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The price of pension risks

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The number of employees in the Netherlands who have to rely on defined contribution pension schemes has increased considerably in recent years. Simulations show that the risks inherent in these new contracts are significant. Employees bear these higher risks without being aware of this. Our simulations indicate that the pension premium should more than double in order to provide them with adequate compensation for the higher risk.

1 INTRODUCTION

On the spectrum of pension schemes, there are two extremes, with hybrid variations falling in between. At one end of the spectrum, there are the defined benefit (DB) pension schemes that are mostly based on 70% of the employee's average salary. Approximately 90% of employees in the Netherlands participate in schemes of this kind. At the other end of the spectrum, there are the defined contribution (DC) pension schemes that consist of the sum of the annual contributions plus any investment yields. Typically, contributions are equivalent to a uniform percentage of gross salary. Furthermore, there are combinations of both varieties, whereby a common variety is the collective defined contribution (CDC) pension scheme. In a CDC pension scheme, the defined benefit is combined with a fixed contribution that is promised to the participant by the employer. In 2008, 5% of employees participated in DC schemes. In particular, the number of employees participating in a DC scheme has risen considerably, while the corresponding pension contributions for DC schemes have hardly risen (see Table 1 on the next page).

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TABLE 1 Types of pension schemes in the Netherlands.

	Pension schemes (%)		Employees (%)		Contributions (%)	
	2003	2008	2003	2008	2003	2008
DB	88	72	94	90	96	93
DC	5	10	2	5	1	1
Other	7	18	4	5	3	6

Source: De Nederlandsche Bank (2009).

In recent years, a number of employers in the Netherlands have switched from a DB scheme to a DC scheme. Some reasons for this are, among others, the higher pension contributions, the stricter prudential supervision of DB pension funds (the Financial Assessment Framework, or "FTK") and accounting standards (the International Financial Reporting Standards (IFRSs)) that require that DB schemes be valued and then recognized on the balance sheet of the employer, as this could lead to future obligations to pay additional amounts (Bovenberg (2005)). In DC schemes, employers are not obliged to pay extra contributions in unfavorable times and, as a result, this accounting requirement does not apply. Therefore, the operating result of the employer is not affected by the investment results of the pension fund. This makes it attractive for employers, particularly where it concerns stock-listed companies, to opt for a DC scheme instead. In addition, the buffer requirements specified by the supervisor do not apply to DC schemes in the way that they apply to DB funds.

As a result of the economic crisis, pension funds have suffered losses on their investments and they have had to discount their liabilities on a lower interest rate. Consequently, many pension funds with DB schemes became underfunded. Approximately half of the funds were obliged by law to draw up recovery plans specifying the measures that would be taken to restore the cover ratio. In some cases, pension funds considered reducing the accrued pension entitlements or gradually economizing on the scheme in the future. As a result, the essence of DB was threatened: the pension benefits that had been promised in the pension scheme would not be paid out in full. It could be argued that the uncertainty inherent in DB schemes does not differ fundamentally from that of DC schemes. Then, labeling the existing schemes as DB would only be a matter of "window dressing", since in fact they have a CDC/DC character but people are not fully aware of this. In this line of reasoning, it would be more transparent practice to present these DB schemes as CDC schemes, as the uncertainty would be indicated more clearly in this manner. However, the difference in pension result between the types of schemes is so considerable that a DB scheme

offers much more added value, even in difficult times. Put differently, when a transition is made from a DB scheme to a DC scheme, participants generally do not receive compensation for the large risk that they assume. This can also be seen in Table 1 on the facing page: more schemes and employees were qualified as DC, but the share of DC contributions in the total contributions has not increased at the same rate.

2 THE ESSENCE OF DEFINED BENEFIT AND DEFINED CONTRIBUTION

Both DB and DC schemes are funded pension schemes, but they work in different ways. In the case of a DB scheme, the benefit is fixed and the contributions can vary, whereas the opposite applies to DC schemes. In order to be able to secure the benefit in a DB scheme, the paid-in contributions are managed collectively. There is also an intergenerational and intragenerational solidarity, whereby retired persons, participants and future participants collectively share the risks of positive and negative investment returns and demographic trends. In DC schemes this is, in principle, not the case and each participant bears the investment risks individually.

In this paper, we compare DB schemes with individual DC schemes, in order to determine the difference between the schemes for the individual participant in terms of risks and returns. The point of departure is a DB scheme that satisfies the supervisory criteria of the FTK. Furthermore, a simulation of a DC scheme is made in order to see how the expected benefit of a DC scheme compares to the defined benefit of a DB scheme. This simulation mainly focuses on the risks. The underlying reason for a transition from a DB scheme to a DC scheme is usually that the employer no longer wishes to bear the risks of higher contributions, sponsor payments and accounting for the pension liabilities in the balance sheet. This poses the question of what this shifting of risks entails for the individual.

3 CRITERIA FOR A TRANSITION FROM A DEFINED BENEFIT SCHEME TO A DEFINED CONTRIBUTION SCHEME

Three criteria are important in the decision regarding the transition from a DB scheme to a DC scheme. The first criterion is whether, within a DC scheme, a return comparable with that realized by a participant in a DB scheme can be realized at a comparable cost. The second criterion concerns the risk that the actual benefit in the DC scheme will be lower than the defined benefit in the DB scheme. It should, however, be observed that those benefits are also not fully guaranteed, as is now apparent from the recovery plans. The confidence level of the FTK (97.5%) for DB schemes was used in the simulation. Put simply, this criterion implies that a fund may be underfunded, on average, once in a period of forty years. For the DC scheme, this has to

be translated as a confidence level of 97.5% that sufficient capital will be available on the retirement date. The third criterion concerns the distribution of the risks over the employers and the employees. In DB schemes, employers and employees can both be obliged to pay additional contributions or extra payments when the pension fund is unable to meet its obligations. In the case of a DC scheme, the employer is not obliged to do this and the employee will receive a lower benefit. On the other hand, the additional contributions that an employee would have to pay can also be calculated to ensure, with the same level of confidence, that the employee would receive the same benefit. In these terms, the extra contributions have been calculated that would be necessary in a DC scheme to be able to attain the same confidence level as for a DB scheme.

4 SIMULATION

In order to show the essence of the difference, the simulation is based on a simplified model, in which the calculation is based on a representative participant: the average person, aged twenty-five, who builds up a pension up to the age of sixty-five. During this period, the assumption is made that there is no inflation and a uniform contribution rate is paid over a salary that remains constant in real terms.[1] Uniform accrual has also been assumed for the salary and the pension, ie, the average wage and a corresponding pension are used. The dependents' pension and disability pension have not been taken into consideration. Therefore, only the old-age pension is included in the calculation. The reference point is the conversion at the age of sixty-five, so that only the accumulation of the pension capital of the DB and DC schemes are compared with each other. In other words, to the extent that DB schemes allow for a gradual conversion to take place more easily than DC schemes, this advantage of DB schemes has not been taken into consideration in the simulation (see Table 2 on the facing page for the variables that have been used as inputs for the simulation).

The simulation starts with the modeling of a DB scheme in accordance with the FTK parameters for prospective returns, volatility, correlations and the confidence level of 97.5%. The outcome of this DB scheme in terms of an amount at the age of sixty-five has then been taken as the target amount for a DC scheme. The simulations show the contributions that have to be paid into a DC scheme to generate the same pension amount, with the FTK confidence level of 97.5%, as would result from a

[1] Of course, not adjusting for inflation creates an artificial view of the investment practice. Nevertheless, because both DB and DC are subjected to this same assumption, it does not hinder the comparison. It could be argued that the characteristics of investment in real asset classes (eg, real estate and inflation-linked bonds) can be achieved more readily in a DB context, because of higher transaction costs, duration considerations, etc. As explained in the last section, we use DB-type strategies for both types of schemes.

TABLE 2 Variables and their values used as inputs for the simulation calculations.

Variable	Value
Targeted pension income per year	€13 307.76
Annual uniform contribution DB scheme	€1786.51
Length of pension accrual (accumulation period)	40 years
Length of retirement (decumulation period)	20 years
Fixed asset mix	50% bonds, 40% equities, 10% real estate
Bonds (μ,σ)	$\mu = 4.5\%$, $\sigma = 8.8\%$
Equities (μ,σ)	$\mu = 9.0\%$, $\sigma = 25\%$
Real estate (μ,σ)	$\mu = 6.5\%$, $\sigma = 15\%$
Correlation equities: real estate	0.75
Correlation bonds: equities	0.50
Correlation bonds: real estate	0.50

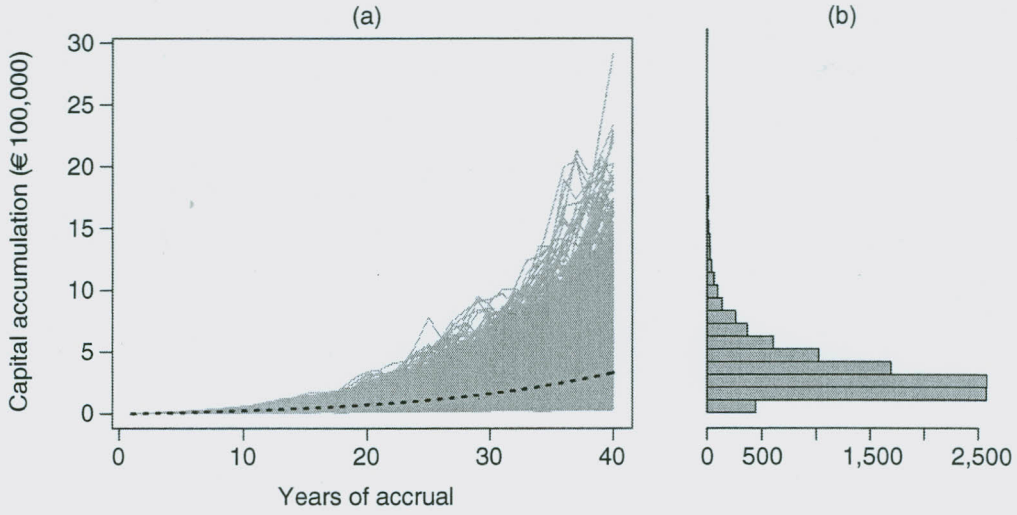
DB scheme. In this case, the contributions are invested under identical circumstances according to an asset mix that consists of bonds, equities and real estate. The volatility of the various asset categories is not provided in the FTK parameters (Ministerie van Sociale Zaken en Werkgelegenheid (2006)). Therefore, the standard deviations used here have been calculated in accordance with the FTK approach, in which calculations are made taking shocks into account (De Nederlandsche Bank (2006)).

5 RESULT

In order to arrive at a clear representation of the distribution of the investment results in a DC scheme, 10 000 Monte Carlo simulations were carried out with various returns on the three types of assets. In these simulations, correlated normal distributions were used with the variance/covariance structure of Table 2.[2] A summary is provided in Figure 1 on the next page, which shows the development of the pension sum over the forty years of accrual in part (a) and the distribution of the pension sum in the fortieth year in part (b). The dashed line represents the DB scheme and the gray lines represent the accrual in the 10 000 scenarios that were generated for the DC scheme. In the case of a defined contribution, it appears that, rather than 2.5%, 60%

[2] We also used resampling of empirical return distributions of the assets, which, by and large, showed the same results. The disadvantage of using historical returns is that they are extremely sensitive to the choice of data period, eg, resampling on a 1965–2005 period is different from resampling on a 1969–2009 period.

FIGURE 1 Accrual of DB and simulated DC pension sums, and distribution of DC sums after forty years, with a level contribution.

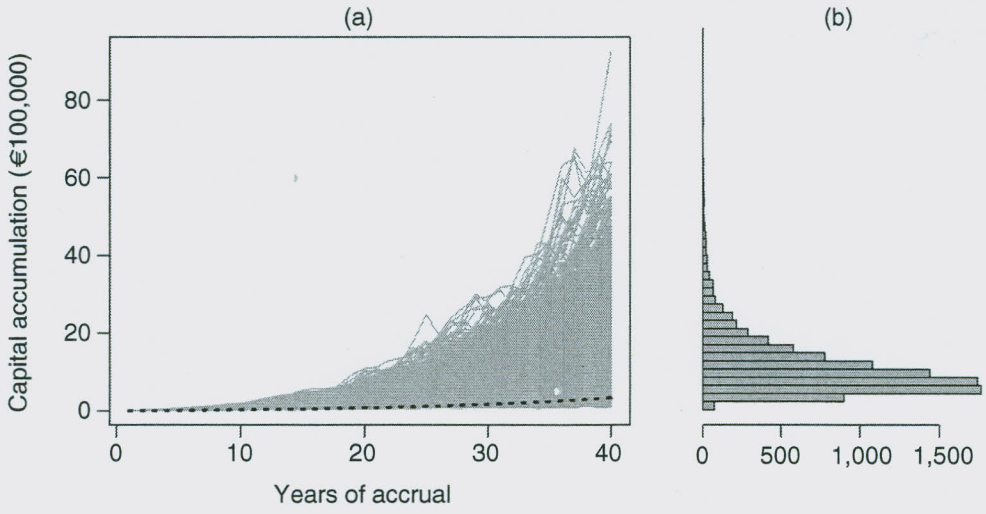


The dashed line denotes the DB accrual.

of the DC outcomes lie under the DB outcome. It is apparent from further calculations that the DC contributions would have to be approximately 2.45 times as high as the contributions in a DB scheme in order to achieve at least the same result with the same confidence level. The results are shown in Figure 2 on the facing page, where the dashed line represents the DB scheme and the gray lines represent the accrual in the 10 000 scenarios that were generated for the DC scheme. In view of the fact that, generally, 20% of the labor costs salary goes towards the pension contribution in DB schemes, it can be calculated quickly that this DC equivalent would result in almost half of the salary. In other words, for the same confidence level, employees in a DC scheme would be working for their pensions for half of their time.

It should be clear that the simulations depend strongly on the standard deviations that are used. A calculation of the minimum values results in a standard deviation for bonds, equities and real estate of 6%, 19% and 12%, respectively. A simulation with these much lower values results in a contribution multiplication factor of 1.65 in order to bring the DC scheme up to the level of the DB confidence level. However, assuming higher volatility is probably more realistic. In terms of the model, using a higher volatility assumption, ie, higher standard deviation, is one way to compensate for using a normal distribution, which has tails that are thinner and shorter than actual asset return distributions. Of course, even higher volatility results in an even higher contribution multiplication factor.

FIGURE 2 Accrual of DB and simulated DC pension sums, and distribution of DC sums after forty years, with contributions to the DC plan that are 2.45 times as high as for the DB plan.



Dashed line denotes the DB accrual.

6 ANALYSIS

Such a large difference demands an explanation. This can be found in the fact that DB schemes have institutionalized risk sharing. As a result, the negative and positive investment results can be spread over the whole population of participants in the pension fund. The effect of the volatility of the investment result per participant is therefore substantially lower than in an individual DC scheme. Consequently, a participant in a DB scheme runs considerably less risk of ending up below the target pension capital level than a participant in a DC scheme, who does not have these risk-sharing possibilities.

It can be observed that this is not a purely hypothetical situation. In the US, it is certainly possible that people with a DC scheme could lose half or more of their pension capital in the year that they had planned to retire. In fact, this actually occurred in 2008. In order to have reached a sufficiently robust target capital, they would have had to pay twice as much in contributions. As they obviously have not done so, they now, as much as possible, have to continue to work for a considerable time in order to realize a proper pension income for their remaining life expectancy. It should be mentioned that, in our calculations, DC participants did not have more than 40% in equities, so they are less susceptible to the type of scenario experienced in the US during the last two years. If we had modeled actual investment practices in the

US, which have been heavily equity-centric, the results would have been even more significant.

In abstract terms, the difference can be described as follows. The volatility of the funding ratio of a pension fund is completely different from the volatility of an individual pension scheme, even if one assumes that they could be invested in the same manner, at the same costs and with the same economies of scale. Recovery periods of three to fifteen years, as assumed for recovery plans, are completely different for an individual than for a pension fund. After all, during such a period, a pension fund can spread the negative and positive results over a large number of participants of various ages, whereas individuals will have to bear the losses themselves during such a period. The risk is further increased due to the fact that the accrued DC capital has to be converted into a lifelong annuity on the retirement date.

There is a statistical aspect, too. The standard deviations are approximately as large as the average return. It is due to the very-long-term character of the pension assets and the pension liabilities that the collective risk-bearing investment of pension capital offers better results than individual investment. In fact, this is exactly what pension funds do. Individuals run into insurmountable difficulties when returns are low for longer than a ten-year period, whereas pension funds can sit out such a phase. The industry-wide pension funds, in particular, are able to profit from this long investment horizon as they offer the highest level of continuity.

It should be noted that a contribution that is 2.45 times as high could lead to average and maximum outcomes that are much higher than 2.45 times the regular DB pension outcomes, as Figure 2 on the preceding page clearly shows. The average pension, after forty years, of approximately €300 000 thus becomes approximately €1 million due to the increase in the contributions. The individual consequences of the volatility remain within limits due to this higher expected return. By setting the target much higher, an unacceptably low outcome can be avoided. The price for this would be a large gross-to-net wedge during the working years. However, the resulting risk-neutral scheme is fiscally unacceptable. After all, the tax authorities require that "The system must be directed at a pension that after thirty-five years of accrual does not amount to more than 70% of the salary at that point in time" (Belastingdienst (2007)).

One could question whether the confidence level, namely the FTK limit of 97.5%, was not chosen too strictly. If this were the case for individual DC schemes, then this would have to be the case *a fortiori* for pension funds with DB schemes. After all, such pension funds are better able to absorb the volatility of financial markets than individuals are, by maintaining buffers and by having long recovery periods. Defined contribution schemes with 2.45 times higher contributions also actually build up such a buffer, but that must be much higher than the 25–30% buffers built up by the DB pension funds, because individuals do not have a recovery period, or have a very minimal one, and they cannot share the risks with others. In the event that the risk

level is set even higher, for example, at a confidence level of 99%, the resulting contribution increases are obviously a multiple of 245%.

In view of the fact that, in daily practice, the contributions for DC schemes are not 2.45 times as high as the contributions for DB schemes, the implication is that participants in a DC scheme run the substantial risk of ending up with lower pension capital than participants in a DB scheme. In those cases, in which the participant starts out with a DC scheme, it can, in any case, be recommended that a mechanism be incorporated for sharing the risk among the participants so that the downward risk is partially hedged on the retirement date (De Jong *et al* (2008)).

7 COLLECTIVE DEFINED CONTRIBUTION SCHEMES

We have now outlined why the partial transition from a DB to a DC scheme has to be monitored carefully. This also applies with regard to the transition to collective DC schemes. In CDC schemes, the risks are shared between the participants. Nevertheless, compared with the DB schemes, there are important differences. In CDC schemes, the contributing employer (sponsor) will not make additional payments or extra contributions in the event of underfunding. The ratio between the upward and the downward risk for a DB scheme therefore differs from that of a CDC scheme. Collective defined contribution pension schemes are applied relatively often in situations where the pension fund is large in comparison with the sponsor. In the event of a DB scheme, the company would then run a large pension risk that has to be valued and recognized in the balance sheet according to IFRS accounting standards. The transition from DB to CDC relieves the company of these risks. This would also offer a solution to the US case, where retirement benefit obligations put the solvency of the sponsoring firm at risk. The participant populations in these funds are characterized, in general, by relatively many deferred members and retired members, and a smaller group of active employees. This typical composition of the pension fund population leads to the result that both the employer and the group of active employees may run a higher risk of a raise in contributions. Because the inactive participants with deferred rights and the retirees are not susceptible to contribution payment, the security provided to them has a strong leveraging effect on the risk of the employer and the active members of the pension fund. Reducing the risk budget in CDC pension schemes in view of this higher risk also has the disadvantage that targets have to be revised downwards, as with less risk the probability of investment gains also becomes lower. These risks play less of a role in industry-wide pension funds, because the contribution instrument can still be utilized and the populations are much larger and more varied than in specific CDC funds.

8 CONCLUSION

The simulations show that DC schemes have disadvantages for participants, because participants bear a high investment risk in such schemes. Realizing a DC pension with the same confidence level as a DB pension would require almost 2.5 times the level of contributions and is therefore unaffordable for participants and employers. Even for a calculation with minimal variances, the contribution would still have to be 1.65 times as high. In a transition from a DB scheme to a DC scheme, participants generally do not receive compensation for assuming these risks. In prosperous times, the necessity of doing this is less apparent as the upward risk is then the central issue. The shocks on the financial markets underline the notion that security is a valuable commodity where pensions are concerned. Employers and employees should therefore proceed very cautiously in the event of a transition from a DB scheme to a DC scheme. Even though pension funds with DB schemes feel the impact of the risks of financial markets, they offer a much better result for the participating employees.

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