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Abstract

In the Netherlands, the typical pension contract nowadays comprises an average earnings defined benefit pension in which only nominal benefits are guaranteed, but with the intention to provide wage indexation. In the new supervisory regime, the guaranteed pension rights, based on market valuation, are subject to risk-based solvency requirements. Provisioning is not required for conditional pension rights, though contributions have to be consistent with the indexation ambition, as communicated with the participants. This paper analyses to what extent indexation is indeed likely, given different indexation and contribution policies. Thereby, it explains how intergenerational risk sharing in defined benefit pension plans can provide a reasonable insurance of pension benefits against wage or price inflation. Moreover, it illustrates the tenability of defined benefit pension plans under ageing, the new fair-value accounting regimes, and possible volatility on financial markets. The analysis is based on a stochastic Pension Asset and Liability Model for the Netherlands (PALMNET). According to the PALMNET simulations, voluntary provisioning for indexation is to be recommended. Without reserving, indexation cuts may be severe and the solvency requirements incidentally lead to extreme premiums. Fully guaranteed indexation is virtually unaffordable under the new supervisory regime, because the real discount rate is generally both very low and volatile.

Keywords: Average wage defined benefit pension; Monte Carlo simulations; Regulation

J.E.L. Code: C15, C59, G23, J18

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1 Introduction

An inflation-proof pension scheme is a very valuable asset for pension fund participants.[1] Generally, only inflation-proof pensions can protect them from financial insufficiency after retirement.[2] The provision of insurance against wage or price inflation based on intergenerational risk sharing is even considered an important reason for the existence of defined benefit pension funds (Ponds, 2003). In the Netherlands, indexation of pension benefits to either wage or price increases has long been considered a guaranteed right. Although indexation used to be conditional on the pension fund's financial position, in practice full indexation was virtually always given. In the communication to pension beneficiaries the possibility of indexation cuts was not given much attention. The adverse stock market returns during 2000-2002 have radically changed this perception and practice of automatic indexation, as many pension funds became severely underfunded. In order to recover, not only were pension premiums increased firmly, but indexation was reduced as well. Moreover, many pension arrangements were renegotiated and, as a result, changed from a conditional defined benefit (DB) final wage system to a conditional DB average earnings scheme. Consequently, indexation cuts can not only be applied to pensioners but also to active workers.

Although the stock market crash certainly triggered the increased use of indexation cuts, other developments also contributed to financial fragility of pension funds and, hence, indexation cuts. First, interest rates have dropped considerably over the last decade. These low interest rates imply lower expected future returns, raising the discounted costs of future pension benefits. Under the current regulatory regime, the actuarial interest rate, used to calculate pension premiums and the funding ratio of the fund, remained constant at 4%. Therefore, the gradual deterioration of the funding position was not well detected and premiums had decreased far below the cost-covering level. A second, though related, reason for the pension funds' financial weakness is the gradual change in the investment portfolio of pension funds. With the decline in (real) interest rates, a bond dominated portfolio no longer guaranteed sufficient returns to safeguard indexation, given the contribution level. One of the responses of pension funds was to invest more in the stock market, which increased average returns, but also mounted risk. A third reason for applying indexation cuts more often is the change in international accounting rules (IFRS). Companies with DB pension plans are obliged to report the assets and liabilities of their pension fund on their own balance sheet. As this will increase the volatility of their results, companies have focussed on

[1] Not only private but also public pension systems tend to index benefits, see e.g. Weller (2004), Table 6.

[2] Summers (1983) on the other hand, claims that indexation guarantees in pension contracts will generally not be efficient as pension beneficiaries are much better hedged against inflation risk, for instance due to home ownership, than are the bearers of pension liabilities. Assuming total compensation for employees is equal to their marginal productivity (Sharp, 1976), such inefficiencies also reduce welfare for workers.

other instruments to absorb the pension funds risks, including through indexation cuts.[3] Finally, the aging of the population increases the ratio of pension liabilities to the total wage bill. Consequently, the premium instrument will become less effective to absorb adverse developments.

Partly in response to the changing environment, at the end of the 1990s the Dutch supervisor of pension funds started the development of a new supervisory regime. Early 2007, this new Financial Assessment Framework (*Financieel Toetsings Kader*, FTK) will become effective. A dilemma in designing such a supervisory framework is that, on the one hand, it should be strict enough to safeguard the solvency of relatively weak funds, but, on the other, it should not be too restrictive, as this might induce excess volatility or interfere with the optimal policy of a fund. Moreover, overly strict rules might induce pension fund sponsors to change the pension contract (reduce guarantees or even switch to defined contribution).[4] In the FTK, a balance is sought by prescribing relatively strict solvency requirements for guaranteed (in practice, nominal) pension rights, whereas much more flexibility is given regarding conditional rights (such as indexation). For guaranteed rights, the new regulatory regime is in line with modern finance views in the sense that market valuation is not only applied to assets but also to liabilities, and that more risk taking results in higher required buffers. In principle, guaranteed commitments should always be fully funded. For conditional rights, provisioning is not required, though pension contributions and policies have to be consistent with communicated indexation ambitions. Pension funds are required to disclose their indexation ambitions to their members, including a realistic estimate of the likelihood of success in pursuing this ambition. In addition, pension funds have to ensure consistency between expectations raised, finances, reserves and actual indexation decisions. Thus, as a result of increasing consistency between expectations and outcomes, confidence in Dutch pension funds may be strengthened. Like the FTK in general, these rules impose minimum requirements or constraints without making explicit recommendations regarding pension funds' policies.

The purpose of this paper is threefold. First, it investigates to what extent the new Dutch regulatory regime does indeed achieve greater clarity with respect to indexation ambitions. Second, it analyses whether and to what degree FTK's minimum requirements can provide reasonable guarantees that indexation ambitions will be realised. And third, it assesses whether the FTK regime is overrestrictive on funds that already pursue sound policies. These questions are analysed with the help of the Pension Asset and Liability Model for the Netherlands, named PALMNET (Van Rooij, Siegmann and Vlaar, 2004). Although our analyses are based on Dutch data, the approach is rather general, so that the results can easily be generalised. Hence, this paper

[3] A number of companies have moved to defined contribution (DC) systems, which are not subject to these reporting requirements. In such DC systems, there is no indexation issue.

illustrates how intergenerational risk sharing in defined benefit pension plans can still provide a reasonable insurance of pension benefits against wage or price inflation, also under difficult conditions such as ageing, the new fair-value accounting regime, and volatility on financial markets.

The structure of this paper is as follows. Section 2 provides an overview of the three-pillar pension system prevailing in the Netherlands and explains the main principles of the new minimum supervisory requirements laid down in the FTK. Section 3 describes the main features of the PALMNET model, especially on the adjustments to make it FTK-compatible. Section 4 gives the outcome of the PALMNET simulations, showing probability distributions of the results over time for each of the model's key variables. Section 5 summarises and concludes.

2 Pension schemes in the Netherlands

The Dutch old age pension system may be compared with a three-stage rocket. The first stage is a national insurance scheme which provides a basic pension for every person over 65 (in Dutch indicated by AOW). These AOW benefits are financed according to the pay-as-you-go method, that is, the government levies contributions as a component of income taxes. The second stage consists of mandatory company-wide or industry-wide pension schemes for employees for a pension in addition to the AOW benefit. This stage of the Dutch pension scheme is funded and covers almost all employees. The third stage comprises savings schemes of life insurance firms which people arrange individually. The second and third stage savings benefit from tax privileges, provided certain conditions are met.

The Netherlands has around 600 company pension funds and 100 industry-wide pension funds. End 2004, they managed € 540 billion in pension capital (111% of GDP). Besides pension funds, life insurance companies directly manage about one quarter of second stage pension schemes. In 2004, gross pension premiums to pension funds added up to almost € 23 billion, whereas their pension benefits amounted € 16.5 billion against annual AOW payments of € 22.9 billion. Pension funds serve around 6 million active employees, 2.4 million pensioners and 8 million currently non-active members (in part active employees in other funds). Participation in the pension scheme offered by the employer is compulsory for each employee by law. Pension contributions are spread over employer and employee, where the employer often takes most of the burden. Almost all pension schemes managed by pension funds are of the defined benefit (DB) type (99%),[5] whereas insurance companies primarily (71%) offer defined contribution (DC) schemes. Most DB pension contracts guarantee only a nominal pension, but price or wage

[4] According to Davis (2004), the increased burden of regulation in the UK since the mid-1980s has lead to the closure of most private defined benefit schemes to new entrants.
[5] Currently, a number of pension funds consider a shift from DB to (collective) DC.

indexation is aimed for. In recent years, we observe a gradual move from final pay pension schemes to average earnings schemes. In an average earnings scheme, a person's pension benefit is linked to the average pay earned over the years, whereas in a final pay scheme, the benefits are related to the last-earned salary. The average earnings schemes make it easier to control the cost of pension contributions, as adjustments of benefits to wage or price inflation can be reduced (also for active workers) when pensions capital are insufficient. Moreover, there is no need to increase existing pension benefits in the case of career moves (the so-called backservice).

Internationally, the Dutch system of old age provision is quite unique, see for instance Kuné (2003). Only few countries have saved for their second stage pensions in a comparable manner via a compulsory fully funded system and cover almost all employees. In the UK and the US, countries which have also built up a substantial pension capital (in percentage points of GDP) through funding schemes, DC schemes dominate the market and their proportion is increasing (Blake, 2000). As in many European countries, the number of persons over the age of 65 as a percentage of the 20–64 age group will double in the next 25 years. In international terms, the post-WWII decline in the birth rate came late in the Netherlands, so that the ageing of its population will peak at a relatively late stage.

The decline in share prices during 2000-2002 has revealed that pension liabilities of some Dutch pension funds were not covered sufficiently by pension capital to be able to overcome protracted unfavourable market developments. The prolonged decline in long-term bond rates towards historically low levels also challenges the solvency of pension funds. Up till now, the pension liabilities are calculated on the basis of a fixed actuarial interest rate of at most 4% (a number that has not been changed since 1969), which was considered a conservative estimate of the expected long run return on the asset portfolio. Under FTK, the fixed actuarial interest rate to calculate liabilities is replaced by the market rate. This new framework imposes minimum requirements on pension funds. In accordance to the current and the coming new Pension Laws, the FTK distinguishes sharply between guaranteed (which in practice means: nominal) pension entitlements and conditional rights to indexation linked to wage or price inflation. Pension funds only have to provision for unconditional pension liabilities, with the size of the mandatory provisions based on those liabilities' current market value.[6] If, due to adverse circumstances, the funding ratio (i.e. the ratio between a fund's assets and its mandatory provisions) falls below 105%, this rate has to be restored by some means or other, under normal conditions within one year. This may be done by (a combination of) reducing or eliminating indexation, increasing contributions, receiving a subordinate loan, or by renegotiating the unconditional rights (between the management and trade unions). In exceptional circumstances, the supervisor can allow for a

[6] For pension funds providing a nominal guarantee only, this value is calculated by expressing expected benefits in cash against the nominal term structure of interest rates. If an additional indexation guarantee has been given, the *real* interest rate term structure must be used.

longer recovery period. The nominal funding ratio must, in principle, be sufficient at all times to maintain a less than 2.5% probability of insolvency (defined as a funding ratio below 100%) within one year. For an average pension fund, this implies a nominal funding ratio of 130%. If the nominal funding ratio falls below this minimum, a recovery plan must be implemented (consisting of extra contributions and/or indexation cuts) that redresses the shortfall within the next 15 years. Provisioning or premium surcharges for conditional pension rights (e.g. indexation) are not mandatory, as long as full consistency between ambition, expectations raised and actual indexation decisions is preserved. By means of a so-called continuity analysis, funds should explain to their members what the outlook for indexation exactly is.[7] Pension funds should levy a so-called cost-covering premium including normal costs of guaranteed rights, administrative costs, normal costs of conditional rights, and costs to build up the solvency buffer. The actual premium will thus be higher if the buffer is too small. Premiums below cost-covering level are only allowed if the funding ratio is high enough to guarantee both conditional and unconditional pension rights without endangering the solvency of the fund. To calculate the premium, pension funds can either use the actual market rate, a moving average of past market rates and/or portfolio returns with a maximum smoothing period of ten years, or a fixed rate. Smoothing or fixing is allowed for in order to mitigate the volatility of premiums.

3 The PALMNET model

We use the model PALMNET to evaluate a range of pension fund policies with increasing levels of indexation ambition. PALMNET is a model of the average Dutch pension fund, assuming an average earnings defined benefit system. This model describes future pension fund behaviour in a stochastic setting. The view that stochastic simulation models are an invaluable tool for pension funds has long been recognised. Early examples are Wilkie (1986, 1995) for the UK and Boenders (1997) for the Netherlands. In PALMNET, the inflation rate, interest rates and stock market returns are stochastic variables. Interest rates are based on a two factor term structure model, where the factors are the short-term nominal interest rate and expected inflation (see Appendix). Expected stock market returns are three percentage point higher than the five year interest rate, with a volatility of 18% annually.

Regarding the pension contract, only the nominal part of the benefits is guaranteed, although the ambition is to index benefits to wage inflation, in line with common practise in the Netherlands.[8] In the model, this indexation objective is expressed in a prominent role for the real funding ratio,

[7] Although, at the moment, the requirements of the continuity analysis are not yet known, the continuity analysis should show how realistic the assumptions are regarding recovery after unfavourable shocks.
[8] An alternative such as indexation linked to price inflation is also possible.

that is, assets divided by total liabilities, discounted by a real rate.[9] This real funding ratio is the key variable that decides both whether or not pension commitments are indexed to wage inflation and what the level of contributions is. To discount total liabilities (including conditional indexation), the real discount rate can either be based on the current or smoothed market rate, possibly augmented by a risk supplement, or a fixed discount rate. This fixed rate is determined as a conservative estimate of expected returns on a representative investment portfolio, a 50/50 mix of bonds and equities. In the settings assumed in this paper (5-year interest rate 4.6%, equity risk premium 3%, wage inflation 3%), this amounts to a value of 3.1%.[10] Contribution policy is assumed to aim at a real funding ratio ('target coverage') that is just high enough to maintain a less than 2.5% probability of the real funding ratio falling below 100% within one year. At the chosen parameter values, this is the case if the real target funding is 122%.[11] Naturally, if the share of equities is larger, the real funding ratio increases also to reflect the increased risk.

The moment the target funding level has been attained, contributions are levied at the actuarial rate until a real funding ratio of 125% is reached. From there, contributions are reduced at a linear rate down to nil at a 140% real funding ratio. However, if the real funding ratio is below the target, a contribution mark-up is levied that is expected to be sufficient to restore the target funding ratio in 15 years' time. Indexation is applied in full if the real funding ratio is 105% or more, and declines at a linear rate to reach nil if the real funding ratio falls to 85% or less. When the real funding ratio is 125% or higher, past indexation cuts are made up for.

Besides the real funding ratio, PALMNET also calculates the nominal funding ratio, using the actual nominal term structure of interest rates. In the baseline version of the model, this funding ratio is not given an active role. In the FTK-compatible version, however, the nominal funding ratio does play an important role:

1. If the nominal funding ratio is below 105%, a contribution is levied that is expected to be sufficient to restore nominal funding to 105% within the year. The model does not incorporate alternative solutions such as receiving a subordinate loan, renegotiating the unconditional rights (between the management and trade unions), or use a longer recovery period, as, in exceptional circumstances, may be allowed by the supervisor.
2. Apart from the recovery mark-up on contributions needed to regain the target *real* funding ratio in 15 years' time (to secure indexation), a second recovery mark-up is calculated if the *nominal* funding ratio falls below target (which is about 130%), intended to restore that target in 15 years' time (to secure the unconditional commitments). The higher of both mark-ups is

[9] Ambachtsheer (1992) analyses a pension fund's optimal buffer ratio in relation to inflation protection for beneficiaries. He also gives an overview of actual behaviour of Canadian pension funds in the late eighties, which revealed that the actuarial approach of many firms did underestimate the impact of inflation.

[10] Enlarging the share of equities does not raise the discount rate, because the discount rate applied within PALMNET is based on a *representative*, not the *actual* portfolio.

applied. Although the new regulation does not explicitly require provisioning for conditional commitments, such as indexation, a role for the real funding ratio is still acknowledged, because it indicates the extent to which indexation ambitions are funded. A fund that takes its indexation ambitions seriously should adjust its policy accordingly.

3. Indexation cuts are not only triggered by too low real buffers, but also by a low nominal funding rate. Indexation is cancelled if the nominal funding ratio falls below 105%, while between 105% and 130%, indexation is increased in linear terms from nil to full indexation.

Besides the role for the nominal funding ratio, PALMNET's FTK-version also features a higher cost-covering premium (including a mark-up for building a capital buffer), and this premium level has to be maintained up to a relatively high funding level. Moreover, even under 15-year recovery plans, contributions are assumed not to rise too rapidly.[12] Hence the annual increase is limited to 3 percentage points of the contribution basis. This limit is, however, not applied to nominal underfunding, because of the one-year recovery requirement. In all cases, it is assumed that pension contributions can not be higher than 50% of the premium base (about 28% of gross wages).

As there are also pension funds with weaker (or no) indexation ambition, and as provisioning for conditional indexation is not obligatory, PALMNET can also be run without a prominent role for the real funding ratio. The simulations start in 2002, the year in which the funding ratio reached rock bottom, and end in 2100. The pension wealth evaporated during the end of the nineties needs to be replenished, on top of the pension provisions in the equilibrium situation. Simulation results will be worse for a pension fund, whose initial financial position is less favourable.

4 Simulation results

Within the framework of the FTK, pension funds should make at least three crucial decisions with respect to indexation:[13]

a the level of indexation ambition,

b whether indexation is guaranteed or conditional, and

c in the case of conditional indexation, whether voluntary provisions are made which are earmarked for indexation.

Following these three criteria, we simulate results under the FTK regime for four different hypothetical pension funds with increasing indexation ambition. The first fund makes no explicit

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[11] Although the equivalent nominal funding ratio depends on current interest rate developments, its average level in the model simulations is 163%.

[12] This rule of thumb of PALMNET is not based on FTK requirements.

[13] One of the auxiliary documents underlying the FTK regime contains a so-called indexation matrix, which distinguishes several indexation classes that represent increasing levels of ambition.

indexation commitments, though indexation is given if sufficient capital is available. The second fund has the ambition to index pensions to wages, but does not pursue an explicit policy to build up reserves for this. However, premiums do reflect this ambition. The third fund has the same ambition, and, moreover, an explicit strategy to maintain an adequate provision for this ambition. The fourth fund is even more ambitious as indexation is guaranteed. These simulations are compared to a variant prepared with the baseline version of PALMNET, where the nominal funding ratio has no role (that is, without the FTK requirements). The conditional indexation assumption and the focus on the real funding ratio in this benchmark scenario are identical to those for the third pension fund.

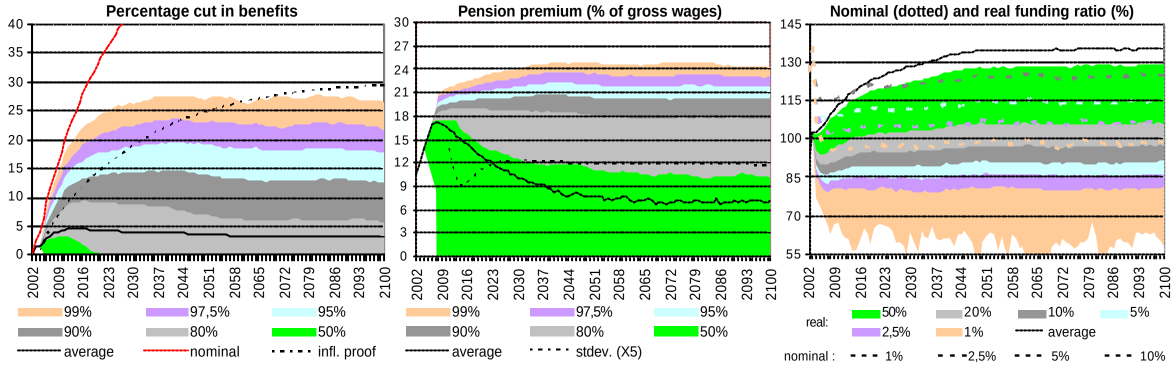
Simulations start off from the situation applying to the average pension fund at end-2002. Realised figures with respect to interest rates, returns on investments and wage developments for the year 2003 were used as input, while the 2004 level and those of later years were simulated. Also with respect to the asset mix, the choice of the average pension fund with 50% equity and 50% bonds, was assumed in all simulations. As in practice, the average bond duration is taken to be five years, even though a higher bond duration might be beneficial for pension funds (Vlaar, 2005).

1 Base variant without FTK requirements

The Dutch pensions industry has voiced many complaints about the strict requirements imposed by FTK, especially the limitation of the recovery period to only one year in case of nominal underfunding. This requirement is said to make any nominal mismatch unacceptably risky, leaving little room to pursue an investment policy aimed at securing indexation. In order to test this hypothesis, we first show results for a benchmark version of PALMNET. This first benchmark variant, referred to as the 'base variant' or 'Variant 1', does not take the FTK requirements into account. The baseline version of PALMNET uses a 3.1% fixed discount rate to calculate liabilities and pension premiums. The fixed discount rate method better exploits the long term perspective of pension funds, leading to less volatility and lower cost, see Van Rooij, Siegmann and Vlaar (2004) and Vlaar (2005). The pension fund's policy is aimed at realising its long-term indexation ambitions, which is reflected in a real funding ratio target of 122%. No separate role is played by the nominal funding ratio.

Pension contributions initially rise from 10.5% in 2002 to an average of 17% in 2007, in order to repair the buffer capital (see Figure 1). The real funding ratio increases from 94% in 2002 to 115%, on average, in 2012, and thereafter continuing a gradual rise up to about 135%. Contributions are allowed to decline slowly, despite a non-negligible probability that, in scenarios with adverse market conditions, they may remain high or even continue to rise. Because returns generated by the enlarged buffer capital contribute to further funding, average contributions may be permitted to come down gradually, in the course of a few decades, to some 7%. Contributions to the median fund, however, decline to 10% rather than 7%. This asymmetry is caused by the fact that substantial contribution refunds take place when the real funding ratio exceeds 200%, a threshold chosen by the authors. There is a small chance of contributions remaining high (e.g. at least 20% after 10 years with 10% probability) or even increasing (to more than 25% with 1% probability). Contribution volatility, calculated as the average 10-year standard deviation, is circa 2.4%, implying that unforeseen developments in capital markets (with respect to stock prices and bond rates) may cause real-world contributions to deviate substantially, over time, from their 'average' modelled development.[14] During the initial years, indexation is cut because of insufficient capital buffers. The average benefit level comes out only about 3% lower than it might have been without indexation cuts. Dispersion, however, is huge: the long-term probability of no cuts being applied at all is about 64%, but there also is a 10% chance of 13% or deeper cuts and a 1% chance of over 27% cuts. In the long term, an indexation ambition striving to compensate for wage inflation is quite likely to be achieved. The problem is, however, that the need to cut indexation arises just when inflation becomes unexpectedly high.

Figure 1: Base variant, no impact of nominal funding ratio.



Nominal funding never falls short. The probability of the nominal funding ratio sliding off below 105% is constant at just over 2%. This result suggests that the strict nominal solvency requirements of the FTK are hardly necessary for pension funds with serious indexation ambitions. However, one should be aware that these relatively good results are based on correct investment return assumptions. As the continued use of the 4% actuarial rate in the Netherlands shows, a fixed rate method bears the risk that too optimistic return assumptions are maintained in an environment changing unfavourably. The probability of real underfunding is about 13% in the long run, substantially higher than the 2.5% used to derive the real target ratio. This is because the 2.5% probability of underfunding applies only if the capital buffer is at or above its target level. During a recovery period, this probability is higher. Recovery is not always completed within 15 years, both because recovery roadmaps are based on expected returns and because contribution increases are subject to limitations.

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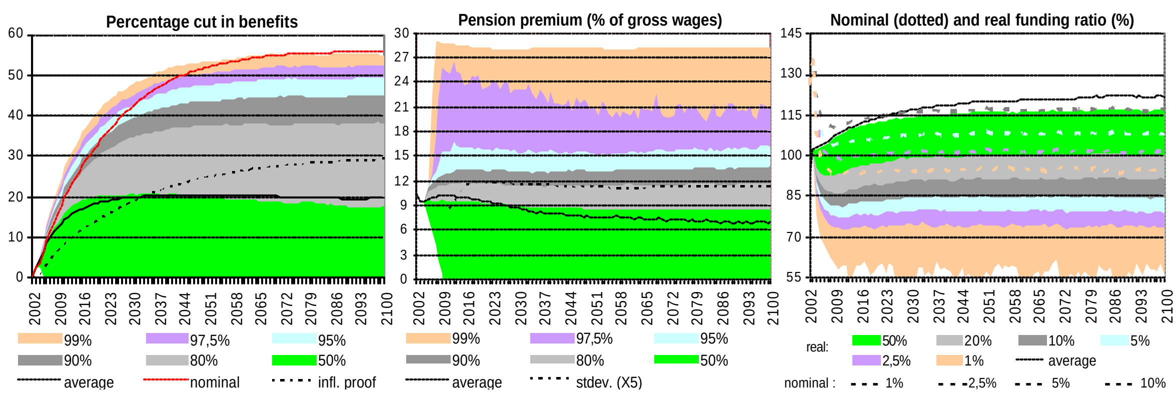
[14] Premium restitutions are set to zero when calculating the standard deviation.

2 Policy of no indexation ambition

Variant 2 describes pension funds without explicit indexation commitments, and thus without any obligation to provide funding earmarked for indexation. Indexation may be applied, the funding ratio permitting, on a case-by-case basis. In this 'incidental indexation' variant there is no voluntary provisioning, nor any indexation mark-up on the contribution. The variant is based on the market valuation principle, with the current nominal interest rate term structure used to determine contributions. The use of a fixed discount rate or smoothed historical interest rates or investment returns, to determine contributions is not formally ruled out for this class, but it would not be realistic to allow a mark-up on the discounting rate for such threadbare schemes. The fact, moreover, that the nominal liabilities are guaranteed makes a mark-up less attractive, because a higher discount rate would increase the risk of nominal underfunding to an excessive level. Indexation may be financed partly from surplus returns on investments, since expected returns exceed the nominal interest rate. Returns on investments might be expected to be around 1.1 percentage point above the nominal 16-year rate, i.e. the discount rate used to calculate the nominal funding ratio and the contributions. Even if we take the returns on the capital buffer into account as well, such a fund may not expect to provide even inflation-proof pensions without levying extra contributions.

Figure 2 shows the results for this incidental indexation variant. In this setting, the real funding ratio, based on a fixed discount rate of 3.1%, is used to determine whether indexation can be granted and whether premiums can be reduced. Below a real funding ratio of 105% no indexation is given, linearly increasing to full wage indexation at 125%. From a real funding ratio of 125% on, first previous indexation cuts relative to full wage indexation are repaired, after which premiums are linearly reduced to zero at a real funding ratio of 140%. Contribution refunds are, as before, carried out above a 200% real funding ratio.

Figure 2: No official indexation ambition, discounting by current nominal interest rate



As the long term nominal interest rate at the end of 2002 and 2003 is still about 5%, on average, pension premiums do not have to rise initially. As a consequence, however, the financial position of the pension fund is not improving substantially. Therefore, the implicit buffers of the fund to withstand a sudden drop in interest rates are relatively small, and nominal underfunding remains a serious threat (about 3.75% probability). The assumed 1-year recovery terms thus lead to very high contributions, even compared to the first variant. Hence, the FTK requirements may cause real pain to ambitionless pension funds. The moderate initial contribution levels reflect the absence of indexation ambitions. Naturally, there is a downside to this: even apart from the greater probability of nominal underfunding, average benefits lag far behind wage developments with cumulated cuts of about 20%, on average. In worst-case scenarios, indexation cuts are even almost as severe as they would have been under a merely nominal pension scheme in an average inflation scenario (a 3% cut every year). In the worst 2.5% of scenarios, for instance, cuts after 10 and 20 years run to 27% and 40%, respectively.

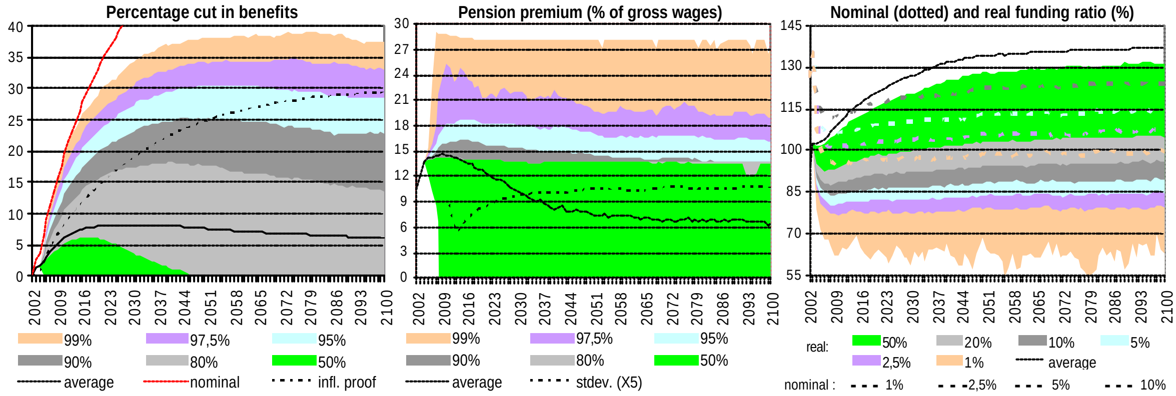
3 Conditional indexation without voluntary provisioning

An explicit indexation objective offers participants more certainty with respect to indexation. Variant 3 presents the simulation effects of pension fund policy with a wage indexation ambition. The variant shows the impact of a fund that only follows the minimum requirements of the FTK. That is to say, the cost-covering contribution rate is made in accordance with the indexation ambition. Shortfall contributions are levied in response to too low *nominal* funding ratios, in line with FTK requirements, as in Variant 2. There are no voluntarily shortfall contributions in response to too low *real* funding ratios, as would be expected in the case of more serious indexation ambition. The pension fund does not actively build up an earmarked provision for indexation. In normal times, the higher pension premiums should still be sufficient to build up capital funding for indexation. However, especially if inflation is high, nominal interest rates are likely to be high as well, and adequate funding for guaranteed nominal rights, including buffers, might not be sufficient to also safeguard indexation. High indexation might quickly deplete resources in this case as liabilities are not likely to be fully funded in real terms.

The variant is based on a 3.1% fixed discount rate to determine pension contributions and the real funding ratio.[15] Since this rate is below the nominal market rate, cost-covering contributions in this scenario are also higher (about 13.5%). Therefore, in contrast to the previous ambitionless variant, average pension contributions initially increase from 10.5% to 14.5% (see Figure 3).

[15] In this variant, the real funding ratio is used as one of the indicators to decide whether indexation is given (indexation only above 85%), and to calculate possible contribution refunds (above 200%).

Figure 3: Conditional indexation, none earmarked reserves



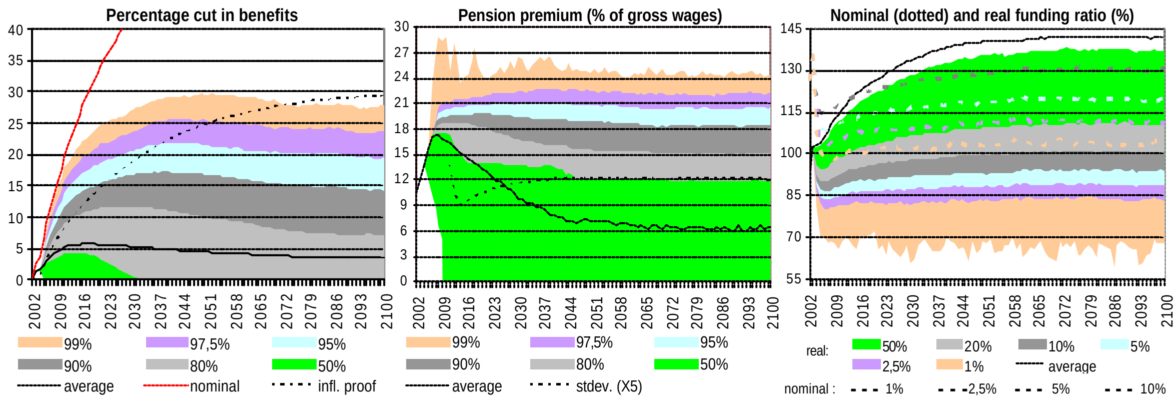
Apart from a higher cost-covering contribution level, this is also caused by the higher indexation level, which increases the probability of insufficient nominal buffers. Eventually, buffers are larger than in the previous variant (with the real funding ratio increasing to 136%, on average), as a result of the buffer-building mark-up on the cost-covering contributions. By consequence, average contributions can be allowed to drop to, in the long run, 7% because the larger capital buffers lead to larger returns on investment. This equilibrium premium level is very similar to both the baseline scenario (Variant 1) and the ambitionless one (Variant 2). With respect to indexation, the average cut will be at most 8%, only slightly worse than the 5% in the base variant and much better than the 20% in the incidental indexation variant. In a high-inflation scenario, however, the fund may launch recovery plans too late, i.e. when the nominal funding rate dips below 130%, because this variant disregards the real funding ratio. At that stage, the fund will have run up a large deficit in real terms, necessitating a long period of high contributions and/or indexation cuts. Consequently, indexation cuts in extreme cases are almost 10 percentage points higher than in the baseline variant. Moreover, the erosion of real buffers also involves a relatively high probability of nominal underfunding (about 2%). The one-year trajectory under the FTK leads to soaring contributions, for instance over 28% of gross wages in the worst 1% of cases.

4 Conditional indexation with provisioning

A pension fund that has a more serious indexation ambition than in the previous variant will seek to reserve funds for indexation. However, neither the desired size of the earmarked reserves nor the manner in which they should be built up have been regulated. We assume here that the same rule regarding a 2.5% underfunding probability within the year is also applied to indexation. Should the real capital buffer fall short, then a (voluntary) recovery policy is triggered (involving contribution mark-ups and indexation cuts) that is expected to lead to full recovery in 15 years. The same assumptions were used in the base variant. In most cases, a recovery policy will be triggered by a real funding ratio below target. However, in a low inflation environment (and hence, low interest rates) the nominal funding ratio may pose stricter constraints.

Comparing Figure 4 with Figure 1, it is clear that the impact of the FTK on a pension fund with a serious, though conditional, indexation ambition is only small. There is a slight probability of nominal underfunding, especially in the early years as initial financial buffers are insufficient. The one-year recovery plans lead to more extreme premiums in the worst 1% of cases. For the 97.5, 95, 90 and 80 percentiles on the other hand, this FTK variant leads to somewhat lower contributions than the base variant. The median premium is again higher under FTK. This is due to the high cost-covering premium under FTK (including a mark-up for buffer building), and the choice of a relatively high capital buffer threshold, which needs to be met before a reduction in premiums is allowed. Consequently, funding ratios are somewhat higher in the long run, leading also to on average lower premiums. In terms of indexation cuts, the results are only slightly worse than in the base variant, but much better than in the previous no-provisioning variant.

Figure 4: Conditional indexation, voluntary provisioning



So the additional FTK requirements, in particular the one-year nominal underfunding recovery term, turn out to cause little trouble to funds that take indexation ambitions seriously.[16] Only in the 1% worst cases, premiums are extreme. This seems to be an acceptable price for the increased protection for unconditional rights. In this simulation, the real funding ratio is again based on a fixed discount rate. The danger inherent to this choice is that when a decline in interest rates and stock yields turns out to be permanent, return assumptions remain the same, thereby becoming overoptimistic. The present variant limits this risk to some extent in that it takes a market valuation approach to the nominal funding rate. Therefore, at least the unconditional pension rights can not be endangered by overoptimistic return assumptions.

5 Unconditional indexation

The last variant assumes unconditional full wage indexation. As indexation is unconditional, the solvency tests for this fund are applied to the real funding ratio, based on a discount rate equal to

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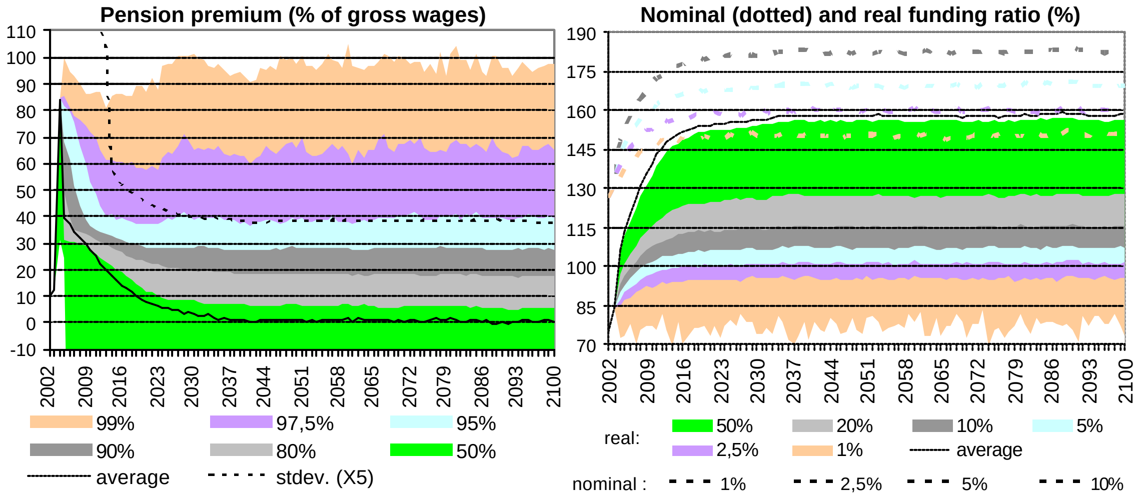
[16] In the UK, the one-year recovery prescriptions in case of underfunding were relaxed in March 2002 to a three-year term. The definition of underfunding is different though. The critical *real* funding ratio (with a

the actual real market interest rate. The same interest rate is used to determine pension premiums as old and new pension rights should not be measured differently. As indexation cuts can not be used to alleviate financial deficiencies, the maximum premium boundary is not applied in this variant.

Initially, application of FTK rules leads to totally unacceptable contribution levels, needed to achieve the required 105% funding ratio (Figure 5). Average contributions continue to be high at 35% after 5 years and 22% after 10 years, but they decline to nil in the very long run. With 10% probability, contributions remain above 28% and with 1% probability, even over as high as 95%. The real funding ratio is expected to rise to almost 160%, determined by a mere 2% average discount rate. In nominal terms, that corresponds to a 250% funding ratio. The likelihood of benefit cuts is nil, as promised. Of course, requirements would have to be relaxed initially for this indexation class, in order to prevent contributions from becoming unacceptable. However, a non-negligible probability of unacceptably high contributions persists even in later years.

Figure 5: Unconditional indexation, fair-value valuation, no mark-up



This variant illustrates how the requirement under FTK to redress underfunding within the year turns full unconditional indexation into a (practically) untenable proposition without seriously adjusting the asset mix of the fund. This is caused by the volatility of real interest rates (the standard deviation being some 60 basis points per annum), which leads to strong fluctuations in liabilities over time. Reducing the mismatch between assets and liabilities might alleviate this problem somewhat, but would certainly not eliminate it completely.[17] Even if the fund could hold

maximum inflation compensation of 5%) should be at least 90%. In the US, it is even allowed to amortize a shortfall over 30 years, although a shortening to 18 years has been proposed.

[17] An alternative is to invoke the guaranteed benefit cutback rule – which requires permission from the supervisor. This rule makes it possible to regain a 105% funding ratio by lowering members' entitlements, so that retirees and deferred members carry their share of the burden. This alternative has not been included in this simulation, because the cutback rule runs counter to the idea of unconditional indexation.

an exactly replicating portfolio (which at the moment is not possible due to the absence of wage-indexed bonds), substantial premium volatility would remain as the cost-covering premium is very sensitive to real interest rate changes.[18]

6 Selected overall results

Table 1 summarizes the main results of the five variants. Two variants deviate strongly from the rest. One is Variant 2, representing a pension scheme without official indexation ambition. Excess returns can not be expected to be high enough on average to offer a substantial indexation level. Moreover, poor returns on investment or declining interest rates will cause severe contribution rises even in this variant, as a result of nominal underfunding. The other deviating variant is number 5, with unconditional indexation. Initially, huge contributions are required to realise this ambition. Thanks to the capital buffers thus built (the real funding ratio grows, after 10 years, to 146%, given a 2% expected discount rate), contributions may eventually fall far below the levels seen in the other simulations. Yet, under unfavourable conditions (low returns on investments or low interest rates), contribution rates remain extremely high. Cuts in real-term commitments are ruled out in this variant, in line with the unconditional nature of its indexation.

Table 1 Average and unfavourable simulation results for key variables

Percentages

	Contribu-tion rate			Indexation cut			Nominal funding ratio[a]			Real funding ratio[a]		
After ... years	5	10	20	5	10	20	5	10	20	5	10	20
Average results												
1 Base variant	17	16	12	3	5	4	145	157	168	108	116	125
2 Incidental indexation	10	10	9	10	15	19	142	149	155	105	110	114
3 Indexation, no provisioning	14	14	12	4	7	8	142	152	165	105	112	122
4 Indexation with provisioning	17	16	13	4	5	6	145	159	173	108	117	128
5 Unconditional indexation	35	22	7	0	0	0	201	232	247	126	146	155
2.5 % worst-case scenarios												
1 Base variant	19	21	22	9	16	21	103	104	105	83	85	85
2 Incidental indexation	18	27	24	15	27	40	100	99	100	79	78	79
3 Indexation, no provisioning	18	23	22	10	19	27	101	102	103	81	81	82
4 Indexation, with provisioning	19	21	22	9	17	22	103	106	109	84	85	87
5 Unconditional indexation	78	65	59	0	0	0	148	157	160	94	99	100

[a] Assets expressed as a percentage of the required pension provisions in, respectively nominal and real terms. In the first four variants, the required pension provisions in real terms are calculated using a fixed discount rate of 3,1% and in the last variant using the actual real interest rate. The nominal funding ratio is always computed using the actual nominal interest rate.

The typical pension contract in the Netherlands offers conditional wage indexation. This is modelled in Variants 1, 3 and 4. In these variants high initial average pension contributions are needed to build up capital buffers. After more than fifteen years, average pension contributions

[18] As the duration of new pension rights is about 35 years, a reduction of the real interest rate from 2.2% (the equilibrium value) to 0.86% (the 2.5 percentile), would for instance lead to an increase of the premium from 15.25% to 22.5% of gross wages.

come down substantially and low contributions may suffice, owing in part to the returns on the large capital buffer. At the same time, there is a low probability of continued high contributions. After incomplete indexation in the early years, the probability of benefit cuts in later years is commonly very low. Thus, in the long run, the degree of pension security is very reasonable, reflecting that most of our simulations present pension fund policies that take indexation seriously. This attitude has been translated into a 'sufficient' mark-up on contributions. If investment returns are relatively low however, substantial cuts are still possible.

On average, the differences between the three conditional indexation variants are only minor. Not provisioning for indexation leads to somewhat lower initial premium increases. This comes at the cost of higher benefit cuts, especially in adverse scenarios. The extent to which underfunding of guaranteed rights incidentally leads to extreme premiums depends on the size of implicit buffers. Without voluntary reserves above required provisions, extreme premiums can hardly be avoided, as is illustrated by Variants 2 and 5. Implicit reserves via higher cost-covering premiums (Variant 3) reduces the probability of nominal underfunding considerably, though at the 1% worst cases premiums still rise to the maximum level. In case of active provisioning for conditional rights (Variant 4), the one-year recovery plans seem hardly problematic.

5 Conclusions

Although index-linked benefits are of great importance to pension beneficiaries, almost no scheme in the Netherlands includes unconditional indexation commitments. This has bred uncertainty concerning future pension benefits. Inadequate information on this subject could severely harm confidence in pension funds and encourage participants to accumulate non-optimal (i.e. excessive) savings. Under the new supervisory regime in the Netherlands, pension funds are required to communicate their indexation ambitions to their participants and to indicate to what extent realisation of indexation is likely. Also, pension funds' funding and provisioning policies must be consistent with their declared indexation ambitions. This will help to reduce uncertainty about indexation and to sustain and reinforce confidence in pension funds.

This paper presents illustrative simulations of indexation policies with varying degrees of ambition, using PALMNET. These simulations provide an understanding of the average expected development of pension contributions, indexation cuts, funding ratios, et cetera, but also of the dispersion of these variables, thus sketching the outcomes of unfavourable scenarios. Thereby, the simulations constitute a long-term feasibility analysis of indexation ambitions including the uncertainty surrounding the key variable results, just as the required continuity analysis should do. The main conclusions are as follows.

As regards transparency, a major improvement is that pension funds have to inform their participants in explicit terms about their indexation ambitions. The likelihood of indexation must be determined on the basis of a continuity analysis. Yet, the content of that information would be inadequate if the emphasis is only on long-term *average* values of the key variables. In our view, differences between pension fund policies become most clear in the worst-case scenarios. Hence, adequate information should include – stylized facts of – the future *distribution* of the key variables. The likelihood of indexation depends on factors, such as the earmarked reserves for indexation and mark-ups on the cost-covering premium level, which have not been regulated, as the supervisor does not presume to take over the responsibilities of a pension fund's board. Different funds will pursue different policies on, for instance, maximum contributions, recovery from a capital buffer shortfall or indexation cuts. An extended continuity analysis, including the full distribution of key variables, will have to provide conclusive evidence on the likelihood of indexation.

The question whether the minimum FTK requirements concerning conditional indexation offer sufficient assurance that a fund's ambition will be realised can be answered in the affirmative. Despite the fact that provisioning for conditional commitments has not been made mandatory, indexation cuts turn out to remain fairly limited, though still substantial in adverse circumstances.[19] On the one hand, this is because cost-covering contributions as defined under FTK are, in fact, more than cost-covering (as it includes a capital buffer building mark-up). On the other, it is because of the occasionally very high contributions due to one-off nominal underfunding (when, as in our simulations, benefit cutbacks and other solutions are ignored). It turns out that pension funds that intend to provide indexation with minimum effort (read: minimum contributions), so that voluntary indexing reserves fail to materialize, are more risk-prone in the sense that these funds run a much greater risk of nominal underfunding, incidentally leading to soaring contribution rises. If no surcharges to the premium are levied to finance indexation, cuts will be substantial, and moreover nominal underfunding resulting in extreme premiums is hard to avoid.

The question whether FTK implies overrestrictive requirements to a pension fund offering conditional indexation can be answered in the negative. The complaint, frequently voiced by the pension industry, that the FTK – and the 105% minimum funding ratio in particular – will impede indexation, because mismatching will become too risky, is not corroborated by our simulations. A pension fund that has serious indexation ambitions, should build up earmarked indexation

[19] This outcome is, however, conditional on the assumption that no sustained inflation rise occurs.

reserves. That will make the risk of underfunding very low, even assuming the current investment mix of 50% equities.[20]

For pension funds offering an indexation guarantee, the simulation outcomes are unfavourable. Under FTK, realisation of unconditional indexation will be far more difficult, because very large implicit capital buffers need to be shored up. Further, such buffers are also extremely sensitive to movement in the real interest rate. For instance, the current 16-year interest rate of 3.8%, implies a discount rate of just 0.8%. By consequence, as long as underfunding can only be dealt with by contribution rises, premiums may rise to extreme levels. The volatility in the funding ratio might be reduced by improving the match of investment portfolio and liabilities, but only to a limited extent, as wage-indexed bonds are yet unavailable and as the cost-covering premium is also sensitive to real interest rate changes.

All in all, our simulation analyses show that defined benefit pension plans can provide a reasonable insurance against wage or price inflation, even where full guarantees are fairly unattainable. Further, they illustrate the tenability of defined benefit pension plans under ageing, the new fair-value accounting regimes, and possible volatility on financial markets.

[20] This result applies to the average pension fund. For a fund facing worse initial circumstances, the 105% requirement may impose a different optimum policy during the current ramp-up phase towards financial soundness.

Appendix: PALMNET's inflation and interest rate block

Long term interest rates in the model are based on an affine two-factor term structure model (Duffie and Kan (1996), Duffee (2002)). The determining variables are the short term interest rate and expected (short term) inflation. This model assumes a first order vector autoregressive structure for expected inflation and 3-month interest rates. The model is heteroscedastic in the sense that volatility is rising with the level of inflation or interest rates. This way, it is guaranteed that nominal interest rates can not become negative. The same heteroscedasticity structure is used in all model equations in order to preserve the affine (that is linear) term structure relationship without having to rely on independence between shocks to inflation and interest rates. Longer term interest rates are a linear function of future short term interest rates and the price of risk. The former follow directly from the current short term interest rate and expected inflation, whereas the latter is determined by the covariance of the pricing kernel with expected inflation and short term interest rates, respectively. The model is calibrated on quarterly data for Germany. We use German data as these are most representative for the euro system's monetary policy, which is relevant for the interaction between interest rates and inflation. The quarterly frequency of two-factor term structure model (as opposed to the annual frequency of the rest of PALMNET) is used, first, to increase the number of observations, second, to be able to perform simulations with smoothed interest rates, and, third, to reduce the probability that short term interest rates become negative.

In principle, the model for inflation and short and long term interest rates can be estimated simultaneously. However, it turns out that the expected time series behaviour of short term interest rates and expected inflation, according to the term structure of interest rates, is not the same as the one actually observed in the past. As we simulate over a forecast horizon of 100 years, including proper time series parameters is most important. Therefore, a four-step procedure was used instead. In the first step the dynamics of short term interest rates (i^s) and (short-term) expected inflation (p^e) is estimated, using a Kalman filter approach (Harvey, 1989) to decompose actual inflation into expected inflation, surprise inflation and seasonal patterns. This is done on quarterly data from 1960-I until 2004-II:

$$\begin{bmatrix} i_t^s \\ p_t^e \end{bmatrix} = \begin{bmatrix} \bar{i}^s \\ \bar{p}^e \end{bmatrix} + \begin{bmatrix} 0.90 & 0.11 \\ -0.00 & 0.95 \end{bmatrix} \begin{bmatrix} i_{t-1}^s - \bar{i}^s \\ p_{t-1}^e - \bar{p}^e \end{bmatrix} + \sqrt{0.03 i_{t-1}^s + 0.15 p_{t-1}^e} \begin{bmatrix} e_t^i \\ e_t^p \end{bmatrix},$$

$$\begin{bmatrix} e_t^i \\ e_t^p \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & 0.27 \\ 0.27 & 0.59 \end{bmatrix} \right)$$

where $(\bar{i}^s)$ and $(\bar{p}^e)$ represent sample averages.

In the second step, the covariances of the pricing kernel with shocks to the short term interest rate and expected inflation are estimated, given the estimated parameters and the optimal prediction of expected inflation from the first step. Hereby, the measurement errors of the bonds of different maturities are allowed to be correlated. The measurement errors represent factors in longer term yields that are independent from inflation and short term rates. For instance, long term interest rates in Europe are, at least in the short run, influenced by bond returns in the US.

In the third step, these measurement errors are examined. It turns out that they are indeed highly correlated, both cross-sectionally and over time. The measurement errors are very similar for all maturities, though slightly bigger for longer ones. Therefore, we decided to model longer term yields as the yield following from the term structure model plus a measurement error that is identical for all maturities, apart from a scaling factor. This measurement error follows a first order autoregressive process with an AR(1)-parameter of 0.9.

Finally, we deal with the problem that the time series pattern of the past need not be representative for the future. For instance, the average inflation rate over the sample was 3%, whereas, for the future, 1.9% is assumed. For the short rate, an equilibrium value of 4.2% is supposed. Moreover the volatility of interest rates and inflation in the seventies was much higher than in recent times. Therefore, we rescaled volatilities of inflation and short rates to 55% of historical values. The volatility of innovations to the long-term measurement errors was calibrated at 85% of the short rate volatility, in accordance with results for the last 20 years. In order to remain a reasonable fit for long term rates, the covariances with the kernel are adjusted somewhat as well, such that the fit for 2003 was reasonably good.

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