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Measuring lifetime redistribution in Dutch occupational pensions

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Abstract in English

This paper quantifies lifetime redistribution in Dutch occupational pension schemes associated with uniform pricing. Information about the extent of redistribution is important because it will influence the public acceptance of the pension system. The uniform contribution rate is split up into a saving share and a transfer share for different socioeconomic groups. The transfer share, in turn, consists of intergenerational and intragenerational transfers. We find that the relative size of the saving- and transfer shares strongly depends on socioeconomic characteristics, such as gender and level of education. The saving part is higher for females than for males and it increases with the level of education, which implies that uniform pricing involves a large transfer from males to females and from low educated to higher educated workers. The impact of intergenerational transfers is modest.

Key words: lifetime redistribution, uniform pricing, net benefit
JEL code: G23

Abstract in Dutch

In deze studie wordt de herverdeling in de tweede pijler van het Nederlandse pensioenstelsel in kaart gebracht die voortvloeit uit de doorsneepremie in combinatie met de tijdsevenredige pensioenopbouw. Inzicht in deze herverdeling is van groot belang, omdat zowel de richting als de omvang ervan van invloed kunnen zijn op het maatschappelijke draagvlak voor het pensioenstelsel. De doorsneepremie wordt gesplitst in een zuivere spaar- en een overdrachtscomponent waarbij onderscheid wordt gemaakt naar sociaal-economische status van de deelnemer. De overdrachtscomponent kan nader worden onderverdeeld in inter- en intragenerationele herverdeling. Uit de analyse blijkt dat de grootte van de spaar- en overdrachtscomponent sterk samenhangt met sociaal-economische status. Zo is voor vrouwelijke werknemers het spaargedeelte van de doorsneepremie hoger dan voor mannelijke werknemers. Hetzelfde geldt voor hoger opgeleide werknemers in relatie tot lager opgeleide werknemers. Deze uitkomsten impliceren dat in de tweede pijler grote overdrachten plaatsvinden tussen enerzijds mannen en vrouwen en anderzijds tussen laag- en hoogopgeleiden. De omvang van de intergenerationele herverdeling is beperkt.

Steekwoorden: herverdeling (over de levensloop), doorsneepremie, netto profijt

Contents

Summary

This study measures lifetime redistribution in the second pillar of the Dutch pension system. It is important to have a clear idea about the magnitude and direction of the redistributional effects, because the relative size of socially desired and undesired redistribution will determine the public acceptance of the pension system. In addition, from an economic point of view redistributional effects can provide useful information about potential labour market distortions.

In the Netherlands, collective second-pillar pension schemes are supplementary to the unfunded (first-pillar) pension provision and are characterized by collective agreements, funding, uniform pricing, mandatory participation and forced annuitization. The market value of the annuity contracts offered by these pension schemes depends on individual characteristics, like age and gender, which does not hold true for the uniform contributions charged. Differences between the market price of a pension scheme and the costs imply redistribution between groups of participants. The goal of this paper is to quantify the extent of this redistribution for different socioeconomic groups.

This paper focuses solely on redistribution that is independent of a shock occurring and ex ante leads to transfers between groups of participants (ex ante redistribution). Redistribution that relates to risk sharing and occurs after the pension fund experiences financial losses or gains will not be considered (ex post redistribution). We measure redistribution as the difference between the expected present values of pension contributions and pension benefits. This way of measuring lifetime redistribution enables us to break down the uniform contribution rate into a saving share and a transfer share.

The transfer share entails two sources of redistribution: intergenerational redistribution and intragenerational redistribution. Intergenerational redistribution originates from the gift that was made to the elderly working generations at the time the uniform contribution rate was implemented. For old workers the uniform contribution rate is lower than the actuarial value of the pension rights build up, while for young workers it is higher. Consequently, the introduction of uniform pricing creates a gain for the workers who are elderly at that time because they benefit from below actuarially fair contributions without having made above actuarially fair contributions earlier. The burden of this gift is imposed on all subsequent generations who face a lower return on their pension contribution than they would have earned had they invested it on the capital market. This foregone return can be interpreted as an interest payment on the unfunded introductory gift and in this sense, it entails intergenerational redistribution.

Intragenerational redistribution originates from individual differences in either life expectancy, income growth or labour force participation growth. The present discounted value of pension benefits as a percentage of lifetime income is increasing in life expectancy and the growth rates of income and labour force participation. As a consequence, uniform pricing

redistributes from persons with a short life expectancy to persons with a long life expectancy and from persons with a high growth in income or labour force participation to persons with low growth in these variables.

In the Netherlands, there are large differences in life expectancy across socioeconomic groups. Females have in general longer life expectancies than males. The same holds for high educated persons compared to low educated persons, irrespective of gender. Hence, uniform pricing redistributes from male workers to female workers and from low educated workers to high educated workers. To allow for these socioeconomic differences in life expectancy, we consider a pension fund that consists of participants who differ in age, level of education and gender. Intragenerational redistribution in this study therefore focuses on transfers between males and females (cross-gender transfers) and transfers between agents of the same gender but with different educational levels (intereducational transfers).

Although the Dutch occupational pension system consists of a wide variety of pension funds, the vast majority of the participants have a pension scheme with Defined Benefits (DB) based on the average wage earned. Our modelling of the system involves some necessary simplification. In order to quantify lifetime redistribution, we represent the entire system using a model of a single representative pension fund. We impose that the pension fund does not experience funding deficits or surpluses and that pension rights of participants are (unconditionally) indexed to wages. This simplification is defensible since we are only interested in ex ante redistribution.

We find that the saving share in the uniform contribution rate is much larger than the transfer share. Nevertheless, there are significant differences across socioeconomic groups. The saving share is higher for females than for males and it increases with the level of education, which implies that uniform pricing involves large transfers from males to females and from low educated to higher educated workers. We find that differences in life expectancy are far more important for the size of intragenerational transfers than individual differences in income growth or labour force participation growth. The impact of intergenerational transfers is modest.

Population forecasts reveal a convergence in life expectancies of males relative to females in the near future. In addition, there is evidence that labour force participation rates of females will increase in the coming decades. Both developments affect the amount of cross-gender redistribution. The first one will actually reduce cross-gender redistribution, the second one will increase it. We find that the effect of converging life expectancies dominates which implies that the transfers from males to females are likely to decline in the future.

1 Introduction

Redistribution is an important objective of unfunded (first-pillar) pension schemes. According to the well known proposal of the World Bank, first-pillar pensions should exactly perform this task, while the saving function should be achieved by the second pillar (see World Bank (1994)). In practice, however, redistribution may also play a role in second-pillar pensions which are typically funded and characterized by a uniform contribution rate (in percentage of the wage earned) and a linear pension accrual. The market value of the annuity contracts offered by these pension schemes depends on individual characteristics, like age and gender, which does not hold true for the uniform contributions charged. Differences between the market price of a pension scheme and the costs imply redistribution between groups of participants.

There are surprisingly few studies that quantify the extent of redistribution in collective funded pension schemes. Most of the existing literature focusing on redistribution is restricted to unfunded pensions (see, e.g., Ter Rele (2005), Börsch-Supan and Reil-Held (2001), Cubeddu (2000) and Sommacal (2006)). In this paper, though, we investigate redistribution in the second pillar of the Dutch pension system. The collective pension schemes in the second pillar are supplementary to the basic first-pillar pension provision and are characterized by funding, mandatory participation, forced annuitization and uniform pricing.[1]

Information about the magnitude and direction of the redistributional effects is important because it will influence public acceptance of the pension system (Börsch-Supan and Reil-Held (2001)). As long as contributions are perceived as savings and not as taxes, workers are more willing to pay them and there will be no or only small deadweight losses. If, in turn, contributions are viewed as pure taxes, welfare losses are created by lower labour supply in the form of reductions in work hours or, more drastically, less participation (Cubeddu (2000)).

The goal of this paper is to identify the relative importance of the saving share and transfer share of the pension contributions for different socioeconomic groups. We distinguish between intragenerational redistribution and intergenerational redistribution. In the analysis we only focus on old-age pensions leaving aside the role of surviving dependants' pensions. In order to quantify redistribution, we consider a single pension fund which is representative for the second pillar of the Dutch pension system. This fund offers a pension scheme with Defined Benefits (DB) linked to the average wage earned. Participants differ with respect to age, gender and level of education. Intragenerational redistribution takes place between males and females on the one hand (cross-gender redistribution) and between individuals with different levels of education on the other hand (intereducational redistribution). We first calculate a baseline scenario in which the economic and demographic environments are held constant, but we also present alternative

[1] Throughout this paper, we define uniform pricing as the combination of a uniform contribution rate (in percentage of the contribution base) and a linear pension accrual.

scenarios that allow for changing demographic circumstances.

Our method of measuring redistribution in a funded pension scheme with uniform pricing is based on generational accounting and closely related to Ter Rele (2005). Ter Rele (2005) emphasizes the need to measure redistribution on a lifetime basis. Annual redistribution is misleading as an indicator of redistribution because an individual's net benefit from collective arrangements does not remain constant throughout life. We therefore measure redistribution as the difference between the expected present values of pension contributions and pension benefits, which is a standard way of measuring lifetime redistribution in the literature (see Börsch-Supan and Reil-Held (2001)). We focus solely on redistribution that is independent of a shock occurring and ex ante leads to transfers between groups of participants (ex ante redistribution). Redistribution that relates to risk sharing and occurs after the pension fund experiences a financial loss or gain will not be considered (ex post redistribution).

The paper complements the study of Ter Rele (2005) who measures lifetime redistribution in the first pillar of the Dutch pension system. Related literature includes Boeijen et al. (2006) and Bonenkamp et al. (2006) who analyse intergenerational redistribution in Dutch occupational pensions but do not consider intragenerational issues. The paper is closer in spirit to that of Hári et al. (2006) who quantify the money's worth of participation in collective pension schemes for different socioeconomic groups. Our paper complements this work along two lines. First, we measure redistribution on a lifetime basis rather than on an annual basis thereby controlling for intrapersonal transfers over the lifecycle. Second, to measure redistribution appropriately both benefits and costs of participation in a pension scheme should be included. While Hári et al. (2006) mainly restrict their analysis to a comparison of the benefits of participation among different groups, we also include the uniform contributions charged.

We find that the saving- and transfer share of the uniform contribution rate heavily depend on socioeconomic characteristics, such as gender and level of education. The saving share is higher for female workers than for male workers and it increases with the level of education. In addition, we observe a large transfer from males to females and from low educated workers to other workers. If we account for the expected convergence of life expectancies between males and females in the coming decades, the cross-gender redistribution will reduce to some extent. The impact of intergenerational redistribution seems to be modest.

This rest of this study is organised as follows. In section 2 we introduce the different sources of redistribution in a funded pension scheme with uniform pricing. Section 3 describes the representative pension fund and its heterogeneous participants. In addition, it shows how to calculate the different sources of redistribution defined in section 2. In section 4 we present the baseline scenario in which the economic and demographic exogenous variables are held constant, whereas section 5 discusses two alternative scenarios in which we allow for two future demographic developments, namely increasing life expectancy and increasing labour force participation of females. Finally, section 6 concludes.

2 Defining redistribution

In the Netherlands, a pension fund is obliged to charge a uniform contribution rate. That means that all participants of a pension fund, irrespective of age, gender and level of education, pay the same contribution rate. The uniform contribution rate differs from the actuarially fair contribution rate, i.e. the contribution sum that exactly matches the value of new accrued pension rights in that specific year. At the individual level, the actuarial cost price of a given pension benefit increases with age. The reason for this is that the period over which the contributions of a worker yield returns becomes shorter as this person approaches retirement. In addition, the likelihood of surviving until retirement increases as people get older. Because building up pension rights is linear in the Netherlands, the positive link between cost price and age turns over to the actuarially fair contribution rate which also increases with age.

The difference between the contribution that a participant *actually pays* each year (i.e. the uniform contribution) and the contribution that *should be paid* according to the actuarial value of the accrued pension rights (i.e. the actuarially fair contribution), defines the yearly redistribution between a participant and other members of the pension fund. Uniform pricing implies a large redistribution from young workers to old workers. For young agents the redistribution is generally positive implying that they contribute more to the pension fund than the actuarially fair level. For older participants it is just the other way around. They face a negative redistribution which means that they receive a subsidy on their actuarially fair contribution. Calculations for the Netherlands suggest that a 25-year-old worker contributes on average 25% too much, whereas a 60-year-old worker contributes 30% too little (Bonenkamp et al. (2006)).

2.1 Lifetime redistribution

Since a worker is a net contributor during the first part of his working life and a net receiver during the second part, uniform pricing actually involves a redistribution of pension contributions over an individual's career. To correct for these intrapersonal payments we define redistribution on a lifetime basis.

Börsch-Supan and Reil-Held (2001) distinguish three concepts of lifetime redistribution: deviations from absolute equivalence, deviations from relative equivalence and deviations from the principle that no opportunity costs should be foregone. The first one, *deviations from absolute equivalence*, is the standard way of defining transfer in the literature and also the one used in this paper. A transfer to or from an individual is defined as any difference between the expected present discounted values of benefits and contributions. The second concept, *deviations from relative equivalence*, is a weaker concept. A pension scheme is considered as obeying the principle of relative equivalence if, for each individual, the present discounted value of pension benefits is not necessarily equal but at least proportional to the net present value of contributions.

This definition is much weaker than the previous one because the proportionality factor does not have to be one.

Often participation in the pension scheme is mandatory. If there are alternative investments that can serve as an equally generous provision for old-age consumption but yields higher returns, there are *opportunity costs* of being forced into the mandatory pension scheme. Under this view, the difference between the return in alternative schemes and the rate of return in the mandatory pension scheme could be interpreted as the tax share of contributions (or, if negative, as the subsidy share). In this paper, we also briefly discuss this last concept of redistribution, but the main focus will be on the first concept, deviations from absolute equivalence.

In a funded pension scheme with uniform pricing there are two reasons why the present value of lifetime pension contributions can differ from that of lifetime pension benefits. The first reason is that the pension contributions of the current and future participants partly entail a redistribution to former generations for which they do not get any compensation (subsection 2.2). Second, since participants of a pension fund generally differ in terms of life expectancy, income perspectives and labour force participation profile, uniform pricing also redistributes between individuals of the same generation (subsection 2.3).

2.2 Intergenerational redistribution

In the first part of one's working life workers subsidize older workers, during the second part they receive a subsidy. Viewed in this way, a pension scheme with a uniform contribution rate has some characteristics of a pay-as-you-go (PAYG) system. This notion allows us to draw a parallel between a PAYG scheme and a funded pension scheme with uniform pricing.

Consider a country that introduces a public PAYG pension scheme. At the time of introduction the people who are retired benefit, because they receive a public pension provision without having made any contribution to the system in the past. However, this introductory gain of the first generations cannot be passed on to all subsequent generations without any cost. These generations are forced to participate in a pension scheme with a *lower* return than the market rate of interest they would earn if the PAYG contributions were invested in the capital market. To see this, note that in a stable economic and demographic environment the implicit return in a PAYG system is equal to the population growth rate plus the growth rate of aggregate income. In a dynamically efficient economy this composite growth rate will certainly be lower than the market interest rate in the long run. Since any pension scheme must be a zero-sum game among all participating generations, the present value of the missed returns of all subsequent generations is equal to the introductory gain of the first generations (Sinn (2000)).

A funded pension scheme with uniform pricing can be viewed as a mixture between a pure PAYG scheme and a completely fair funded pension scheme. Therefore, the economic logic of a PAYG scheme also partly applies to a funded scheme with uniform pricing. No matter how the introduction of this scheme will be organised, it creates a gain for the elderly working generations at that time. These generations benefit from below cost-effective uniform contributions without having made above cost-effective contributions earlier. Like in a pure PAYG scheme, the burden of the introductory gain is necessarily imposed on all subsequent generations. These generations participate in a pension deal with a composite rate of return that falls somewhere between the market interest rate and the implicit return of a PAYG scheme. As long as an economy is dynamically efficient, this composite return is lower than the market interest rate. This implies that for a given level of pension benefits, a participant has to contribute more than he would contribute in a funded pension scheme with fair pricing. Similar to a PAYG scheme, the additional contributions imposed on all subsequent generations are equal to the introductory gain in present value terms. Therefore, these additional contributions can be viewed as an intergenerational redistribution from future generations to the generations who received the introductory gain.

2.3 Intragenerational redistribution

For Dutch schemes, Kuné (2005) gives an extensive overview of the types of intragenerational redistribution we may think of, such as redistribution between males and females, between individuals with a steep and flat career, between low and high educated people, between workers and disabled persons, between single and married people, etc. Some of these transfers might be desired, others might be undesired, but they all share the property that they are not related to the financial position of a pension fund and, hence, are pure forms of ex ante redistribution.

Theoretically, intragenerational transfers in funded pension schemes with uniform pricing originate from differences in life expectancy, income growth and labour force participation growth. The actuarial value of future pension benefits is increasing in life expectancy since in expectation people with low life expectancies will receive pension benefits over a shorter period than people with high life expectancies. Therefore, uniform pricing redistributes from persons with a short life expectancy to persons with a long life expectancy. The uniform contribution rate also redistributes from persons with a flat income or participation profile to persons with a steep one. People with a steep profile benefit from uniform pricing because they build up relatively more pension rights at the end of the career, the period in which pension accrual is subsidized by young workers.[2] As such, it is not the *level* of income or labour force participation that determines intragenerational redistribution as is often thought, but the individual *change* in income or labour force participation relative to those of other persons.

The extent to which intragenerational redistribution is profitable or harmful for an individual,

[2] Note that this channel of intragenerational redistribution is more important in a final-wage scheme than in an average-wage scheme. The Netherlands has recently experienced a large-scale transition from final-wage schemes to average-wage schemes. Therefore, the impact of this redistribution has been declined.

depends on the distribution of the relevant individual characteristics (i.e. life expectancy, income profile and labour force participation profile) over the total pension fund population. If these characteristics are more or less uniformly distributed, the gains and losses will be of equal size at the individual level. If the distribution is skewed, however, the persons with extremely deviating characteristics will experience large gains or losses while the majority of the persons will hardly be affected. For example, the advantage of uniform pricing is higher for a person with a long life expectancy, if he is the *only* individual with this characteristic, because then the uniform contribution rate is low compared to his actuarially fair rate. At the same time, the disadvantage of the other persons is limited as they can spread the burden over a relatively large group. However, if the number of persons with long life expectancy increases, this will drive up the uniform contribution rate and will reduce (increase) the advantage (disadvantage) of a person with a long (short) life expectancy.

3 The pension fund

Although the second pillar in the Netherlands consists of a wide variety of pension funds, 76% of the participants have an DB pension scheme based on the average-wage system (DNB (2007)). In this system pension benefits are linked to the average wage over a participant's entire career. We represent the entire second pillar using a model of a single representative pension fund. This pension fund offers an average-wage DB scheme. Most pension funds in the Netherlands aim at wage- or price indexation. This is not guaranteed, but is conditional on the financial position of the fund. For simplification, we abstract from conditional indexation and assume that the pension fund does not experience funding deficits or surpluses and pension rights are unconditionally indexed to wages. This simplification is defensible since we are only interested in ex ante redistribution, i.e. redistribution that takes place regardless of the financial position of the pension fund.

3.1 The participants

It is well known that females have a longer life expectancy than males. Therefore, a pension scheme with uniform pricing will redistribute pension contributions from males to females. Also, there is much evidence that high educated people have a higher life expectancy than low educated people. Hoyert et al. (2001), for example, show that mortality rates for Americans aged 25 to 64 who have attended college are less than half the rates for those who stopped education after completing high school. Deboosere and Gadeyne (2002) conclude, using Belgian data, that the difference in life expectancy between high educated and low educated males is 5.3 years. For females this difference amounts 3 years. In the Netherlands this difference is 4.9 years for males, while for females it amounts 2.6 years (Van Herten et al. (2002)).

To allow for these socioeconomic differences in life expectancy, we consider a pension fund that consists of participants who differ in age, level of education and gender. There are four educational levels: low education (L), low secondary (LS) education, high secondary (HS) education and high (H) education.[3] Since we also distinguish between male and female workers, there are in total eight socioeconomic groups, each of which has its own survival probabilities, labour force participation profile and income profile. As a consequence, intragenerational redistribution in this paper can be split up into redistribution between males and females (cross-gender redistribution) and transfers between agents of the same gender but with different educational level (intereducational redistribution).

[3] Low education means primary school only, low secondary education contains lower vocational training, high secondary education represents secondary and intermediate college level and finally, high education contains higher vocational training and academic level.

3.2 The pension scheme

Average-wage scheme

For simplification it is assumed that the development of the population is only determined by death and birth. There is no emigration or immigration. We allow for population growth (decline) and time-varying mortality rates. It is further assumed that deaths and births occur at the end of a period. Let n denote the growth rate of cohort sizes at birth, B the cohort size and $\varepsilon(j)$ the probability that an individual of age j lives throughout age $j+1$. Then a cohort of age $j = 0,\ldots, j_e$, with j_e the maximal attainable age, and at time $t = 1,\ldots,\infty$, evolves according to:

$$B(j,t) = \begin{cases} (1+n(t-1))\,B(0,t-1) & \text{if} \quad j=0 \\ \varepsilon(j-1,t-1)B(j-1,t-1) & \text{if} \quad 0<j\leq j_e \end{cases} \tag{3.1}$$

Obviously, $\varepsilon(j_e,t) = 0$.

All residents of the Netherlands receive a first-pillar PAYG benefit from the age of 65. Funded pensions in the second pillar are supplementary to this first-pillar benefit. This implies that workers do not need to build up future pension benefits over their entire gross income. Instead, a franchise is deducted to compensate for the first pillar. Full-time income (Y), franchise (F) and contribution base (G) of a cohort of age $j = j_w,\ldots, j_r - 1$, with j_w the entrance age and j_r the retirement age, are given by:

$$Y(j,t) = \big(1+g(t)\big)\big(1+\phi(t)\big)Y(j,t-1) \tag{3.2}$$

$$F(t) = \big(1+g(t)\big)\big(1+\phi(t)\big)F(t-1) \tag{3.3}$$

$$G(j,t) = Y(j,t) - F(t) \tag{3.4}$$

with g real wage growth and ϕ the inflation rate.

In an average-wage scheme the level of pension benefits depends on the average wage the participant has earned during his career. Each year the participant builds up a fixed percentage (α) of his contribution base as pension accrual. To correct for part-time employment, non-participation, and early retirement the contribution base will be multiplied by the labour force participation rate (p), expressed in full-time equivalents. So, the individual pension accrual (A) equals,

$$A(j,t) = \alpha G(j,t)p(j,t), \qquad j_w \leq j < j_r \tag{3.5}$$

The pension scheme is characterized by a uniform contribution rate (π_U). The pension contributions will be fully attributed to the participants. This assumption implies that the employer's part of the contributions are shifted on to the employee. The uniform contribution rate is defined as the present value of the total (i.e. aggregated over all socioeconomic groups) pension accrual divided by the total contribution base. That is,

$$\pi_U(t) = \frac{\sum_{j=j_w}^{j_r-1} B(j,t)A(j,t)\delta(j,t)}{\sum_{j=j_w}^{j_r-1} B(j,t)G(j,t)p(j,t)} \tag{3.6}$$

where $\delta(j)$ denotes the unit cost price of a wage-indexed pension benefit at age j.[4]

The uniform contribution rate is the rate that is actually paid by the participants but it is not equal to the actuarially fair contribution rate (π_F), which is defined as,[5]

$$\pi_F(j,t) = \frac{A(j,t)\delta(j,t)}{G(j,t)p(j,t)} \tag{3.7}$$

or, by substituting equation (3.5),

$$\pi_F(j,t) = \alpha\delta(j,t), \qquad j_w \leq j < j_r \tag{3.8}$$

In contrast to the uniform contribution rate π_U, the actuarially fair rate π_F is increasing in age because the cost price δ increases with age.[6]

Parameter values

The parameter values of the average-wage scheme are summarized in table 3.1. The accrual rate is 2% of the pension wage per year worked, which is quite common in Dutch occupational pension schemes (DNB (2007)). It is further assumed that the pension fund can only invest in one asset with a certain real rate of return of 3%. At this point we abstract from population growth ($n = 0$) and set the real productivity growth at 1.7%. Note that this configuration implies that the implicit return on the intergenerational transfer is lower than the explicit rate of return on pension savings (see the discussion in subsection 2.2). The retirement age is exogenous. All participants start working at age 25 and will retire at age 65. Nobody becomes older than age 99.

Table 3.1 Characteristics average-wage scheme

Accrual rate (α)	2%
Franchise in base year (F)	€ 10,000
Real portfolio rate of return (r)	3%
Real productivity growth (g)	1.7%
Inflation rate (ϕ)	2%
Age of entry (j_w)	25
Retirement age (j_r)	65
Maximal attainable age (j_e)	99

3.3 Measuring redistribution

Recall that we define redistribution as any difference between the expected present discounted value of benefits (PV_B) minus the expected present discounted value of contributions (PV_C).

[4] See equation (A.1) in appendix A for a formal definition of δ.

[5] Note that for the pension fund it does not matter whether the contributions are financed by π_U or π_F. In both cases it collects the present value of the total pension accrual given by the nominator of equation (3.6).

[6] The interested reader can check this from equation (A.1).

Seen from the perspective of the worker, this deviation from absolute equivalence represents the net benefit (*NB*) of participating in the pension scheme. Formally, the net benefit of a worker who enters the pension scheme at (the end of) time t and from age j onwards and plans to retire at age j_r, is:

$$NB(j,t) = PV_B(j,t) - PV_C(j,t) \tag{3.9}$$

in which:

$$PV_B(j,t) = \sum_{k=0}^{j_r-j-1} A(j+k,t+k)\delta(j+k,t+k)R(k)$$

$$PV_C(j,t) = \sum_{k=0}^{j_r-j-1} \pi_U(t+k)G(j+k,t+k)p(j+k,t+k)R(k)$$

$$R(k) = \prod_{l=1}^{k} \frac{\varepsilon(j+l-1,t+l-1)}{1+r(t+l)} \quad \text{for} \quad k>0 \quad \text{and} \quad R(0)=1$$

where r is the discount rate which equals the nominal market interest rate.

In the simulations later on, we break down the uniform contributions into a saving share and a transfer share. This boils down to rewriting (3.9) in $PV_C(j,t) = PV_B(j,t) + PV_T(j,t)$, with $PV_T(j,t) \equiv -NB(j,t)$, and denoting $PV_B(j,t)$ as the saving share and $PV_T(j,t)$ as the transfer share. So defined, a *positive* transfer represents a payment, a *negative* transfer a subsidy.

Equation (3.9) takes the discount rate r as given. When we instead interpret the net benefit as a function of the discount rate r, set $NB(r)$ to zero and solve for the discount rate, we obtain the implicit rate of return of the pension scheme. Differences in the rates of return within a generation can be interpreted as intragenerational redistribution, while differences of the implicit returns between generations represent intergenerational redistribution.

Recall that the total transfer (PV_T) can be split up into inter- and intragenerational transfers. The intragenerational transfer, in turn, can be subdivided into cross-gender and intereducational transfers. In order to identify these different sources of redistribution, we define three separate uniform contribution rates: the individual uniform contribution rate, the generational uniform contribution rate and the gender-specific uniform contribution rate.[7] These contribution rates share the common property that they are constant and actuarially fair over the working life of the individual, the generation, or the gender involved.

Having defined these contribution rates, total redistribution, expressed as percentage of the contribution base, is equal to the uniform contribution rate minus the individual uniform contribution rate (see table 3.2). To isolate the intergenerational transfer we have to compare the uniform contribution rate with the generational uniform contribution rate. In the exceptional case that the implicit return of a pension scheme with uniform pricing is equal to the market interest rate, the uniform contribution rate coincides with the generational uniform contribution rate. In

[7] See appendix A for a formal definition of these uniform contribution rates.

Table 3.2 Measures of redistribution (% contribution base)

Total transfer	=	uniform CR (3.6)	−	individual uniform CR (A.5)
Intergenerational transfer	=	uniform CR (3.6)	−	generational uniform CR (A.6)
Cross-gender transfer	=	generational uniform CR (A.6)	−	gender-specific uniform CR (A.9)
Intereducational transfer	=	gender-specific uniform CR (A.9)	−	individual uniform CR (A.5)

Notes: CR = contribution rate. Numbers in brackets refer to the corresponding equation.

this case there is no intergenerational redistribution. However, if the market interest rate exceeds the implicit return, as we have assumed, there is intergenerational redistribution.

To compute the cross-gender and intereducational transfers out of the intragenerational transfer, we use the gender-specific uniform contribution rate, defined for males and females separately. The difference between the generational and gender-specific uniform contribution rate measures the cross-gender transfer. Finally, the difference between the gender-specific uniform contribution rate and the individual uniform contribution rate represents intereducational redistribution.

4 Baseline scenario

In this section, we quantify lifetime redistribution related to uniform pricing. We present a baseline scenario in which demographics and labour force participation rates are held constant. We start by explaining the data, then we turn to our main results and finally, we examine how sensitive these results are for the underlying assumptions.

4.1 Data

Participants differ in terms of age, gender and educational level. These differences boil down to three factors: survival probabilities, labour force participation and income. Recall that differences in life expectancy (or survival probabilities), income profile and labour force participation profile determine the direction and magnitude of the intragenerational transfers. In addition, the magnitude of these transfers also depends on the relative size of the socioeconomic groups in the pension fund population. In this subsection, we will discuss the baseline values of these variables together with the population composition.

Population composition

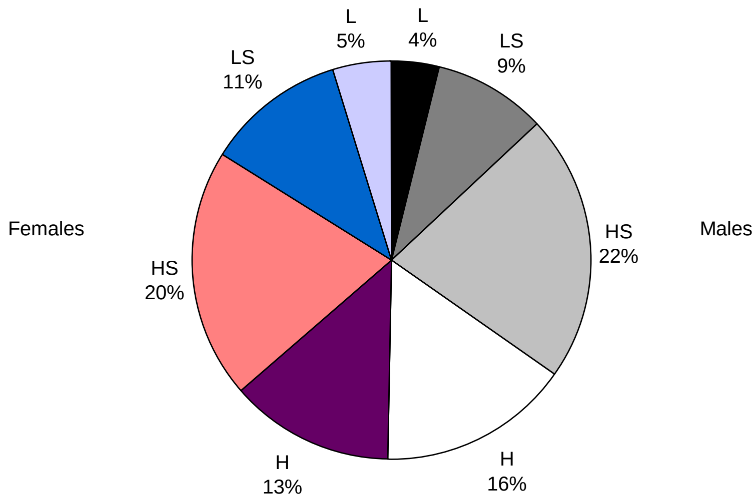
Figure 4.1 shows the composition of the current Dutch population between age 25 and age 64 distinguished by gender and level of education. The distribution of the educational levels over males and females is quite similar. For each gender the fraction of the people with high secondary education is the highest, while the fraction of the people with low education is the lowest. The percentage of the people with high education is higher in the male population while the percentage of the people with low secondary education is lower.

Once we know the size of the educational- and gender-specific birth cohorts, the population structure is completely determined by equation (3.1). We have calibrated these birth cohorts in such a way that the relative sizes of the socioeconomic groups in the total population is consistent with figure 4.1.

Survival probabilities

While educational-specific life expectancies are publicly available for the Netherlands, this is not the case for the underlying mortality rates. Fortunately, Deboosere and Gadeyne (2002) calculated educational-specific mortality rates for Belgium for the period 1991-1996. We use their results to estimate Dutch mortality rates for each socioeconomic group. To compute these estimates we have largely followed the procedure described in Hári et al. (2006). The main idea is the following. First, we calculate, using these Belgian mortality data, for each socioeconomic group the ratio between the educational-specific mortality rate and the average mortality rate. The average mortality rate in this case, is the weighted average of Belgian mortality rates where

Figure 4.1 Composition of population 25-65 by socioeconomic group, 2005



Source: Statistics Netherlands (CBS)

weights are based on the number of persons present in each socioeconomic group in the Netherlands. Second, we apply these ratios to gender-specific mortality rates of the Dutch population, which, of course, are publicly available. Finally, we rescale the ratios in such a way that for each socioeconomic group the life expectancy of a 25-year-old individual exactly matches the corresponding life expectancy in actual Dutch data, as published by Van Herten et al. (2002).

Table 4.1 Life expectancy by socioeconomic group (in years), 1995-2000

	Males					Females				
	25	35	45	55	64	25	35	45	55	64
Low education	73.1	73.8	74.5	75.9	78.4	79.5	79.9	80.4	81.4	83.0
Low secondary education	76.0	76.4	77.0	78.1	80.1	82.0	82.3	82.7	83.6	84.9
High secondary education	76.0	76.4	76.9	78.0	80.0	82.1	82.3	82.7	83.6	84.9
High education	78.0	78.2	78.6	79.4	81.2	82.1	82.3	82.7	83.5	84.8

Note: own calculations based on Deboosere and Gadeyne (2002) and Van Herten et al. (2002).

In the baseline calculation we keep the mortality rates constant. Table 4.1 displays for each socioeconomic group and for different ages the life expectancy. The difference in life expectancy between low and high educated males and females is 4.9 and 2.6 years, respectively. Given gender the most pronounced difference in life expectancy is between persons with low education and persons with higher educational levels. There is little difference between the life expectancy of males with low secondary and high secondary education. For females we observe equal life expectancies for the three highest levels of education.

Labour participation

Statistics Netherlands provides labour force participation rates per level of education for groups of age cohorts. Table 4.2 displays these participation rates for the year 2005. From this table we notice three facts that are relevant for the size of the redistributional effects. First, the labour force participation of females is significantly lower than that of males, in particular for participants with low and low secondary levels of education. Second, for each gender labour force participation positively depends on the level of education. Third, there is a remarkable drop in labour force participation for ages between 55 and 64.

Table 4.2 Labour force participation by socioeconomic group (in % of the cohort size), 2005[a]

	Males				Females			
	L	LS	HS	H	L	LS	HS	H
Age 25-34	65.0	84.5	87.2	90.8	27.6	53.3	73.4	87.6
Age 35-44	65.8	84.2	88.7	92.7	32.8	52.6	67.2	80.8
Age 45-54	64.8	82.9	86.2	90.9	32.5	49.7	65.8	77.3
Age 55-64	37.9	50.5	51.5	60.5	14.3	18.4	32.0	47.8

[a] The participation rates are defined as the active working force in percentage of the total population.
Source: Statistics Netherlands (CBS)

Income profiles

As far as we know there are no income profiles available by gender and level of education. We might assume however that both the level of starting income and career profile positively depend on the level of education. The left panel of table 4.3 presents the income profile imposed for male workers.

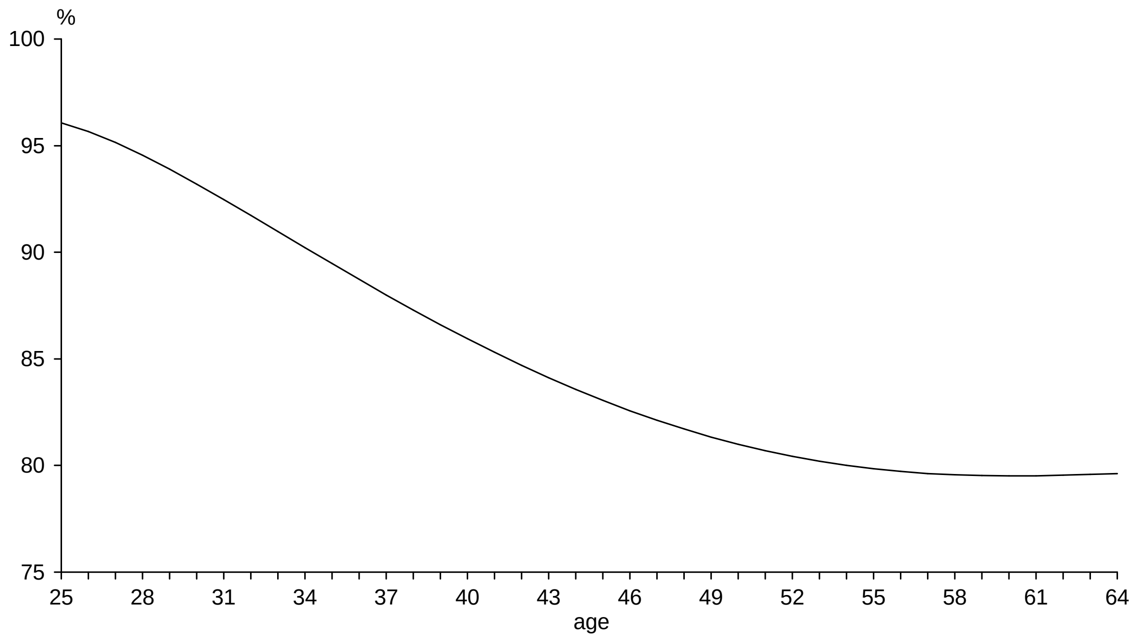
Table 4.3 Incidental wage increase (% per year) and income (in € 2006) at age 25 by socioeconomic group

	Males				Females			
	L	LS	HS	H	L	LS	HS	H
Incidental wage increase at:								
Age 26-34	2.0	2.5	3.0	3.5	1.3	1.8	2.3	2.8
Age 35-44	1.0	1.5	2.0	2.5	0.2	0.7	1.2	1.7
Age 45-54	0.5	1.0	1.5	1.5	0.1	0.6	1.1	1.1
Age 55-64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Income at age 25	18,000	22,000	25,000	28,000	17,292	21,135	24,017	26,899

Figure 4.2 displays the gross full-time income of a female as a percentage of the corresponding income of a male. This ratio is decreasing in age. By lack of data we impose that the relative income differential of figure 4.2 holds for each level of education. Combining the information from the left panel of table 4.3 and figure 4.2 we are able to calculate educational-specific

starting incomes and career steps of females. These figures are displayed in the right panel of table 4.3.

Figure 4.2 Female income as a percentage of male income by age, 2004



Source: Statistics Netherlands (CBS)

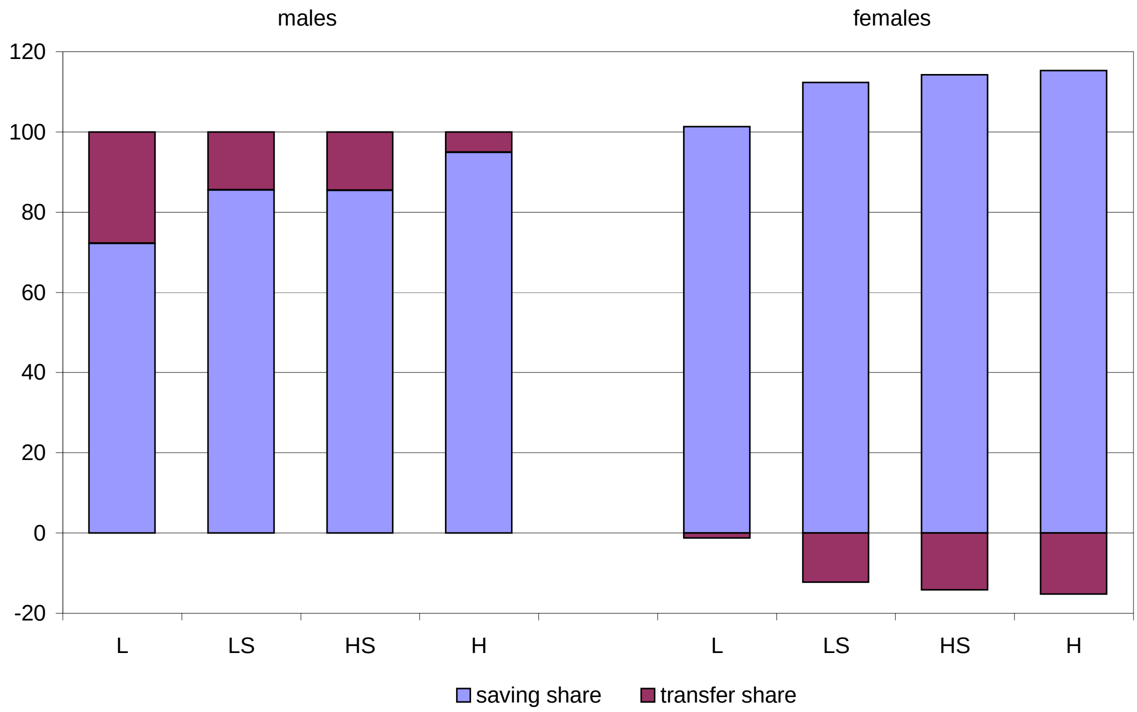
4.2 Results

We decompose the uniform contribution rate into a saving share and transfer share. The transfer share, in turn, is subdivided in an intergenerational transfer, a cross-gender transfer and an intereducational transfer. In our static baseline scenario the redistributional effects (in percentage of the uniform contribution rate) are constant over time. Recall that a positive transfer represents a payment, a negative transfer implies a subsidy.

For each socioeconomic group, the saving share is by far the most important component of the uniform contribution rate (see figure 4.3). Nevertheless, the relative size of the transfer- and saving share differs across groups. The saving share is higher for females than for males and it increases in the level of education, ranging from 72% for a male participant with low education to 115% for a female worker with high education. Observe that for female (male) participants the saving part is higher (lower) than the uniform contribution paid, implying that they receive (pay) a transfer.

The decomposition of the transfer share is shown in figure 4.4. Since the real market interest rate (3%) is higher than the real productivity growth rate (1.7%) plus the population growth (0%), the implicit return of a pension scheme with uniform pricing is lower than the explicit return of a pure funded scheme. Therefore, the contribution rate is higher than the generational

Figure 4.3 Saving and transfer share by socioeconomic group (% uniform contribution rate)



uniform contribution rate. This difference, defined as the intergenerational transfer, is 2% of the uniform contribution rate.

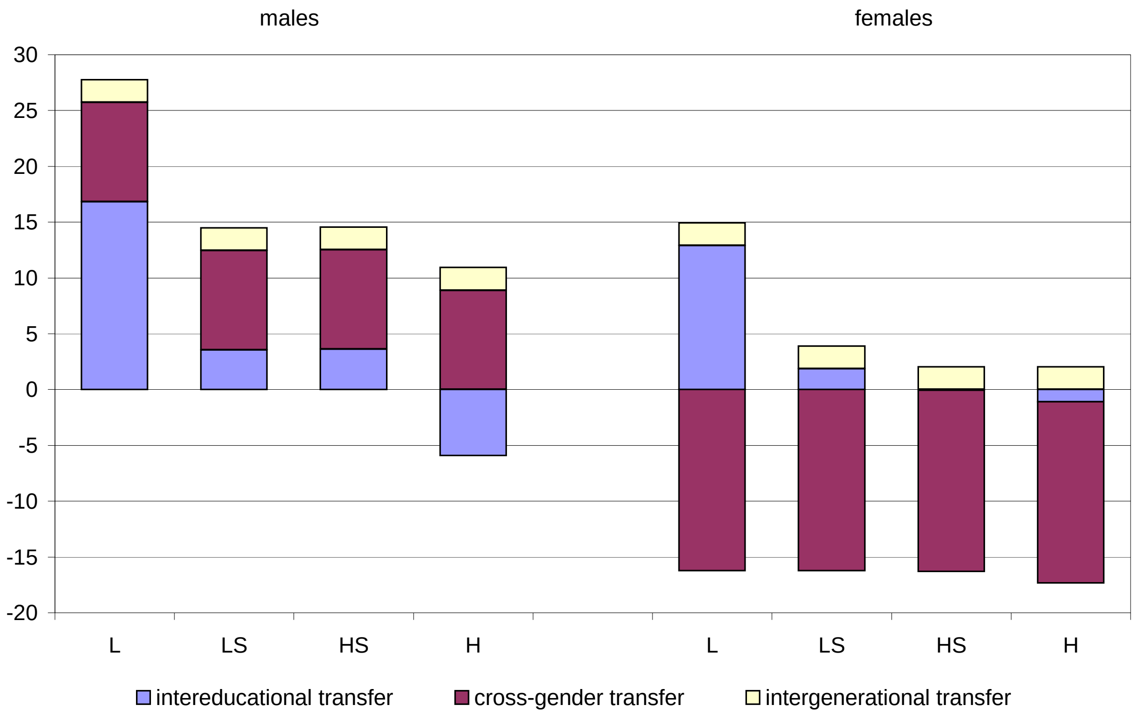
The cross-gender transfer equals 8.9% for males and -16.3% for females. That means that for each euro a male worker contributes to the fund, nine cents is transferred to female workers. Analogously, for each euro a female contributes, she gets a subsidy from the male participants of around sixteen cents. The reason for the large difference between the payment and subsidy stems from the fact that there are relatively more male workers in the pension fund population.

Irrespective of gender, uniform pricing entails a large redistribution from low educated workers to higher educated workers. The high burden imposed on low educated workers can be explained by two factors. First, the life expectancy of low educated workers is relatively low so that the actuarial value of their pension rights is relatively low. Second, low educated persons only constitute about 9% of the working population. Consequently, the intereducational transfer is imposed on a relatively small group of workers.

Net Benefit and implicit return

Figure 4.5 shows the net benefit (in percentage of lifetime income) of participating in a pension scheme with uniform pricing from the age of 25. Remember from equation (3.9) that the net benefit is defined as the difference between the present discounted value of benefits and contributions. Also in terms of the net benefit we observe a large redistribution from males to females. The net benefit of male workers is negative, while that of female workers is positive.

Figure 4.4 Composition transfers by socioeconomic group (% uniform contribution rate)



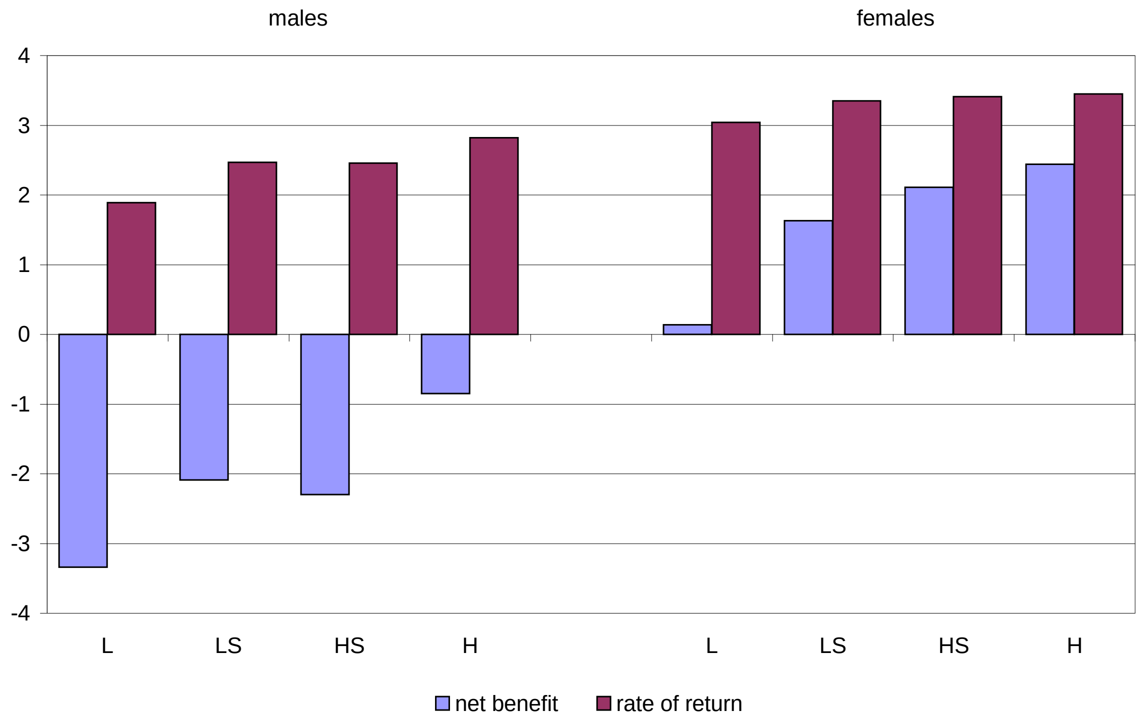
Intereducational redistribution leads to large differences in the net benefit as well. Surprisingly, a male worker with low secondary education has a higher net benefit (-2.1%) than a worker with high secondary education (-2.3%). The reason for this is that the former has a slightly higher life expectancy than the latter (see table 4.1). For a female worker with low education, whose net benefit is (close to) zero, uniform pricing turns out to be more or less actuarially fair.

The net benefit calculations take the discount rate as given. Alternatively, we can solve for the implicit rate of return under the assumption that the net benefit equals zero. Differences in the implicit rates of return within a generation can then be interpreted as intragenerational redistribution. Figure 4.5 also presents the implicit rates of return for each socioeconomic group. The implicit return of a low educated male (1.9%) is only slightly higher than the real productivity growth (1.7%). For a low educated female the implicit return is close to the market interest rate (3%) which confirms the insight already obtained that uniform pricing for this person is close to actuarial fairness. For secondary levels of education, the return of males is roughly 0.5%-points lower than the market interest rate, while the return of females exceeds this rate by about 0.4%-points. Roughly speaking, for given levels of education the implicit rate of return of males is 1%-point lower than that of females.

Incomplete career

So far, we assumed that a worker participates over their whole career (i.e. from age 25 until age 64) in the pension scheme. In practice, though, not each individual will work for forty years

Figure 4.5 Net benefit (% lifetime income) and real rate of return (%)

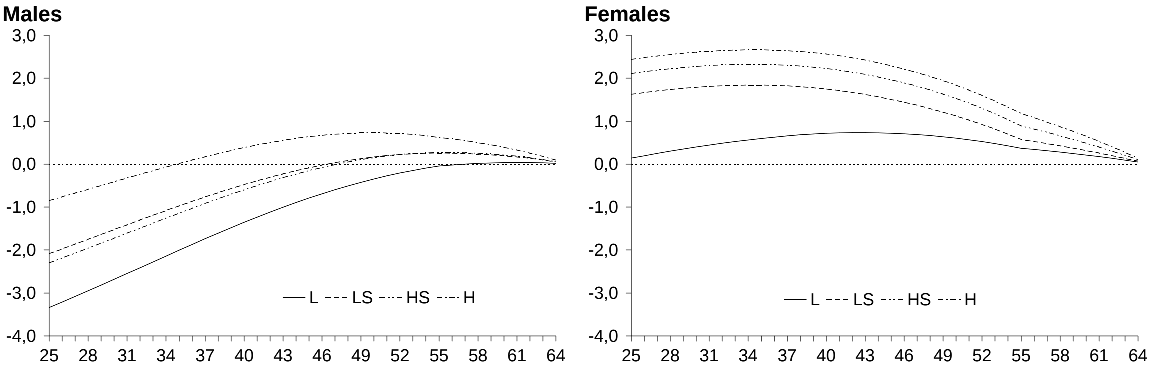


continuously. Figure 4.6 shows the net benefit of an individual, where the numbers on the horizontal axis indicate the age at which this individual enters the pension scheme. For each socioeconomic group we observe that the net benefit first increases if participation is postponed and then gradually declines. This reflects the fact that the uniform contribution rate is higher (lower) than the actuarially fair contribution rate at lower (higher) ages. The size and shape of the net benefit profiles strongly depend on gender and level of education though. Compared to a pension contract with an actuarially fair contribution rate, in which there is no redistribution at all, participation in a pension contract with uniform pricing is beneficial if the net benefit is equal to or larger than zero. For females the net benefit is positive, irrespective of the age they enter and their level of education. Male workers mostly face negative net benefits. For a male with low education participation is only beneficial at the age of 58 beyond. For males with low secondary, high secondary and high education this age is, respectively, 47, 48 and 35.

The entrance age at which the net benefit is maximal also differs between socioeconomic groups. For a female worker with low education the entrance age with maximal net benefit is 43. For female workers with a higher level of education this age is much lower, namely 34. The differences with male workers are large. A high educated male should enter the pension scheme at age 50 to obtain maximal benefit from participation. If he has a secondary level of education, this age increases to 55 and in case he is low educated, he should wait until the age of 61.

To get some feeling about the redistributional effects in absolute terms, table 4.4 shows the net benefits in real euros for different spells of participation. These figures are based on the

Figure 4.6 Net benefit profile (% lifetime income)



labour force participation rates and wage levels as displayed in tables 4.2 and 4.3, respectively. In absolute terms uniform pricing is really disadvantageous for a male with high secondary education. The excess contribution that this person pays roughly amounts to € 18,800 if he participates from age 25 until age 64 and to about € 17,500 if he chooses to opt out at age 44. For a high educated female instead, uniform pricing is very profitable. The total transfer she receives is about € 19,300 if she works forty years continuously and € 18,100 if she enters later on at age 45. We know that for young workers the uniform contribution rate is in general higher than the actuarially fair contribution rate. For old workers the opposite holds. From table 4.4 we observe, however, that for male workers with low or secondary education the uniform contribution rate also exceeds their actuarially contributions in the second half of the career. For female workers with secondary or high education, in turn, uniform pricing is also profitable in the first half of the career.

Table 4.4 Net benefit (in € 2006)

	Males				Females			
	L	LS	HS	H	L	LS	HS	H
Participation age:								
25-64	− 12,208	− 13,261	− 18,764	− 8,953	204	5,236	11,371	19,314
25-44	− 9,318	− 12,711	− 17,533	− 15,689	− 861	391	781	1,185
45-64	− 2,890	− 550	− 1,232	6,736	1,065	4,845	10,590	18,129

4.3 Sensitivity analysis

To investigate the sensitivity of the results with respect to the assumptions underlying the baseline scenario, we consider four alternative calculations. In the first one we increase real productivity growth by 0.5%-points to 2.2%. In the second alternative calculation we increase the real market rate of return from 3% to 4%. In the third and fourth calculations we take an alternative view with respect to the gender- and educational-specific income profiles and labour force participation rates.

Table 4.5 Sensitivity analysis: effects of alternative assumptions relative to baseline results[a]

	$g = 2.2\%$	$r = 4\%$	Equalization of: Wages	Participation
	% of the uniform contribution rate			
Males, low education				
Saving share	0.6	− 2.2	0.4	− 1.2
Intereducational transfer	0.0	− 0.2	− 2.3	− 0.9
Cross-gender transfer	0.7	− 1.3	1.9	2.0
Intergenerational transfer	− 1.2	3.8	0.0	0.1
Males, high education				
Saving share	0.5	− 2.5	− 1.1	− 2.1
Intereducational transfer	0.0	0.0	− 0.8	0.1
Cross-gender transfer	0.7	− 1.3	1.9	2.0
Intergenerational transfer	− 1.2	3.8	0.0	0.1
Females, low education				
Saving share	2.2	− 5.6	1.9	− 1.5
Intereducational transfer	0.3	− 0.8	− 2.1	0.2
Cross-gender transfer	− 1.3	2.6	0.2	1.2
Intergenerational transfer	− 1.2	3.8	0.0	0.1
Females, high education				
Saving share	2.2	− 5.9	− 0.2	− 1.5
Intereducational transfer	0.3	− 0.5	0.0	0.2
Cross-gender transfer	− 1.3	2.6	0.2	1.2
Intergenerational transfer	− 1.2	3.8	0.0	0.1

[a] Figures are in absolute difference from the baseline.

First consider the impact of a higher productivity growth (first column of table 4.5). This increases the real value of wage-indexed pension rights, and consequently, the uniform contribution rate also increases from 24.5% to 28.1%. The positive shock in productivity growth has almost no effect on intereducational redistribution, while the transfer from males to females slightly increases. Since females generally live longer than males, the value of their pension rights will relatively increase more. The cross-gender redistribution therefore rises from 8.9% to 9.6% for males and decreases from -16.3% to -17.6% for females.

Higher productivity growth has relatively most effect on the intergenerational payment, which declines from 2% to 0.8%. With higher productivity growth the implicit rate of return of a pure PAYG scheme increases and, consequently, the rate of return of a pension scheme with uniform pricing increases as well. The decline of the intergenerational transfer leads to an increase of the saving share for each socioeconomic group. This increase is higher for females than for males because the cross-gender transfer has also changed in favour of the female worker.

An increase of the market interest rate to 4% has effects opposite to a change in productivity growth (second column of table 4.5). The interest rate increase leads to a drop of the uniform contribution rate to 18.8%. Again, the intereducational redistribution is almost unaffected. The interest rate decline has a relatively large effect on the pension rights of females. The cross-gender redistribution therefore declines to 7.6% for males and increases to -13.6% for females. There is also a substantial increase in the intergenerational transfer (from 2% to almost 6%) since the implicit rate of return of the pension scheme has been declined.

The third column presents the redistributional effects if we assume complete wage equalization. In this scenario all workers, irrespective of gender and level of education, face the wage profile of a low secondary male (see the third column of table 4.3). The fourth column does the same for labour force participation. We observe that in our average-wage scheme both wage equalization and labour force participation equalization have very small effects on redistribution. Recall that from a theoretical point of view uniform pricing redistributes from persons with a short life expectancy to persons with a long life expectancy and from persons with a flat income or participation profile to persons with a steep one. However, the results from table 4.5 indicate that, from an empirical point of view, redistribution from persons with short life expectancies to persons with long life expectancies is much more important than the other two factors of intragenerational redistribution.

5 Two alternative scenarios

The population forecast of Statistics Netherlands suggests a further increase and convergence in life expectancies of males and females in the coming decades. In addition, it is reasonable to assume that labour force participation of especially females will increase in the Netherlands (Euwals and Van Vuuren (2005)). In this section we will investigate how the redistributional effects of the baseline calculation change if we allow for these two future developments.

5.1 Increasing life expectancy

The population forecasts of Statistics Netherlands contains age-specific survival probabilities per gender. We have used these forecasts to calculate the future development of the mortality rates per socioeconomic group.[8] There is international evidence that the relative differences in mortality rates between socioeconomic groups has not declined in the last decades (see, e.g., Mackenbach et al. (2003) and Pappas et al. (1993). Following Hári et al. (2006) we have therefore imposed that the relative differences between the educational-specific survival probabilities will not change in the future. In appendix B we explain in detail how the survival probabilities have been computed.

Table 5.1 Life expectancy for a 25-old individual, 1995/2005, 2025 and 2050

	Males			Females		
	95/05	2025	2050	95/05	2025	2050
Low education	73.1	74.6	75.3	79.5	80.5	80.7
Low secondary education	76.0	77.4	78.1	82.0	82.9	83.1
High secondary education	76.0	77.4	78.1	82.1	83.0	83.2
High education	78.0	79.3	80.0	82.1	83.0	83.1

Note: based on population forecast of Statistics Netherlands (2006-2050). See appendix B for more details.

Table 5.1 shows the life expectancies for three years, the base period (1995/2005), 2025 and 2050. After 2050 the survival probabilities are held constant and hence, life expectancy will not further improve thereafter. The figures reveal a convergence in life expectancy of males and females in the coming decades. Between 2005 and 2050 the life expectancy of males is expected to increase with 2.2 years, which is twice as much as the increase of 1.1 years of females. By assumption, the absolute increase of life expectancy over time is similar for the different socioeconomic groups.

Apart from the survival probabilities, we change two other assumptions of the baseline

[8] See the Statline database of Statistics Netherlands (at http://www.cbs.nl) for the most recent population forecast (2006-2050).

calculation as well in order to make the demographic environment more realistic. First, we set the population in the base year equal to the actual Dutch population in 2005. Second, the growth rate of the cohort size at birth (n) is no longer set at zero. Instead, the growth rate is calibrated using the population forecasts of Statistics Netherlands. This growth is very low and sometimes even negative, reflecting the fact that fertility rates are low in the Netherlands. After 2050 the growth rate is set at zero again.

Results

The new demographic assumptions imply that the redistributional effects are not constant anymore. They will gradually change over time until the population structure becomes stable again. We restrict the analysis to the average redistributional effects over the period 2007-2012 for a worker of age 25.

The uniform contribution rate increases by 1.7%-points. This is primarily due to higher survival probabilities, which entail a longer retirement period relative to the working period. Since we have assumed that the relative discrepancies in survival rates between different socioeconomic groups do not change in the future, the intereducational redistributional effects are similar to those in the baseline calculation (see table 5.2).

Table 5.2 Redistribution effects with increasing life expectancy, 2007-2012

	25-old male				25-old female			
	L	LS	HS	H	L	LS	HS	H
	% of the uniform contribution rate							
Saving share	77.3	89.6	89.5	98.2	99.3	109.3	111.2	112.1
Intereducational transfer	15.7	3.4	3.5	− 5.2	12.1	2.1	0.3	− 0.7
Cross-gender transfer	7.3	7.3	7.3	7.3	− 11.1	− 11.1	− 11.1	− 11.1
Intergenerational transfer	− 0.3	− 0.3	− 0.3	− 0.3	− 0.3	− 0.3	− 0.3	− 0.3

Note: positive figures represent pension contributions paid, negative figures are pension contributions received.

The convergence in life expectancies between males and females reduces the amount of cross-gender redistribution. We observe that, relative to the baseline calculation, the subsidy male workers provide to their female colleagues reduces by 1.6%-points to 7.3% of the uniform contribution rate. Female workers are confronted with a decline in the subsidy they receive from male workers equal to 5.2%-points. As a consequence, the saving part of the contribution rate increases for males and decreases for females.

Interestingly, the intergenerational redistribution is negative (-0.3%) for a 25-old worker. Recall that this transfer is defined as the difference between the uniform contribution rate and the generational uniform contribution rate. The generational uniform contribution rate is forward looking and takes the increased life expectancy of this 25-old worker fully into account.[9] The uniform contribution rate, instead, reflects the pension accrual of all currently working participants and will gradually adjust when old workers with relatively low life expectancy are replaced by younger generations of workers. This implies that a generation temporarily receives a higher return than could be earned at the capital market. To understand this, note that increasing life expectancy necessarily leads to population growth. Similar to a PAYG system, population growth increases the implicit return of a pension scheme with uniform pricing because the transfers to old workers can be borne by more young workers. In the long run, if life expectancies have converged, the intergenerational transfer will be positive.

5.2 Increasing labour force participation females

In the baseline calculation we assumed constant female labour force participation rates. However, due to sociological and cultural considerations, it is reasonable to expect that these participation rates will increase the coming decades (Euwals and Van Vuuren (2005)). Obviously, an increase of labour force participation of females affects the size of the intragenerational redistribution, because it changes the composition of the pension fund population. We therefore extend the previous scenario with increasing female participation rates. Euwals and Van Vuuren (2005) expect that the labour force participation of males will not change very much in the future. We therefore keep the labour force participation rates of males constant, as before.

Table 5.3 Labour force participation of females (in % of the cohort size), 2005, 2008 and 2012[a]

	L			LS			HS			H		
	2005	2008	2012	2005	2008	2012	2005	2008	2012	2005	2008	2012
Age 25-35	27.6	31.7	33.2	53.3	56.6	58.1	73.4	75.4	76.7	87.6	88.9	89.8
Age 35-44	32.8	36.4	36.6	52.6	56.3	56.5	67.2	70.0	70.1	80.8	82.6	82.6
Age 45-54	32.5	35.4	36.8	49.7	52.6	54.0	65.8	68.6	69.8	77.3	79.3	80.1
Age 55-64	14.3	16.5	19.2	18.4	21.2	25.0	32.0	35.3	39.6	47.8	51.1	55.7

[a] The participation rates are defined as the active working force in percentage of the total population.
Note: based on Knoef (2006). See appendix B for more details.

Knoef (2006) decomposes the development of Dutch female labour force participation during the last decade into age, period and cohort effects. The estimated age, period and cohort effects provide a tool to predict future participation rates for different socioeconomic groups. The forecasts of Knoef (2006) are based on the assumption that the relative differences between socioeconomic groups will not change in the future. The forecasts are defined in gross terms

[9] See equation (A.6) in appendix A.

(labour force divided by total population) and for each age cohort. We follow the convention used by Statistics Netherlands to define the participation rates for groups of ten age cohorts. In addition, participation rates are defined in net terms (active labour force divided by total population) because only people who are actually working build up occupational pension. Appendix B explains how we have transformed the gross participation rates into net rates.

Table 5.3 shows the predicted labour force participation rates for two years, 2008 and 2012. The 2005 figures repeat the participation rates of the baseline scenario. After 2012 we keep the labour force participation constant. The coming years female labour force participation is expected to increase for each cohort group. In particular, the participation rates of female workers of age 55 and older will increase substantially. The same holds for the youngest category female worker with a low level of education.

Table 5.4 Redistribution effects with increasing female labour force participation, 2007-2012

	25-old male				25-old female			
	L	LS	HS	H	L	LS	HS	H
	% of the uniform contribution rate							
Saving share	77.0	89.3	89.2	97.8	99.3	109.7	111.5	112.3
Intereducational transfer	15.6	3.4	3.5	− 5.1	12.4	2.0	0.2	− 0.6
Cross-gender transfer	7.8	7.8	7.8	7.8	− 11.2	− 11.2	− 11.2	− 11.2
Intergenerational transfer	− 0.4	− 0.4	− 0.4	− 0.4	− 0.4	− 0.4	− 0.4	− 0.4

Note: positive figures represent pension contributions paid, negative figures are pension contributions received.

Results

Table 5.4 presents the redistributional effects over the period 2007-2012, again for a 25-year-old worker. The increasing labour force participation of females slightly rises the uniform contribution rate by 0.1%-points. Obviously, the increase in female labour force participation does not affect the intereducational redistributional effects of male workers.

The effects on cross-gender redistribution are quite modest. Compared to the previous variant, the transfer that a male worker pays to females rises with 0.5%-point to 7.8% and the transfer that a female worker receives, decreases with only 0.1%-point to −11.2%. Consequently, the insurance part of the uniform contribution rate slightly decreases for males and increases for females.

In the sensitivity analysis of subsection 4.3 we concluded that the impact of labour force participation profiles on the redistributional effects is much lower than that of different life expectancies. In this section we observe the same picture. The converging life expectancies of males and females reduces the cross-gender transfers, but the increase of female labour force participation only slightly affects these transfers.

6 Concluding remarks

In this study we analysed the size of the saving- and transfer component in Dutch occupational pensions for different socioeconomic groups. We focused solely on the (ex ante) redistributional effects associated with uniform pricing. In reality of course, there are more forms of redistribution on which we did not pay attention, like redistributional effects caused by risk solidarity or by the tax regime. Especially the first one, risk solidarity, may lead to large intergenerational transfers (see, for example, Hoevenaars and Ponds (2006)). However, contrary to redistribution related to uniform pricing, these redistributional effects are not structural in the sense that they depend on the financial position of the pension fund.

The main findings of the study are as follows. First of all, at the individual level a pension scheme with uniform pricing is not a fair insurance over the entire career. As long as the growth rate of the population plus that of aggregate income is less than the market interest rate, each participant pays an implicit tax which is necessary to service the introductory gain given away to the first generations. This intergenerational transfer is rather small (2%), although its size is very sensitive to the market interest rate. In addition, since participants of a pension fund differ ex ante in terms of life expectancy, income perspectives and labour force participation profile, uniform pricing also redistributes between individuals of the same generation. Our analysis reveals that differences in life expectancy are far more important for intragenerational redistribution than differences in income profile or the development of labour force participation.

Second, the saving- and transfer share of the uniform contribution rate significantly differ across socioeconomic groups. We find that 9% of the contribution of males is transferred to females. On the other hand, females receive a transfer of 16%. In addition, uniform pricing leads to a substantial redistribution from low educated people to higher educated people. Not only is the life expectancy of low educated people significantly lower than that of higher educated people, also their share in the pension fund population is relatively small which further increases the burden imposed on an individual of this group.

Third, a pension scheme with uniform pricing is disadvantageous for low and middle educated males and beneficial for middle and high educated females. The net benefit of male workers is negative, varying from -3.3% of lifetime income for a low educated male to -0.9% for a high educated male. For female workers, in turn, net benefit is positive, ranging from about 0.1% for a low educated female to 2.4% for a high educated female. The same picture emerges from socioeconomic differences in implicit rates of return.

Finally, in the near future the population forecasts reveal a convergence in life expectancies of males relative to females. In addition, it might be reasonable to assume that labour force participation rates of females will increase in the coming decades. Both developments affect the amount of cross-gender redistribution. The first one will actually reduce cross-gender redistribution, the second one will increase it. We conclude that the effect of converging life expectancies dominates which implies that the transfers from males to females are likely to decline in the future.

In the paper we have made some simplifying assumptions. First, the Dutch occupational pension system, which consists of a large amount of industrial pension funds and company pension funds, has been captured in a single representative fund. It is likely that the heterogeneity of the participants in actual firm- or industry-specific pension funds could be somewhat less pronounced than that in our representative fund. Second, we have only focused on old-age pensions while most of the pension arrangements also include a uniform surcharge to finance surviving dependants' pensions. Since in general the chance that the wife survives her husband is higher rather than the other way around, uniform pricing of surviving dependants' pensions can (partly) mitigate the cross-gender redistribution. On the other hand, in the Netherlands at least, participants can convert the accrued surviving dependants' pension rights into a more generous old-age pension. Further analysis is required to investigate to what extent these simplifying assumptions are decisive for the main conclusions.

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Appendix A Technical details

In this appendix we provide formal definitions of the individual, generational and gender-specific uniform contribution rates used to identify the intergenerational, cross-gender and intereducational transfers. First we define the unit cost price of a wage-indexed pension benefit.

Unit cost price

In the main text we used the letter j as age indicator and the letter t as time indicator. Here we introduce two additional symbols to indicate gender and level of education of an individual. Let h be the gender indicator to distinguish males (m) from females (f), that is $h = m, f$, and let i denote the educational level, where $i = L, LS, HS, H$. Then the cost price of a wage-indexed pension benefit of one euro for an individual of gender h, with level of education i, of age j and at the end of time t is given by:

$$\delta(h,i,j,t) = \prod_{l=0}^{j_r-j-2} \frac{\varepsilon(h,i,j+l,t+l)\,(1+g(t+l+1))\,(1+\phi(t+l+1))}{1+r(t+l+1)} \times Z(h,i,j_r-1,t+j_r-j-1) \tag{A.1}$$

for $j_w \leq j < j_r - 1$ and with:

$$Z(h,i,j_r-1,t) = \sum_{n=1}^{j_e-j_r+1} \prod_{m=1}^{n} \frac{\varepsilon(h,i,j_r+m-2,t+m-1)\,(1+g(t+m))\,(1+\phi(t+m))}{1+r(t+m)} \tag{A.2}$$

Note that $\delta(h,i,j_r-1,t) = Z(h,i,j_r-1,t)$. Equation (A.2) represents the value of a wage-indexed pension benefit of one euro measured at the age just before retiring (i.e. $j_r - 1$). Equation (A.1) is the discounted value of this annuity at age j, which is $j_r - j$ periods from retiring.

Individual uniform contribution rate

We define the following two variables for $j = j_w, \ldots, j_r - 1$:

$$PV_A(h,i,j,t) \equiv A(h,i,j,t)\delta(h,i,j,t) \tag{A.3}$$

$$\hat{G}(h,i,j,t) \equiv G(h,i,j,t)p(h,i,j,t) \tag{A.4}$$

Then the individual uniform contribution rate (π_{IU}) is defined as:

$$\pi_{IU}(h,i,t) = \begin{cases} \frac{\sum_{k=0}^{j_r-j_w-1} PV_A(h,i,j_w+k,t+k)R(h,i,k)}{\sum_{k=0}^{j_r-j_w-1} \hat{G}(h,i,j_w+k,t+k)R(h,i,k)} & \text{if} \quad j = j_w \\ \pi_{IU}(h,i,t-1) & \text{if} \quad j_w < j < j_r \end{cases} \tag{A.5}$$

with discount factor R already defined in equation (3.9).

Generational uniform contribution rate

The generational uniform contribution rate (π_{GU}) is given by:

$$\pi_{GU}(t) = \begin{cases} \frac{\sum_h \sum_i B(h,i,j_w,t) \sum_{k=0}^{jr-jw-1} PV_A(h,i,j_w+k,t+k) R(h,i,k)}{\sum_h \sum_i B(h,i,j_w,t) \sum_{k=0}^{jr-jw-1} \tilde{G}(h,i,j_w+k,t+k) R(h,i,k)} & \text{if} \quad j = j_w \\ \pi_{GU}(t-1) & \text{if} \quad j_w < j < j_r \end{cases} \tag{A.6}$$

Now we can stress the relation between the generational uniform contribution rate (π_{GU}) and the uniform contribution rate (π_U). For simplification, assume that productivity growth (g), the nominal interest rate (r), survival probabilities (ε) and labour force participation rates (p) are constant. Also, let the growth rate of the cohort at birth be zero ($n = 0$). Then, using equation (3.1), (3.2), (3.3) and (3.4), we can rewrite the first branch of equation (A.6) in a similar fashion as equation (3.6). This gives,

$$\pi_{GU}(t) = \frac{\sum_h \sum_i \sum_{k=0}^{j_r-j_w-1} B(h,i,j_w+k,t) PV_A(h,i,j_w+k,t) S(k)}{\sum_h \sum_i \sum_{k=0}^{j_r-j_w-1} B(h,i,j_w+k,t) \tilde{G}(h,i,j_w+k,t) S(k)} \tag{A.7}$$

with,

$$S(k) = \left(\frac{1+g}{1+r}\right)^k \tag{A.8}$$

Note that, besides the factor S, equation (A.6) is identical to equation (3.6). Since there is no population growth, the implicit return of a PAYG scheme is $1+g$. Remember that the rate of return of a pension scheme with uniform pricing is a weighted average of the implicit return of a PAYG scheme and the market interest rate. Hence, if the return of a PAYG scheme equals the market interest rate, a pension scheme with uniform pricing offers exactly the same return as the capital market. In this case $S(k) = 1$ for each k, and the generational uniform contribution rate is equal to the uniform contribution rate. However, if $r > g$, as we have imposed in the baseline calculation, the uniform contribution rate exceeds the generational uniform rate and the difference entails intergenerational redistribution.

Gender-specific uniform contribution rate

The gender-specific uniform contribution rate has exactly the same form as equation (A.6), instead that we know have to aggregate over males and females separately. Denoting this contribution rate by π_{SU} we thus have,

$$\pi_{SU}(h,t) = \begin{cases} \frac{\sum_i B(h,i,j_w,t) \sum_{k=0}^{jr-jw-1} PV_A(h,i,j_w+k,t+k) R(h,i,k)}{\sum_i B(h,i,j_w,t) \sum_{k=0}^{jr-jw-1} \tilde{G}(h,i,j_w+k,t+k) R(h,i,k)} & \text{if} \quad j = j_w \\ \pi_{SU}(h,t-1) & \text{if} \quad j_w < j < j_r \end{cases} \tag{A.9}$$

Appendix B Data issues

Computation of the future mortality rates

Since forecasts of the educational-specific mortality rates are not publicly available for the Netherlands, we have to compute these figures ourselves. Starting points are the gender-specific mortality rates of the most recent population forecast of Statistics Netherlands, denoted $\hat{\sigma}(h, j, t)$. The forecast horizon of these estimates ranges from 2006 to 2050. The computation of the educational-specific mortality rates involves the following two steps:

1. **Weighting**. The educational-specific mortality rates are generated by the following formula:

$$\hat{\sigma}(h,i,j,t) = \omega(h,i,j)\hat{\sigma}(h,j,t) \tag{B.1}$$

in which the adjustment factors $\omega(h,i,j)$ are time-invariant and computed using a procedure described in Hári et al. (2006). In fact, $\omega(h,i,j)$ measures the discrepancy of the mortality rate of an individual of gender h, educational level i and age j relative to the average rate.

2. **Scaling**. We have not used the levels $\hat{\sigma}(h,i,j,t)$ in our calculations directly. Instead, we have applied the following scaling to get rid of the discrepancy between the population forecast, $\hat{\sigma}(h, j, t)$, and the mortality rates we use in our baseline calculation (see table 4.1).:

$$\sigma(h,i,j,t) = \begin{cases} \sigma(h,i,j,\text{base year}) & \text{if} \quad t = \text{base year} \\ \sigma(h,i,j,t-1) + \Delta\hat{\sigma}(h,i,j,t) & \text{if} \quad t > \text{base year} \end{cases} \tag{B.2}$$

where 2005 is our base year. Obviously, the survival rates $\varepsilon(h,i,j,t)$ used in the formulas in the text are equal to $1 - \sigma(h,i,j,t)$.

Computation of the female labour force participation rates

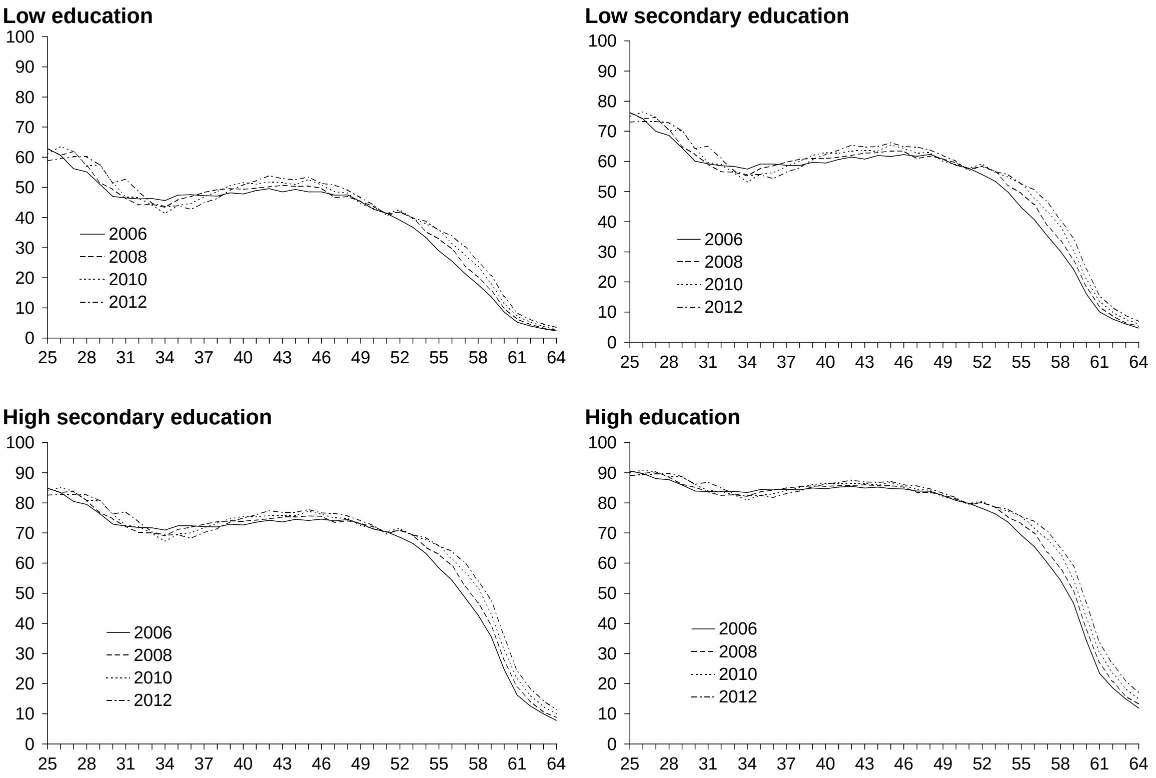
Knoef (2006) predicts female labour force participation rates for each age cohort (see figure B.1). These rates are in gross terms, i.e., they are defined as the total labour force (employed and unemployed people) divided by the total population. In this study, labour force participation rates are defined in net terms, i.e. as the active working force divided by the total population. In addition, Statistics Netherlands reports educational-specific participation rates for groups of age cohorts only. The transformation from gross participation rates, defined for each age cohort, to net participation rates, defined for groups of age cohorts, involves the following three steps:

1. **Grouping**. Let z denote the group indicator, i.e. $z = 1,2,3,4$, and l_z and u_z the lower- and upper-bound of z, expressed in age. The lower-bounds are $l_1 = 25, l_2 = 35, l_3 = 45, l_4 = 55$ and for the upper-bounds we have $u_1 = 34, u_2 = 44, u_3 = 54, u_4 = 64$. Denoting the predicted gross participation by $\hat{p}_B$, the grouped participation rates are defined as:

$$\hat{p}_B(f,i,z,t) = \frac{\sum_{j=l_z}^{u_z} \hat{p}_B(f,i,j,t)\hat{B}(f,j,t)}{\sum_{j=l_z}^{u_z} \hat{B}(f,j,t)} \tag{B.3}$$

where the age-dependent participation rates are weighted with the corresponding female population obtained from the population forecasts of Statistics Netherlands.

Figure B.1 Predicted gross labour force participation rates of females



Source: Knoef (2006)

2. **Deflating**. The predicted net participation rates $\hat{p}$ are derived from the formula:

$$\hat{p}(f,i,z,t) = \hat{p}_B(f,i,z,t)\,(1-\hat{u}(f,i,z,t)) \tag{B.4}$$

with $\hat{u}$ the predicted unemployment rate (i.e. the total number of unemployed as percentage of the labour force). Predictions of educational-specific unemployment rates are not available. Hence we have to rely on some approximation rule. The CPB Netherlands Bureau for Economic Policy Analysis publishes projections of the macro unemployment rate. We use the following approximation rule:

$$\hat{u}(f,i,z,t) = u(f,i,z,2005)\frac{\hat{u}(t)}{\hat{u}(t-1)} \tag{B.5}$$

3. **Scaling**. Confronting the predicted values $\hat{p}$ with the realised values p for the year 2005 reveal some small differences. Therefore, we will not use these predicted participation rates directly. Instead, we take first differences and relate these differences with the realisations in the base year (2005).

$$p(f,i,z,t) = \begin{cases} p(f,i,z,\text{base year}) & \text{if} \quad t = \text{base year} \\ p(f,i,z,t-1) + \Delta\hat{p}(f,i,z,t) & \text{if} \quad t > \text{base year} \end{cases} \tag{B.6}$$