of one exchange rate for another. The interest rate parity is the basic identity that relates interest rates and exchange rates. Interest rate parity says that the spot and future prices for currency trades incorporate any interest rate differentials between the two currencies. The return a Dutch investor gets when she/he hedges for currency risk is calculated as follows:

\[
\text{Investing internationally: FX hedging, or not?}
\]

<table>
<thead>
<tr>
<th>Dutch Investor</th>
<th>UK Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td></td>
</tr>
<tr>
<td>€1500</td>
<td>(€/JPY) (€/£)</td>
</tr>
<tr>
<td>1:0.66</td>
<td>€1000</td>
</tr>
<tr>
<td>Return 33.3%</td>
<td>Real estate return 50%</td>
</tr>
<tr>
<td>(for a Dutch investor)</td>
<td>(for a UK investor)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td></td>
</tr>
<tr>
<td>€2000</td>
<td>(€/£) (€/£)</td>
</tr>
<tr>
<td>1:0.75</td>
<td>€1500</td>
</tr>
</tbody>
</table>

Appendix 13 contains a more detailed description of interest rate parity.
(1 + \( r^{\text{Hedged}} \)) = (1 + \( r^{\text{Local}} \)) \times \frac{F_0}{S_0} = (1 + \( r^{\text{Local}} \)) \times \frac{(1 + i^{\text{NL}})}{(1 + i^{\text{Local}})}

Where:

\( r^{\text{Hedged}} \) = Return for the Dutch investor, hedged for currency risk
\( r^{\text{Local}} \) = Return for the local investor
\( S_0 \) = Spot or current exchange rate of the two currencies in the beginning of investment
\( F_0 \) = Forward or future exchange rate of the two currencies delivered and paid on a specific future date.
\( i^{\text{NL}} \) = Risk free rate in the Netherlands
\( i^{\text{Local}} \) = Risk free rate in the specific country

Combining the two options, hedging or not hedging, leads to a third option which is partly hedge for currency risk. This is done by combining both options, giving certain weights to both options. For example, 37% currency hedging and thus 100% - 37% = 63% not hedging for currency risk.

After the Dutch pension investor has decided how much he wants to hedge she/he has to decide what the evaluation period will be. In other words, how much time do the real estate data have to track the ILB index. The evaluation period or horizon is a setting in the model as well and can be adjusted to the investors’ preference. The horizon is based on a moving average. The moving average for a time period is the arithmetic mean of the values in that time period and those close to it. To compute the three-year moving average for any time period, the time series values in that year and the previous two years must be averaged.

The last setting in the model is the delagging of appraisal based real estate data. As real estate does not have a real market to trade with daily pricing, new information relevant for the property’s (change in) value is taken approximately a year later into account. Delagging sets the real estate data back in time. For example, a real estate return that occurred in 2007 is now delagged 1 year and set back to 2006, comparing the real estate return from 2007 with the return on the inflation linked bond of 2006. If all settings are adjusted to the preferences of the Dutch pension investor, the mismatch measurement can finally take place.

### 4.5 Results

#### 4.5.1 Example result

The example results come from the yearly data and are based on ABP Investment settings, which are:

- Duration liabilities: 17 years
- Horizon / evaluation period: 3 years, annualized
- Delagging: 1 year
- Currency hedging: 100%

The real returns are lagged by one year to reflect that property appraisals tend to lag the market with a one year delay. With the evaluation period of three years, ABP Investments is able to track the marked to market value of the pension liabilities while it is still acceptable as a practical evaluation period.

An example of a good mismatch performer is given. Two different UK shopping centre indices appear to be a good hedge against the value changes of the liabilities. Figure 4.7 shows the total returns of the ILB index/ the pension liabilities as well as the total returns of two UK shopping centre indices separately. The total returns of both the shopping centre indices show considerable co-movement with the liabilities. This implies a limited volatility of the difference in the returns and thus a low mismatch risk. The limited volatility is apparent in figure 4.8. The figure shows the excess return of the two indices compared to the pension liabilities. Mismatch

---

49 Appendix 1.4 contains an example of the calculation of the horizon using moving average
50 No corrections were made for overlapping data.
51 Appendix 1.5 contains much more example figures of different indices and their mismatch risk performance.
risks are indicated. A mismatch risk of 4.3% means that in each year there will be 68% probability\textsuperscript{12} that the real estate index will miss the pension liabilities returns by $+ \text{ or } -4.3\%$.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure4.7}
\caption{Total returns hedged UK shopping centres and liabilities}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure4.8}
\caption{Excess total return hedged UK shopping centres minus liabilities}
\end{figure}

4.5.2 Overview and main results
Real estate has potential as a liability-hedge. The model outcome shows that a lot of specific real estate indices can be labelled liability-hedge. The sector retail however, has the best potential to function as a liability-hedge. In general, the following main conclusion can be made regarding the mismatch risk and thus the liability-hedging characteristics:

\begin{center}
\begin{tabular}{c}
\textbf{RETAIL} < \textbf{RESIDENTIAL} < \textbf{INDUSTRIAL} < \textbf{OFFICE}
\end{tabular}
\end{center}

This conclusion is based on several useful indices from different countries where a mature real estate market exists. The difference in standard deviation between real estate sectors was already known in an asset-only framework. This result however is relative risk, or the risk of an investment compared to the pension liabilities of Dutch pension funds. The conclusion even holds stand after adjusting the model settings such as the duration profile of the liabilities and hedging for currency risk.

\textsuperscript{12} This is under the assumption of having normal distributions.
However adjusting the variables naturally does have its effect on mismatch risk. Furthermore, as for a few examples both smoothed versus unsmoothed data were used as well as leveraged property returns versus non leveraged returns, the affect of these aspects on mismatch risk is taken into account as well. The following table provides a short overview of the effect on mismatch risk:

<table>
<thead>
<tr>
<th>Effect on MMR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hegging for currency risk</td>
<td>slightly lower</td>
</tr>
<tr>
<td>Delagging real estate data</td>
<td>lower</td>
</tr>
<tr>
<td>Decreasing duration liability profile</td>
<td>slightly lower</td>
</tr>
<tr>
<td>Using shorter horizon/ evaluation period</td>
<td>higher</td>
</tr>
<tr>
<td>Using leverage (around 35%)</td>
<td>slightly higher</td>
</tr>
<tr>
<td>unsmoothing (confidence factor 0.5)</td>
<td>slightly higher</td>
</tr>
</tbody>
</table>

The next table is based on duration of the pension liabilities of 17 years; while model's other variables are adjusted. Liability-hedging candidates can be identified, as well as poor performers. The following table shows some examples:

<table>
<thead>
<tr>
<th>Index</th>
<th>Country</th>
<th>Sector/ region</th>
<th>MMR (%)</th>
<th>MMR (%)</th>
<th>MMR (%)</th>
<th>MMR (%)</th>
<th>MMR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Retail</td>
<td>4.0</td>
<td>6.6</td>
<td>5.8</td>
<td>8.8</td>
<td>12.8</td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Supermarkets</td>
<td>4.1</td>
<td>5.6</td>
<td>3.9</td>
<td>9.2</td>
<td>12.5</td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Shopping Centres 25,000 - 50,000 sqm</td>
<td>4.3</td>
<td>7.2</td>
<td>5.3</td>
<td>8.7</td>
<td>13.5</td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Shopping Centres &gt; 50,000 sqm</td>
<td>4.1</td>
<td>8.6</td>
<td>5.9</td>
<td>8.9</td>
<td>13.3</td>
</tr>
<tr>
<td>PCA</td>
<td>Australia</td>
<td>Retail</td>
<td>4.1</td>
<td>4.9</td>
<td>4.6</td>
<td>9.4</td>
<td>14.4</td>
</tr>
<tr>
<td>NCREIF</td>
<td>USA</td>
<td>Appartments</td>
<td>4.1</td>
<td>12.4</td>
<td>4.6</td>
<td>8.3</td>
<td>16.8</td>
</tr>
<tr>
<td>IPD</td>
<td>FR</td>
<td>Office</td>
<td>11.4</td>
<td>11.7</td>
<td>11.3</td>
<td>14.0</td>
<td>13.9</td>
</tr>
<tr>
<td>IPD</td>
<td>IR</td>
<td>Office</td>
<td>11.6</td>
<td>12.5</td>
<td>12.9</td>
<td>15.5</td>
<td>15.8</td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Mid Town/ West End Offices 0 - 1,000sqm</td>
<td>11.5</td>
<td>13.9</td>
<td>12.5</td>
<td>16.0</td>
<td>20.3</td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Rest of South Eastern Offices 1995 - 2004</td>
<td>12.1</td>
<td>15.6</td>
<td>11.0</td>
<td>16.7</td>
<td>32.1</td>
</tr>
<tr>
<td>Case</td>
<td>USA</td>
<td>NYC Brooklyn multifamily</td>
<td>14.6</td>
<td>15.3</td>
<td>14.5</td>
<td>18.9</td>
<td>24.6</td>
</tr>
<tr>
<td>ROZ/IPD</td>
<td>NL</td>
<td>Residential</td>
<td>5.8</td>
<td>5.9</td>
<td>11.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROZ/IPD</td>
<td>NL</td>
<td>Residential Unsmoothed .5</td>
<td>6.1</td>
<td>6.2</td>
<td>12.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROZ/IPD</td>
<td>NL</td>
<td>Retail</td>
<td>5.4</td>
<td>5.8</td>
<td>10.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROZ/IPD</td>
<td>NL</td>
<td>Retail Unsmoothed .5</td>
<td>5.4</td>
<td>6.0</td>
<td>10.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSCI</td>
<td>World</td>
<td>Equity shares</td>
<td>15.2</td>
<td>15.2</td>
<td>21.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GSCI</td>
<td>World</td>
<td>Commodities</td>
<td>11.5</td>
<td>11.5</td>
<td>25.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LHVGCRP(IN)+10</td>
<td>US</td>
<td>Lehman Aggregate Gov/ Credit</td>
<td>11.3</td>
<td>11.3</td>
<td>16.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Let land</td>
<td>9.2</td>
<td>10.2</td>
<td>8.1</td>
<td>12.8</td>
<td>14.6</td>
</tr>
</tbody>
</table>

The table shows that the performance is in line with the main conclusion. Amongst the best performers are mainly retail indices with in almost all cases lower mismatch risk. Overall, the worst performers are mainly offices.

Furthermore it is interesting to conclude that the Lehman US aggregate government/ corporate bonds performs in an FX unhedged setting similar as the FX unhedged IPD France office index, which is not one of the best liability-hedging candidates. Compare this to an asset-only framework where bonds are said to be low risk.
5 Conclusion

5.1 Introduction

Chapter five states and discusses the main results of this research on liability-hedging real estate. In addition, an evaluation of the study takes place to see if the original research question along with the relevant sub questions is answered. Recommendations for further research are given as well.

5.2 Main results

This section discusses the main results of the research.

Liability-hedging is best measured by using the mismatch risk. Mismatch risk is calculated by:

\[ MMR = \sigma [r_a - r_l] \]

Where:

- \( MMR \) = Mismatch risk (tracking error)
- \( \sigma \) = Standard deviation (volatility)
- \( r_a \) = Total return of the assets
- \( r_l \) = Total return of the liabilities

Real estate has potential as a liability-hedge. The model outcome has shown that a lot of specific real estate indices can be labelled liability-hedge. The sector retail however, has the best potential to function as a liability-hedge. In general, the following main conclusion can be made regarding the mismatch risk and thus the liability-hedging characteristics:

\[
\text{RETAIL < RESIDENTIAL < INDUSTRIAL < OFFICE}
\]

This conclusion is based on several useful indices from different countries where a mature real estate market exists. The difference in standard deviation between real estate sectors was already known in an asset-only framework. This result however is relative risk, or the risk of an investment compared to the pension liabilities of Dutch pension funds. The conclusion even holds stand after adjusting the model settings such as the duration profile of the liabilities and hedging for currency risk.

However adjusting the variables naturally does have its effect on mismatch risk. Furthermore, as for a few examples both smoothed versus unsmoothed data were used as well as leveraged property returns versus non leveraged returns, the affect of these aspects on mismatch risk is taken into account as well. The following table provides a short overview of the effect on mismatch risk:
Based on the 'ABP Investment settings' of the model variables, some liability-hedging candidates are identified, as well as some poor performers. The following table shows some examples:

<table>
<thead>
<tr>
<th>Index</th>
<th>Country</th>
<th>Sector/ region</th>
<th>MMR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Retail</td>
<td>4.0</td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Supermarkets</td>
<td>4.1</td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Shopping Centres 25,000 - 50,000 sqm</td>
<td>4.3</td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Shopping Centres &gt; 50,000 sqm</td>
<td>4.1</td>
</tr>
<tr>
<td>PCA</td>
<td>Australia</td>
<td>Retail</td>
<td>4.1</td>
</tr>
<tr>
<td>NCREIF</td>
<td>USA</td>
<td>Apartments</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>FR</td>
<td>Office</td>
<td>11.4</td>
</tr>
<tr>
<td>IPD</td>
<td>IR</td>
<td>Office</td>
<td>11.6</td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Mid Town/ West End Offices 0 - 1,000sqm</td>
<td>11.5</td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Rest of South Eastern Offices 1995 - 2004</td>
<td>12.1</td>
</tr>
<tr>
<td>Case</td>
<td>USA</td>
<td>NYC Brooklyn multifamily</td>
<td>14.6</td>
</tr>
<tr>
<td>ROZ/IPD</td>
<td>NL</td>
<td>Residential</td>
<td>5.8</td>
</tr>
<tr>
<td>ROZ/IPD</td>
<td>NL</td>
<td>Residential Unsmoothed .5</td>
<td>6.1</td>
</tr>
<tr>
<td>ROZ/IPD</td>
<td>NL</td>
<td>Retail</td>
<td>5.4</td>
</tr>
<tr>
<td>ROZ/IPD</td>
<td>NL</td>
<td>Retail Unsmoothed .5</td>
<td>5.4</td>
</tr>
<tr>
<td>MSCI</td>
<td>World</td>
<td>Equity shares</td>
<td>15.2</td>
</tr>
<tr>
<td>GSCI</td>
<td>World</td>
<td>Commodities</td>
<td>11.5</td>
</tr>
<tr>
<td>LHGVCRP(IN)+100</td>
<td>US</td>
<td>Lehman Aggregate Gov/ Credit</td>
<td>11.3</td>
</tr>
<tr>
<td>IPD</td>
<td>UK</td>
<td>Let land</td>
<td>9.2</td>
</tr>
</tbody>
</table>

The table shows that the performance is in line with the main conclusion. Amongst the best performers are mainly retail indices, while the worst performers are mainly offices.

Furthermore it is interesting to conclude that the Lehman US aggregate government bonds/ corporate bonds performs in an FX unhedged setting similar as the FX unhedged IPD France office index, which is not one of the best liability-hedging candidates. Compare this to an asset-only framework where bonds are said to be low risk.

### 5.3 Evaluation of the research

Section three evaluates the research to see if the original research question is answered, along with the relevant sub questions.

Recall the original research question from chapter one:

---

53 Model settings are: Duration 17, Appraisal based real estate data delagged 1 year, Real estate data 100% hedged for currency risk, evaluation period of 3 years annualized.
Which real estate investments are a candidate for Dutch pension funds to offer a hedge against the changes in value of corresponding liabilities?

To give a solid well-founded answer to this research question, it was subdivided into several sub questions. The sub questions are stated below:

1. What is a liability-hedge?
2. How should a liability-hedge be measured?
3. Which real estate investments are a liability-hedging candidate?

The research has given answers to all the subquestions as well as to the main research question. This is done by analysing the concept liability driven investment (LDI) and by explaining that the best way to measure liability-hedging qualities is to use mismatch risk. Furthermore, the model has incorporated the outcome of a theoretical analysis and semi-structured interviews with research-, financial- and property professionals.

The research question was formulated into an objective, which was the following:

Find and identify liability-hedging real estate candidates for Dutch pension funds by analysing the changes in value of pension liabilities and the returns of real estate indices and measuring the mismatch between them. The deliverable is a useful support model for strategic management decisions.

By having answered the main research question the objective is also fulfilled. The research model can calculate mismatch risk (and other measures as well) for over 400 indices. All these calculations are possible while the investor still has the flexibility to adjust the variables to her/ his preferences. With this model, an investor has a good way to get insight into the liability-hedging qualities of real estate. For example, by adjusting the settings, one can see the effects on the mismatch risk of the real estate indices. Furthermore, the model increases insight as it uses some other asset classes as well. In this way, the mismatch performance of the real estate indices is related to the mismatch performance of the other asset classes.

Other uses of the model are possible as well. The calculation model is an instrument which can be used to measure the mismatch risk of numerous indices of other asset classes as well. A first step was already been taken by measuring MSCI, GSCI and a few other indices.

The model also allows other investors to use it, such as insurance companies or foreign pension funds. As insurance companies do not have to pay out inflation linked claims, the liabilities do not have to be linked to inflation, but can be replaced by the insurers’ own relevant benchmark. Foreign pension funds can also use this model to find real estate that is a hedge for their liabilities. In that case the liabilities have to be replaced by the representative liabilities of the foreign fund. This includes the rate of inflation of the specific country.

In short, the model is flexible, updatable and allows other users and uses as well. Furthermore, the model provides a new way of measuring real estate risk based on an innovative concept.

The theoretical relevance of the research is that it has created new knowledge on real estate investments. This research is the first in its kind to discuss and find liability-hedging real estate using a quantitative model for measuring mismatch risk of over 400 indices. The model has practical relevance as well. It provides a starting point across 25 countries and main real estate sectors to further search within the identified indices for liability-hedging real estate. Practical uses of the model are:

- Support decisions on potential investments

Appendix 16 contains an example of a semi-structured interview.
• Further negotiate on an identified liability-hedging candidate
• Define new real estate investment strategies
• Formulate a new investment mandate
• Find liability-hedges within other asset classes

The research model has proved its value. It has already been used in practice to support the real estate department and the innovation committee from ABP Investments in its decision to label a specific real estate investment of €400 million as an innovative strategy. ABP Investments decided to invest €180 million in the real estate objects, adding it as one of the first innovative liability-hedging products into ABP’s liability-hedging portfolio.

The final goal of liability-driven investment is to improve the well-known efficient frontier, ultimately generating a better risk/return reward and thus better pensions for the participants of the pension fund. However, to really be able to do this, more research is inevitable and necessary.

5.4 Recommendations for further research

This research has created new knowledge on real estate investment. The quantitative model measured mismatch risk for over 400 indices and is typically backward-looking and top-down driven. The model is just one of the many approaches to decide on the liability-hedging capacities of real estate. It provides a starting point for further research:

• A qualitative, bottom-up approach can be used to identify liability-hedges. This can be done by, for example, using a checklist which combines all relevant characteristics that make a real estate object a liability-hedge. This can be a tricky subject however, as it involves many different aspects. It is probably best to divide it into separate researches.
• As a result of the research option above, try to find solutions within the category real estate to further tailor-made investments, serving its purpose as a liability-hedge. An example would be to strip out the inflation component from the returns on a real estate investment to use as a partial liability-hedge.
• Use forward-looking research which takes into account the behaviour of the mismatch risk in different economic regimes. In other words, how does a certain economic regime influence the mismatch risk performance of a real estate index?
• Look at mismatch risk in a portfolio context aiming at finding the optimal weightings of the liability-hedging portfolio (LHP) and the risk optimizing portfolio (ROP). This can be done by combining different asset classes and, for example, using the ‘solver’ function in Excel to find the most efficient portfolios in terms of mismatch risk and excess return.
• As discussed earlier this chapter, research the mismatch risk of real estate or other asset classes for foreign pension funds or insurance companies. This can be done relatively easy by replacing the liabilities for a benchmark which is relevant to the specific fund or insurer.
• Further compare and contrast real estate as a liability-hedge to other Liability Driven Solutions (LDS).

55 Some examples of (probably) relevant characteristics are the influence of leverage, the length of leases, lease contracts which are linked to inflation or another index, high quality stable cash flows, scarcity or highly regulated real estate markets, other specific real estate risks
56 According to Wim Barendsen from ABP Investments, four main regimes can be identified as they appeared in different decades. The four regimes consist of combining low/high global growth and low/high inflationary pressure.
Appendices
Appendix 1: Profile ABP, ABP Investments and ABP Real Estate

ABP Investments is the internal fund manager of ABP pension fund, which stands for ‘Algemeen Burgerlijk Pensioenfonds’. It is a pension fund for the civil servants (government and educational sector)\(^{57}\). With €201.1 billion of invested assets and €155.6 billion of pension liabilities\(^{58}\), ABP is the largest pension fund in Europe [IPE Real Estate, March/April 2007]. The following table shows the top five pension funds in the world by assets under management as of September 2006 [Pension and Investments, 2006].

<table>
<thead>
<tr>
<th>Name</th>
<th>Country</th>
<th>Assets ($billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Pension Investment</td>
<td>Japan</td>
<td>871</td>
</tr>
<tr>
<td>Government Pension</td>
<td>Norway</td>
<td>236</td>
</tr>
<tr>
<td>ABP</td>
<td>Netherlands</td>
<td>227</td>
</tr>
<tr>
<td>National Pension</td>
<td>Korea</td>
<td>214</td>
</tr>
<tr>
<td>California Public Employees</td>
<td>USA</td>
<td>196</td>
</tr>
</tbody>
</table>

It is ABP’s objective to be in a position to guarantee for its fund participants an adequate pension at all times at the lowest possible premiums. ABP Investments aims to meet these objectives through achievement of the highest possible return on invested capital, while taking well-considered risks [ABP]. In order to remain in a position to offer good pensions at affordable premiums, ABP aims at an average nominal return on investment of 7%\(^{59}\). As can be seen in the following graph, during the years 1993-2005 the ABP portfolio generated an average return of 8.4%. Over the same period, the portfolio return has also outpaced 4% plus the wage inflation in the Dutch government and educational sector, which was the relevant objective when the pension liabilities were valued using a fixed 4% discount rate\(^{60}\). The pursuit of the required return entails risks. By means of a wide spread of the investments and an alert investment policy ABP seeks to restrict these risks as much as possible.

![Cumulative return (1993=100)](image_url)

For the purpose of achieving the highest possible return at low costs and acceptable risks, ABP Investments invests on its own as much as possible. This enables ABP to control the risks and respond faster to

---

\(^{57}\) ABP serves over 4200 employers and 2.6 million participants of which 1.1 active participants and 1.5 inactive participants [ABP, 2005].

\(^{58}\) As of October 2006.

\(^{59}\) This 7% is based on 4% plus a long term wage inflation of 3%. From now on, the return target is set more in accordance to the ‘fair valuation’ of the liabilities. The return target is set in relation to the liabilities, i.e. to match the return of a long duration (17-year) index-linked bond plus 2.5% excess return.

\(^{60}\) This will be discussed in more detail in chapter 2.
developments in the market. The unit’s own specialists manage about 80% of the ABP capital. Only in cases in which third parties are demonstrably in a position to offer added value in terms of costs and expertise is it an option to call in their services.

Given that ABP is a pension fund, the investment managers of ABP can operate with a longer time horizon than commercial asset managers. This means working with a time horizon of 1 to 2 years instead of the usual 3 to 6 months. This offers potential opportunities to achieve extra return.

ABP Investments has offices in Amsterdam, Heerlen, New York and Hong Kong. In all, ABP Investments has a workforce of some 400 persons, of whom 160 work at the Amsterdam office, 160 at the Head Office in Heerlen, 80 in New York and 6 just started in Hong Kong. ABP as a whole employs a workforce of about 2500 persons.

The following figure shows the organisational chart of ABP Investments including its main platforms [ABP]. The platforms will be discussed in more detail (excluding fulfilment):

**Figure a.2 Organisational Chart ABP Investments**

**Allocation and research**

The following main tasks are carried out by Allocation & Research:

- Asset Liability Management (ALM): bringing the investment strategy in line with the pattern of future pension payment liabilities
- Beta management: managing the strategic investment mix
- Allocation: allocating investment resources to the various investment categories
- Strategic and fundamental research

The allocation platform gives advice with respect to the central allocation of the total assets of ABP across the various asset categories, and adjusts the allocation flows by means of the Overlay Fund. The planning of the investment process is divided into three stages. In the first place, every three years a Strategic Investment Plan is drawn up. Secondly, an Annual Investment Plan is defined which is the basis for the investment activities in the current year. Thirdly, the Allocation Committee decides from month to month on the distribution of the pension fund's assets across the various investment categories. The monthly allocation cycle also provides a basis for adjustment of the interest rate sensitivity of the ABP portfolio and the exchange rate risks involved. In short, the platform formulates and implements these plans.

The allocation decisions are in essence based on the views of ABP Investments concerning the medium- and long-term economic development. This essential assessment is generated every three months by Global Markets Research, by its views on the economic developments in a Market Outlook.

The views developed by Global Markets Research are translated into an investment policy by Portfolio Construction and Overlay Management (PCOM). PCOM coordinates the production of the Strategic Investment Plan and the Annual Investment Plan and prepares the basis for the Allocation Committees decision making.

PCOM also carries out the decisions made by the Allocation Committee. This can be done by allocating resources to the various investment categories (cash allocations) or by adjusting the allocation by means of the Overlay Fund. Against this background PCOM also implements so-called overlay strategies, such as hedging of the exchange rate risk or managing other risks, including the mismatch risk.

In order to be able to realise the highest possible return while taking calculable risks, the asset managers of ABP Investments need the right kind of information, a clear strategy, and effective tactics. Research covers those aspects.

Research initiates, creates, innovates and assesses active strategies for ABP Investments. Within this scope of activity the unit maps out new active investment strategies and makes contributions to research which puts ABP Investments in a position to outperform the market. Moreover, it calculates the effect of such investment strategies on risk and return. The research projects undertaken are aimed at perfecting the investment process.

The economists and econometrists working in the Research unit make calculation modules, perform strategic analyses and work out quantitative models. They provide the Board as well as the fund managers with advice in connection with the investment decisions to be made and they are co-responsible for the three-yearly strategic investment plan and the annual investment plans.

A key activity is the development of quantitative investment models, which are used by the various departments for the purpose of calculating the effects of decisions.

The researchers look for innovating investment categories which may hold out attractive prospects, for instance because they could offer a more favourable risk/return profile. The specialists of Research work on the development and elaboration of Asset Liability Management instruments and models which can be used for quantification of the impact of various strategies.

**Equity**

The activities of the equity platform have been clustered within international funds, divided over several worldwide strategy sectors:

- **Sector Allocation**
  Sector allocation is concerned with the purchasing of shares of all companies active in a selected sector, for instance pharmaceuticals, energy, or consumer goods. In sectors from which an extra value addition is expected, relatively larger amounts of resources are invested and vice versa.

- **Fundamental equity selection**
  On the basis of certain selected properties, the best shares are chosen in specific sectors and these are held on to for a longer period of time.

- **Quantitative equity selection**
  Within this sector, ABP Investments' own models are used for the purpose of detecting relatively minor inefficiencies in the market. Furthermore, these models are used in order to beat the benchmarks. In addition, the equity platform relies on the expertise of external specialists within areas where local insight is required, such as emerging markets and small caps.

Putting into practice several strategies at the same time, which represents the so-called multi-alpha strategy, is seen by ABP Investments as a tool to achieve the highest possible return, while at the same time it enables

---

61 As can be seen in the organizational chart, various asset categories are carried out by three platforms: Equity, Fixed Income and Alternative Investments. An overlay fund is a cost-efficient way of dealing with small adjustments that need to be made to the different asset categories. This is mostly done by gaining exposure to a specific market using derivatives, instead of actually buying the asset.
optimum risk control to be achieved. In addition, the strategy is based on a worldwide rather than a regional approach to the equity markets.

Fixed income
Fixed income constitutes a stable factor within ABP Investments' portfolio. This category of investments generates a fairly predictable return from year to year and the market value shows less fluctuation than in the case of for instance shares. An additional advantage is that fixed income often performs well during periods when the return on shares is low. The share of fixed income in the portfolio is around 40%.

Government loans are an important subcategory within fixed income. In this subcategory the investor runs little risk, but on the other hand he has to put up with a lower return in the form of interest payments. Because of that certainty, government loans are an important component of the investments in fixed income within ABP Investments' portfolio.

Nevertheless, the emphasis of the fixed income platform is not on government loans, but in particular on mortgage loans, structured investments, and corporate loans to companies of various rates of credit standing. The reason why ABP Investments' focus is on these particular categories is that their return in the medium term is higher compared to government loans, while the risk involved can yet be restricted due to good portfolio management.

Alternative investments
The scope of the alternative investments platform comprises real estate, private equity, commodities, hedge funds, and specific active mandates.

Alternative investments are interesting for a pension fund because the return in this category has little correlation with the results from the more traditional categories of investment such as shares and fixed income. In addition they usually offer better protection against inflation.

Alternative investments are often made in non-liquid and less transparent markets. Also, in comparison with the standard investments, alternative investments are more complex products in many cases. This manner of investment fits-in very well with ABP Investments' policy of spreading risks. Moreover, ABP Investments has available in-house expertise that is needed for assessment and selection of complex investment products. A characteristic feature of the alternative investments platform is that it is always looking for small niches in the market, for instance new methods or strategies with which extra return can be obtained.

The asset mix of ABP roughly looks like this [ABP/FSA, March 2007]:

<table>
<thead>
<tr>
<th>ABP assetmix</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>43</td>
</tr>
<tr>
<td>Eurozone (excl. NL)</td>
<td>26</td>
</tr>
<tr>
<td>Netherlands</td>
<td>13</td>
</tr>
<tr>
<td>Europe other</td>
<td>7</td>
</tr>
<tr>
<td>Other developed markets</td>
<td>7</td>
</tr>
<tr>
<td>Emerging markets</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ABP assetmix</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity</td>
<td>39</td>
</tr>
<tr>
<td>Fixed income</td>
<td>41</td>
</tr>
<tr>
<td>Alternatives</td>
<td>20</td>
</tr>
</tbody>
</table>

ABP Real Estate
The role of real estate in the total portfolio is to diversify risk and enhance returns [See among other sources Vastgoedmarkt, October 2006; Vastgoedmarkt, December 2006 and IPE Real Estate, 2007]. In the long run it may have some important liability-hedging characteristics.

The pension fund allocates around 10% to real estate, which is around €24 billion. As scale is not a problem, all management is done in-house by a global staff of 30 employees. In-house management also creates synergies as the real estate department invests in both listed (65%) and non-listed real estate (35%). However, the idea is to rebalance it to 50-50.

ABP is currently diversified across more than 250 listed and 70 non-listed funds. The listed category is more of a tactical play, while the unlisted investments take a more strategic role. The unlisted portfolio contains stakes in plain vanilla funds as well as customised joint ventures and co-investments. The strategic role for non-listed investments is also due to the relative lack of liquidity. However, ABP is a long term investor and does not see illiquidity as an issue. Their view is that in the very long run mature markets offer as risk/return trade-off which is the same for listed as for unlisted real estate. Therefore, the main priority is to invest in the right opportunities.
Since 1996, all investments are indirect as ABP believes this is the only way to be a true diversified and global investor. ABP tries to select the best-in-class asset managers around the globe and direct investments, which need day-to-day property management, would only distract ABP’s attention.

ABP Real Estate is very much in favour of setting up joint ventures with investment managers that have a specific skill set and local presence. It effectively means that the fund is customized. ABP selects a strong manager together with a small number of like-minded investors. Through joint ventures ABP is able to optimize governance and closely align their interest with those of the asset manager. Other advantages are a more focussed strategy on a desired sector and region, an easy and cost efficient way to deploy large amounts of capital at once, accessibility to market information and a better understanding of property portfolio behaviour and performance drivers. Las but not least, through joint ventures ABP Real Estate can act more quickly. On average, ABP Real Estate has participations in property joint ventures of €100 to 150 million.

ABP’s real estate portfolio can be divided by region:

Diversification by region:

- Europe 50%
- USA 40%
- Asia Pacific 10%

There are big differences in the various regions regarding transparency, maturity and thus in predictability and volatility. In addition, each region follows a different pattern on the property cycle and the correlations between regions differ as well. This is all due to (local) regulations, developments and other property issues. Asia is more heterogeneous than Europe, which makes the region very interesting from a diversification point of view. ABP Real Estate recently opened an office in Hong Kong to be closer to the markets and to better fulfil the objective of increasing exposure to Asia. It will bring ABP closer to key relationships which are important, especially as Asian markets still lack transparency.

The real estate portfolio can also be diversified by risk category:

- Core 75%
- Value-added 15%
- Opportunistic 10%

ABP Real Estate will increase to add to the risk categories value-added and opportunistic to capitalise as much on market recoveries and emerging property markets, like Russia, India, Vietnam and China. From a macro point of view these markets are all interesting. However, the availability of vehicles which have a good track record and alignment of interest is limited.

The real estate portfolio can also be divided by sector:

- Offices 32%
- Retail 28%
- Residential 19%
- Industrial 6%
- Other 4% (prisons, hotels, parking garages, etc)

ABP is increasing investments in niche categories, like hotels and senior housing. Both niches are more directly correlated to GDP outlook. Driven by macro economic trends, these niche categories will become more important and the investable universe in those assets will increase.

Especially in the more risky categories (value-added and opportunistic) and in the niche sectors, the selection of the right manager is the key performance generator. Alignments of interests are of great importance as it is the fund manager who should unlock the property value. In short, it will be the underlying real estate together with the manager that has to perform.

62 Like-minded on strategy and corporate governance issues.
Appendix 2: Overview pension assets across countries

<table>
<thead>
<tr>
<th>Country</th>
<th>1996 (US$ billion)</th>
<th>2006e (US$ billion)</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>2007.0</td>
<td>6774.2</td>
<td>2010.7</td>
</tr>
<tr>
<td>Japan</td>
<td>300.4</td>
<td>2338.4</td>
<td>2038.0</td>
</tr>
<tr>
<td>UK</td>
<td>960.0</td>
<td>1036.8</td>
<td>76.8</td>
</tr>
<tr>
<td>Canada</td>
<td>420.0</td>
<td>873.0</td>
<td>453.0</td>
</tr>
<tr>
<td>Netherlands</td>
<td>349.0</td>
<td>743.4</td>
<td>394.4</td>
</tr>
<tr>
<td>Australia</td>
<td>192.0</td>
<td>565.3</td>
<td>373.3</td>
</tr>
<tr>
<td>Switzerland</td>
<td>201.0</td>
<td>311.7</td>
<td>110.7</td>
</tr>
<tr>
<td>Germany</td>
<td>157.9</td>
<td>68.0</td>
<td>-89.9</td>
</tr>
<tr>
<td>France</td>
<td>111.0</td>
<td>33.0</td>
<td>-78.0</td>
</tr>
<tr>
<td>Ireland</td>
<td>62.0</td>
<td>25.0</td>
<td>-37.0</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>1996 (as % of GDP)</th>
<th>2006e (as % of GDP)</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>46%</td>
<td>100%</td>
<td>+54%</td>
</tr>
<tr>
<td>Canada</td>
<td>70%</td>
<td>81%</td>
<td>+11%</td>
</tr>
<tr>
<td>France</td>
<td>4%</td>
<td>7%</td>
<td>+3%</td>
</tr>
<tr>
<td>Germany</td>
<td>8%</td>
<td>11%</td>
<td>+3%</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>16%</td>
<td>33%</td>
<td>+17%</td>
</tr>
<tr>
<td>Ireland</td>
<td>44%</td>
<td>51%</td>
<td>+7%</td>
</tr>
<tr>
<td>Japan</td>
<td>43%</td>
<td>69%</td>
<td>+26%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>85%</td>
<td>132%</td>
<td>+47%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>86%</td>
<td>148%</td>
<td>+62%</td>
</tr>
<tr>
<td>UK1</td>
<td>79%</td>
<td>99%</td>
<td>+20%</td>
</tr>
<tr>
<td>United States2</td>
<td>87%</td>
<td>105%</td>
<td>+19%</td>
</tr>
<tr>
<td>Weighted average</td>
<td>58%</td>
<td>81%</td>
<td>+24%</td>
</tr>
</tbody>
</table>

63 [Watson Wyatt, 2007]
Appendix 3: Valuing multiple-period cash flows

The present value of a series of cash flows \( a_1, a_2, a_3, \ldots \) can be formulated as follows:

\[
PV = \sum_{i=1}^{\infty} \frac{a_i}{(1 + r)^i} = \frac{a_1}{(1 + r)} + \frac{a_2}{(1 + r)^2} + \frac{a_3}{(1 + r)^3} + \ldots \quad (a.1)
\]

This formula can be used to value any investment that produces a series of cash flows at different points of time. An example where to use this formula is as follows:

If the appropriate discount factor as used in the example is 6\% per annum it can be calculated how much all future cash (out)flows are worth today (2007). It is allowed to add all the present values together as they all occur at the same point in time.
Appendix 4: Investment theory

The main reason to invest in a wide range of assets is because of its diversification potential. In 1952, Harry Markowitz introduced his Nobel price winning concept of what is now called Modern Portfolio Theory (MPT) [Brealey and Myers, 1996]. Modern Portfolio Theory helps rational investors to obtain an efficient portfolio, based on the expected return and risk on a portfolio level. The theory is based on the idea that diversification of assets reduces portfolio risk due to non-perfect correlations of these underlying assets. For example two assets have a negative correlation. If one investment performs well, the other will perform less well and vice versa. In this way, not-perfectly correlated investments will flatten out each other extremes. A short overview of correlations between some asset classes is illustrated in the following table (Bakker, 2006). Modern Portfolio Theory can be applied to all risky assets [Brown and Matysiak, 2000].

<table>
<thead>
<tr>
<th>Correlation matrix</th>
<th>Stocks</th>
<th>Bonds</th>
<th>Indirect Real estate</th>
<th>Direct Real estate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocks</td>
<td>1,00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bonds</td>
<td>0,34</td>
<td>1,00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indirect Real estate</td>
<td>0,56</td>
<td>0,49</td>
<td>1,00</td>
<td></td>
</tr>
<tr>
<td>Direct Real estate</td>
<td>-0,05</td>
<td>-0,09</td>
<td>-0,14</td>
<td>1,00</td>
</tr>
</tbody>
</table>

The historical rates of return of an investment conform closely to a normal distribution. A normal distribution is a probability distribution of the outcome of all possible returns, along with their frequency. In a normal distribution, only two numbers are important for a rational investor, the mean or expected return and the risk as variance. The variance or standard deviation measures the deviation of all outcomes from the expected return. The following figure shows that distribution two has a higher deviation than distribution one and thus a higher risk. It means that the returns from distribution two vary more around the mean than they do in distribution one.

Modern Portfolio Theory is based on this mean-variance concept, using the same definition of risk: the average degree to which returns deviate from the expected return. Basically, Modern Portfolio Theory uses the concept as a substitute for future risk and return expectations. However, historical numbers should be adjusted to fully reflect the investors' view on current market state and potential developments affecting this [Langbroek, 2003].

An investor can create efficient portfolios by using diversification to combine assets, based on their underlying normal distributions. Efficient portfolios can be generated by maximizing its return, given a certain risk appetite or vice versa. Calculating all possible portfolio combinations on risk and return creates a set of efficient portfolios for different risk return preferences. The efficient frontier is the graphical curve in the following figure and contains all possible efficient sets. The expected return of these portfolios can be calculated as follows:

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44 In daily life, risk is associated with danger of damage or loss. It contains the aspect of uncertainty or the possibility of a (negative) event. The concept of risk is not defined univocally and can be connected/re related to several things. For a (real estate) investor risk can be defined as the uncertainty that the expected return will not be realized. Apparently, the financial world relates risk to return.
\[ E(R_m) = x_1 R_1 + x_2 R_2 \]  
(a.2)

Where:

- \( E(R_m) \) = Expected return on portfolio \( m \)
- \( R_1 \) = Expected return of asset 1
- \( R_2 \) = Expected return of asset 2
- \( x_1 \) = Weight of asset 1 in portfolio \( m \)
- \( x_2 \) = Weight of asset 2 in portfolio \( m \)

The risk that is associated to portfolio \( m \) can be calculated as follows:

\[ \sigma_m^2 = x_1^2 \sigma_1^2 + x_2^2 \sigma_2^2 + 2(x_1 x_2 \rho_{12} \sigma_1 \sigma_2) \]  
(a.3)

Where:

- \( \sigma_m^2 \) = Variance of portfolio \( m \)
- \( x_1 \) = Weight of asset 1 in portfolio \( m \)
- \( x_2 \) = Weight of asset 2 in portfolio \( m \)
- \( \sigma_1 \) = Standard deviation of asset 1
- \( \sigma_2 \) = Standard deviation of asset 2
- \( \rho_{12} \) = Covariance between asset 1 and asset 2

The use of leverage (lending or borrowing) extends the range of investment possibilities. If an investor invests in efficient portfolio \( M \) and lends or borrows at the risk free rate \( (r_f) \), she/he can achieve any point on the line from \( r_f \) through \( M \). It results in even better risk return profiles. For a more detailed explanation on leverage see the specific appendix on that topic.

The figure also shows that investments that contain more risk, should offer a higher return. Investors dislike risk and uncertainty. Therefore they require a premium to compensate for the risk they take.

Another theory is the Capital Asset Pricing Model (CAPM), found by Sharpe, Lintner and Mossin. The theory has taken the idea of diversification to a next level. The research found out that not all risk is diversifiable. Investment returns are and will always be exposed to macro-economical developments. Risk can be divided into market risk and specific risk. Market risk (\( \beta \)) is systematic and can not be diversified. It reflects the risk of the total market portfolio, which stems from macro-economical developments. Specific risk is not systematic.
and can be diversified. This is shown in the following figure. By increasing the number of different securities, the investors' portfolio gets more diversified, which results in a decreasing specific risk and total portfolio risk. Specific risk is almost totally diversified by twenty different securities.

![Figure a.8 Different types of risk and their diversification effects](image)

The market only takes into account a risk compensation for the market risk as this is not diversifiable. The total compensation that an investor expects can be explained by the following (CAPM) formula:

\[ E(r_i) = r_f + \beta_i [E(r_m) - r_f] \]  
(a.4)

Where:
- \( E(r_i) \) = Expected return of investment i
- \( r_f \) = Risk free rate
- \( \beta_i \) = Systematic risk of investment i
- \( E(r_m) \) = Expected return on market portfolio
- \( E(r_m) - r_f \) = Risk premium

Individual stocks differ in their 'riskiness' and thus in their beta. The beta is based on the following formula:

\[ \beta_i = \frac{\text{cov}(R_i, R_m)}{\text{var}(R_m)} \]  
(a.5)

Where:
- \( \text{cov}(R_i, R_m) \) = Covariance of return on investment i with return of the market portfolio
- \( \text{var}(R_m) \) = Variance of the return on the market portfolio

Beta measures the sensitivity of the return on investment i in relation to the return of the specific market. An asset is 1.5 times more volatile than the specific market if it has a beta of 1.5. When markets go up with 10%, the asset goes up with 15% and vice versa. The risk of an investment is similar to the market risk if \( \beta = 1 \). A risk free investment has \( \beta = 0 \). The expected return-beta relationship can be portrayed graphically as the Security Market Line (SML). It graphs individual asset risk premiums as a function of asset risk. The Security Market Line is valid for both efficient portfolios and individual assets.
Figure a.9 Security Market Line (SML)
Appendix 5: Example of an active return strategy

The idea is to gain excess (active) return per asset in excess of the benchmark set by the strategic portfolio allocation by actively deviating from this benchmark. An example of this comes from listed real estate. The listed real estate team can decide to deviate from the benchmark they have to outperform. The decision to over- or underweight is a reflection of the view of the listed real estate team on the future performance of a certain market, region or company. An example benchmark could be the Epra/Nareit Pan-European index for real estate companies which are listed in Europe.

Figure A.10 Example of active strategies to outperform the given benchmark.
Appendix 6: Europe's demographic outline and outlook
Figure a.11 Evolution of the European population [Brounen, 2007]

<table>
<thead>
<tr>
<th>(*min.)</th>
<th>1950</th>
<th>1975</th>
<th>2005</th>
<th>2025</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>547</td>
<td>675</td>
<td>724</td>
<td>696</td>
<td>611</td>
</tr>
<tr>
<td>Young (0 - 19)</td>
<td>189</td>
<td>216</td>
<td>163</td>
<td>133</td>
<td>128</td>
</tr>
<tr>
<td>Worker (20 - 64)</td>
<td>313</td>
<td>381</td>
<td>446</td>
<td>414</td>
<td>334</td>
</tr>
<tr>
<td>Retired (65 - 80+)</td>
<td>45</td>
<td>77</td>
<td>115</td>
<td>148</td>
<td>148</td>
</tr>
</tbody>
</table>
As can be seen in the figures and the table above, the composition of the European population is changing. The average age of a European is 38.9 years now and will increase to 47.3 years in 2050. This is called ageing. More people retire, while the number of people that (are able to) work will decrease.

The total European population declines as well to 611 million in 2050. When looked at the age cluster 20-65, the decline of the European cluster shows a very different curve than that of North America.

Populations also alter through migration, but the net effects are milder than most people think. For example, the Dutch population equaled 16.2 million in 2006 of which 104.514 people migrated to the Netherlands and 97.415 people migrated out of the Netherlands. Over the first 6 months of 2004 the net result was even negative.

Another thing to bear in mind is the increasing female participation to work. In 2005, Dutch female participation rates gradually increased from 30% in 1950 to 44% and this percentage is likely to increase even more.
Appendix 7: Convexity

This research assumes a linear relationship between the interest rate and the market value of the liabilities. However, their actual relation is convex. This means that an increase of the interest rate of 1% has less impact on the liabilities at a high interest rate than at a low interest rate. As mentioned in the main text, the duration measures the change in value of the liabilities as a result of changes in the interest rate. In other words, it is the first derivative of the relation between interest rate and pension liabilities. The following figure contains the duration before and after a yield shift, given by the two vector lines in light blue. The second derivative is the convexity. Convexity measures the change in duration itself (as a result of a yield shift). It is the rate of change of the slope. In short, if there is a change in the interest rate, the value of the liabilities will change (measured by duration), as well as the duration itself (measured by convexity). As convexity only has a minor impact for relatively small changes in the interest rate, this research will not take it into account. It should be noted however, that convexity does have an impact for big changes (shocks) in the interest rate.
Appendix 8: Example of an 'older' and a 'younger' pension fund composition

The duration of an older pension profile is lower, as the participants retire earlier in time. Participants of a younger pension profile need to work some more years before they can retire. Therefore, the cash outflows will take place on a later moment in time.

Figure a.14 Young and old liability profile
Appendix 9: Liability Driven Solutions for ABP Investments

ABP taps directly into indexation bonds

IPE.com 5 June 2007 15:27:
NETHERLANDS — The €212bn Dutch ABP pension fund will increase its asset allocation in indexation bonds to 7% by 2009 via its ‘own instruments’.

“We are not planning to buy the existing OATi’s [French government inflation-linked bonds] or the index linkers in the UK, as the returns they offer are much too low,” said Roderiek Munsters, speaking in Brussels last week.

Therefore, the fund is looking, together with its own investment professionals, at investment forms - preferably unlisted - which provide more attractive returns.

“We will also make these kind of instruments ourselves, by looking for parties who can pass on inflation to their clients, who would want to spend alien capital, in a hybrid form perhaps, and who would want to sell this to us,” said Munsters.

He added: “So instead of buying ourselves...we will make a product ourselves.”

The scheme plans to grow its allocation to indexation bonds from 4.2% to 7% mainly through its “financial engineering capabilities,” said Munsters.

The fund declined to comment on the exact parameters of these capabilities, or on the partners it is currently considering.

In February this year, a study by ABN Amro suggested Dutch pension funds will increasingly invest in real assets such as inflation-linked bonds as nominal cover ratios are rising.

Earlier, also PGGM indicated it would increase its investments in the asset class.
Appendix 10: Appraisal process

There are three appraisal approaches:

- Appraisals based on construction costs: mostly used for non-income producing properties which do not have a lot of comparable transactions
- Appraisals based on the discounted cash flow: used for income producing properties
- Sales comparison approach: for frequently sold properties with a lot of comparable transactions

![Appraisal approaches and appraisal process](image)

Appraisals are human estimates of property values [Brounen, 2007]. Unlisted real estate is often valued using appraisals, as prices are not available. Most real estate objects are only appraised once a year. Appraisal-based returns paint a completely different picture of real estate investment in the short and medium term. Due to the behaviour of appraisers, unlisted appraisals exhibit smoothing as well as lagging. Appraisals are based on previous appraisals or old news, and changes in the market since the previous appraisal to reflect market developments. A high degree of autocorrelation between the property values can be seen. Smoothing is the underestimation of risk. It understates the volatility. Lagging reflects the fact that all market developments are incorporated in the appraised value at a later stadium in time. Approximations of lagging are 1-2 years. It leads to the illusion of diversification in portfolios of private and public real estate.

---

66 For example NCREIF seems to lag the NAREIT index with 1 to 2 years
Appendix 11: Leverage

Leverage can be defined as the funding of investments with borrowed securities, such as external financing, or exposure created by the use of derivatives, such as futures/forwards swaps and options. Leverage magnifies the rate at which the value of a portfolio changes in response to movements in the market. As well as increasing expected returns, leverage also increases the related volatility. A distinction is often drawn between accounting leverage and economic leverage:

- **Accounting leverage**
  - Accounting leverage is the ratio of a firm's, fund's or portfolio's total assets relative to its total equity. Accounting leverage basically means financing certain assets and it arises when the total investments (exposure) exceed net asset value (NAV). It can be done by on-balance-sheet transactions (e.g. bank loans), or off-balance-sheet transactions (e.g. derivatives, borrowing and lending of securities, long short strategies). Accounting leverage in itself says nothing about the effect of leverage on the risk/return profile of the underlying portfolio.

- **Economic leverage**
  - Economic leverage is the use of various financial instruments or borrowed capital to increase the potential return of an investment. Economic leverage, in contrast, does say something about the changing risk/return profile of a portfolio. The criterion employed is the volatility, which is the sensitivity of the portfolio return to market developments and movements in the value of the underlying assets.

Economic leverage is in turn divided into relative and absolute leverage:

- **Relative economic leverage**
  - Relative economic leverage arises if the risk on a given portfolio, defined as the volatility of the return, is greater than that on the benchmark (unleveraged) portfolio.

- **Absolute economic leverage**
  - Absolute economic leverage arises if the risk on the leveraged portfolio, defined as the volatility of the return, is greater than that on the unleveraged portfolio. Economic leverage is a measure of the extent to which the absolute or relative volatility or risk profile of the portfolio is influenced by specific purchase or sale transactions.

In short, leverage creates two effects: exposure and risk. This distinction is very important. In some cases the accounting or balance sheet leverage (exposure) can be very large, while the economic leverage (risk) can be very small. Think of a long short strategy with a long position of up to 120% of the notional or net asset value that is offset with a short position of 20%. This leads to a balance sheet leverage of 40%, while the economic leverage is 0%.

A numerical example of economic leverage is stated here. In this example an investor, apart from equity, makes use of debt to finance an investment. The use of debt can have a positive or negative impact on the investors' return. A numerical example:

<table>
<thead>
<tr>
<th></th>
<th>Equity (30%)</th>
<th>Debt (70%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total investment value</td>
<td>€3.000.000, -</td>
<td>€7.000.000, -</td>
</tr>
<tr>
<td>Total return 7%</td>
<td>€700.000, -</td>
<td>€350.000, -</td>
</tr>
<tr>
<td>Return on equity</td>
<td>€350.000, -</td>
<td>€350.000, -</td>
</tr>
<tr>
<td>Return on equity</td>
<td>(€350.000, - / €3.000.000, -)*100 = 12%</td>
<td></td>
</tr>
</tbody>
</table>

The use of debt resulted in a positive leverage effect of +5%. However the use of debt can also result in a negative leverage effect:

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67 Investopedia; ABP, 2006a
68 Long strategy is buying a security, with the expectation that the asset will rise in value. The opposite is a short position. A short strategy is the sale of a borrowed security with the expectation that the asset will fall in value. For example, an investor who borrows stocks from a broker and sells them on the open market has a short position in the stocks. The investor must eventually return the borrowed stocks by buying it back from the open market.
Equity (30%)  & €3,000,000, -  
Debt (70%)  & €7,000,000, -  

Total investment value  & €10,000,000,-  
Total return 7%  & €700,000, -  
Debt services 7.5%  & €525,000, -  

Return on equity  & €175,000, -  
Return on equity  & $(€175,000, - / €3,000,000, -) * 100 = 6\%$  

In this example the use of debt resulted in a negative leverage effect of -1\%.

In general, a positive leverage effect occurs when more debt will increase the equity investor’s return. A negative leverage effect occurs when more debt will decrease the equity investor’s return. Overall, leverage can be seen as a risk.

With the following formula the effect of leverage on the return can be measured:

\[ r_t = (\alpha * r_d) + \{1 - (1 - \alpha) * r_e\} \]  \hspace{1cm} (a.6)

Where:
- \( r_t \) = Total return
- \( \alpha \) = Portion of debt
- \( r_d \) = Cost of debt
- \( r_e \) = Return on equity

And:

\[ r_e = \{(r_t - (\alpha * r_d)) / (1 - \alpha)\} \]  \hspace{1cm} (a.7)

For the numerical example this will lead to the following:

\[ r_e = \{(0.07 - (0.7 * 0.05)) / (1 - 0.7)\} = 0.12 = 12\% \]
\[ r_e = \{(0.07 - (0.7 * 0.075)) / (1 - 0.7)\} = 0.06 = 6\% \]

Whenever the return component is higher in the underlying property than it is in the mortgage loan, there will be positive leverage effect in that return component.

Under the typical assumption that the loan is less risky than the underlying property, leverage will increase the total return on the equity investment.
Appendix 12:  Real estate transparency index

The following table shows a list of the transparency of the real estate market in different countries. The study results from a yearly survey made by Jones Lang LaSalle.

The survey defines transparency as 'any open and clearly organized real estate market operating in a legal and regulatory framework that is characterized by a consistent approach to the enforcement of rules and regulations and that respects private property rights'. Furthermore, it involves 'the ethical and professional standards of private sector advisors, agents and brokers who are licensed to conduct business in each country'.

The real estate markets that are transparent are characterized by:
'having long time-series investment performance indices, readily available data on market fundamentals, strong accounting standards and disclosure regimes, consistently applied regulations, strong legal frameworks and high professional standards'.

The study gives insight in the state of development of the real estate markets in 56 countries. The index can be used as a tool to classify markets and market risk. It can be linked with other metrics to develop a global strategy.

Some examples are that:
- There is a negative correlation between real estate transparency and GDP per Capita
- Corruption is more prevalent in less transparent real estate markets
- Real estate transparency is linked to favorable business environments
- Transparent countries have larger shares of institutional real estate
- Transparent countries are more liquid, having higher transaction volumes

<table>
<thead>
<tr>
<th>2006 Country</th>
<th>Transparency Score 1–5</th>
<th>2006 Tier</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Australia</td>
<td>1.15</td>
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<tr>
<td>2 United States</td>
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<td>5 United Kingdom</td>
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<td>6 Hong Kong*</td>
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<td>7 Netherlands</td>
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<td>9 France*</td>
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<td>4</td>
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<td>17 Belgium</td>
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<td>24 Portugal*</td>
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<td>25 Mexico</td>
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<td>27 Hungary</td>
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<tr>
<td>27 Poland</td>
<td>2.76</td>
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<tr>
<td>28 2006 Country</td>
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<td>2006 Tier</td>
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<td>39 Thailand</td>
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<td>40 Argentina*</td>
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<td>41 India*</td>
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<td>42 P.R. China</td>
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<td>4</td>
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<tr>
<td>43 Macau</td>
<td>3.65</td>
<td>4</td>
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<tr>
<td>44 United Arab Emirates</td>
<td>3.77</td>
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<td>45 Costa Rica</td>
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<td>46 Indonesia</td>
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<td>51 Uruguay</td>
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<td>4</td>
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<td>54 Egypt</td>
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<td>5</td>
</tr>
<tr>
<td>55 Venezuela</td>
<td>4.43</td>
<td>5</td>
</tr>
<tr>
<td>56 Vietnam</td>
<td>4.69</td>
<td>5</td>
</tr>
</tbody>
</table>
Appendix 13: Interest rate parity

Parity stands for equality or the ratio of the value of one exchange rate for another. The interest rate parity relates interest rates and exchange rates. It is a theoretical concept which comes from economical assumptions.

Interest rate parity is an arbitrage condition, which says that the returns from borrowing in one currency, exchanging that currency for another currency and investing in interest-bearing instruments of the second currency, while simultaneously purchasing futures contracts to convert the currency back at the end of the investment period should be equal to the returns from purchasing and holding similar interest-bearing instruments of the first currency. If the returns are different, investors could theoretically arbitrage and make risk-free returns [Hull, 2005; Investopedia].

Looking at it differently, interest rate parity says that the spot and future prices for currency trades incorporate any interest rate differentials between the two currencies.

Two versions of the identity are commonly presented in academic literature: covered interest rate parity and uncovered interest rate parity.

The basic covered interest parity (also called interest parity condition) is

\[
(1+i_{NL}) = \left(\frac{F_0}{S_0}\right) (1+i_{Local})
\]

Where:

- \(i_{NL}\): The Dutch interest rate
- \(i_{Local}\): The interest rate in the foreign country (for a local investor)
- \(F_0\): Forward exchange rate between domestic currency (€) and foreign currency (c), i.e. €/c
- \(S_0\): Spot exchange rate between domestic currency (€) and foreign currency (c), i.e. €/c

The covered interest parity states that the interest rate difference between two countries' currencies is equal to the percentage difference between the forward exchange rate and the spot exchange rate. If the parity condition does not hold, an arbitrage opportunity exists.

In general one can say that when the NL interest rate is lower than the foreign/local interest rate, the forward price of the foreign currency will be below the spot price. Conversely, if the NL interest rate is above the foreign/local interest rate, then the forward price of the foreign currency will be above the spot price.

An arbitrage example

Assume for this example that:

\[
(1+i_{NL}) < \left(\frac{F_0}{S_0}\right) (1+i_{Local})
\]

This would imply that one dollar invested in the US < one dollar converted into a foreign currency and invested abroad. Such an imbalance would give rise to an arbitrage opportunity, where in one could borrow at the lower effective interest rate in US, convert to the foreign currency and invest abroad.

The following is a rudimentary example to understand covered interest rate arbitrage (CIA)

Consider the interest rate parity (IRP) equation,

\[\text{69 In economics and finance, arbitrage is the practice of taking advantage of a price differential between a temporary imbalance between two or more markets}\]
\[(1+i_{NL}) = \left(\frac{F_0}{S_0}\right) \times (1+i_{Local})\]

Assume:
- the 12-month interest rate in US is 5%, per annum
- the 12-month interest rate in UK is 8%, per annum
- the current Spot Exchange is 1.5 $/£
- the current Forward Exchange is 1.5 $/£

From the given conditions it is clear that UK has a higher interest rate than the US. Thus the basic idea of covered interest arbitrage is to borrow in the country with lower interest rate and invest in the country with higher interest rate. All else being equal this would help you make money risk less. Thus,
- Per the LHS of the interest rate parity equation above, a dollar invested in the US at the end of the 12-month period will be: $1 \cdot (1 + 5\%) = $1.05
- Per the RHS of the interest rate parity equation above, a dollar invested in the UK (after conversion into £ and back into $ at the end of 12-months) at the end of the 12-month period will be: $1 \cdot (1.5/1.5)(1 + 8\%) = $1.08

Thus, one could carry out a covered interest rate (CIA) arbitrage as follows,
1. Borrow $1 from the US bank at 5% interest rate.
2. Convert $ into £ at current spot rate of 1.5$/£ giving 0.67£
3. Invest the 0.67£ in the UK for the 12 month period
4. Purchase a forward contract on the 1.5$/£ (i.e. cover your position against exchange rate fluctuations)

At the end of 12-months
1. 0.67£ becomes 0.67£(1 + 8\%) = 0.72£
2. Convert the 0.72£ back to $ at 1.5$/£, giving $1.08
3. Pay off the initially borrowed amount of $1 to the US bank with 5% interest, i.e. $1.05

Making an arbitrage profit of $1.08 - $1.05 = $0.03 or 3 cents per dollar.

Obviously, any such arbitrage opportunities in the market will close out almost immediately.

In the above example, any one or combination of the following may occur to re-establish the equilibrium of the IRP to close out the arbitrage opportunity,
- US interest rates will go up
- Forward exchange rates will go down
- Spot exchange rates will go up
- UK interest rates will go down
Appendix 14: Moving average

A moving average for a time period is the arithmetic mean of the values in that time period and those close to it. To compute the three-year moving average for any time period, the time series values in that year and the previous two years must be averaged. An example:

<table>
<thead>
<tr>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>39</td>
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<tr>
<td>2005</td>
<td>37</td>
</tr>
<tr>
<td>2006</td>
<td>61</td>
</tr>
<tr>
<td>2007</td>
<td>58</td>
</tr>
</tbody>
</table>

The three-year moving average for 2006 is $\frac{137}{3} = 45.7$, while the three year moving average for 2007 is $\frac{156}{3} = 52$.

The more period you take into consideration when calculating the moving average, the smoother the series becomes. It is important to realize that the objective is to smooth the time series sufficiently to remove the random variation and to reveal the other components (trend/ cycle/ season/et cetera) present. With too little smoothing, the random variation distinguishes the real pattern. With too much smoothing, however, some or all of the other effects may be eliminated along with the random variation.

Two drawbacks are associated with the moving average method of smoothing time series. First, no moving averages can be calculated for the first sets of time periods. If the time series has few observations, the missing values can represent an important loss of information. Second, the moving average forgets most of the previous time series values. For example, in the three-year moving example described, the average for year 2007 reflects years 2005 to 2007 but is not affected by 2004.

70 Source: [Keiler and Warrack, 2003]
Appendix 15: Model output - example graphs

The following figures are examples of the output from the research model. The figures should be interpreted as follows:

A Dutch pension fund investor which invests in (international) real estate compares the real estate total returns with the liabilities of the fund. Mismatch risk is measured and given as a percentage at the bottom of each set of graphs.

The example graphs are total return indices, based on a moving average evaluation period (horizon) of three years observed at a yearly frequency (annualized). No corrections were made for overlapping data. The variables are set according to the preferences of ABP Investments. It is also possible to adjust the settings in the model. The duration of the liabilities of ABP Investments is set at 17. The real estate data are delagged 1 year and either 0% or 100% hedged for currencies. Only indices are usable which have more than approximately 15 years of data. This is also given by the fact that real estate cycles are around eight to ten years. Less data is also from a statistical point of view not desirable. Backward-looking standard deviation (mismatch risk) can be affected by the chosen time interval. If the analysis covers a short time interval, it may be a period during which no extreme market conditions occurred. This may lead to an underestimation of risks.

The example graphs are ordered by country, with each time a graph that shows the specific index and the liabilities (ILB) index separately. The other graph shows the excess return of the specific index. In other words, the returns on the ILB are subtracted from the real estate returns. These sets of graphs are shown on a 100% currency hedged and on 0% currency hedged basis.

The settings are: the duration of the liabilities, number of years delagging of real estate data, currency hedging percentage and the evaluation period/ horizon. E.g. a horizon of 3 years means a moving average time frame of 3 years observed at a yearly frequency (annualized).
Figure a.20  Total returns unhedged Australian retail and liabilities

Figure a.21  Excess return unhedged Australian retail minus liabilities

Figure a.22  Total returns hedged Australian retail and liabilities

Figure a.23  Excess return hedged Australian retail minus liabilities

<table>
<thead>
<tr>
<th>Year</th>
<th>PCA Australia Retail</th>
<th>Unhedged</th>
<th>Pension liabilities</th>
<th>Nominal return</th>
<th>PCA Retail</th>
</tr>
</thead>
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Pension liabilities: Nominal return = PCA Retail

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Pension liabilities: Nominal return = PCA Retail

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Pension liabilities: Nominal return = PCA Retail

-4.9%

-4.1%
Figure a.36 Total returns unhedged UK supermarkets and liabilities

Figure a.37 Excess return unhedged UK supermarkets minus liabilities

Figure a.38 Total returns hedged UK supermarkets and liabilities

Figure a.39 Excess return hedged UK supermarkets minus liabilities
Figure 4.57 Total returns hedged: UK Let Land and Liabilities

UK Let Land

100% hedged

Figure 4.58 Total returns: Vesteda, KFN

Vesteda; KFN

Figure 4.59 Total return on equity: Vesteda - Liabilities, KFN - Liabilities

UK Let Land - Liabilities

100% hedged

Figure 4.59 Total return on equity: Vesteda and KFN minus liabilities

Vesteda - Liabilities; KFN - Liabilities

9.2%

-6.3% -8.7%
Figure 4.4: Correlation hedged: UK supermarkets and liabilities

Correlation

100% hedged

R² = 0.3527

Figure 4.5: Correlation hedged: UK shopping centres and liabilities

Correlation

100% hedged

R² = 0.336

Figure 4.6: Correlation hedged: US industrial and liabilities

Correlation

100% hedged

R² = 0.2586

Figure 4.7: Correlation hedged: Australia retail and liabilities

Correlation

100% hedged

R² = 0.2488
Appendix 16: Example semi-structured interview

Interview and discussion with prof. Dr. Aart Hordijk MRICS from, ROZ/IPD

27 March 2007
14:30 – 16:00
WTC (G) 5.63 aquarium

Aart Hordijk
Patrick Kanters
Rob van den Goorbergh
Niels Coolen

1. Introduction
2. Introduction and objective research
3. ROZ/IPD
4. Other IPD
5. Other indices
6. Ideas qualitative guideline model (listed/ non-listed)
7. Other relevant points

1. Introduction

2. Introduction and objective research
Find and identify real estate that meet the liability hedge criteria, by analyzing the factors that influence the value of pension liabilities and the returns of real estate investments

3. ROZ/IPD and other IPD indices
   - Basis
   - Unsmoothing
4. **Other indices**
   - Aedex
   - PCA
   - NCREIF
   - EPRA/NAREIT
   - hedge stock market sentiment

The listed return series are very volatile and appear to be driven by the sentiment of the overall stock market (high correlation). The hedged returns become less volatile and display less coherence with the common stocks.

The idea:
- Filter for stock market sentiment
- Use the residual as long term indication of real estate performance
- Not improving real estate returns, but replacing it for research purposes

The biggest annoyance is a discount to NAV

5. **Ideas qualitative guideline model (listed/ non-listed)**
Factors influencing real estate total returns related to liabilities:
- Income return
- Capital Gain (upward potential/ downside risk)
- Underlying location and object/ portfolio quality
- Leverage
- Other

6. **Other relevant points**
Investment Property Databank (IPD)

IPD produces 31 market indices across 19 national markets. The IPD indices show unlevered time-weighted returns on direct investments held through the year. The indices are based on the open market appraised valuations of real buildings. All valuations used in the indices have been produced for investment purposes by property professionals. One of the important aspects of the IPD country indices is the market coverage. The market coverage measures how representative the index is for the total underlying investor market of a specific country. The ‘all property indices’ are build up by the summation of the sector indices that are covered by IPD in a country. However, each country index puts different weights to each sector when building up an all property index. An overview of the sector coverage as a percentage of the total capital value is given in the following figure [IPD, 2007]:

[Figure 6.9 Overview sector coverage as a percentage of the total capital value [IPD, 2007]]

IPD indices are set up differently per country. A short overview of major obstacles per country index is given here:

- **UK**
  The IPD UK index has data available from 1972 and onwards. Appraisals are based on the professional standards of the Royal Institute of Chartered Surveyors (RICS). However, last few years might be questionable as the UK return data showed a significantly different pattern compared to all the other countries covered by IPD. The IPD UK index is a ‘frozen’ index, which is mandatory when introducing real estate derivatives as IPD UK has recently done. In 2006, the total value of the properties covered by the databank represented 49% of the value of the holdings of UK institutions and listed property companies.

- **Ireland**
  Officially the index started in 1985, but is constructed synthetically back to 1982

- **Germany**
  The German index is based on a building costs index, not reflecting true market levels and movements. Data are available from 1996 and onwards.

- **Netherlands**
  The Dutch ROZ/IPD index checks all appraisals on correct use of input and assumptions (e.g. used discount rate). What is more important, ROZ/IPD is independent and does not have any commercial objectives. This is in contrast to most other IPD offices. The ROZ/IPD index is a ‘frozen’ index, which is mandatory when introducing real estate derivatives as ROZ/IPD is doing at the moment. The derivatives are based on a swap, exchanging the return on a government loan, plus basis points, for direct return on real estate. In 2006, the total value of the properties covered by the databank represented 60% of the value of the holdings of the financial institutions and quoted property companies.
France
The French IPD index starts in 1998 for the sectors retail and industrial. The sectors residential and office started much earlier in 1986. This is because IPD bought a German Company BD2I and used their available data. The data of the latter are smoothed as they are based on a biased views of only few professionals. In December 2005, the total value of the properties covered by the databank represented 54% of the value of the holdings of the financial institutions and quoted property companies.

Spain
With a low market coverage ratio, the Spanish IPD index can not be labelled as representative.

Portugal
In 2006, the total value of the properties covered by the databank represented 54% of the value of the holdings of the financial institutions and quoted property companies.

Italy
The Italian IPD index has low market coverage.

Norway
The Norwegian index is fairly new, with limited data availability. In 2006, the total value of the properties covered by the databank represented 44% of the value of the holdings of the financial institutions and quoted property companies.

Sweden
The Swedish IPD index started in 1996, but is constructed synthetically for previous years until 1987 based on internal appraisals. In 2006, the total value of the properties covered by the databank represented 34% of the value of the holdings of the financial institutions and quoted property companies.

Finland
IPD has made a deal with another company (KTI) to use Finnish property data.

Switzerland
Appraisals are based on bond yields, thus comparing real estate with bonds. The index does not reflect true market levels and fluctuations as appraisers do not acknowledge real estate as a separate asset class. On paper, this index could possibly do well as a liability hedge, but could give problems when the exit value in the market does not reflect the book value.

South Africa
The South African index started in 1995.

Danish
In 2006, the total value of the properties covered by the databank represented 41% of the value of the holdings of the financial institutions and quoted property companies.

Canada
In 2006, the total value of the properties covered by the databank represented 50% of the Canadian institutional market.

Belgium (2005)
The total value of the properties covered by the Databank represented 17% of the Belgian investment market. The Index shows return on capital employed in standing investments. Standing investments are properties held from one annual valuation to the next. The standing investments exclude properties bought, sold or under development in the course of a year. The annual results are chain-linked into a continuous time-weighted index series.

A complete overview of the IPD market size and market coverage per country index is as follows [IPD]:
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### Semi structured Interviews or discussions:

**Externally**
- Robert Weisz, TU/e
- Kees Kokke, TU/e
- Ruben Langbroek, KFN
- Laurens te Beek, Epia / Nareit
- Sjoerd Rothweiler, AXA REIM
- Aart Hordijk, ROZ/ IPD
- Bert Teuben, ROZ/ IPD
- Angelien van Dok, Vesteda
- Dirk Brounen, Erasmus University Rotterdam

**Internally at ABP Investments**
- Patrick Kanters
- Rob van den Goorbergh
- Rob Bingen,
- Bart Kuilpers
- Stephan Lundbergh
- Leroy Tuijtje
- Roderick Molenaar
- Steven Bloom
- Frank van Weegbergh
- Annemarie Manning
- Martijn Vos
- Victor Santing
- Renee Bies
- Roel Harden