Conditional indexation in defined benefit pension plans in the Netherlands

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Abstract

In an ageing society, defined benefit (DB) pension plans are increasingly difficult to manage by means of contribution policy only, as the contribution base is likely to shrink relative to total pension provisions. This development, together with increased emphasis on market valuation in regulatory and accounting rules, has lead to a switch of DB plans to defined contribution plans throughout the world. In the Netherlands, a different solution has been sought. The typical pension contract nowadays comprises an average earnings DB pension in which only nominal benefits are guaranteed, but with the intention to provide wage or price 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. In this paper, it is analysed to what extent indexation is indeed likely, given various indexation and contribution policies. Simulations show that voluntary provisioning for indexation is to be recommended. Fully guaranteed indexation is virtually unaffordable under the new supervisory regime, because the real discount rate is generally both very low and highly volatile.

Keywords: Average wage defined benefit pension; Monte-Carlo simulations; Pension fund model, Regulation, Wage or price indexation;

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1 Introduction

An inflation-proof pension scheme is a very valuable asset for pension fund participants. 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 awarded. 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 the practice of automatic indexation, as many pension funds became severely underfunded. In order to recover, not only were pension contributions increased firmly, but indexation was reduced as well. Moreover, many pension arrangements were renegotiated and, as a result, turned from a conditional defined benefit (DB) final wage system to a *conditional* DB average earnings scheme. Consequently, indexation cuts cannot only be applied to pensioners but also to active workers.[3]

Although the stock market crash certainly triggered the increased use of indexation cuts, other developments also contributed to decreased security regarding indexation. First, both nominal and real 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 previous regulatory regime, effective until end-2006, the maximum allowed actuarial interest rate, used to calculate the level of contributions and the funding ratio of the fund, remained constant at 4%. Therefore, the gradual deterioration of the funding position was not well detected and

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contributions. Views expressed are those of the authors and do not necessarily reflect official positions of the Nederlandsche Bank

[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 (Sharpe, 1976), such inefficiencies also reduce welfare for workers.

[3] Because indexation of pension benefits is only awarded if the financial position of the fund allows it, the Dutch system is hybrid rather than pure DB. It combines a Defined Benefit nominal pension with Targeted Benefit indexation. Although in this system the employees bear some risk, the term *Conditional* DB is more apposite than DC, since contributions are not fixed whereas (maximum) benefits are clearly defined.

contributions 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 growing uncertainty regarding indexation is the recent 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 increases the volatility of their results, companies become more in favour of defined contribution (DC) schemes. So far, the number of Dutch firms offering genuine DC pension plans is still negligible however. Finally, the aging of the population increases the ratio of pension liabilities to the total wage bill. Consequently, the contribution 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. Begin-2007, this new Financial Assessment Framework (*Financieel Toetsings Kader*, FTK) has 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, e.g. reduce guarantees or even switch to defined contribution. In the UK for instance, the increased burden of regulation since the mid-1980s has lead to the closure of most private defined benefit schemes to new entrants (Davis, 2004). 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. Guaranteed commitments should always be fully funded, including risk related buffers to protect against adverse developments. For conditional rights, provisioning is not required, though pension contributions and policies have to be consistent with communicated indexation ambitions.[4] 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, financing, reserves and actual indexation decisions. 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 security that indexation ambitions will be realised. And third, it assesses whether the FTK regime is too restrictive 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). The results illustrate how intergenerational risk sharing in conditional 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 accounting and regulatory regimes, both based on fair-value, and volatility on financial markets. The main caveat is, however, that the analysis is only partial. There is no discontinuity risk in the model, and the above cost-covering contributions are assumed to have no labour market repercussions.

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. 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.

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[4] This outcome was a compromise between the government, employees and employers. As most pension funds were heavily underfunded in real terms at the end of 2002, stricter rules regarding conditional rights were unacceptable for

2 Pension schemes in the Netherlands

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

End 2006, the Netherlands had 767 pension funds under supervision by the Dutch Central Bank (of which 643 company pension funds and 103 industry-wide pension funds). In that year they managed € 680 billion in pension capital (129% of GDP). Besides pension funds, life insurance companies directly manage about one sixth of the second pillar pension schemes. In 2005, gross contributions to pension funds added up to € 25 billion, whereas their pension benefits amounted € 18 billion, against annual AOW payments of € 23 billion. 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 usually takes most of the burden.

Almost all pension schemes managed by pension funds are of the (conditional) defined benefit type (99%),[5] whereas insurance companies primarily (71%) offer DC schemes. Most DB pension contracts guarantee only a nominal pension, but price or wage 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 benefits are linked to the salary at the moments contributions are paid, 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

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the social partners, as such rules would have led to either excessive rises in contribution or cut backs on vested pension rights.

[5] Currently, a number of pension funds consider a shift from DB to (collective) DC, primarily in response to changes in international accounting standards (IFRS).

workers) when pension capital is insufficient. Moreover, there is no need to increase existing pension benefits in the case of career moves (the so-called 'back service').

Internationally, the Dutch system of old age provision is quite unique. Only few countries have saved for their second pillar 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).

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. Until end-2006, the pension liabilities were calculated on the basis of a fixed actuarial interest rate of at most 4% (a number that had not changed since 1969), which was considered a conservative estimate of the expected long run real return on the asset portfolio. Under FTK, the fixed actuarial interest rate to calculate liabilities is replaced by the (nominal) market rate.

The FTK distinguishes sharply between guaranteed (which in practice means: nominal) pension entitlements and conditional rights (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

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

the management and trade unions). In exceptional circumstances, the supervisor can allow for a longer recovery period.[7]

The nominal funding ratio must, in principle, be sufficient to maintain a less than 2.5% probability of insolvency (defined as a nominal funding ratio below 100%) within one year. For an average pension fund, this implies a target nominal funding ratio of at most 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 for conditional pension rights (e.g. indexation) is 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 long term outlook for indexation exactly is.

Pension funds should levy a so-called cost-covering contribution including normal costs of guaranteed rights, administrative costs, normal costs of conditional rights, and costs to build up the solvency buffer. The actual contribution will generally be higher if the buffer is too small. Contributions 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 contribution, pension funds can either use actual market rates, a moving average of past market rates and/or portfolio returns with a maximum smoothing period of ten years, or a fixed rate. The use of expected returns, rather than the real term structure of interest rates to calculate cost-covering contributions, can be justified by the fact that indexation is not guaranteed. Smoothing or fixing is allowed for in order to mitigate the volatility of contributions.

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

[7] With the passing of the new Pension Law, in effect from begin-2007, the original one-year recovery plan was replaced by a three-year one. Under certain conditions, however, the supervisor may still require a one-year plan. In

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). Each year, the expected stock market return is three percentage points higher than the prevailing five year interest rate, with a volatility of 15% annually. Stock market shocks are assumed not to be correlated with inflation or interest rate shocks. Economic theory provides various causal relationships between these variables, although some result in positive correlations whereas others cause negative correlations. Empirical estimates of these correlations are not significantly different from zero. Note also that Dutch pension funds have world-wide investments, whereas inflation is a purely domestic phenomenon.

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 order to reflect both the nominal guarantee and the conditional indexation ambition, the pension fund policy regarding contributions and indexation is assumed to depend both on the nominal and the real funding ratio. For relatively low funding levels, the minimal requirements for the nominal funding ratio become binding, whereas policy is determined by the total ambition (reflected in the real funding ratio) in case of sufficient funding.

Table 1 shows the standard policy ladders used in Palmnet. The critical nominal funding ratio of 124.5% is calculated such that the probability of insolvency in the next period is exactly 2.5%, given the assumed model parameters and the representative asset mix with 50% bonds (average duration 6 years) and 50% equity. A real target funding ratio of 110% is actively pursued in order to keep the pension contract attractive to new entrants, even after adverse return developments. The on average lower pension contributions resulting from higher financial buffers compensate for the relatively high contribution volatility due to the ageing society.

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this study, a standard one-year recovery plan is assumed.

In order to preserve the long run perspective of pension funds, contributions and real funding ratios are calculated based on a fixed discount rate equal to the expected long run real return on a representative portfolio (3.06%).[9] This approach greatly reduces contribution volatility (Van Rooij, Siegmann and Vlaar, 2004; Vlaar, 2005). It is validated by the fact that indexation is only conditional and not guaranteed. Contribution volatility is further reduced by assuming a maximum annual contribution change of three percentage points of the contribution base (about 1.8 percentage points of gross wages), except in case of nominal underfunding (maximum increase is 10 percentage points of the contribution base) or restitutions (no limit). In all cases, it is assumed that pension contributions cannot be higher than 50% of the contribution base (about 30% 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 15-year recovery plans in case of a real funding ratio below 110%. In accordance with the FTK, contributions can also be based on actual current or smoothed interest rates. In a pre-FTK version of the model, the nominal funding ratio has no impact on the contribution policy.

In order to calculate pension liabilities, Palmnet keeps track of old age pension rights built up per separate one-year age group. Each year, these pension rights are reduced due to mortality and possibly increased due to indexation. New pension rights are based on the expected number of workers in each age group, based on macro projections regarding total population (according to Statistics Netherlands) and labour market participation (according to Van Ewijk et al., 2000). This way, the impact of the ageing society on the average pension fund is automatically included. The projected ratio of total pension liabilities to the contribution base increases from about 5 in 2002 to 9.5 in the second half of this century. Given pension rights per age group, expected future benefit payments, based on life tables, are discounted using the actual nominal term structure of interest rates (nominal funding ratio), respectively using the fixed real discount rate (real funding ratio).

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[8] An alternative such as indexation linked to price inflation is also possible.

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

4 Simulation results

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

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 indexation commitments, though indexation is given (up to full wage indexation) if sufficient capital is available. The second fund announces an ambition to index pensions to wages, but does not pursue an explicit policy to build up reserves for this. However, contributions 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 a baseline version of Palmnet, where the nominal funding ratio has no impact on the contribution policy (that is, without the FTK requirements).

Simulations start off from the situation applying to the average pension fund at end-2002. The pension wealth evaporated during the turn of the century needs to be replenished, on top of the pension provisions in the equilibrium situation. Simulation results will of course be even worse for a pension fund, whose initial financial position is even less favourable. For 2003 and later, the results were simulated. 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 six years, even though a higher bond duration might be beneficial for pension funds (Vlaar, 2005).

The results are presented in graphical form (Figures 1 to 5), whereas some key features are summarised in Table 2. The figures give an impression of the development over time of the entire distribution of the nominal and real funding ratios (Panels a and b), the contributions as a percentage of gross wages (Panel c) and the cut in indexation (defined as the accumulation of annual cuts) relative to a fully wage-indexed pension (Panel d). Apart from the mean expected values, the graphs show the 2.5, 10, 20, 80, 90 and 97.5 percentiles. For the indexation panels in the first four figures, the result for a pure nominal pension is also shown for comparison. This 'nominal' line expresses the maximum indexation cuts. Furthermore, these indexation panels present a price-indexed pension in an average inflation environment (of 1.9% inflation per year). This 'inflation-proof' line expresses the indexation cuts that eliminate the real wage improvement, but leave the spending power unaffected. Table 2 shows the mean and 2.5% worst results for these key variables after 5, 10 and 20 years, as well as the standard deviation of the annual changes in contributions. [10]

1 Base variant without FTK requirements

The Dutch pensions industry has voiced many complaints about the initially strict requirements imposed by FTK, especially the proposed limitation of the recovery period to only one year in case of underfunding (nominal funding ratio below 105%). This requirement is said to make any nominal mismatch unacceptably risky, leaving little room to pursue an investment policy aimed at higher investment returns to secure 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 fixed discount rate equal to expected long run real returns (3.06%) to calculate liabilities and contributions. 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 110%. The nominal funding ratio only affects the indexation policy (no indexation below 105%), but has no impact on the contribution policy.

[10] Negative contributions are set to zero when calculating the standard deviation.

The model simulations make clear that pension contributions initially rise from 12% in 2002 to an average of 16.5% in 2005, in order to repair the buffer capital (see Figure 1, Panel c). The average real funding ratio increases from 93% in 2002 to its target level of 110% in 2014, and thereafter continues a gradual rise up to about 121% (Panel b).[11] 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 less than 9%. Contributions to the median fund (not shown),[12] however, decline to 13% rather than 9%. This asymmetry is caused by the fact that substantial contribution refunds take place when the real funding ratio exceeds 175%. Unforeseen developments in capital markets (with respect to stock prices and bond rates) may cause real-world contributions to deviate substantially from their expectation. There is a small chance of contributions remaining high (e.g. at least 18.7% with, according to the simulation results, 10% probability) or even increasing (to more than 21.2% with 2.5% probability). Contribution volatility (Table 2), is about 1.3%, implying that a solid funding position may quickly deteriorate.

During the initial years, indexation is cut because of insufficient capital buffers (Figure 1d). The average benefit level comes out up to 7.8% 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 52%, but there also is a 10% chance of accumulated cuts deeper than 23% and a 2.5% chance of over 34% cuts. The problem is, moreover, that the need to cut indexation arises especially when inflation becomes unexpectedly high. Compared to the benchmark of an inflation-indexed pension (real wages are expected to increase 1.1% annually), the average indexation result for this pension fund is better from 2009 on. In the simulation’s 20% and 10% worst case scenarios, this is only the case after, respectively, 2019 and 2033.

The probability of the nominal funding ratio (Panel a) sliding off below 105% is never above 3.8%. 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

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[11] The average real funding ratio is above target within 15 years due to the fact that adverse conditions may lead to an immediate increase in contributions, whereas decreases in contributions are only allowed after the target is attained. The median real funding ratio is still at 109.6% after 15 years.

[12] The median fund is the 50th percentile of the distribution of simulation results with respect to the key variable ‘contributions’.

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.

2 Policy of no indexation ambition

Variant 2 describes pension funds without official indexation commitments, and thus without any obligation to provide funding earmarked for indexation. Indexation will be given however, 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 discount 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.

No indexation is given if required reserves are not sufficient, that is if the nominal funding ratio is below 124.5%. Above it, some indexation is given, up to full wage indexation if the real funding ratio (discounting against 3.06%) is 120%. Above this funding level, compensation for previous cuts relative to a full wage-linked pension, is given as well. After all previous indexation cuts are compensated, contributions may be reduced according to the policy ladder in Table 1. Indexation may be financed partly from surplus returns on investments, since expected returns exceed the nominal interest rate. Even if we take the returns on the capital buffer into account as well, such a fund can hardly be expected to provide even inflation-proof pensions without levying extra contributions however.

Figure 2 shows the results for this incidental indexation variant. As the cost-covering contribution level for this nominal contract is only 8.2%, on average, contributions are even allowed to fall initially (Panel c). Also, in the long run, contributions are within the relatively narrow range of 6.4% to 10.4% for 60% of the simulations. However, this does not mean that contributions are very stable over time, as the standard deviation of annual changes is 1.6%, whereas it was 1.3% for the base variant (see Table 2). There are two reasons for this instability. First, the cost-covering contribution itself is quite volatile (standard deviation of 1.1%), as it depends on the actual nominal term structure of interest rates. Second, due to the relatively low contributions, 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 or a stock market crash are relatively small, and nominal underfunding remains a serious threat (about 4.3% probability). The assumed one-year recovery terms thus sometimes lead to very high contributions, even though a maximum increase of 10 percentage points of the contribution base was assumed to model the allowance for tailor made solutions. 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 more than 25%, on average (Figure 2d). 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 cumulate to 32% and 46%, 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, however, 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 contributions 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 3.06% fixed discount rate to determine pension contributions and the real funding ratio. Since this rate is below the nominal market rate, break-even contributions in this scenario are also (about 13%) higher. Therefore, in contrast to the previous ambitionless variant, average pension contributions initially increase from 12% to 13.8% (see Figure 3, Panel c). This is slightly higher than the break-even contribution, as in the short run a nominal funding ratio below 124.5% is more likely than a real funding ratio above 120%. Eventually, buffers are larger than in the previous variant, with the real funding ratio increasing to 118%, on average (Panel b). By consequence, average contributions can be allowed to drop to, in the long run, 9% because the larger capital buffers lead to larger returns on investment. This equilibrium contribution level is very similar to the baseline scenario (Variant 1). Contribution volatility is 1.4%, so less than in the previous scenario, but higher than in the pre-FTK baseline (Table 2).

With respect to indexation (Figure 3, Panel d), the average cut will be at most 11.7%, which is 4 percentage point higher than in the baseline scenario, but much better than the 28% in the incidental indexation variant. Dispersion is again huge however. In the long run, the probability of a fully wage-linked pension is about 45%, but in the 2.5% worst case scenarios the benefits are at most 62% of the targeted amount. The fact that real underfunding does not necessarily lead to extra contributions also implies a relatively high probability (of about 3.8%) of a nominal funding ratio below 105%. The one-year trajectory may lead to soaring contributions, for instance over 24% of gross wages in the worst 2.5% of the scenarios.

4 Conditional indexation with provisioning

A pension fund that has a more serious indexation ambition than in the previous variant will actively 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 that the target real funding ratio is 110% and in case of insufficient reserves a 15-year recovery plan is triggered (see the policy ladders from Table 1). 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 (with, 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 relatively small. With respect to contributions (Panel c), the expectation is almost the same, but contributions under the FTK-regime are somewhat higher in unfavourable scenarios. For the 90 and 97.5 percentiles the difference is, respectively, 0.3 and 1.7 percentage points. These higher extremes are due to the relatively strict recovery rules in case of nominal underfunding (2.4% probability). This also increases the volatility of the contributions somewhat to 1.5%. The stricter policy has a clear advantage on the benefit side. In the long run, even in the 2.5% worst scenarios the benefit cut is just over 31% (Figure 4, Panel d), whereas it was almost 34% in the baseline scenario (Figure 1, Panel d) and 38% in the no-provision scenario (Figure 3, Panel d).

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.[13] Only in the 2.5% worst cases, contributions are more extreme. This seems to be an acceptable price for the higher probability of indexation and 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 ratio. Therefore, at least the unconditional pension rights cannot be endangered by overoptimistic return assumptions. This is especially important as sustained contribution levels above cost-covering

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[13] 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 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.

level endanger the continuity of the fund since the implicit intergenerational transfers are unfavourable for new entrants. This effect is not modelled here, however.

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 the actual real market interest rate. Contribution policy is based on a fixed discount rate of 2%, the equal to the average discount rate used for the calculation of the real funding ratio. As indexation cuts cannot be used to alleviate financial deficiencies, the maximum contribution boundary is doubled to 100% of the contribution base in this variant.

Initially, application of FTK rules lead to a prolonged period of maximum contribution rises (10% of the base) as the real funding ratio should be at least 105% (Figure 5, Panel b). Average contributions continue to rise to reach a level of 42% in 2009. In adverse scenarios, the contribution even increases to the maximum level of about 60% of gross wages. These very high contributions lead to an average real funding ratio of 144% (219% in nominal terms), even though contribution holidays are allowed at a real funding ratio of 140% and restitutions take place starting at 175%. As these real funding ratios are calculated against a discount rate of on average 2%, whereas the expected real return on the asset portfolio is over 3%, the average contribution level drops to almost zero. However, with 10% probability, contributions remain above 28% and with 2.5% probability, even over as high as 46%. The likelihood of benefit cuts is nil, as guaranteed.

This variant illustrates how the FTK requirements to redress underfunding within the year and to value guaranteed pension rights on ‘certainty’ market base, turn 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. Even if the fund could hold an exactly replicating portfolio (which at the moment is not possible due to the absence of wage-indexed bonds), substantial contribution volatility would remain as the market-based contribution is very sensitive to real interest rate changes.[14]

6 Selected overall results

From the overview in Table 2, it is clear that two variants deviate strongly from the rest in terms of contributions and indexation. One is Variant 2, representing a pension scheme without official indexation ambition. Excess returns cannot 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 131%, 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.

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

[14] In case of market valuation, the standard deviation of annual changes in the market-based contribution is 2.6% of gross wages.

On average, the differences between the three conditional indexation variants are only minor. Not provisioning for indexation leads to somewhat lower initial contribution increases. This comes at the cost of higher benefit cuts, especially in adverse scenarios, and a higher probability of nominal underfunding, leading to more volatile and more extreme contribution levels. In case of active provisioning for conditional rights (Variant 4), the one-year recovery plans are much less 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' financing 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, and funding ratios, 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 contribution 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. On the one hand, this is because cost-covering contributions as defined under FTK do include a surcharge for conditional indexation. On the other, it is because of the occasionally very high contributions due to one-off nominal underfunding. It turns out that pension funds that intend to provide indexation with minimum effort (read: minimum contributions), so that voluntary indexing reserves may 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 contribution are levied to finance indexation, cuts will be substantial, and moreover nominal underfunding resulting in extreme contributions 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 reserves. That will make the risk of underfunding relatively low, even assuming the current investment mix of 50% equities.

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 16-year interest rate of 3.8% in 2005, implies a discount rate of just 0.8%. By consequence, as long as underfunding can only be dealt with by contribution rises, extreme levels are hardly avoidable. 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 market-based contribution is also sensitive to real interest rate changes.

All in all, our simulation analyses show that conditional 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 conditional defined benefit pension plans under ageing, the new fair-value accounting regimes, and possible volatility on financial markets. However, important preconditions for this result, that have been taken for granted in this study, are that the fund will always survive, and that the number of new entrants is not affected by the contribution level. If contribution levels are likely to be too far above cost-covering level for sustained periods, these conditions may no longer be realistic. We leave the relative attractiveness of conditional DB systems compared to individual DC systems for future research.

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 cannot 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 (π^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:

$$\begin{bmatrix} i_t^s \\ \pi_t^e \end{bmatrix} = \begin{bmatrix} \bar{i}^s \\ \bar{\pi}^e \end{bmatrix} + \begin{bmatrix} 0.90 & 0.11 \\ -0.00 & 0.95 \end{bmatrix} \begin{bmatrix} i_{t-1}^s - \bar{i}^s \\ \pi_{t-1}^e - \bar{\pi}^e \end{bmatrix} + \sqrt{0.03 i_{t-1}^s + 0.15 \pi_{t-1}^e} \begin{bmatrix} \varepsilon_t^i \\ \varepsilon_t^\pi \end{bmatrix},$$

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

where $(\bar{i}^s)$ and $(\bar{\pi}^e)$ 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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Table 1 Standard policy ladders used in Palmnet

Funding ratio (in %)	**Indexation**
Under 105 (nominal)	No indexation
105 (nominal) – 105 (real)	Indexation cut declines linearly
105 (real) – 120 (real)	Full indexation, no compensation for previous cuts
Over 120 (real)	Full indexation, with compensation
	Contributions
Under 105 (nominal)	Based on a 1-year recovery plan, maximum increase 10 percentage points per annum
Under 124.5(nominal) or 110 (real)	Based on 15-year recovery plan, no reduction, max increase 3 percentage points
110(real)/124.5(nom.) – 120 (real)	Actual cost, maximum annual change 3 percentage points
120 (real) – 140 (real)	Linear reduction of contribution to zero, maximum annual change 3 percentage points
140 (real) – 175 (real)	Zero contribution (or 3 percentage points lower than last year)
Over 175 (real)	Contribution restitution

Notes: Nominal funding ratios are based on the actual nominal term structure of interest rates. Real funding ratios and contributions are usually based on a fixed discount rate equal to the expected long run real return (3.06%).

Table 2 Average and unfavourable simulation results for key variables

Percentages

		Contributions				Indexation cut[a]			Nominal funding ratio[b]			Real funding ratio[b]		
		Level			Vol.									
	After ... years	5	10	20		5	10	20	5	10	20	5	10	20
Average results														
1	Base variant	16	15	13	1.3	6	8	8	144	151	151	102	109	113
2	Incidental indexation	9	9	10	1.6	13	20	26	139	140	141	97	100	104
3	Indexation, no provisioning	14	14	13	1.4	7	10	12	138	144	146	98	104	109
4	Indexation with provisioning	17	15	13	1.5	6	8	7	144	151	153	102	109	114
5	Unconditional indexation	39	39	3	4.3	0	0	0	165	217	239	98	133	152
2.5 % worst-case scenarios														
1	Base variant	19	19	20		13	21	28	104	106	103	79	82	81
2	Incidental indexation	16	21	23		19	32	46	100	98	98	74	73	76
3	Indexation, no provisioning	20	21	23		14	23	33	100	102	101	75	78	79
4	Indexation with provisioning	19	20	21		13	20	27	105	107	107	80	83	84
5	Unconditional indexation	42	60	42		0	0	0	118	155	162	68	93	101

[a] The accumulation of annual cuts relative to a fully wage-indexed pension; [b] 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 3,06% except in the last variant where the actual real interest rate is used. The nominal funding ratio is always computed using the actual nominal interest rate.

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

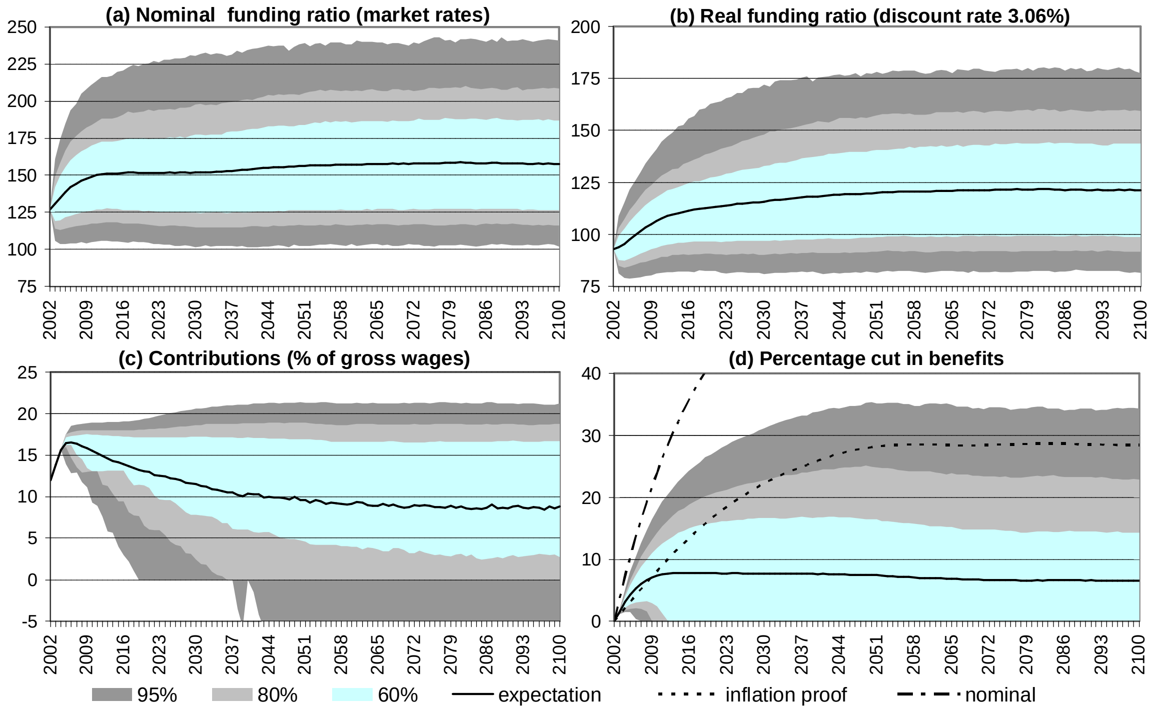

Figure 2: No official indexation ambition, contributions based on nominal term structure

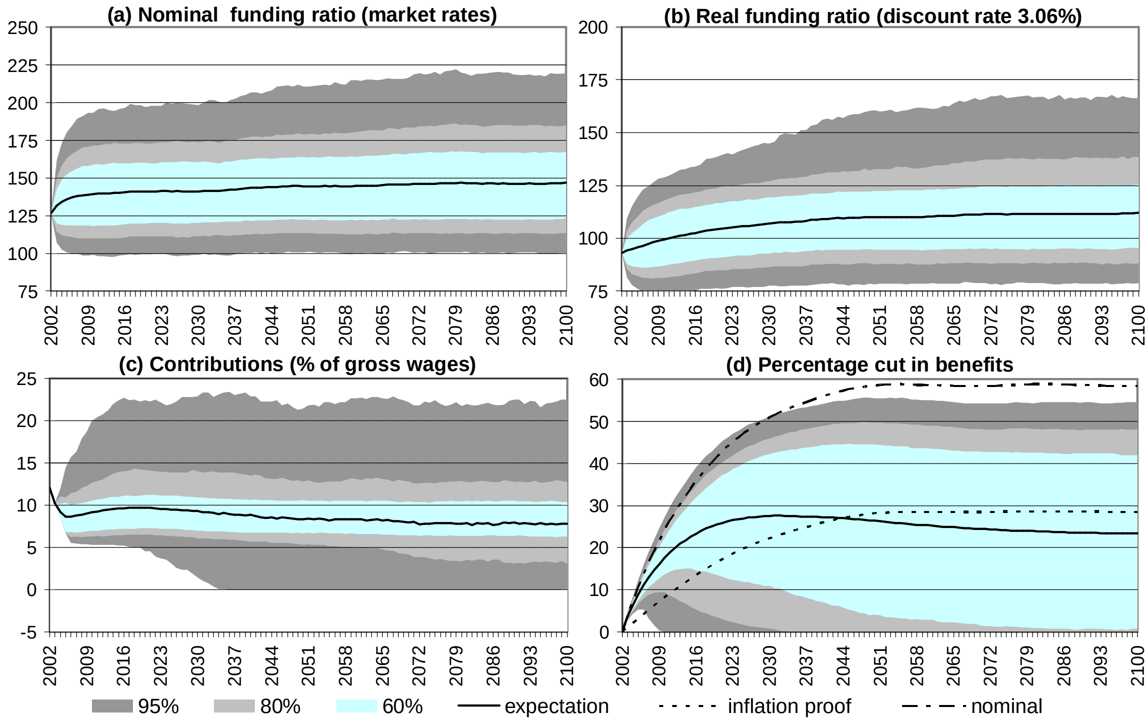

Figure 3: Conditional indexation, none earmarked reserves

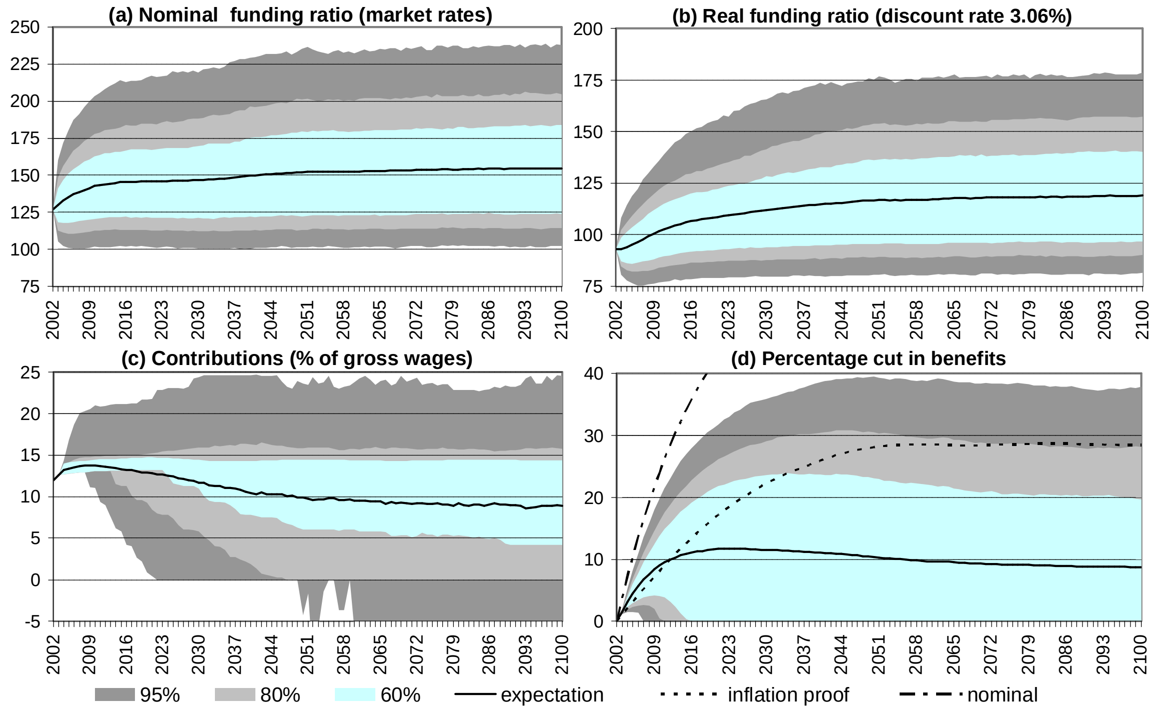

Figure 4: Conditional indexation, voluntary provisioning

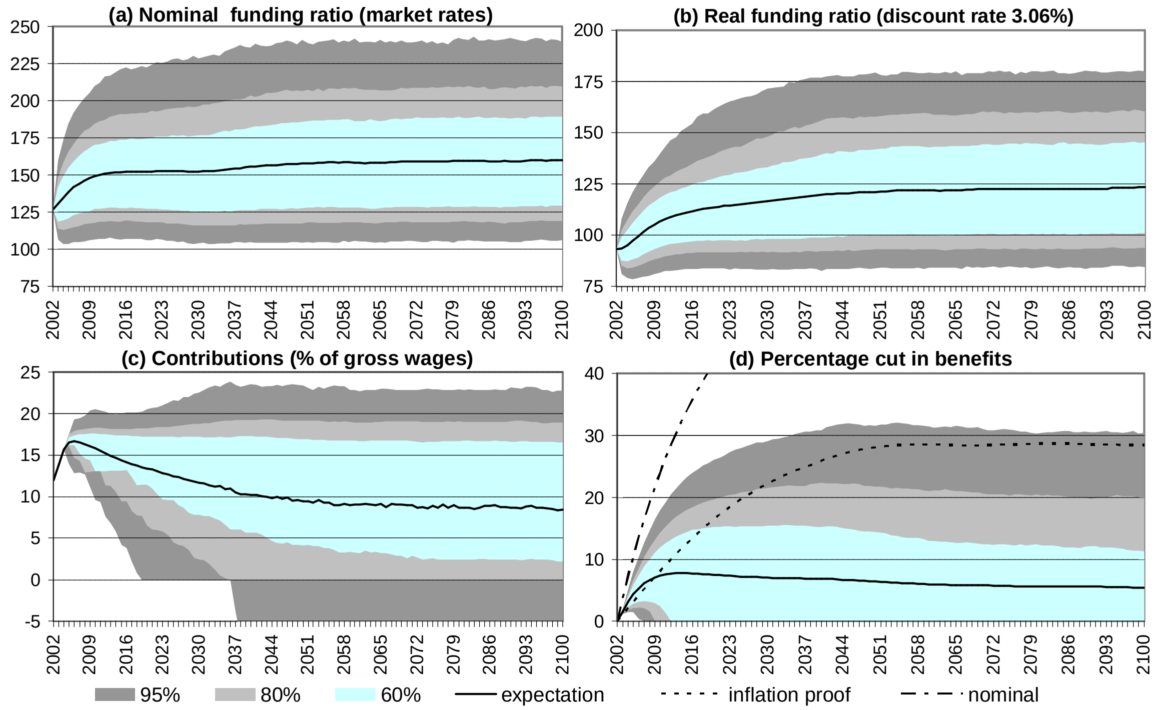

Figure 5: Unconditional indexation, no mark-up