Alternative Investments and the Solvency Requirements for Defined Benefit Pension Schemes

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(note: The quotations appearing in this monograph are exact, except where capitalization and punctuation were changed in keeping with modern style and grammar guidelines.)

Abstract

Market valuation of assets and liabilities plays a central role in new international accounting standards. This means that the Dutch pension fund industry, which has historically been dominated by actuarial valuation techniques, has to incorporate valuation techniques from financial economics. The proposed new Financial Assessment Framework in the Netherlands sets three requirements based on market valuation of assets and liabilities: (1) a minimum funding requirement, (2) a solvency requirement and (3) a continuity requirement. This paper examines the use of alternative investments for pension funds facing these three requirements. Prudent investments in commodities or inflation-linked bonds might provide liability-hedging opportunities, decreasing the probability of pension fund insolvency. Other structured products involving derivative instruments can be used to further protect pension funds against underfunding. We are skeptical about the use of other alternative asset classes for improvement of the speculative or liability-hedging part of the pension fund portfolio.

1. Introduction

Recent developments in financial economics have had a large impact on the valuation of financial assets. Whereas these valuation techniques have been adopted in many fields in the finance industry, pension funds have been reluctant to incorporate these financial economic valuation methods to report their financial status. Moreover, supervisory authorities have also hesitated to implement new financial insights in the requirements they set to regulate the pension fund industry. This paper points out some of the benefits of introducing these theories for the risk management purposes of the pension fund. In particular, I indicate the implications for the optimal asset allocation for pension funds once these insights are put into practice. I focus on the (inflation-indexed) defined benefit (DB) pension system of the Netherlands, but many insights can be applied in a more general context.

Several imminent regulatory developments will affect the pension funds in the Netherlands in the coming years. These changes require that knowledge about actuarial principles as well as valuation techniques from financial economics need to be integrated. Through integration of European markets and international accounting measures, the interaction between actuarial studies and financial economics is most likely not restricted to the Dutch pension market, but will be a worldwide phenomenon.

Each Dutch citizen gets a fixed pension from the age of 65 provided by the government, which is the same irrespective of working history (first pillar). This state pension can be supplemented by a pension provided by employers (second pillar), generally leading to a defined benefit equal to 70 percent of the person's final wage. In addition, the Dutch pension system has fiscal arrangements to allow private savings for retirement (third pillar). The total assets under management of the Dutch second pillar is about €472 billion, which is about €30 thousand per inhabitant. According to the Dutch supervisor, about 30 percent from the 1,000 pension funds are currently underfunded. The Dutch regulatory authority has summoned the board of the pension funds to make plans to regain solvency as soon as possible. The proposed new Financial Assessment Framework sets the standards for pension funds risk management from 2006 onward.

Lately, the pension fund industry has become increasingly attracted to alternative asset classes. For example, the U.S. pension fund industry increased the amount invested in alternatives from $10 billion to $232 billion over the 1986–2001 period. In Europe, about €25 billion was allocated to alternatives in 2001 (Goldman Sachs 2001). Despite the immense growth in popularity nowadays, the long-term impact of alternative asset classes in the pension fund portfolio on the optimal risk-return trade-off is not yet fully understood. Investments in alternative asset classes might be used to diversify positions in traditional asset classes such as stocks and bonds. When returns on alternatives are positively related to returns on liabilities, they are even more attractive from a hedging perspective.

The proposed new regulation for pan-European pension funds consists of limitations on the trade in derivative instruments and alternative assets by pension funds.[1] Restricting pension funds from these investments might harm the participants in the pension schemes since asset allocation will be suboptimal. It goes without saying that pension funds should invest in these asset classes with care. In addition, sophisticated risk management tools are needed to control these positions.

[1] See, for example, "Spain to put the clock back," Investments and Pensions Europe, March 2002. For a description of differences in pension systems and regulation throughout Europe, see Legge (2002).

The remainder of this paper is organized as follows. In Section 2, I describe the newly proposed solvency requirements for the Financial Assessment Framework in the Netherlands. Other regulatory changes affecting Dutch pension funds are also covered in that section. In Section 3, the properties of some popular alternative asset classes are described. Section 4 examines the benefits of alternative assets for the solvency requirements set by the Dutch regulator and Section 5 concludes the paper.

2. New Solvency Requirements in the Netherlands

The old Pensions and Savings Act in the Netherlands dates back to 1954 and has been amended only marginally in almost 50 years, despite path-breaking insights in agency theory, portfolio choice, and risk modeling during this period. The need for a new Pensions and Savings Act is recognized and, over the past several years, stakeholders have been provided the opportunity to indicate the weaknesses of the old pension laws and make proposals for new regulation.

The poor solvency of pension funds since the stock market decline in early 2000 has called for new and improved supervision on their investment behavior and associated risks. The Dutch authority is now in the process of designing a new framework to control these investment risks. This new Financial Assessment Framework should be effective by the start of 2006 at the latest. While the details of the new framework still have to be determined, the three main requirements that pension funds have to fulfill each year are:

- *Minimum requirement*: The funding ratio, defined as the total (actual/market/fair) value of assets under management divided by the total (actual/market/fair) value of pension obligations, should be larger than 100 percent at each point in time.

- *Solvency requirement*: At the end of each year, the pension funds should indicate their expectation of the development of the funding ratio on a one-year horizon. Additional buffers above the minimum requirement

should be present, depending on the risks of the investments relative to the liabilities (i.e., mismatch) of the pension fund.[2]

- *Continuity requirement*: At the end of each year, the pension funds should indicate their expectation of the development of the funding ratio on a long horizon.

The minimum requirement used to be the basic assessment of the solvency of pension funds. As long as this requirement was fulfilled, the supervisory authority used to be satisfied. At one point, the Dutch government even proposed to tax pension funds with current funding ratio above a certain level ("overfunded"), without assessing future developments or mismatch risks in the fund's structure.

The solvency requirement is particularly relevant when the current funding ratio is near or below the minimum requirement. The current explicit statements about financial buffers implies that, depending on market conditions, funding ratios could be required to be above 135 percent. The pension fund board should submit a plan showing how solvency can be restored in the short term.

The Dutch regulator has recently issued a white paper with its ideas about the implementation of the solvency requirement. It has specified that the probability of underfunding should be less than 0.5 percent. Furthermore, the regulator prescribes a number of stress scenarios for which pension funds have to show that solvency remains adequate. The regulator wants to give an incentive for pension funds to monitor their own exposure by using risk models. The regulator could punish funds without proper risk models with a higher level of financial buffers.

This would link the pension fund regulation closer to the Basel Accord for banks, in which the value-at-risk (VaR) for banks play a crucial role.

[2] Currently, the regulator requires the buffers to depend on the performance of the fund over the recent period. The buffers should be such that a drop in equity prices of 40 percent below the highest level over the past 48 months, and 10 percent below the lowest level in the past 12 months can be absorbed. For fixed income, the buffers depend on the current interest rate. If the interest rate is 4 percent, buffers should be 10 percent, linearly declining until the interest rate is 6 percent, when no buffers for fixed income are required.

Both the quality of the VaR model used by the bank and the predicted VaR determine the reserve levels the bank has to hold. The task of the regulator is to check whether the internal models to determine these risks are adequate. The Dutch regulator has recently introduced restrictions on the expected returns for stocks and bonds, as well as expected inflation, as a measure to control existing asset-liability management models by pension funds to determine their future funding ratio.[3]

The assessment of continuity deals with the long-term prospects of the pension funds, in which short-run declines (or increases!) in bond or stock prices are ignored because of time diversification for investors with a long horizon. Campbell and Viceira (2002) indicate that, for investors with an investment horizon beyond 20 years, investments in stocks are only marginally more risky than bonds. The continuity assessment requires a more thorough asset-liability management study than the solvency requirement. Also here the task of the authority should be to verify whether the assumptions underlying the asset-liability management study are appropriately chosen. It is unclear to what degree the regulator will explicitly restrict parameters, such as expected returns, volatilities or correlations between assets and liabilities, compared to the solvency requirement. The regulator has published a white paper on its ideas about the continuity requirement in the fall of 2003, in which no further quantitative restrictions for the long term are put forward.

In addition to these regulatory changes in the Netherlands, more uniform international accounting standards demand that assets and liabilities are to be valued against market values, and profits and losses in the pension fund portfolio should be activated on the balance sheet and eventually on the income statement. The introduction of these accounting standards might give an incentive to the CFO of the firm to hedge the pension liabilities as much as possible to reduce the influence of the pension fund on the reported firm profits. However, it remains to be seen to what extent this influences pension fund investment policy, as we know that

[3] The Dutch authority requires the expected return on bonds to be at most 5 percent, the equity risk premium to be at most 3 percent and price and wage inflation to be at least 2 percent and 3 percent, respectively. The equity risk premium is set considerably below the historic average, but corresponds to the estimates of Fama and French (2002), who estimated the equity risk premium to be between 2.55 percent and 4.32 percent.

firms tend not to hedge their foreign currency exposure, which is a more straightforward activity. Hedging pension liabilities may be particularly fruitful for firms with high default risk, as negative returns on their pension scheme could cause bankruptcy in the short run.[4]

The move from actuarial valuation to actual or market-based valuation is a necessity for risk management purposes, which can be easily demonstrated by this simple example. Suppose a pension fund has to pay out an inflation-indexed claim of €1,000 with certainty in 20 years time. In the Netherlands, pension funds are allowed to value this claim by discounting against an actuarial real rate of (at most) 4 percent per year. The actuarial value of the claim is in this case €456. Suppose further that the assets of the pension fund is one zero-coupon bond that pays €1,000 plus inflation in 20 years, a perfect liability-hedging asset. The market value of assets in the pension fund portfolio also equals €456 if the current real interest rate is 4 percent, so the funding ratio is exactly one.

Suppose the real interest rate has increased during the course of one year to 5 percent. The bond on the asset side is worth €396, but the actuarial value of the liabilities has increased to €475. The funding ratio using actuarial valuation is now 83 percent. The use of actual values recognizes the perfect hedge between assets and liabilities by leaving the funding ratio 100 percent until the maturity of the fund. This latter valuation exposes the real risks of the pension fund (i.e., no risk) better than does the actuarial valuation. Note that, in the simple case of nominal obligations, market values are easily obtained, but the complicated structure of conditionally wage- or price-inflation-indexed obligations requires advanced modeling techniques to estimate this value. Attempts should be made to reduce valuation errors as much as possible, as they can cause a misleading picture just as much as actuarial valuations do.[5]

4 In May 2003, the Dutch company Akzo Nobel announced it wanted to change its DB pension system to a defined contribution system to reduce the influence of the pension fund returns. This move shifts the investment risk from the company to the employee. In the end of 2000, the U.K. company Boots sold its entire equity portfolio in order to reduce the short-term mismatch risk between assets and liabilities.

5 Note that, for the Dutch situation, by far the largest influence on the solvency of pension funds will be the change from the actuarial real interest rate of 4 percent to a substantially lower market-based rate, currently around 3 percent. Nijman and Swinkels (2003b) estimate the value of liabilities to increase about 21 percent if compulsory inflation indexation is accounted for. Over the period 1956–1996, the real interest rate is closer to 2 percent for the Netherlands according to Wolff and Ooms (1998). For the United States, we find a difference of 2.6 percent between returns on long-term government bonds and inflation over the period 1926–2001 (Ibbotson Associates 2002).

The integration of European markets has triggered the pension debate in the European Union (EU). Thus far, little progress has been made on European legislation concerning pension schemes, but the discussion is likely to remain relevant because many countries have been neglecting the pension problems arising from the aging societies in many European countries.[6] Large differences in regulation and organization of the pension fund industry are described in Legge (2002). The EU has thus far agreed that cross-border pension funds should be restricted in their use of derivatives and alternative investments. Prudent use of these instruments might decrease the risks of insolvency for pension schemes, but the operational risks (such as agency problems) with respect to these instruments have been considered a bigger threat. In the next section the pros and cons of current popular alternative investments are discussed, especially in relation to the solvency requirements for pension funds.

3. Alternative Investment Opportunities

As indicated in the introduction, pension funds have increased their exposure to alternative investments over the past decade. I investigated whether there is an economic rationale for this development (such as the effects on the solvency) or whether the popularity of these alternative assets is driven by the career concerns of fund managers.

A traditional pension fund portfolio consists of cash, government bonds and equities. Several pension funds have chosen to take exposure into alternative asset classes, including: alternative bonds (e.g., inflation-protected, commercial or emerging markets debt); real estate (listed or unlisted); alternative equities (e.g., private equity or emerging markets equity); and derivative, structured or hybrid assets (e.g., hedge funds). Let's first investigate why pension funds would invest in these alternative assets and then discuss to what extent these alternatives provide advantages to pension fund portfolios.

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[6] Frits Bolkestein has been one of the most active European Union commissioners in favor of a common market for pensions to increase labor mobility by starting legal procedures against countries that put up barriers against European integration on this matter.

The basis of Markowitz's portfolio theory is diversification: Introducing a new asset to the portfolio reduces the risk, given the level of expected return. Hence, increasing the set of basis assets with alternative assets improves the optimal risk-return trade-off for pension funds. These insights generate positive views on all alternatives because the more to choose from, the better an optimal decision can be made. However, the expected returns, volatilities and correlations are unknown (might be time-varying) and are, in general, hard to estimate. Spurious estimation results may distort optimal asset allocations and lead to an increase instead of a decrease in insolvency risk. Regulatory authorities might prohibit investments in several alternative asset classes to prevent pension funds from engaging in these unknown risks. Different restrictions of this type apply in several European countries.

The second reason alternative assets could be beneficial for pension funds involves their liability-hedging properties. See Sharpe and Tint (1990), for example, for a derivation of optimal portfolio weights for a mean-variance investor in the presence of liabilities.[7] Positive correlation between the return on alternatives and liabilities increases the weight in the alternative assets because, when liabilities become more expensive, the value of the asset side is also expected to rise. In the example in Section 2, the hedge between assets and liabilities was perfect. Inflation-protected bonds are attractive assets, since they're a good hedge against the fund's inflation-protected liabilities. Blake (2001) advocates that the optimal portfolio for pension funds consist of assets that provide the closest hedge for the pension liabilities. He argues that pension funds should invest in bonds with the same duration as the liabilities until the end of the observed term structure, and invest in stocks for longer-maturity obligations.[8] According to Blake, pension fund regulation should be such that this

7 The framework presented by Leibowitz et al. (1994) is a special case of the surplus optimization framework presented by Sharpe and Tint (1990). For full surplus optimization for a pension fund with an initial funding ratio of 100 percent, the two approaches are equivalent.

8 Elton and Gruber (1992) examined the portfolio problem of an investor with liabilities and showed that cash flow matching is always optimal, but that investments in active or duration matched portfolios depend on the degree of belief in market efficiency of the pension fund manager.

optimal allocation is not distorted.[9] His view, however, is not uncontroversial in this respect.

The third and, in my view, worst reason to start investing in alternatives is herding behavior to reduce peer group risk. Since the liability structure of each fund is different, the optimal asset allocation is fund-specific, and management incentives relative to peer group performance are unwanted and unnecessary. Frequently, fund managers start investing in new investment classes because colleagues have successfully entered a new market and not because they are well-informed about the potential return (and, hence, risk) distribution. These novel investment categories are bound to become bad news for the fund sponsors, as risks tend to be underestimated or expected returns tend to be overestimated.[10]

Let's investigate to which extent several popular alternative investment classes diversify the traditional asset portfolio, and their liability-hedging properties. For inflation-indexed DB pension schemes, the economic value can best be proxied by inflation-linked bonds. Recognizing this, Treasury Inflation Protected Securities (TIPS) should not be treated as an alternative asset class, but as the most important basic asset class, as it is, for inflation-protected retirement schemes, the closest asset to the risk-free.

One of the earliest alternative investments in the pension fund portfolio has been real estate. Dutch pension funds were for a long time restricted to take equity positions, and created equity market exposure by investing in unlisted real estate. Another rationale for investing in this asset class is its inflation hedge potential. However, the poor returns on investment and high asset illiquidity subsequently caused many pension funds to shift funds away from this asset category. Valuation of real estate generally takes place at low frequently, and correlation analyses at higher frequencies might easily lead to erroneous estimates of correlation with the market portfolio.[11] Hence, diversification benefits might be considerably

9 Blake further notes that, in the past, yields on inflation-linked bonds have changed considerably due to the changing insights of pension fund regulators.

10 Barberis and Shleifer (2003) introduce a model in which investors drive prices of a popular investment style up too much and are left with the negative returns when another style takes over popularity.

11 See Campbell, Lo, and MacKinlay (1997, Chap. 3) for models of nonsynchronous trading and the effect on the measurement of (auto)correlations.

overestimated. Listed real estate investment trusts (REITs) allow the market value of real estate to be valued at high frequency, but REIT returns tend to be highly correlated with the stock market index and, thus, real estate seems to provide only few diversification opportunities compared to the traditional portfolio of stocks and bonds (see, e.g., Froot 1995). Others claim that real estate is a good hedge against inflation on the long run, but there seems to be little empirical evidence in favor of this hypothesis.[12]

Reduced geographical diversification opportunities are used as an argument to invest in alternatives. Goetzmann, Li, and Rouwenhorst (2005) indicate that geographical diversification is still possible by holding more countries than before, but newly developing economies have to be included in the portfolio. Recent crashes in emerging markets have exposed the vulnerability of these developing economies, which lessened the appetite of institutions to invest in these countries. Nevertheless, the foregone diversification benefits of not investing in emerging markets might ultimately increase the long-term riskiness of the pension fund portfolio.

Another alternative investment is private equity. This is nothing other than unlisted equity. The shares of these unlisted companies are illiquid, and proper market valuation is therefore cumbersome. The equity nature of these investments suggests that their correlation with the equity market should be considerable. Nevertheless, a risk premium for liquidity might imply that expected returns on private equity are somewhat higher than on listed equity.[13] A higher average return for private equities may also mean that they are riskier on other dimensions. For example, unlisted stocks are generally issued by smaller companies, and small companies tend to contain more market risk.[14] Corporate governance for private equity is

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12 I estimate a correlation coefficient of 0.60 between the returns of the U.S. stock market and North American REIT (NAREIT) using quarterly data over the period 1973–2003. The quarterly correlation between U.S. stock returns and U.S. inflation over this period is – 0.16, and between NAREIT and inflation is – 0.13. See Ross and Zisler (1991) for a more detailed analysis on the risk and return of real estate. They claim that the expected return of real estate is somewhere halfway between bonds and equity.

13 Moskowitz and Vissing-Jørgensen (2002) claim that returns on private equity are not higher than on listed equity for the U.S. market.

14 Fama and French (1996) claim that small company stocks not only have higher market risk, but also serve as a proxy for a risk factor different than the equity market. The results, however, are not without controversy.

undertaken by several large shareholders and not by market discipline. It is as yet unclear what the exact impact of corporate governance is on the long-run expected return on the equity of these firms.

The added value arising from pension fund exposure to commodity markets dates at least back to Bodie (1980).[15] The price of commodities on the world market influences the production costs and consumer prices. Hence, exposure to commodity markets might partially eliminate the risk in inflation-protected liabilities, such as pension payments. Froot (1995) finds that commodities reduce the risk of a traditional portfolio more than real estate or the equity of commodity-related industries. Nijman and Swinkels (2003a) investigated the liability-hedging properties of commodities for U.S. pension funds and found that funding ratio risk can be reduced substantially for inflation-protected pensions, while, for nominal pension schemes, the benefits of investing in commodities are less obvious.

The results of Nijman and Swinkels (2003a) were driven not only by the negative correlation between the returns on traditional assets and commodities, but also by the positive correlation between commodities returns and the returns on inflation-protected pension liabilities. Their results indicate that commodities have a liability-hedging property in the sense of Sharpe and Tint (1990). This investment vehicle has additional advantages that it is tradable and fairly liquid, and that it does not rely on management ability because it is an a priori dynamic trading strategy in short-term commodity futures. Nevertheless, if all pension schemes start investing in these commodities, the price of these futures might go up, reducing the expected future returns.[16]

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[15] Other papers investigating commodity returns are, for example, Ankrim and Hensel (1993) and Lummer and Siegel (1993).

16 Several commodity markets are in "backwardation," which means that futures prices reflect that speculators are rewarded for providing hedging opportunities for commodity producers. Rolling futures with short maturity to longer maturity will generate positive returns when futures markets are "backwardated." When more speculators are willing to provide these hedges the "backwardation" will disappear or even become negative, known as contagion. The effects on the liability-hedging properties of commodities probably remain, but expected returns are reduced making them somewhat less attractive.

Chow et al. (1999) indicated that correlations among assets and alternatives seem to increase in extreme periods when diversification is most wanted. They found that diversification properties of commodities remain even in extreme situations.[17]

The latest vibe in pension fund management is the addition of hedge funds to the investment portfolio. The investment styles of these funds are highly diversified, which makes it hard to speak of a homogenous asset class. The common feature of hedge funds is that the investment behavior of their management is virtually unregulated. The potential danger of these strategies became visible to the world when it was widely reported in the press that Long Term Capital Management, a hedge fund advised by two Nobel-prize laureates, suffered huge losses on highly levered positions in the Russian bond market in 1998. Since hedge funds are not required to report their net asset value to a regulator, little is known about their average performance.

Several biases in collected hedge fund data are discussed by Fung and Hsieh (2000). Furthermore, long-run performance over business cycles is hard to predict with widespread voluntarily reported return data starting in the early 1990s. Agarwal and Naik (2003) used style analysis on this short horizon to derive the expected return in the long run and concluded that expected returns have lower than the average observed returns over the last decade. Since most hedge funds are black-box investment vehicles, meaningful risk management is virtually impossible and such style analysis is a reasonable approach.[18] Most institutional investors use fund-of-funds to gain exposure to this alternative asset class. Their historic average returns over the period 1927–2001 are estimated to be between 7 percent and 8 percent annually, with volatility around 12 percent; the stock market had a

17 The average return of the Goldman Sachs Commodity Index over the period January 2000–December 2002 has been + 11 percent per annum, while an internationally diversified stock index produced average returns of – 13 percent over the same three years.

18 Anecdotal evidence suggests that pension funds invest in hedge funds to circumvent the pension fund's own risk management system, for example, to get past short sale constraints. Risk management of such funds fails either because the restriction on short positions is unwanted, or because it is not able to identify risky short positions taken by the hedge funds. .

12 percent return per annum over the same period, with volatility of 19 percent.

Instead of investing in black-box investment vehicles such as hedge funds, pension funds could also use structured products containing derivative instruments. These products typically take the risk profile of the pension fund as the starting point and build a fully transparent payoff structure that suits the management of the pension fund. In general, these structured products are developed such that unacceptable risks are hedged, leading to smaller probabilities of underfunding and, hence, reduced solvency buffers. In many instances, however, the statutes of the pension fund do not allow the use of derivative instruments on a large scale. This is in contrast with the policy of the Dutch regulator, which encourages the prudent use of derivative instruments that reduce the risk of insolvency.

4. The Impact of Alternatives on Solvency Requirements

Section 2 discussed the three requirements set by the Dutch authority on pension funds: the minimum, solvency and continuity requirements. In this section, I present an illustrative example on the impact of alternative assets on these three regulatory assessments.

The current funding ratio is, at least in principle, a known (deterministic) variable, calculated by dividing the current value of assets by the current value of liabilities. Blake (2001) claims that the financial economist's value of liabilities is independent of the assets in the portfolio. I agree with this view if the dependence of the pension fund's default probability and its asset allocation are assumed to be absent. If the asset allocation of a pension fund implies that the default probability is increased substantially, the value of existing pension claims is reduced due to the possibility that the claims will never be paid by the fund. Thus, assuming that the portfolio choice does not influence the fund's probability of default, the assets and liabilities can be valued without knowledge of the particular asset allocation. Despite this assumption, the minimum funding requirement in the new Dutch system is sensitive to the asset allocation, as the solvency margin depends on the asset allocation.

The recent proposals on the solvency requirements state that the probability of underfunding within one year should be less than 0.5 percent. Table 1 illustrate the impact of such requirement with a simple, stylized example.

Table 1
Stylized Parameters for Asset Returns

	Expected Return	Volatility	Correlation Bonds	Correlation Stocks
Bonds	5.0%	8.0%	1.0	0.2
Stocks	10.0	20.0	0.2	1.0
Hedge Fund	7.5	10.0	0.0	0.2
Commodities	7.5	20.0	0.2	-0.3

Note: Expected returns and volatilities are in percentages per year.

Let us first investigate the case without alternatives. Assume that the fund has a short position in the bond (liability) and long positions of 50 percent in bonds (liability hedge part) and 50 percent in stocks (speculative part). Assuming normality of returns, the required initial funding ratio is about 130 to satisfy the solvency requirement.[19] The empirical observation that extreme return probabilities tend to be underestimated by normal distributions would imply that the initial funding ratio should be even higher.

Table 2 displays, for some portfolio allocations, the expected return on the funding ratio and the volatility of the funding ratio. When a position in alternatives is financed with an equal position in stocks and bonds, the expected return on the funding ratio remains the same, so the costs of the pensions are unaltered. Using the expected returns, volatilities and correlations of Table 1, we find that the alternative hedge funds reduce the funding risk less than commodities do.

[19] The normality assumption is a proxy at best, especially for hedge fund returns. This illustration could be made more realistic by incorporating higher-order moments, such as skewness and kurtosis, or copulae to model the dependency structure.

Table 2
Initial Funding Requirements Including Alternative Assets

Bonds	Stocks	Hedge Funds	Commodities	Expected Return	Volatility (std. dev.)	Initial Funding
100%	0%	0%	0%	0.0 %	0.0 %	100.0
50	50	0	0	2.5	10.0	130.3
40	40	20	0	2.5	9.1	126.5
40	40	0	20	2.5	7.8	121.3
50	30	20	0	2.0	7.2	119.8
50	30	0	20	2.0	6.1	115.9

Notes: Using the asset allocation of the first four columns, the expected return and volatility of the funding ratio are displayed, using the parameters of Table 1. The last column contains the minimum initial funding ratio for which the probability of underfunding is below 0.5 percent, assuming normality of returns.

The minimum initial funding ratio required for a probability of underfunding less than 0.5 percent reduces from 130.3 to 126.5 and 121.3, respectively. The reduction of this buffer means that the sponsor company has less capital locked up in its pension fund, which it can use for its core business instead. Reduction of this buffer is more than twice as big when commodities are added than when hedge funds are added. Note that the results from this stylized example depend on the parameters of Table 1, and differences in input may lead to different outcomes. The appendix shows some robustness analyses when expected returns and correlations are altered. In general, for short-term risk management purposes, the correlations are more important than the correct specification of expected returns.

The influence on the continuity assessment is a complicated problem. Campbell and Viceira (2002) use vector autoregressive models to compare long-term volatilities on stocks and bonds. They argue that stocks are much more volatile, relative to bonds, in the short run, but the difference in volatility on longer investment horizons is much smaller. This observation has large implications for strategic asset allocation for pension funds because, in the long run, the risk-return trade-off is more advantageous for stocks than bonds. We know very little about long-horizon expected returns and volatilities of alternative asset classes. Nevertheless, investigating

which assumptions are consistent with the current pension fund investment strategy provides insight into its sensibility. In the long run, return on investment should be sufficient to pay out all pensions. Several Dutch pension funds have recently discovered that their current contribution ratios (often below 10 percent of wage) imply that the expected return on risky assets is more than 12 percent per annum. If this assumption is not realistic, contributions should be increased substantially or the pension payments will be less generous in the future.

5. Conclusions

Recent developments in financial economics have found their way into pension fund management and regulation in the Netherlands. The basic principle underlying valuation of claims on both the asset and liability side of the balance sheet is that the market determines how much it is worth (instead of an artificial value). This has direct implications for asset allocation, as assets that hedge the liabilities reduce the risk in the funding ratio, something that was not taken into account using actuarial valuation.

The increasing popularity of alternative investments in pension fund portfolios can be understood as part of the speculative portfolio, if it has high expected returns, or as part of the hedging portfolio, if it has high correlation with returns on liabilities. I am skeptical about the benefits of alternative asset categories such as hedge funds, private equity and (unlisted) real estate for pension funds, since they correlate highly with the liquid equity market, and there is little evidence for superior expected returns on these asset classes. Inflation-linked bonds or commodities provide hedging opportunities for the liabilities of the pension fund and are, therefore, promising asset classes to reduce the short-term risks on the funding ratio.

The true unconditional expected returns on these asset classes are of key importance for analyses with a long horizon. Unfortunately, estimates for these key parameters are generally unreliable due to limited data availability. More research in this area may provide better advice on strategic asset allocation and the risk management of pension funds and their sponsor companies.

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Appendix

Robustness Analysis

Hedge funds may have expected return equal to stocks, while commodities may have expected returns equal to bonds. The complete set of parameter choices is displayed in Table A1.

Table A1
Stylized Parameters, Different Expected Returns on Alternatives

	Expected Return	**Volatility**	**Correlation Bonds**	**Correlation Stocks**
Bonds	5.0%	8.0%	1.0	0.2
Stocks	10.0	20.0	0.2	1.0
Hedge Fund	**10.0**	10.0	0.0	0.2
Commodities	**5.0**	20.0	0.2	– 0.3

As can be seen from Table A2, the difference in initial funding ratio only marginally decreases for a 2.5 percentage point increase in expected returns. In addition, the lower expected returns for commodities only slightly increase the initial funding ratio required for the solvency test with a one-year horizon. This suggests that the covariance structure is more important for short-run risk requirements.

Table A2
Initial Funding Requirements Including Alternative Assets

Bonds	Stocks	Hedge Funds	Commodities	Expected Return	Volatility (std. dev.)	Initial Funding	Old Initial Funding
100%	0%	0%	0%	0.0 %	0.0 %	100.0	100.0
50	50	0	0	2.5	10.0	130.3	130.3
40	40	20	0	**3.0**	9.1	**125.7**	126.5
40	40	0	20	**2.0**	7.8	**122.1**	121.3
50	30	20	0	**2.5**	7.2	**119.1**	119.8
50	30	0	20	**1.5**	6.1	**116.6**	115.9

Notes: Numbers in bold are different from Table 2. The last column contains the funding ratio of Table 2 for ease of comparison.

The covariance structure between traditional and alternative assets and liabilities can be altered in many dimensions. I display here what happens if correlations of hedge funds are changed such that they are more attractive to be included in the portfolio, while commodity return correlations are changed such that they are less attractive. The changed correlation structure is given in Table A3.

Table A3
Stylized Parameters, Different Correlations of Alternatives

	Expected Return	Volatility	Correlation Bonds	Correlation Stocks
Bonds	5.0%	8.0%	1.0	0.2
Stocks	10.0	20.0	0.2	1.0
Hedge Fund	7.5	10.0	**0.2**	**0.0**
Commodities	7.5	20.0	**0.0**	**-0.2**

Table A4
Initial Funding Requirements Including Alternative Assets

Bonds	Stocks	Hedge Funds	Commodities	Expected Return	Volatility (std. dev.)	Initial Funding	Old Initial Funding
100%	0%	0%	0%	0.0 %	0.0 %	100.0	100.0
50	50	0	0	2.5	10.0	130.3	130.3
40	40	20	0	2.5	**8.5**	**124.1**	126.5
40	40	0	20	2.5	**8.7**	**124.9**	121.3
50	30	20	0	2.0	**6.6**	**117.6**	119.8
50	30	0	20	2.0	**7.0**	**119.1**	115.9

Notes: Numbers in bold are different from Table 2. The last column contains the funding ratio of Table 2 for ease of comparison.

In Table A4 the volatility and initial funding ratio are shown when the correlation structure from Table A3 is used instead of those from Table 2. The parameters have been changed such that the funding ratio volatility is lower compared to the addition of commodities. Since the expected returns have not been altered, the change in correlation structure is responsible for the change in minimum initial funding ratios. Although the effect is not large (between 2 and 4 percentage points), inclusion of alternatives in an optimal investment portfolio is affected by the correlation structure. A more detailed investigation of (time-varying) correlation structures, especially when markets are in distress, might provide better advice for asset allocation.