Institutional Reform in the Dutch Pension Sector

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Summary

We discuss recent developments in the Dutch pension sector and identify current and future problems that are due to the ageing of the population. Using an applied general equilibrium model of the Dutch economy, we assess the effects of two changes in pension institutions that aim to make them more robust to macroeconomic shocks. The first is to base pensions on average wages rather than final wages as is current practice, and introduce conditional indexation. The second is to replace the current defined-benefit system with a defined-contribution system. We stress the role that pension institutions play in the intergenerational redistribution that is due to macroeconomic shocks.

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1 Introduction

Like many industrialized countries, Dutch society will see a dramatic change in its demographic structure over the coming decades. Indeed, the so-called dependency ratio, the number of pensioners per worker, is expected to grow from 0.22 in 2000 to 0.43 in 2040. Efforts to assess the impact of this change on all aspects of the economy are plentiful. Both international analyses and work specific to the Dutch economy has been carried out. Mostly, the focus has been on the sustainability of current arrangements: can the government afford to maintain the system of pay-as-you-go pensions (PAYG) at current levels without exploding the public debt? Do pension funds have enough assets to cover their increasing liabilities? The answer to the second question is especially important for the Netherlands, where supplementary pension funds form a large part of the average retirement arrangement. These funds had accumulated assets in excess of € 560 billion in 2001 (Van de Ven and Van Ewijk 2002), or approximately 130% of GDP.

This paper stresses the impact ageing has upon the robustness of pension institutions. The higher number of retirees relative to workers aggravates the impact of any macroeconomic shock that forces pension funds to raise their contribution rates. This has efficiency effects since pension premiums are linked to labour income and therefore may be considered implicit labour income taxes. It also has intergenerational distributional effects since only part of the generations pay pension premiums. Since risk sharing may raise social welfare (Gordon and Varian (1988)), it is an important criterion to be used in evaluating different pension institutions. Because of that, it is useful to explore alternative institutions that mitigate the impact of shocks upon pension contribution rates. We evaluate two of them, pensions based on average wages and pensions based on defined contribution. In a sense, our analysis is partial, *i.e.* we evaluate alternative pension institutions only on their risk-sharing effects, whereas a more complete analysis would require to analyse other effects as well, like for example labour supply effects (Lindbeck and Persson (2003)).

Our tool in these assessments is an applied general equilibrium model of the Dutch economy called Gamma. The model captures most of the institutional arrangements that are specific to the situation in the Netherlands, yet is general enough to allow us to simulate different policies. Importantly, the model includes overlapping generations and therefore allows us to explore the effects upon different groups of generations (working, retired and yet unborn).

We discuss the model briefly in Section 2. In the next section, we discuss the effects that a change in the pension arrangement has on pensioners, current and future members. We compare the outcome for different generations by looking at the change in their net profit from participating in the pension fund. This measure isolates the effects that flow through the supplementary pension system; other effects may be experienced through altered government taxes or transfers. It turns out that the outcome of the institutional change varies significantly

over different generations. Section 4 assesses the robustness of different arrangements. To this end, we simulate four different, unexpected, shocks to the economy. These shocks include a fall in interest rates, lower productivity growth, a stock market crash and an increase in life expectancy. The effects of the shocks are felt by different generations, depending on the institutional arrangements. We conclude in Section 6.

2 The Gamma model

GAMMA attaches the following features to the Dutch economy. First, it considers the Dutch economy to be small relative to the outside world. In particular, Dutch supply and demand for capital are unable to affect the interest rate, which is determined on world capital markets. Second, the goods produced at home are perfectly substitutable with those produced abroad. Third, the model is deterministic. Lifetime uncertainty is recognised, but also perfect capital markets are assumed which allow households to insure against this type of risk. As the model abstracts from other types of risks, it features a zero equity premium. In particular, both equity and bonds earn a return each year that equals the world interest rate.

The GAMMA model is forward looking and features perfect foresight *(i.e.* economic agents in GAMMA let their current decisions depend on the expectations of future variables, and these expectations coincide with realisations). Furthermore, agents are completely rational *(i.e.* they maximize their utility functions given the constraints they face).

Pension Funds

In the Netherlands, a variety of pension funds with different rules exists. We model one pension fund, which may be considered representative of the whole of Dutch pension funds. This representative pension fund has some important characteristics. Firstly, pensions have the character of a defined-benefit final-wage system. This implies intergenerational redistribution in case of a shock. These redistribution effects would be absent in case of defined contribution system. Secondly, participation in the pension fund is obligatory. Thirdly, pensions are fully indexed to wages. Fourthly, pension funds behaviour is reflected in the premium rule. This premium rule reflects the rules of the pension supervisory authority in the Netherlands. This authority rules how fast underfunding has to disappear. Pension premiums have impact upon labour supply as pension premiums are implicit taxes. Moreover, the pension premium rule determines which generations will be affected through pension fund policies and how much they will be affected. Fifthly, pension funds generally use only the premium rate instrument. The instrument of reduced indexation is seldomly used; it is used only in case of a very severe shock.

In the final wage system, workers accumulate *pension years*, an indication of the number of years that they have paid premiums into the fund. Benefits are a function of the amount of

pension years, as well as the final wage. They are indexed to real wage- and price increases. In formulae:

$$Y_{i,t}^{F} = Y_{i,t-1}^{F} + \phi_F \cdot L_{i,t}^{s}$$

$$P_{i,t}^{F} = \left(w_i^{64} - f\right) \cdot Y_{i,t}^{F} \cdot \prod_{s=t_{ret}}^{t} (1+\pi_s)(1+\dot{w}_s)$$

Here, a person *i*'s pension years at time *t*, $Y_{i,t}^{F}$, are a accumulation of his past labour supply multiplied by a fraction ϕ_F that is 0.019 in our model. When labour supply is measured in fte's, the value of $Y_{i,t}^{F}$ at the time of retirement indicates the height of the pension as a percentage of final wage (minus the franchise *f*).
Pension benefits $P_{i,t}^{F}$ are related to the accumulated pension years, the final wage minus the franchise, and are indexed to inflation π and real wage increases $\dot{w}_s$.

We will discuss the shift to an average-wage DB pension system. In an average wage system, pension benefits are tied to the average career wage, indexed by real wage and price increases. However, these indexations are conditional on the financial position of the pension fund. This changes the formulas to

$$Y_{i,t}^{AV} = (1+\pi_{t-1})(1+X_{t-1}\cdot\dot{w}_{t-1})Y_{i,t-1}^{AV} + \phi_{AV} \cdot L_{i,t}^{s} \cdot (w_{i,t} - f)$$

$$P_{i,t}^{F} = Y_{i,t}^{AV} \cdot \prod_{s=t_{ret}}^{t} (1+\pi_s)(1+X_s \cdot \dot{w}_s)$$

Here, an average wage for person *i* at time *t* is computed as $Y_{i,t}^{AV}$; notice that it is indexed with inflation and real wages, but that the latter indexation is provisional: the variable X_t, which is normally equal to one, can take values between zero and one if the financial position of the pension fund is too weak.
If we set the fraction ϕ_{AV} at a value that is slightly higher than ϕ_F and precisely corrects the profile that makes indexed average wage smaller than final wage, and if there are no financial calamities, the two pension funds are exactly the same. With the latter system, however, the fund has an extra instrument which may be used to spread risks across pensioners and workers.

Finally, we will also discuss the shift to a defined contribution system. In a defined contribution system, assets are accumulated for which the worker bears full financial responsibility. When the worker retires, yearly annuities are paid out from his assets that keep pace with wage- and price increases.

$$A_{i,t} = (1+r)A_{i,t-1} + \delta_i \cdot L^s_{i,t} \cdot (w_{i,t} - f) - P^{DC}_{i,t}$$

$$P^{DC}_{i,t} = A_{i,t} /(1+c_{i,t})$$

$$c_{i,t} = \frac{\chi_{i,t}}{1+r}(1+\pi_t)(1+\dot{w}_t)(1+c_{i,t+1})$$

Here, assets *A* for person *i* at time *t* grow with the interest rate and with a fraction δ_i of each year's labour income. When that person has reach retirement age, each year an annuity $P^{DC}_{i,t}$ is paid out, which takes into account the growth of wages and prices, added interest and the probability of dying during period *t*, $\chi_{i,t}$

The pension fund adjusts the premium so that the ratio of assets to obligations (coverage rate d_t) returns to its desired value in 8 years. This is done using the following formula

$$p_{2,t} = \lambda \frac{(1+b)R_t}{G_{t-1}} + [(1-\lambda) - (1+\tilde{r})]\frac{R_t}{R_{t-1}}\frac{A_{t-2}}{G_{t-1}} - \left[p_{1,t} + \frac{P_{t-1}}{G_{t-1}} \right]$$

Here, $p_{2,t}$ is the extra premium that has to be levied over and above the actuarially fair premium $p_{1,t}$ to repair a shortage in the coverage ratio A_{t-1} / R_t while G_t stays for the premium base. The coverage ratio measures assets *A* relative to acquired rights *R*. The desirable value of this ratio is 1+*b*, which is larger than one because of the buffer requirements. The speed of adjustment is set by λ, which is ¼ in our simulations. This fixes of most of the shortage in eight years. It can be shown that the above formula follows from the partial adjustment scheme $\Delta d = \lambda\left(d^* - d_{t-1}\right)$, where *d* is the coverage ratio A_{t-1} / R_t .

Households

The life cycle model provides the basic theoretical framework for modelling household behaviour. According to the life cycle theory, households rationally choose levels of current and future consumption. Labour supply is, although age-dependent, taken to be exogenous at all ages.

Every household is represented by a finitely-lived adult. Lifetime uncertainty is assumed to be diversified by letting each household receive an annuity from a life insurance company in return for bequeathing it its remaining assets upon its decease (Yaari, 1965). These assumptions result in budget equations that describe, as usual, the development of financial wealth of households by the difference of net income and consumption. However, income doesn't only consist of labour, transfer income and income from wealth, but also of intra-generational transfers received from life insurance companies.

From this life cycle model it follows that consumption rises with age if the real interest rate exceeds the subjective discount rate or if the consumption tax rate declines over time.

Firms

The model uses a neo-classical model of the firm. This implies that the firm maximizes its value, which equals the discounted value of its future dividend flows. The dividend payments equal revenue minus the wage bill, corporate taxes and investments. The tax base for corporate taxes consists of revenues minus the wage bill and fiscal depreciation allowance. Fiscal depreciation is based on the historical cost price of investment, and is geometric. The firm can sell its product at the given market price. Production takes place with labour and capital according to a CES production technology. Capital deteriorates at a constant rate.

The productivity of labour is assumed to depend on both age and calendar time. In particular, different age cohorts have different productivity levels. Apart from their productivity, labour supplied by households of different ages is homogeneous.

These assumptions lead to factor demand relations for capital and labour and to a definition for the user costs of capital. The factor price frontier relates the real wage rate to the real user costs of capital.

Note, employees pay pension premiums, not employers.

Government

The model contains a government sector, including PAYG-based first-pillar pensions.

Net profit as a rating device

To assess the impact of changes on different generations, we compute each generation's *net profit* from participating in the pension fund. This is done by discounting all premium payments and pension payouts to the basis year, using the rate of return that pension funds get on their assets. That is, net profit is

$$NP_i = \sum_t \frac{1}{(1+r)^t}\left[Pens_{i,t} - Pay_{i,t}\right]$$

where $Pens_{i,t}$ is the pension payout for a person i in year t and $Pay_{i,t}$ are the premiums paid by the same person in that year. The time index t runs from the base year ($t=0$) over all applicable years. For a pension system that has exactly enough assets to cover its obligations, and which does not run into unexpected shocks, net profit for a starting member should be zero.

In our analysis, we only look at *changes* in net profit. This means that it does not matter whether we include payment history ($t<0$) in the computation, as these values are fixed. Often, data on historical premium payments is hard to obtain.

We judge the impact of changes in the pension system for a generation by their effect on net profit for a typical member of that generation. This measure indicates whether inter-generational transfers play an important role in the change. Shocks to the system are evaluated in a similar way. For shocks in which wealth vanishes, such as an unexpected stock market crash, the change in net profit can be negative for all members. Otherwise, changes in net profit may cancel, indicating that wealth is transferred between generations.

Looking at net profit excludes the effects that work through other channels than the pension fund. For instance, the fiscal deductibility of pension premiums may cause the government balance to shift after a reform has taken place. It is important to recognize that these effects are not reflected in our net profit measure.

3 Effects of two reforms

Our base case is a final-wage based defined-benefit (DB) pension system. That is, the level of pension benefits is determined by the final wage of a member, as well as by the number of years spent in the labour force. This system automatically updates old rights to new price and real wage levels. Pensions are indexed yearly by the increase in nominal contract wages. In case of a shock that jeopardizes the financial position of the pension fund, the pension-fund raises current and future pension contribution rates to restore solvency.

We will discuss the shift to an average-wage DB pension system. As the name implies, in this system pensions are tied to the average wage over the entire career. To keep rights comparable to current level wages, the rights already built up are indexed each year to the change in this variable. This system therefore indexes not only the rights of the retired generations, but also explicitly, rather than implicitly, the rights of the active generation. This creates an extra instrument for pension funds, as they can now choose to delay indexation of the current workers' rights if they are hit by a negative shock. The implication is that this mitigates the necessary rise in the pension contribution rate. Note that, apart from variable indexing, this is the only difference between our final-wage and average-wage system. That is, we model the average-wage scheme such that in the absence of any shock and apart from variable indexing, it makes pensions as generous as in the original final-wage scheme[2].

The second alternative system is a full defined contribution (DC) system. In this case, the assets of the pension fund are divided among workers and pensioners according to their accumulated rights. Members then manage their own assets, and are liable for any shocks that

[2] The final-wage scheme and average-wage scheme are different in case different households have different career profiles. Pensions of those with relatively steep career profiles are higher under a final-wage scheme than under an average-wage scheme. Moreover, final-wage schemes may imply stronger incentives for human capital formation. Our model neglects these considerations

may occur. Pension contributions are not linked to labour income. This means that, unlike under a DB scheme, under a DC scheme a shock that requires a rise in pension contribution rates does not have adverse labour market effects. Also, the DC system completely precludes all intergenerational transfers after it has been adopted.

3.1 An average-wage DB system

Transfer of existing rights

Assume the introduction of an average-wage DB system with full indexation to prices and variable indexing to the real wage rate. Variable indexing means that pensions and pension rights real-wage indexation occurs conditional on the coverage rate, the rate of fund assets to obligations. Partial indexation to the real wage rate takes place when the coverage rate becomes below 128%, which is the ratio mandated by Dutch pension authorities. No real wage indexation is given at all with a coverage rate below 100%. In the latter case only price indexing takes place. Thus, a welfare-linked pension is no longer guaranteed: with to low a coverage rate pensions are lower. Current workers participate in the costs: their rights are also indexed to the average contract wage increase conditional on the coverage rate. However, they also experience the positive side of this policy: the use of the indexation instrument leads to less premium fluctuations than in a DB system without variable indexation. When the burden is borne by pensioners as well as current workers, pension funds become more shock proof, especially when the dependency ratio increases.

Effects of the new system

Assume a transfer of the final wage system rights to the average wage system. The aspiration level remains the same, which implies that the system does not economize. However, pensions decrease immediately relatively to the base simulation due to a coverage rate below 128% in 2005 on the base path. Pensioners experience the introduction of this system as a change for the worse. Figure 3.1 shows the change in net profits; Table 3.1 gives some macro economic indicators.

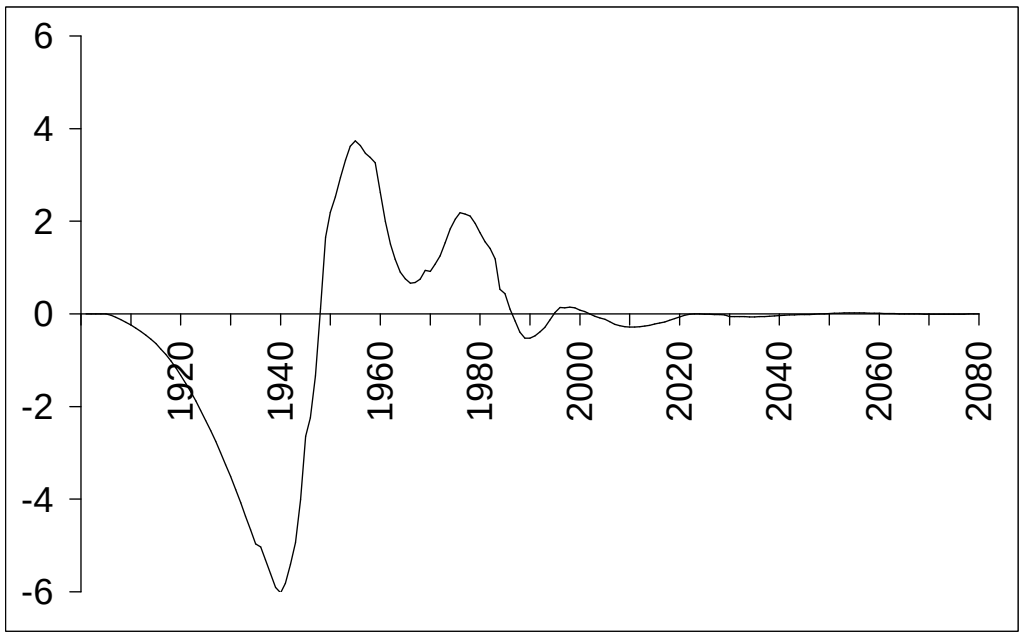

Figure 3.1 **Change in net profits due to a transfer in 2005 to an average wage DB system with variable indexation. Year of birth on the horizontal axis, changes in net profits (1000 €) on the vertical axes.**

The indexation of pensions and pension rights is usually equal to the nominal contract wage increase: 100% indexation means welfare linked pensions. However, we mentioned that the introduction of the new system takes place when the coverage rate stays below its desired level. This leads to a reduction of the indexation of pensions and pension rights of current workers. The premium rate can be set lower than in an average-wage DB system without variable indexing. However, the diminished indexation causes losses to pensioners and current workers for several years. After the desired coverage rate is attained, full indexation (100%) again takes place. As a result pensioners lose in net profit terms (Figure 3.1). Their pensions decrease, and they do not gain by the lower premiums. Current workers take advantage of the transitional arrangement. They have disadvantages from partial indexing in the transfer period but gain from the lower premiums during their working life.

Table 3.1 Introduction of an average wage DB system with variable indexation in 2005

	2005	2010	2015	2025	2050	2100
Pension premiums (% wages)	- 2,6	0,1	1,3	- 1,8	- 0,3	0,1
Pension payments	- 1,8	- 5,8	- 4,9	- 1,5	- 0,9	0,1
Coverage rate	1,2	- 0,4	- 0,2	0,6	0,0	0,0
Indexation to real wages	5%	74%	98%	100%	100%	100%
Tax payments	0,4	- 0,1	- 0,3	0,3	0,0	0,0
Government debt (% GDP)	0	- 2	- 1	0	- 2	- 3
GDP (market prices)	0,0	0,0	0,0	0,0	0,0	0,0
Consumption	- 0,1	- 0,1	0,0	0,1	0,0	0,0

3.2 A defined contribution system

The final- and average-wage pension systems with full indexation are pure *defined benefit* systems because welfare-linked pensions are guaranteed. Pension funds carry the risks due to shocks on the system. These financial risks are implicitly shifted on to current workers. In this paragraph we discuss the transfer to a *defined contribution* system. As a main characteristic the pension rights of a participant are directly related to his accumulated capital. This system does not cause intergenerational transfers by definition.

Transfer of existing rights

Assume a transfer of the 'final-wage defined benefit system' rights to the defined contribution system. The existing pension funds are liquidated at the transfer year 2005 and wealth is divided among the participants, the current workers and pensioners. Division occurs proportional to the rights built up under the old system. Pensioner rights equal the expected value of benefits over the remaining pension years. In the final-wage system, current worker rights are proportional to actual wages and the pension years already built up and are negatively related to future working years. After the transfer every participant manages his own pension wealth and runs the complete risk due to shocks. Pension wealth is a little bit larger than the pension rights, because the coverage rate in the year of transfer is larger than 100%.

After fixing everybody's wealth a cohort-specific DC system is introduced. The aspiration level is a pension equal to 57% of last earned wage. The pension premium results from the aspiration level and initial wealth. This pension premium is fixed at the transfer date and is not changed later on. The premium rate for new participants has been determined every year given the same aspiration level, which aims for a pension equal to the one obtained under the old system. The premium rate of new participants does not change afterwards, too. The premiums paid remain tax deductible, while pension payments are taxed. The effects of the transfer to the DC system

are presented in Figure 3.2 and Table 3.2 The figure shows the change in net profits; the table gives some macro economic indicators.

Effects of the new system

We consider again the transfer effects on four different groups. Pensioners gain from the transfer because they obtain the expected value of their pensions plus a part of the buffer. Participants with only a few future working years at the transfer date (birth year 1940-1950) lose. Their rights increase automatically in the final-wage DB system; this automatism stops after the transfer. To pay the indexation by oneself isn't possible due to limited participation of the 55-65 year-olds. These cohorts obtain a lower pension than in the base run (final-wage DB system). This can be explained by the PAYG element in the final-wage DB system: relative to the obtained rights participants pay much premium in their first working years while rights are built up relatively cheap in their later working years. The older working generations, who lose from the DC system, have experienced the expensive years of the final-wage system but do not get to experience the cheap years.

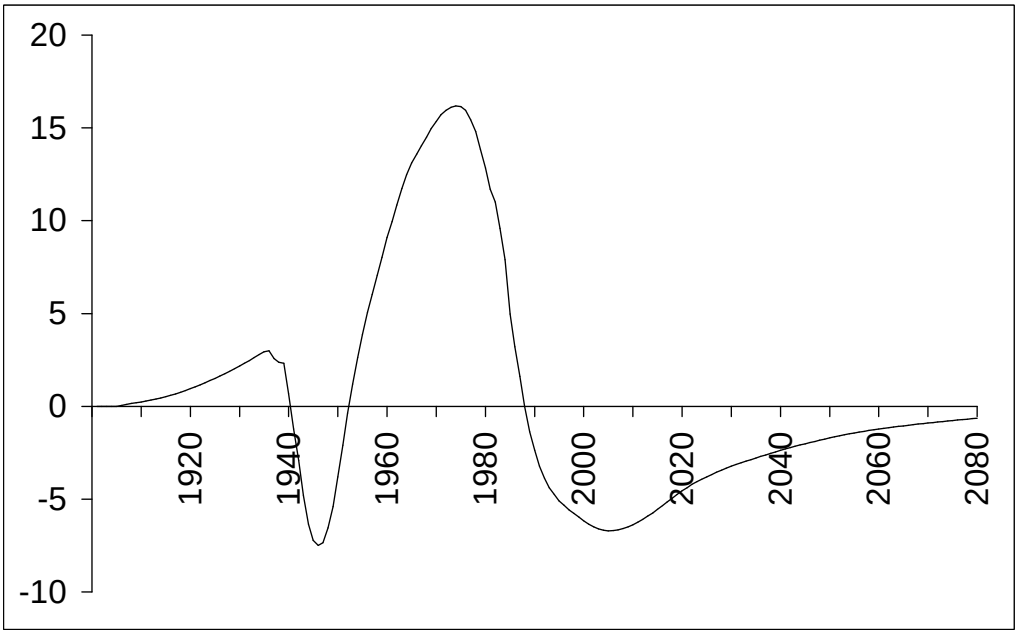

Figure 3.2 **Change in net profits due to a transfer in 2005 to defined contribution (DC) system with variable indexation. Year of birth on the horizontal axis, changes in net profits (1000 €) on the vertical axes.**

The third group, year of birth 1950-1985, gain from the transfer to the DC system. These generations suffered relatively hard from restoring the coverage rate for the final-wage DB pension system in the base run and did not gain from the 'cheap years' in that system. They are released from their buffer liability and from the transfers to close-on pensioners and obtain a part of the available buffer stock. On the other hand their welfare-linked pension disappears, increasing their risk exposure; this isn't illustrated by the presented figures, because we don't simulate with uncertainty.

The last distinguished group isn't active at the labour market at the transfer date (year of birth 1985 and later). In the base run, these generations profit from the buffer stock, built up by the older cohorts. The transfer is a change for the worse to them, because the buffer stock is divided between the other cohorts.

At the macro economic level we see a consumption increase through the lower pension premiums and an increase in tax payments. Shortly after the transfer date pensions increase too, because pensioners obtain the buffer stock. The price for this period of increase in activity has to be paid by those that have to build up their pensions by their own.

Table 3.2 Transfer to a defined contribution system in 2005

	2005	2010	2015	2025	2050	2100
Pension premiums (% wages)	- 15,4	- 15,6	- 1,2	- 3,8	6,7	8,7
Pension payments	3,4	1,5	- 2,1	- 1,9	- 1,2	- 1,1
Coverage rate	-	-	-	-	-	-
Tax payments	1,1	1,4	0,4	0,6	- 0,6	- 1,1
Government debt (% GDP)	2%	- 8%	- 12%	- 20%	- 31%	5%
GDP (market prices)	0,1	0,1	0,1	0,1	- 0,1	- 0,4
Consumption	0,8	0,8	0,7	0,5	- 0,7	- 2,5

The transfer to the DC system finishes the intergenerational transfers for once and for all. The change in net profits is positive for those who had to make those transfers, negative for those who expected to get them. However, we have abstracted from the consequences of uncertainty in our simulations. Those consequences are the subject of next paragraph.

4 Robustness of the different schemes

We will study the robustness of the three pension schemes (DB final-wage, DB average-wage and DC) in the face of four different shocks. Besides distributional issues we will look at the variability of taxes and premiums, as well as pensions, to assess the overall macroeconomic distortions that each system entails.

Because of the perfect-foresight nature of our model, incorporating risks is not an easy task. We simulate each of the shocks as an unexpected occurrence, which takes place five years after the system reform (if applicable). However, real uncertainty is never introduced, and after the shock has taken place perfect foresight is in effect again. That is, we do not model the

reaction to uncertainty that agents exhibit in real life. Nonetheless, these simulations are interesting because they present a clear base case, in which agents act optimally.

4.1.1 An interest rate decrease

Until now, we assumed a constant risk free interest rate of 6%. The risk premium is constant too at a level of 3%. The assumption of a constant interest rate is common for a small, open economy due to the minimal influence of local saving and investment behaviour on the world interest rate.

In this paragraph we study the influence of an interest rate decrease for different pension systems. An interest rate decrease at the world capital market can be the result of aging in the western countries. Aging leads to an increase of capital supply, because the population share of the age cohorts with positive wealth rises. In particular, these are pensioners who are chiefly dependent on their savings for their future income. Capital demand declines in the western countries too because the complementary factor labour declines. The interest rate is subjected to downward pressure as a result. The resulting movement of the interest rate depends on the absorption capacity of non-aging countries. From a literature survey Knaap *et al.* (2003) conclude that a decrease of the interest rate with a half percentage point is possible.

Assume an unexpected permanent decrease of the interest rate in 2010. We look at the consequences for the three pension systems. A lower interest rate leads to larger liabilities and less income for pension funds, which is bad news. The lower interest rate leads to increasing investments. These investments bring about an increase in capital, a production factor that is complementary with labour. Employees become more productive and wages rise. In a defined benefit system pensions are linked to wage, leading to an increase in benefits and of net profits for pensioners. As said, the lower interest rate is bad news for pension funds: not only do actual pensions increase but also the discounted value of their future liabilities, leading to a deterioration of the coverage rate. This implies a higher premium for the current workers.

Figure 4.1 shows the change of net profits for the three pension systems. The final wage defined benefit system gives positive changes for pensioners and a deterioration for current workers. In the final wage system net profit is largest for those who are in their last working year just before the shock.

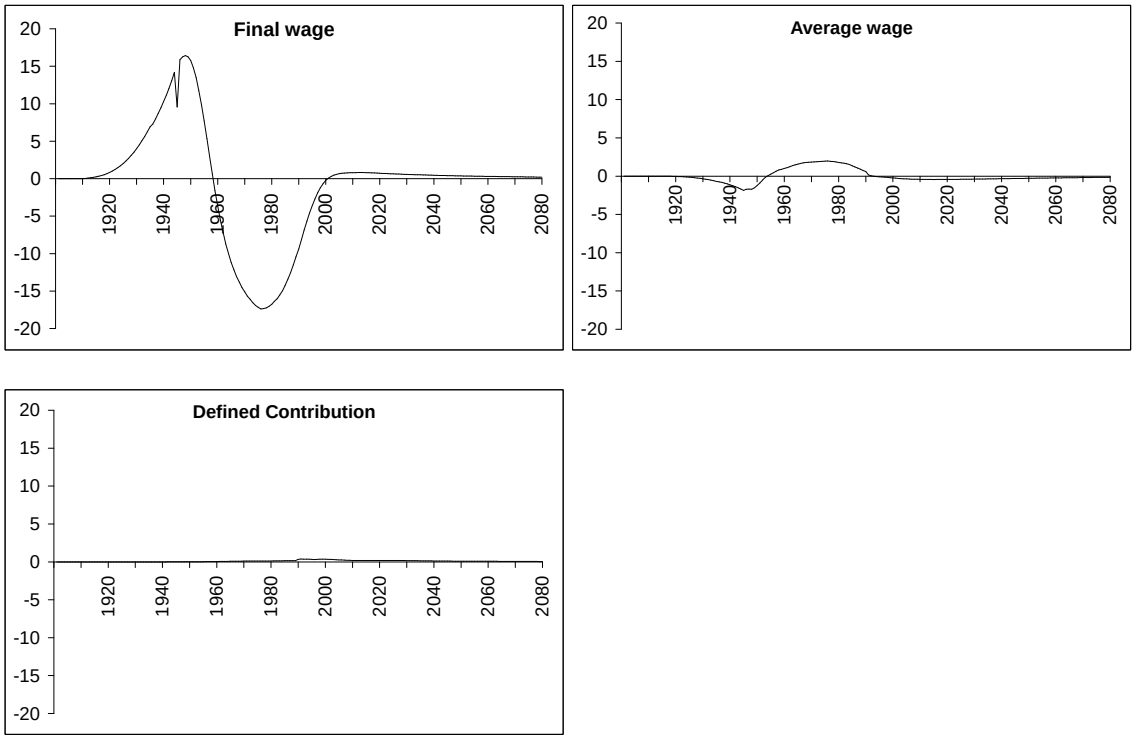

Figure 4.1 **Change in net profits in three pension systems after an unexpected permanent interest rate decrease of one percent point in 2010. Year of birth on the horizontal axis, changes in net profits (1000 €) on the vertical axes.**

The shock is spread over pensioners and current workers in an average wage system with variable indexing. Net profits are lightly negative for pensioners, who are cut back in their indexation. Current workers, who are also cut back in their rights, gain from a smaller pension premium increase than in a DB-system without variable indexation.

In the DC system the change in net profits for current workers and pensioners is zero. They obtain less interest over their saved pension wealth but simultaneously lower their discount rate which is used in calculating net profits. The figure illustrates that net-profit is a relative measure: while the situation deteriorates due to the lower rate of return, investment in the DC pension fund is not worse than the possibilities that exist outside the fund. Membership of the DC system is no extra burden, as the rate of return declines in the whole economy.

Table 4.1 Cumulated effects of a permanent reduction interest rate in 2010

Final wage	2010	2015	2025	2050	2100
Pension premium (% wage)	5,9	12,7	4,4	3,3	3,3
Pension payments	5,2	5,3	5,5	5,6	5,6
Coverage rate	- 18,4	- 13,8	- 0,2	0,0	0,0
Tax payments	1,4	- 2,2	- 1,8	- 2,6	- 3,6
Average wage	2010	2015	2025	2050	2100
Pension premium (% wage)	5,8	7,0	4,1	3,8	3,3
Pension payments	- 0,4	- 3,4	- 3,0	2,6	5,6
Coverage rate	- 17,3	- 5,4	- 0,2	0,0	0,0
Indexation	- 61%	- 18%	0%	0%	0%
Tax payments	1,2	- 1,4	- 1,7	- 2,8	- 3,6
Defined Contribution	2010	2015	2025	2050	2100
Pension premium (% wage)	0,0	0,1	0,6	2,6	2,8
Pension payments	- 6,9	- 8,9	- 13,9	- 22,7	4,4
Coverage rate	-	-	-	-	-
Tax payments	2,2	0,0	- 0,9	- 3,2	- 3,4

Table 4.1 presents the cumulated effects on pension premiums, pension payments, tax payments and the coverage rate, relative to the base case of each pension system. The interest shock leads to a considerable decline of the coverage rate in the final wage and average wage systems, which has to be compensated by a premium increase and by a smaller growth in benefits, in the case of variable indexation. The pension premium of current workers remains unchanged in the defined contribution system, but pension payments reduce. This reduction is largest for cohorts that start saving in 2010; they have no possibility to change their premium rate. Cohorts that become active after 2010 take the lower interest rate into account when determining their premiums. This leads to a considerable pension decline until 2050. When the cohorts that started to work after the interest shock become pensioners, the pension level re-establishes. The tax payments increase in 2010 through a once-only investment tax increase. Income taxes rise over the whole period through increasing wages, but less than proportional because of the the rise in tax deductible pension premiums .

4.1.2 A decline of the wage growth rate

Real wages increase every year with 1.75% in the base projection. This results from technological progress which goes ultimately to workers. Assume a permanent decrease of the growth rate of labour-augmenting technological progress of 0.25%, starting in 2010. This shock leads to lower wage increases and to a decline of GDP growth. The liabilities decrease in the final and average wage system because pensions are real wage linked. This results in lower pension premiums.

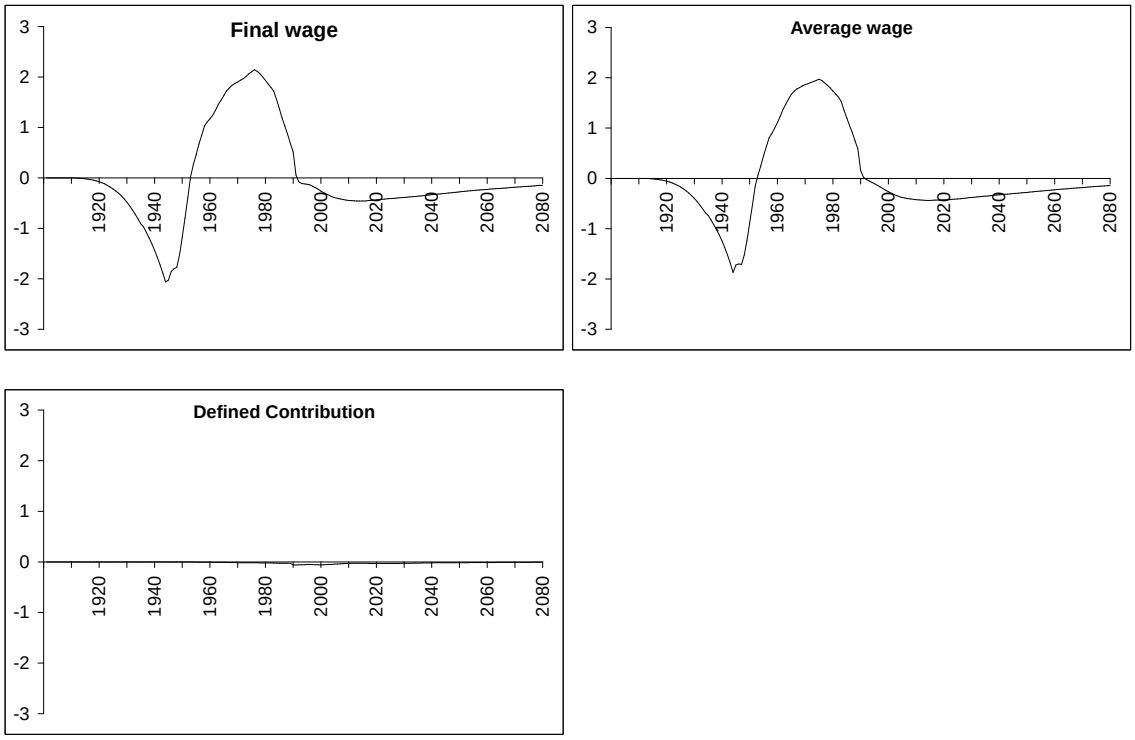

Figure 4.2 **Change in net profits in three pension systems after an unexpected permanent productivity growth decrease of one percent point in 2010. Year of birth on the horizontal axis, changes in net profits (1000 €) on the vertical axes.**

Figure 4.2 presents the change in net profits due to decrease in the productivity growth rate. Though a smaller growth rate is a negative shock on the economy as a whole, net profits from pension funds increase for some groups. This happens in the final- and average-wage system and is caused by a decrease in the future liabilities of pension funds through in these wage-linked systems. The coverage rate increases unexpectedly in 2010, leading to lower premium rates. This decrease benefits those who are not retired in that year. However, for pensioners it is a change for the worse, their income decreases through the shock leading to lower net profits. Net profits donot change at all in the defined contribution system. Savings and pension payments change through the alteration in the basis, but the discounted value of the change is zero.Some macro economic indicators of the shock are presented in Table 4.2. Note: all variables are presented relative to the base run of their respective systems.

In the system with variable indexing, negative shocks are shared by the pensioners, but positive shocks accrue only to the active premium-paying population. This is largely the case in the current simulation. However, note that the base run of the average-wage system with variable indexing is characterized by limited indexation for the year 2010, due to initial shortages of the pension fund. This explains why pensioners also gain a little from the productivity shock in that year; we see a small increase of the pension payments. Most of the gains go to the active members, however.

The lower pension premiums are favourable for the government because of their deductability; the tax payments increase. The other effects of the shock are favourable for the government too, because many of her expenditures are wage linked.

Table 4.2 The cumulated effects of a permanent decrease of productivity growth from 2010 onwards

Final wage	2010	2015	2025	2050	2100
Pension premium (% wage)	- 11,5	- 0,2	- 0,8	- 0,7	- 0,7
Pension payments	- 0,2	- 1,4	- 3,7	- 9,4	- 19,9
Coverage rate	4,8	- 0,4	0,0	0,0	0,0
Tax payments	1,8	0,1	0,6	1,1	1,5
Average wage	2010	2015	2025	2050	2100
Pension premium (% wage)	- 10,6	- 0,4	- 0,7	- 0,7	- 0,7
Pension payments	0,1	- 1,1	- 3,6	- 9,8	- 20,1
Coverage rate	4,6	- 0,4	0,0	0,0	0,0
Indexation	16%	- 1%	0%	0%	0%
Tax payments	1,6	0,2	0,6	1,1	1,5
Defined Contribution	2010	2015	2025	2050	2100
Pension premium (% wage)	0,0	0,0	- 0,1	- 0,5	- 0,6
Pension payments	1,6	0,9	0,1	- 2,5	- 19,8
Coverage rate	-	-	-	-	-
Tax payments	- 0,2	0,0	0,4	1,3	1,5

4.1.3 A stock market crash

We consider now the effects of an unanticipated decrease in the value of stocks owned by the pension funds and households. The crash occurs in 2010 and leads to a decrease in the value of stocks with 20%.

The crash leads to a decline in financial wealth of pension funds and to a lower coverage rate. This leads in the final- and average- wage systems to a pension premium increase. In the defined contribution system the premium remains unaltered, but the diminishing wealth does lead to declining pensions. The shock is most severe for those with largest pension wealth, the current workers who are just about to retire. The pensioners do not escape from a decline of their pensions after the crash either. In the average wage system, the shock is shared by the pensioners and the current workers. The indexation of both groups is reduced. This brings about less liabilities, leading to a smaller premium rate increase than in the final-wage system.

Figure 4.3 shows the change in net profits for the three pension systems after the shock. Table 4.3 presents some macro economic indicators. The figures show that the financial risks are borne by those who have saved financial wealth in a defined contribution system. In a final-wage system current workers bear the risk. In the average-wage system with variable indexing the risks are shared by both groups. The table shows also that pensioners bear the risk in the DC system. The final-wage system leads to large premium increases which leads to labour market distortions and to less tax payments.

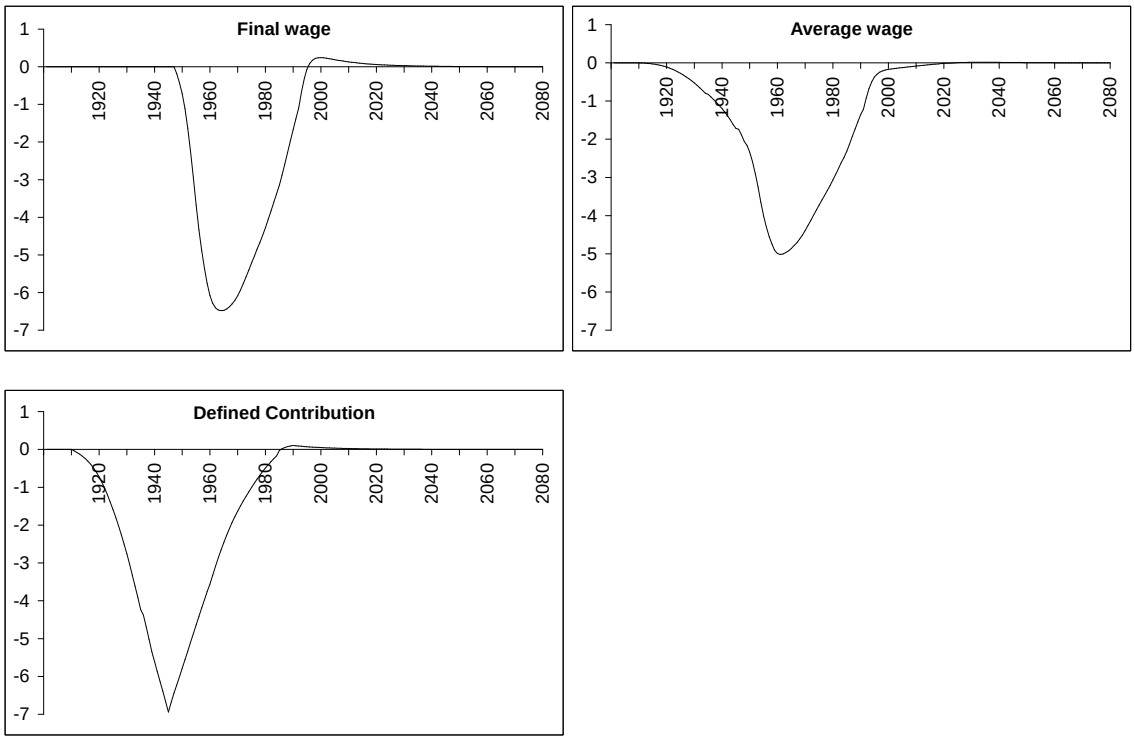

Figure 4.3 **Change in net profits in three pension systems after a crash in the stock market of 20% in 2010. Year of birth on the horizontal axis, changes in net profits (1000 €) on the vertical axes.**

Table 4.3 Cumulated effects of a crash at the share markets in 2010

Final wage	2010	2015	2025	2050	2100
Pension premium (% wage)	0,0	3,8	- 0,1	- 0,1	0,0
Pension payments	0,0	0,0	0,0	0,0	0,0
Coverage rate	0,0	- 3,2	- 0,1	0,0	0,0
Tax payments	- 0,5	- 1,8	- 0,7	0,0	0,0
Average wage	2010	2015	2025	2050	2100
Pension premium (% wage)	0,0	2,6	0,0	0,1	0,0
Pension payments	0,0	- 2,0	- 2,1	- 0,8	0,0
Coverage rate	0,0	- 3,3	0,1	0,1	0,0
Indexation	0%	- 12%	0%	0%	0%
Tax payments	- 0,5	- 1,6	- 0,8	- 0,1	0,0
Defined Contribution	2010	2015	2025	2050	2100
Pension premium (% wage)	0,0	0,0	0,0	0,0	0,0
Pension payments	- 8,2	- 7,9	- 6,6	- 2,4	0,1
Coverage rate	-	-	-	-	-
Tax payments	- 0,7	- 1,2	- 0,8	- 0,1	0,0

The tax receipts of the government decrease in the three systems. This results from the larger (tax deductible) pension premiums in the final- and average-wage system and by a decrease in the indirect taxes in the DC system.

4.1.4 An increase in life expectancy

Now we consider the consequences of an increase in life expectancy. The base run used the demographic expectations of Statistics Netherlands. This projection takes into account an increase in life expectancy due to improvements in health care, social circumstances and lifestyle. This paragraph considers the effects of an unanticipated additional increase of life expectancy in 2010.

This shock leads to an immediate increase of pension funds liabilities, which are based on the expected life span of their members. The increase in life span also results in larger health care expenditures for the government.

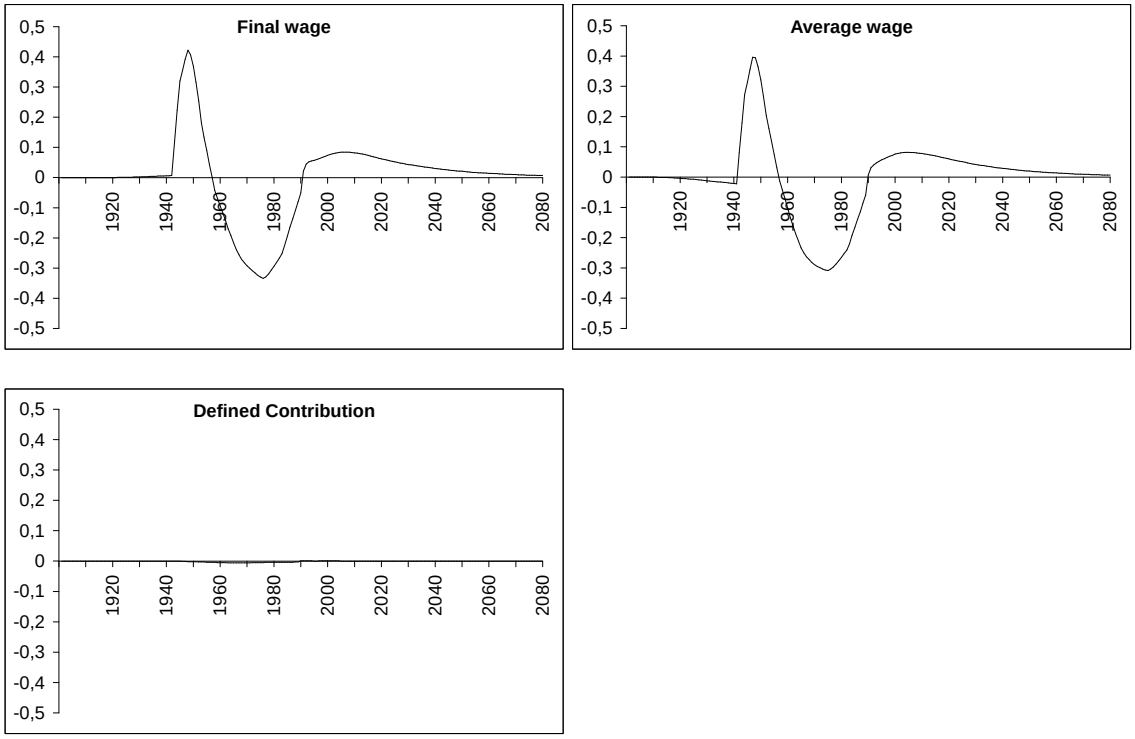

Figure 4.4 **Change in net profits in three pension systems after an increase of life expectancy in 2010. Year of birth on the horizontal axis, changes in net profits (1000 €) on the vertical axes.**

This paragraph considers the consequences of a one year shift in the death rate of persons below the age of 65 years. That means, the death rate of a 51-year-old becomes equal to that of a 50-years-old, *Et Cetera*. This results in an increase of life expectancy. The news of this shock is

announced in 2010. Figure 4.4 shows the change in net profits after the shock and Table 4.4 presents some macro economic indicators.

Net profits rise mainly for cohorts that have just gone into retirement. They get pension benefits over a longer period, pay no additional premium in the final-wage pension system and get only slightly less indexation in the average-wage variable indexing system. The burden of the shock is carried by the current workers. The participants offset the cost of a longer life on their own in a defined contribution system: pensioners and current workers diminish their pensions, while people that start working after 2010 will fix their premium rate at a larger level.

Table 4.4 Cumulated effects of an increase in life expectancy in 2010

Final wage	2010	2015	2025	2050	2100
Pension premium (% wage)	1,8	0,1	0,1	0,0	0,0
Pension payments	0,0	0,2	0,7	1,1	0,9
Coverage rate	- 0,7	0,1	0,0	0,0	0,0
Tax payments	- 0,3	0,0	0,0	0,1	0,1
Average wage	2010	2015	2025	2050	2100
Pension premium (% wage)	1,6	0,1	0,1	0,0	0,0
Pension payments	0,0	0,2	0,7	1,2	0,9
Coverage rate	- 0,7	0,0	0,0	0,0	0,0
Indexation	- 2%	0%	0%	0%	0%
Tax payments	- 0,3	0,0	0,0	0,1	0,1
Defined Contribution	2010	2015	2025	2050	2100
Pension premium (% wage)	0,0	0,0	0,0	0,1	0,1
Pension payments	0,0	0,0	0,0	0,1	1,0
Coverage rate	-	-	-	-	-
Tax payments	0,0	0,0	0,0	0,0	0,1

5 Future work

In future work, we aim to endogenize labour supply. This makes more clear that higher pension contributions that do not promise higher pension benefits work as distortionary labour income taxes. It also allows us to explore more carefully the implications of macroeconomic shocks and government policies upon the government budget. In addition, we want to include precautionary saving. In both cases studied here, households feature increased uncertainty about the level of their pensions. Including precautionary savings may give a better picture of the macroeconomic and budgetary effects of shocks and policies.

6 Conclusion

We considered the consequences of a transfer to two different pension systems and looked at the characteristics of these systems given different unanticipated shocks to the economy. The transfers as well as the shocks bring about intergenerational redistribution, leading to changes in the net profits which different cohorts obtain from the pension fund.
One conclusion of the previous analysis is that no system change exists with only winners. Net profits indicate that different cohorts will have different preferences concerning the desirable pension system. The question is whether there is a preferred, tenable system? We evaluate this in Table 6.1 using three criteria. Using previous analysis not all criteria can be evaluated for the three different systems.

Table 6.1 Evaluating the three systems with three criteria

system	Final wage	Average wage	*defined contribution*
criterion			
Minimal labour market distortions	-	+	+
Intergenerational solidarity		+	--
Minimal sponsor risks			++

Minimal labour market distortions are attained by having as few premium fluctuations as possible. This objective is best attained in the defined contribution system. However, that system leads to variation in the pension benefits which may influence private savings. The average-wage system also leads to less premium fluctuations because financial setbacks are covered by current workers as well as pensioners.
Intergenerational solidarity is totally eliminated in the defined contribution system. This is favourable for cohorts that expect to pay for others, for instance the current workers in the base run, who have to pay for the establishment of a buffer in pension fund assets. Risks increase however, due to the diminished solidarity. In the final-wage system current workers show solidarity with pensioners, but not the other way around: pensioners don't share in the costs in case of financial setbacks. Positive shocks are also not shared with pensioners.
The final- and average-wage systems are rather the same with regard to sponsor risks. Sponsor risk isthe risk that pension funds go bankrupt when calamities befall the sponsor as well as the risk that pension funds become unattractive for new participants. Both systems aim at a recovery of the coverage rate in eight years in line with the rules of the pension supervisory authority in the Netherlands. This leaves little space for accidental sponsor risks. To prevent

passing on debt, the defined contribution system is superior because intergenerational transfers are out of the question. Different cohorts in this system do not share benefits, but also cause no nuisance.

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