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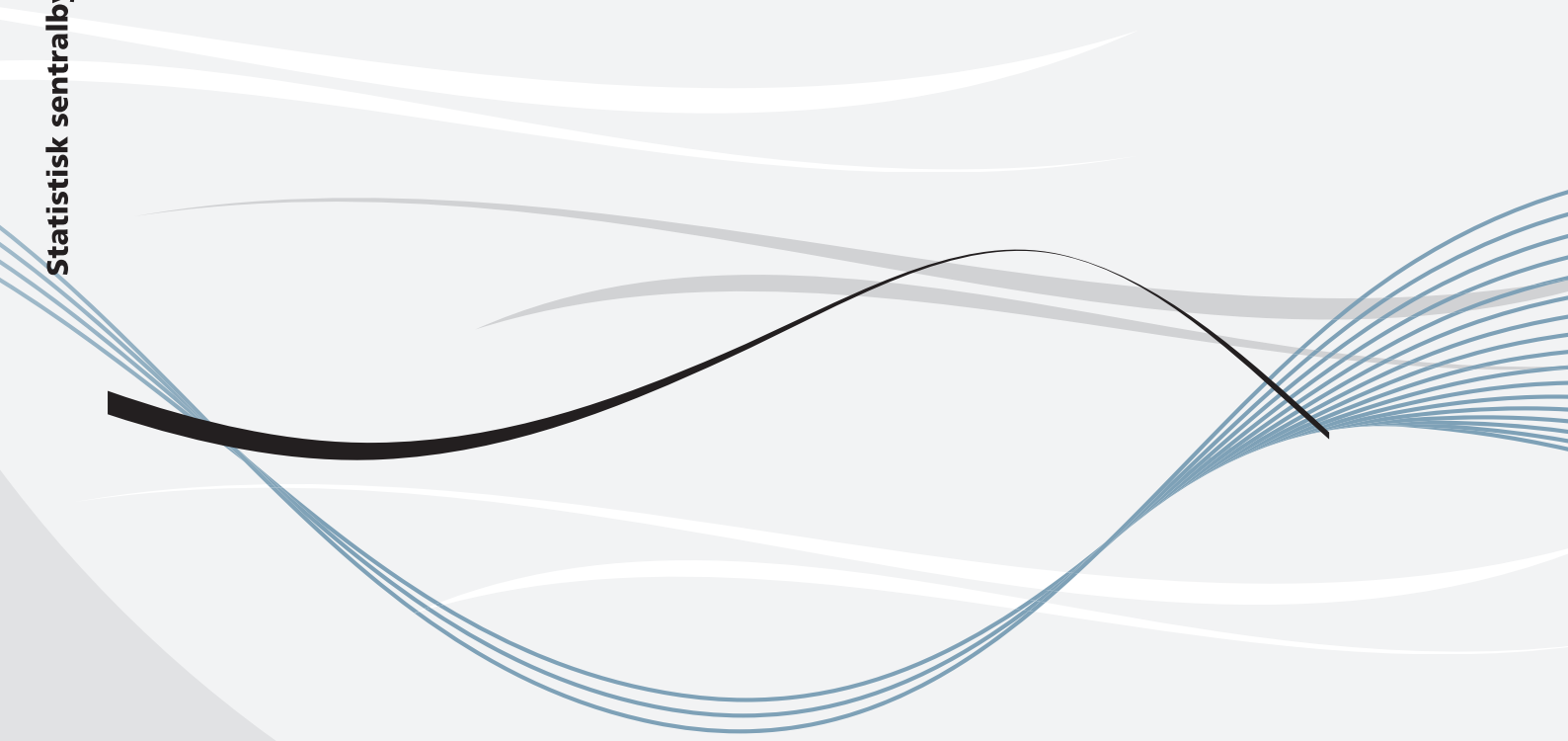

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Life time pension benefits relative to life time contributions

Abstract:
Over the life course members of an insurance system normally will contribute by payments when in working age, and later receive pension benefits as e.g. disabled or old-age pensioners. Total expected discounted contributions from labour market earnings may be compared to the expected discounted sum of benefits from pensions received. The first cohorts covered with benefits from a pay-as-you go pension system will normally receive higher benefits than what follows from their contributions. Reforms of the pension system may also affect the ratio between discounted life time pension benefits and discounted life time contributions.

In Norway the former National Insurance Scheme was introduced in 1967, and a reform of this system has been implemented from 2011. Budgetary and distributional effects are analysed by the dynamic micro simulation model MOSART. The aim of this paper is to analyse the distributional consequences between generations from implementation of the system in 1967 and the reform from 2011. Problems arising in this kind of analyses are discussed, and effects are presented for different groups of the population by birth cohort, gender, education and for natives versus immigrants.

As expected the results show that the cohorts who established the pay-as-you-go system experienced a substantial gain by letting future generations pay. For later cohorts discounted value of benefits received is lower than the discounted value of contributions. With a positive net rate of interest the value of contributions as young is more worth than the corresponding value of benefits received as old. Over the life course the pension system distributes incomes from men to women, but women are more affected by the pension reform in 2011 than men.

Keywords: Pension systems, Intergenerational distribution, Dynamic micro simulation

JEL classification: D31, H55, J16

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Sammendrag

Slik det norske pensjonssystemet er utformet, blir ytelsene en mottar som eldre, finansiert av yngre yrkesaktive over skatteseddelen. Denne analysen sammenholder beregnede mottak av ytelser fra folketrygden med beregnede bidrag til finansieringen for alle født mellom 1910 og 2070. Beregningene viser at alle som var født før folketrygden ble innført i 1967 og ytterligere et par tiår framover, tjente på det. Senere fødselskull må betale for det over skatteseddelen.

Pensjonsreformen fra 2011 reduserer de framtidige utgiftene til alderspensjon. Men reformen innebærer også at framtidige generasjoner vil finansiere mindre enn de ville ha gjort med det gamle systemet. Størrelsen på renten spiller en rolle når en skal sammenligne beløp fra ulike perioder. Under rimelige forutsetninger om denne, vil de som er født mellom 1950 og 1980 tape på reformen. Det vil si at det de mottar av ytelser blir redusert mer enn innbetalingene deres. Kullene født etter rundt 2000 tjener på reformen. For disse kullene vil bidraget til finansieringen reduseres mer enn mottaket av ytelser.

Over livsløpet omfordeler folketrygden inntekt fra menn til kvinner. Dels har dette sammenheng med at pensjonssystemet omfordeler inntekt fra de som tjener mye til de som tjener lite. Dessuten lever kvinner lengre enn menn, samtidig som de også har større sannsynlighet for å havne på uføretrygd. Tilsvarende innebærer folketrygden en betydelig omfordeling fra personer med høy utdanning til personer med lav utdanning og en omfordeling fra rike norskfødte til innvandrere med lavere inntekter.

Så langt det har vært mulig, er resultatene sammenholdt med lignende analyser i Sverige og Nederland. Folketrygden i Norge er trolig mer omfordelende enn de offentlige pensjonssystemene i de fleste land. I andre land med eksplisitte innbetalinger til pensjonssystemet fra hver enkelt, blir det ofte ikke krevd inn pensjonsavgifter av inntekter over en viss grense.

Ettersom pensjonsreformen også innebærer en svekkelse av noen av de omfordelende elementene i pensjonssystemet for å skape større samsvar mellom mottak av pensjon og tidligere arbeidsinntekter, kommer menn litt bedre ut av reformen enn kvinner. Men mesteparten av pensjonssystemets omfordeling fra menn til kvinner blir videreført.

Beregningene er gjennomført med Statistisk sentralbyrås dynamiske mikrosimuleringsmodell MOSART. Utfordringer med slike analyser blir diskutert i studien, og resultatene er særlig følsomme for de forutsetningene som gjøres om renten.

1. Introduction

Insurance against drop in incomes and redistribution are two main objectives for a public pension system. Securing of incomes after retirement from working life and insurance against the consequences of getting disabled before retirement age are probably two of the most important elements. A public pension system financed pay-as-you-go normally will redistribute incomes within and between generations. Emphasis in this paper is put on distribution between generations caused by the public pension system in Norway. As pointed out by Feldstein and Liebman (2002) mapping of distributional effects is an important element in an overall discussion of the trade-off between protection and distortion when designing a pension system. Especially, it is important when discussing or evaluating a pension reform, e.g. the Norwegian from 2011.

Over the life course members of an insurance system normally will contribute by payments when in working age, and later receive pension benefits as disabled or old-age pensioners. To obtain an overall view of distributional effects of the pension system between different birth cohorts, it is relevant to compare expected discounted pension contributions from labour market earnings for each cohort over the life course with discounted sum of pension benefits each cohort is expected to receive. If the size of the different cohorts is roughly constant and the pension system is financed pay-as-you-go, in the long run there has to be a correspondence between contributions paid and benefits received for each cohort. But the first cohorts covered with benefits from a pay-as-you go pension system normally will receive higher benefits than what follows from their contributions. Reforms of the pension system may also affect the ratio between discounted life time pension benefits and discounted life time contributions. With population growth, it may be possible to let the sum of benefits each generation receives be higher than their contribution.

A calculation of actual contribution to the insurance scheme over the working period for a generation with the aim to compare with actual sum of pension benefits, demands data that are hardly available in any country. And more important, actual calculations for each generation are not possible until the last member of this generation is dead. Projected values based on realistic assumptions have to be used. The comprehensive need for a lot of details from past and future data is a major reason why there are few examples of this kind of analyses in the economic literature.

Generational Accounts based on methods developed by Auerbach, Gokhale and Kotlikoff (1991) is one of the most common methods used to analyse distributional consequences between different

generations from given levels of government revenues and expenditures. A recent analysis for the Netherlands is published by Bettendorf et al. (2011) incorporating generational accounts in a model with overlapping generations. Like in Miles and Iben (2000), stylized models with overlapping generations are also used in the literature to show which generations might be gainers, and which losers, from a transition from an unfunded to a funded state pension system.

While the purpose of Generational Accounts is to decide whether the design of a welfare system is in accordance with fiscal sustainability in the long run, the purpose of our analysis is to illuminate effects from the Norwegian pension system on distribution of income between birth cohorts from 1910 to 2070. For this purpose we use Statistics Norway's dynamic micro simulation model MOSART, documented by Fredriksen (1998). The method used corresponds quite a lot to an analysis of lifetime income redistribution from old-age state pensions in the Netherlands by Nelissen (1995) and an analysis of redistribution between generations caused by the design of the Swedish Welfare State published in Pettersson et al. (2006).

In line with recommendations from Orcutt et al. (1986) we use a dynamic micro simulation model to capture the heterogeneity of the population in combination with rather complicated tax and benefit rules. Wolfson (1979) was the first who looked at lifetime incidence of a social security scheme by using this kind of model. Creedy et al. (1993) also use a micro simulation model to analyse the lifetime redistribution of the earnings-related state pension in the UK. By micro simulation it is possible to take into consideration that different parts of the population face different rules. Substantial problems of aggregation to calculate effects on government budgets and to analyse overall distributional effects are rather easily handled. The main strength of micro simulation is to represent a socioeconomic system by a sample of decision units and then model different events which these units may be exposed to. Contrary to what is possible in a macroeconomic approach, detailed and complicated tax and benefit rules may be exactly reproduced.

Like in Wolfson (1979) the focus in the analyses by Creedy et al. (1993), Nelissen (1998), Cornado et al. (2000), Gustman and Steinmeier (2001) and Liebman (2002) is on distributional effects from the social security system on life cycle incomes for persons within specific cohorts. The focus in this paper is more congruent with Nelissen (1995) comparing effects from the social security system on redistribution of life cycle incomes between different cohorts. Although a main emphasis in Nelissen (1995) is on redistribution in lifetime incomes within cohorts, he also looks at changes in redistribution between cohorts born in 1930, 1940, 1950 and 1960, respectively. Pettersson et al.

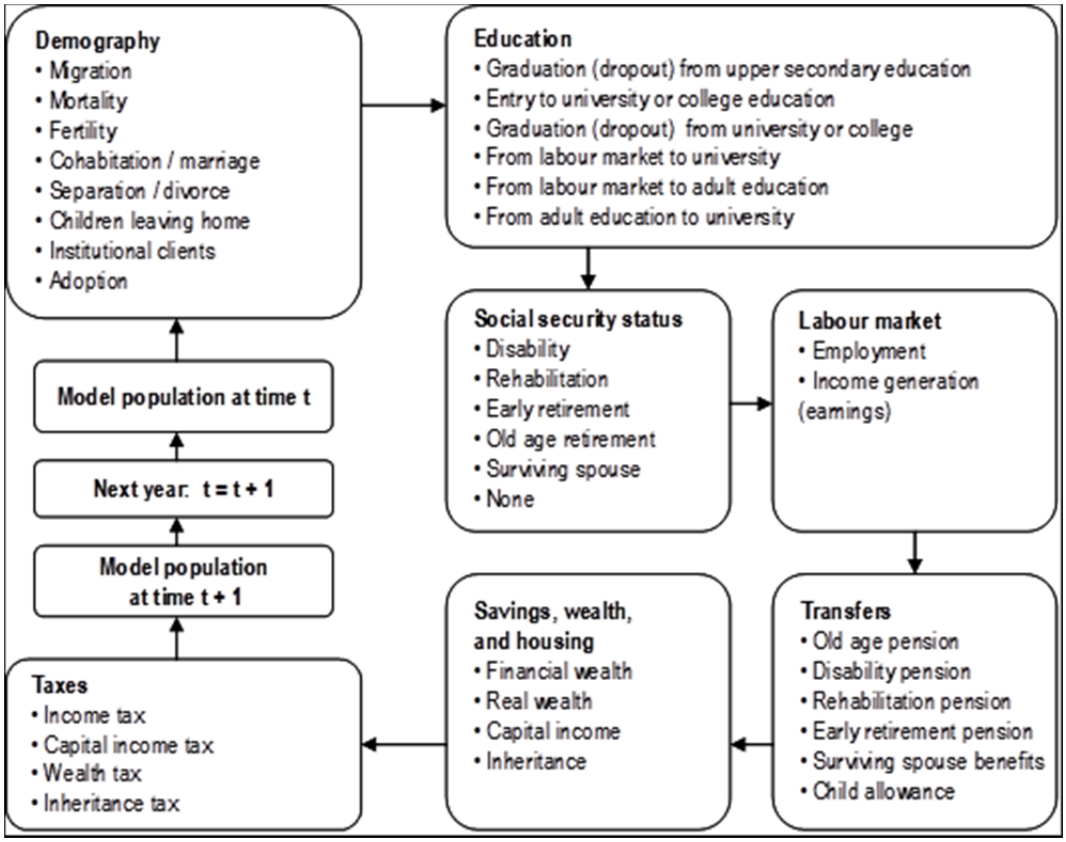
(2006) focus on intergenerational effects by using the Swedish dynamic micro simulation model SESIM in their analyses of distributional effects from major government incomes and expenditures for generations born between 1930 and 2009. The aim of our paper has mainly been to evaluate the redistributive effects of net benefits over the life-cycle between different birth cohorts from the reform of the pension system in 2011 as well as the implementation of the former system in 1967.
The MOSART model is especially designed to analyse budgetary and distributional effects from different designs of the Norwegian National Insurance System, and the model has been heavily used during the past decade to analyse effects from the implementation of the new pension system. In this paper we discuss problems arising in this kind of analysis. In addition to isolated effects from old-age pensions, we have also presented results for the sum of the main elements of the Norwegian National Insurance Scheme included in the MOSART-model, i.e. old- age pensions, disability pensions and survivors' pensions.

2. The dynamic micro simulation model MOSART

The main structure of the MOSART model is presented in Figure 1. Calculations in this paper are made by a version of the model based on a synthetic population from 1960. The life course for each individual in the population is simulated by possible transitions from one state to another, given by transition probabilities depending on each person's characteristics. Transition probabilities are estimated from observed transitions in a recent period. For the period 1961 to 2012 transition probabilities are adjusted to fit aggregate data. Events included in the simulation are migration, deaths, births, marriages, divorces, educational activities, retirements and labour force participation. Public pension benefits are calculated from labour market earnings and other characteristics.

Demographic assumptions for the present analysis are based on the medium alternative of Statistics Norway's demographic projections from June 2012. A total fertility rate of 1.87 and net immigration shrinking from the present level of more than 40 000 persons towards 10-15 000 persons per year in the long run imply a continual growth in the younger part of the population in the first decades. But especially the number of elderly will show a significant growth in the first decades as a result of the larger cohorts born after the Second World War and expected growth in remaining life expectancy at the age of 62 of about 4 years from 2011 to 2050.

Figure 1. Structure of the dynamic micro simulation model MOSART



3. Design of the Norwegian Pension System

3.1. Public old age pensions

The former system for public old age pensions in Norway was based on defined benefits and financed pay-as-you-go. If this system had been maintained expenditures for old age pensions, and thereby the financial burden, would have doubled from 2010 to 2050 because of a strong growth in the number of old age pensioners due to increasing life expectancy and large cohorts born after The Second World War replacing small cohorts born in the previous decades. Heavy work on reforming the system has thus taken place for more than a decade, and implementation of the new pension system started in January 2011. The main change was to make the public old age pension system more actuarially neutral. Based on pension entitlements accumulated over the working period, annual benefits are made dependent on age of retiring and remaining life expectancy. When life expectancy increases annual benefits are reduced unless retiring is postponed. Irrespective of retirement behaviour this design of the new system is expected to reduce growth in pension expenditures.

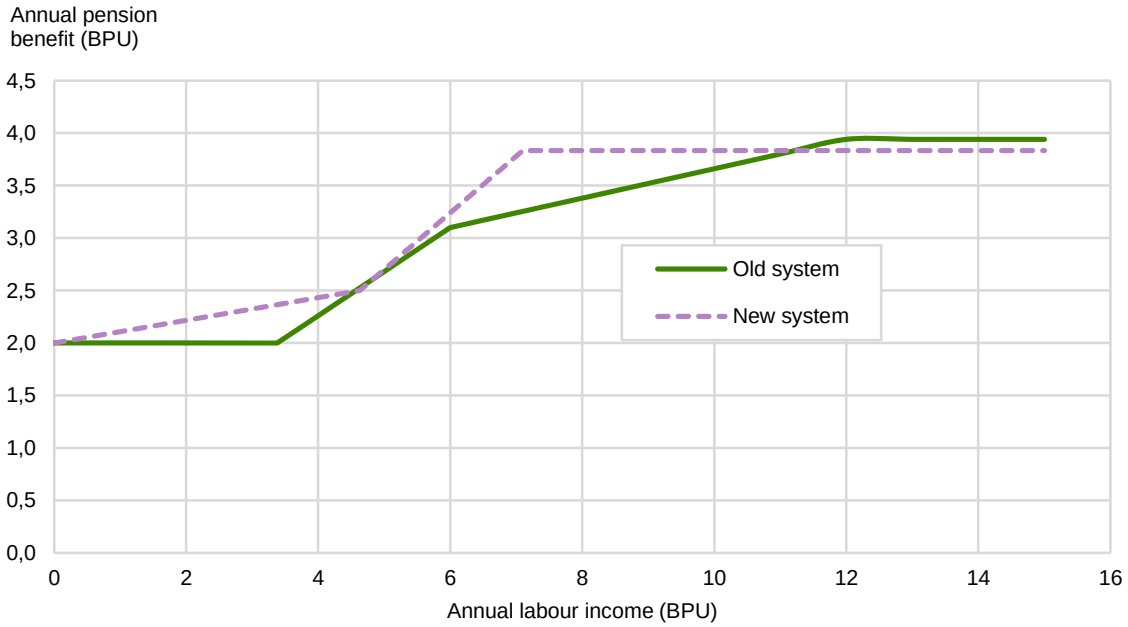
Because of the intension to make the system more actuarially neutral, a closer connection between pension entitlements and former labour incomes is also introduced. Between ages 13 and 75 entitlements for old age pensions in the new system are accumulated by 18.1 per cent of annual labour incomes up to a ceiling of 7.1 times the basic pension unit (BPU). BPU is a measurement unit in the National Insurance Scheme and amounted to NOK 81,153 as a yearly average for 2012 corresponding to about 1/6 of the average annual wage level for a full time employee. The ceiling thus corresponds to approximately 115 per cent of the average wage level.

The main changes to obtain greater correspondence between pension entitlements and former labour incomes compared to the old system are:

- Accumulation of entitlements from the first income earned against 1 BPU with the old system
- A maximum of 40 years of entitlements in the old system is abolished
- A rule for accumulation of entitlements based on the 20 years with highest incomes is also abolished
- Compared to the ceiling of 7.1 BPU for earning of entitlements with the new system, full accumulation of entitlements in the old system took place up to 6 BPU with a slanting roof of 1/3 between 6 and 12 BPU

For persons with unpaid homecare yearly entitlements were increased from 4 BPU in the old system to 4.5 BPU in the new. These entitlements are means-tested 100 per cent against labour incomes. Strong elements of redistribution in the Norwegian pension system compared to most other countries are maintained with the new system. A guarantee pension of 2 BPU for singles and 1.85 BPU per person for couples secures a minimum level of benefits for pensioners with low labour incomes. The guarantee pension is means-tested with 80 per cent against income entitlements, and even persons with small incomes will obtain a level of pension benefits somewhat higher than the minimum level as shown in Figure 2. In this figure the connection between annual pension benefits and former labour incomes is shown with the new and the old system for a single person with constant labour incomes during a period of 40 years. Annual benefits are shown before taking life expectancy adjustments into account, and thus represent the system for accumulation of entitlements. A ceiling on annual incomes for full accumulation of entitlements at 7.1 BPU in the new system compared to 6 BPU in the old means that especially persons in this interval gain from the change in the accumulation model. However, for annual incomes between 7.1 and 12 BPU the connection between former labour incomes and accumulation of entitlements is eliminated.

Figure 2. Connection between annual labour incomes and annual pension benefits with old and new pension system*



*For a single person assuming constant labour incomes for 40 years

The actuarial design with adjustments for changes in life expectancy in combination with flexible retirement over the interval 62-75 years is introduced from 2011. This means that old age pension benefits may be drawn partly or completely from the age of 62, and work and pensions may be freely combined without any earnings test. From accumulated entitlements at retirement age A, $W_{A,}$ annual pension benefits for a cohort K retiring at that age are calculated by dividing by *divisors* $\Phi_{K,A}$ reflecting remaining life expectancy at that age.

(1) $$B_{K,A} = W_A / \Phi_{K,A}$$

Here

$B_{K,A}$ = Annual pension benefits for persons from cohort K, retiring at age A

W_A = Accumulated entitlements at age A, and

$\Phi_{K,A}$ = Divisors for persons from cohort K retiring at age A

The actuarial design reflected in (1) says that accumulated entitlements are divided by expected years as retired. Early retirement leads to lower annual benefits because accumulated entitlements have to be

divided by more years. This is also the case when life expectancy increases for a given retirement age. Lower benefits when life expectancy increases may be counteracted by postponing retirement.
In the new system pension entitlements during accumulation are indexed to wage growth. After retirement income pension in payment is indexed to wages, but subtracted a fixed factor of 0.75 per cent per year. The level of the guaranteed pension will be adjusted by growth in wages, but reduced with higher life expectancy. In demographic projections from Statistics Norway life expectancy at the age of 67 is assumed to increase by approximately 0.5 per cent a year in the long run. Then the indexation of minimum pensions usually will be higher than price indexation.

Persons born in 1953 or earlier will earn their pension entitlements only according to the old system. In the group born from 1954 to 1962 pension entitlements will partly be calculated from the old system and partly from the new with an increasing share. Pension entitlements for persons born in 1954 will be 90 per cent based on the old rules and 10 per cent on the new. Persons born in1963 or later will earn their pension entitlements completely according to the new system.

3.2. Disability pensions and old age pensions for former disabled

Under the old system disability pension and old-age pension were interconnected, and disability pensioners usually kept their pensions unchanged when they were transferred to old-age pension at age 67. About 11 per cent of the population aged 18-67 is on disability pension, and at age 66 about 40 per cent of the new old-age pensioners have been former disabled. As a part of the pension reform the Government in 2011 proposed a new disability scheme and a new model for calculating old-age pensions for earlier disabled. The new disability scheme is introduced from 2015. With this scheme disability pension is calculated more as a short term benefit with a replacement rate of 66 per cent and taxed like earnings.

Like in the old system, disability pensioners will be transferred to old-age pensions at the age of 67. Because persons receiving disability benefits are not in a position to work after this age to counteract higher life expectancy, the government decided that reduction in yearly benefits caused by growing life expectancy for a new disabled at age 67 only should be one half of the reduction implemented for former non-disabled retiring at this age. Over time this more lenient life expectancy adjustment for those who are former disabled will increase incentives for getting disabled before obtaining old age pension. By 2018 life expectancy adjustment of old-age pensions for earlier disabled is to be evaluated in light of whether non-disabled compensate for the life expectancy adjustment by working longer.

3.3. Survivors' pensions

Survivors' pensions are also still interconnected to the old system for old age pensions. Given some conditions about own incomes and common children, a surviving spouse may get extra pension benefits dependent on accumulated entitlements of the deceased spouse. If the surviving spouse receives old age benefits, she may also get a supplementary survivors' pension means-tested against her own entitlements for supplementary / income dependent pension. A majority of surviving spouses are women, and normally their personal pension entitlements are significantly lower than the corresponding entitlements of their husbands.

4. Methodological challenges

4.1. Information for every cohort over the life course

Calculation of pension wealth for each individual over the life course for a range of cohorts meets several methodological challenges. Firstly, data for labour market incomes and pension benefits for each person included in the simulation are necessary. The need for future information for the present and future population is simply met by using the MOSART-model to simulate further life course for each person, also including new persons by birth or immigration. The same approach is also used by Nelissen (1995) and (1998) and Pettersson et al. (2006). A main problem is caused by lack of data from the first years of working activity for present adults. This problem may be solved in several ways:

a) We may start the simulation with a synthetic population in an early year (e.g. 1960). This approach is used by Nelissen (1995) and (1998). He derives a usable sample from the 1947 Census data, and he is thus able to start his analyses with the cohort from 1930 who mainly accumulates their pension entitlements after 1947. However, it is not documented how information on contributions to the accumulation of entitlements is collected for the first cohorts.
b) We may try to establish historical data for wages and pension payments for present adults' early working life, but this data job may demand a lot of resources. This approach is used by Pettersson et al. (2006) by combining macro data for government revenues and expenditures back to 1930 from Statistics Sweden with more or less scattered information on the distribution among individuals with different characteristics.
c) By only focusing on accumulated gross pension wealth, the analyses could be constrained to those younger than 67 years of age, the formal retirement age with the former pension system.
d) The analyses could be constrained to focus on effect from the pension reform on gross pension wealth, and compare with expected income over the remaining life course.

To get a most comprehensive picture as possible of distributional effects from the pension system over the life course for different cohorts, we have chosen to follow the approach by Nelissen (1995) and (1998) according to suggestion a) above. Based on data from the Norwegian Population Census in 1960, it has been possible to start the simulation based on this population of individuals with characteristics consistent with aggregate information. For the period 1961-2012 transition probabilities in the model are also adjusted in order to make the simulation correspond to observed time series at the aggregate level. All persons living in Norway in 1960, or born or immigrated afterwards, are included in the simulation. This method provides a full set of income data for every person in the grown up population born in 1943 (and thereby 17 years of age in 1960) or later. Simulations from 2010 and onwards are partly based on a prolonging of the system that existed before the reform and partly on the approved pension system.

4.2. Labour supply effects

Labour supply with the new system is expected to be higher than with the former. At the intensive margin (before age of retirement) a closer connection between accumulation of pension entitlements and former labour incomes means an implicit reduction of the marginal tax rate for labour. In Stensnes (2007) this implicit tax reduction is estimated to stimulate labour supply on the intensive margin by 2.5 per cent. It is reasonable to think that both labour market participation rates and average working hours may be affected, and we have assumed that they will increase by 1 ¼ per cent each.

Assumptions regarding possible labour supply effects of the Norwegian pension reform in Fredriksen et al. (2005) and Holmøy and Stensnes (2008) are in accordance with the results from Heckman (1993) and Immervoll et al. (2007) indicating that labour supply is more elastic on the extensive than on the intensive margin. Retirement may be postponed as an immediate effect because of the reform, and further postponed when life expectancy increases. The first comprehensive econometric analyses of immediate effects on retirement by Hernæs et al. (2015) confirm that the reform particularly has caused postponed retirement for employees in the private sector entitled to the early retirement scheme. Because the reform of the pension system for employees in the public sector in the first round did not turn out to follow the model from the private sector, retirement behaviour for this group is not expected to be much affected. By weighing effects for different groups together Fredriksen and Stølen (2011) calculate the average immediate effect on retirement above 0.2 years while an average worker (included those working in the public sector) may postpone the retirement age by 0.5 years for each year life expectancy increases. Remaining life expectancy at the age of retirement is expected to

increase during the whole period of simulation, but with a slower degree towards the end of the period than in the beginning.

4.3. Contribution rate

Contrary to the Dutch General Old-Age pension system analysed by Nelissen (1995) and (1998), the Norwegian National Insurance System (NIS) is financed pay-as-you-go. Thus, in the Norwegian system there is no direct connection between taxes and contributions paid and the amount of pension benefits received. Pension contributions and expenditures in NIS are integrated components of the Norwegian government budget. Although payroll taxes and pension premiums on labour incomes are features of the Norwegian tax system that originally were intended to cover total pension expenditures in NIS when the system was introduced in 1967, revenues from these taxes have been far from sufficient. Because of the current low number of old-age pensioners compared to the size of the labour force, the present estimated contribution rate for old age pensions is much lower than the accrual rate of 18,1 per cent in the new system. Actual costs will probably not correspond to this number before around 2040.

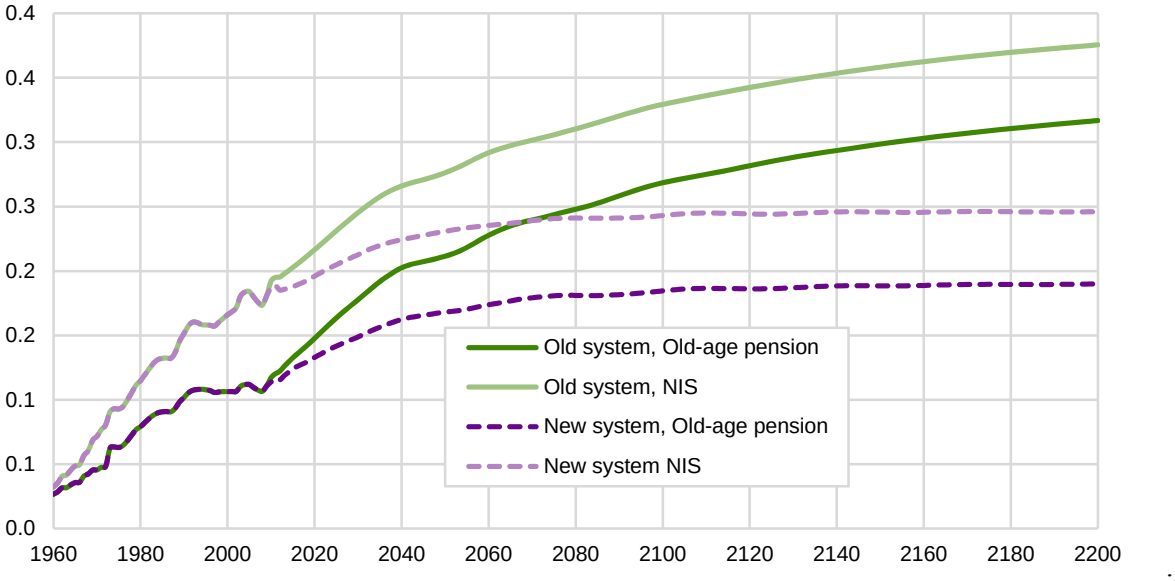
Nevertheless, there are good reasons to say that NIS is financed by its members, and it is possible to produce estimates for how this fiscal burden is distributed. In a pay-as-you-go system in which public pension expenditures are financed by current tax revenues, the so-called average contribution rate defined by Disney (2004) may be a simplified measure for each member's contribution. Disney defined the contribution rate for a public pension scheme as "the average rate (on earnings) that would be required to finance current spending on public pensions without budgetary transfers or the accumulation or decumulation of public pension funds". Under standard pay-as-you-go formula, the contribution rate (CR) may be calculated as the ratio of public pension payments (PP) to labour incomes (LI). Gross pensions are taxed in Norway, but more lenient than labour incomes, and therefore an appropriate contribution rate most in accordance with the Disney definition may formally be calculated as:

$$CR = \frac{PP}{(LI + \gamma * PP)}$$

The right hand side numerator represents nominal public pension expenditures, whereas the denominator is the relevant tax base. The parameter γ represents the more lenient taxation of pension incomes compared to wage incomes, and is estimated to about 50 per cent under the current tax regime. The contribution rate can be interpreted as the tax rate sufficient to finance pension

expenditures, assuming that the entire tax burden falls on labour and pension incomes. Average contribution rates dependent on pension system are presented in figure 3 for old age benefits and NIS also including disability benefits and survivors' benefits.

Figure 3. Average contribution rates dependent on pension system and benefits included



At the start of the period of simulation in 1960 the average contribution rate for old age pensions in Norway was only 2.6 per cent and 3.2 per cent when also disability and survivors' pensions were included. At that time retirement age for old age pensions was 70 years, and because of rather short duration of life, few Norwegians reached that age. Due to decreasing mortality and larger birth cohorts reaching retirement age, the average contribution rate for old age pension grew steadily from 1960 to 1990, but because of small cohorts born between the two World Wars this contribution rate stayed almost constant about 11 per cent from 1990 to 2010. Because of large cohorts born after the Second World War and further growth in life-expectancy, continuing the old pension system would have meant an almost doubling of the old age pension contribution rate from 2010 to 2050. And the contribution rate would have continued to increase as long as life expectancy was increasing and retirement age was kept constant. Due to the pension reform, growth in average contribution rate for old age pensions will be smaller. This contribution rate is estimated to reach about 17 per cent in 2050 and stabilize about 19 per cent towards the end of the period of simulation.

4.4. Net rate of interest

A comparison of the present value of contributions to the financing of old age pensions and NIS over the life course for each birth cohort with the present value of pension benefits received, is probably the most appropriate way to calculate each cohort's net contribution. In calculating present values of contributions and benefits it is necessary to choose a relevant net rate of interest ρ:

$$\rho = (1+i)/(1+w) - 1 = (i-w)/(1+w)$$

Here:
i = the nominal rate of interest,
w = average wage growth.

In NIS accumulated entitlements for old age pensions are indexed by wage growth synonymous with the net rate of interest fixed equal to zero. While this assumption is appropriate for indexation of accumulated entitlements in NIS, it is not suitable when comparing present value of contributions with present value of benefits, or in more general analyses of sustainability in public finance. By assuming that the net rate of interest is zero, what happens today is of no importance compared to what happens in the future with an infinite horizon. For example, a weakening of the government budget today may give an advantage to the tax-payers or the users of government services and pension benefits in the short run that is never counteracted in the long run because a deficit in public finances may be pushed to infinity. If the net rate of interest is zero, there will therefore be no budget constraint by this approach. It is not obvious what net rate of interest that should be chosen, and we will show that the results may be highly sensitive for the choice. A common practice in Norway, also used by the Ministry of Finance to calculate present values of contributions and benefits in the so called Generational Accounts, has been to assume a net rate of interest of 1.96 per cent corresponding to a yearly growth in real wages of 2 per cent and a real rate of interest of 4 per cent.

In his analyses Nelissen (1995) also chooses a net discount rate of 2 per cent, arguing that this is roughly the real interest rate in the Netherlands during the last hundred years. In the paper from 1998, however, Nelissen uses a real discount rate of 4 per cent in the main alternative and shows the effect of alternative assumptions of 2 and 6 per cent respectively. Coronado et al. (2000) use a discount rate of 2 per cent in the main alternative, but they also show the effects from an interest rate of 4 per cent, On the other hand, Pettersson et al. (2006) do not take any discounting into account in their analyses. They adjust incomes and transfers with inflation and economic growth assuming that the value of

contributions and receipts of pension benefits and transfers are independent on when they respectively are paid and received. They argue that individual time preferences and risk aversion should not be taken into account because the analyses intend to show the situation after everyone in a generation is dead. Even though they admit that an amount of money now has to be preferred compared to the same amount later, this argument is met by including capital incomes in the analyses.

4.5. Adjustments for household composition

In horizontal analyses of distributional effects from different kinds of incomes and transfers over the population, it is common to take into account the composition of households to which the individuals belong. Total incomes received by all members of the household (eventually also taxes and other contributions members of the household pay) are divided on each member by using some equivalence scale. Also for analyses of distribution of life time incomes Coronado et al. (2000) and Gustman and Steinmeier (2000) find it relevant to take the incomes and benefits for the spouse into consideration.

However, it is not quite obvious that household composition should be taken into account in distributional analyses between different cohorts. Most old-age pension systems are based on accumulation of individual rights independent of the household a person belongs to. Only with a few exceptions old-age pension benefits are received independently of the household composition. So in this paper, concentrating on distributional effects between different generations we focus on individual contributions and benefits. Contrary, in their analyses of overall distribution of net effects of all governmental revenues (taxes) and expenditures (benefits), Pettersson et al. (2006) choose to take the household composition into account. They therefore choose to charge the home-living children with a part of all taxes paid by their parents, while the parents receive a part of the children allowances and subsidized kindergartens and education. In his analyses of horizontal distributional effects of the pension system over the life cycle for selected cohorts, Nelissen (1995) and (1998) also adjusts the income components for household composition. The pension benefits for couples in the Netherlands seem to be much more integrated than in the Norwegian system.

5. Results

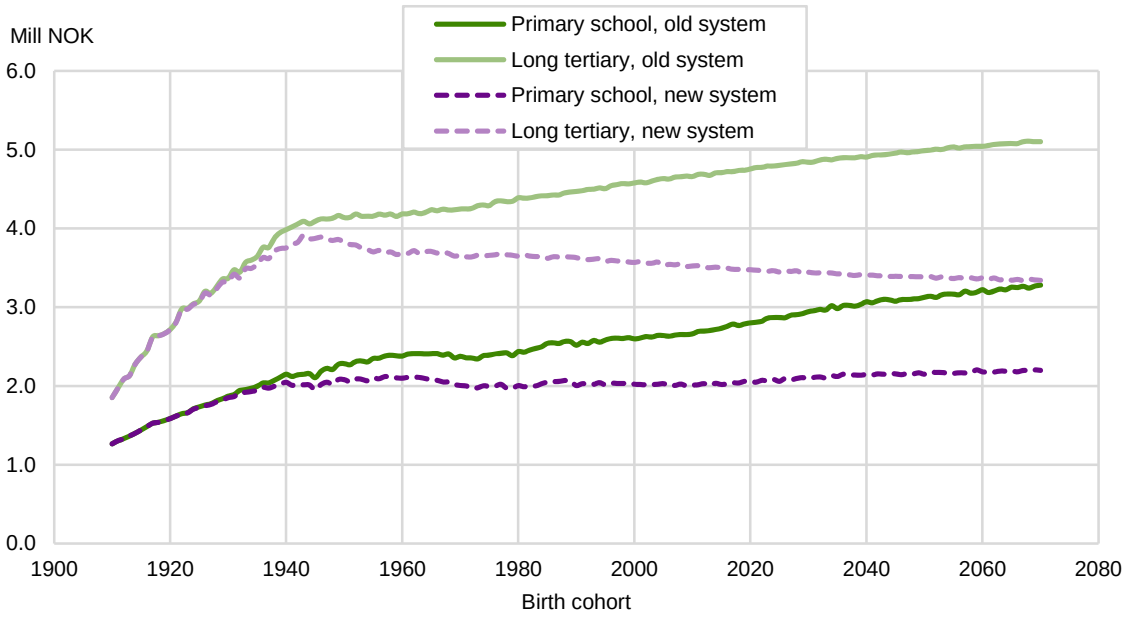
The point of departure for the simulations is every person resident in Norway in 1960, and persons born or immigrated afterwards. Persons born in Norway before 1960, who also have died before that year, are not included in the results presented below. All other persons are included irrespective of how old they were when they died. All amounts are measured in NOK in fixed wages from 2011and are discounted to age 62 for every cohort. As presented below the results are somewhat affected by a

rather high net immigration to Norway. In the recent years net immigration has increased to above 40 000 persons per year, corresponding to more than 0.8 per cent of the entire Norwegian population and 70 per cent of a birth cohort. The size of net immigration affects the results because many persons will only have spent a part of their lives as adults in Norway. Therefore several of the figures below are constrained to natives, i.e. persons resident in Norway since the age of 17. In some figures we have shown the difference between natives and immigrants. Due to former weaknesses in registration of education among immigrants, presented figures by level of education are constrained to natives only.

5.1. Gross pension wealth

The first stage in the empirical analysis is to take a look at gross pension wealth, i.e. expected present discounted value of all pension benefits received over the life cycle. This is shown by level of education for the new and old pension system and for old age pensions and the total of old age pensions, disability pensions and survivors' pensions in Figure 4 and 5 respectively. Although the simulation starts in 1960, it is possible to calculate gross pension wealth for persons born from about 1910. Persons from this generation, who survived until the age for old-age retirement, did not receive old age pensions before 1977, and their total entitlements were then registered. This is also the case for most of their expected rights for disability pensions, although there may be some weaknesses in estimating the expected rights for disability pensions when this generation was relatively young.

Figure 4. Average discounted gross pension wealth at age 62 by level of education and pension system, old age pensions. Mill NOK in 2011 amounts



Growth in average gross pension wealth from the first cohorts included in the presentation is mainly caused by maturing of the former pension system introduced in 1967 as well as longer duration of life. As mentioned before, in the former system it was necessary with 40 years of accumulation to obtain full old age pension. Due to still low labour market participation rates for Norwegian women up to the 1970s, maturing of the system had a significant effect for average gross pension wealth for cohorts born up to the beginning of the 1960s. Increasing life expectancy causes average gross pension wealth to increase for almost every cohort, but the effect is reduced by the discounting and the fact that a greater part of the increasing life expectancy for later cohorts occurs at higher ages.

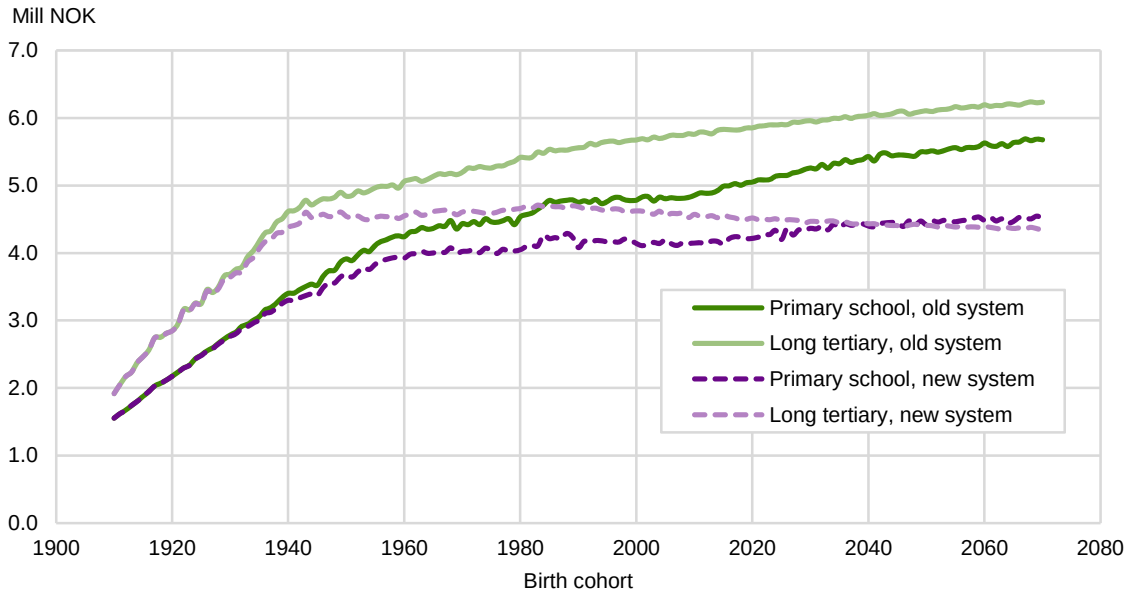
With the new pension system most of the effect from longer duration of life disappears because of the effects from the divisors on postponed retirement or on average pensions in the case if retirement age is unaffected. Therefore the further growth in average pension wealth stagnates for the first cohorts affected by the new system, i.e. cohorts born in 1943 or later. Indexing of pension benefits in payment for already existing old-age pensioners from 2011 by wage growth minus 0.75 per cent even hurts gross pension wealth for cohorts born before 1943.

Persons with a high level of education have a higher average pension wealth because they have higher incomes caused by both higher earnings and higher participation rates, and because they live longer. Introduction of the former pension system in 1967 also had a more immediate effect for this group compared with the group with only primary school because a transition rule rewarded those cohorts born between 1920 and 1940 with high and stable participation in the labour market. Note that a strong growth in the level of education from the cohorts born in the first part of the former century up to the cohorts born in the 1980s means that the graph for long tertiary education is far more representative for the whole population for the later cohorts compared to the older cohorts where the graph for primary school is the most representative. Measured in per cent, the effect from the pension reform does not deviate much between different levels of education. Longer life-expectancy among persons with high education compared to persons with low causes gross pension wealth to decrease slightly for younger cohorts with the new pension system as a result of discounting and indexing of pension benefit in payments.

If disability pensions and survivors' pensions are added as presented in Figure 5 the difference between different levels of education gets smaller. This is caused by a much higher share of disabled among those with only primary school compared to those with long tertiary education. Disability

pensions also get a large weight because of the discounting since they normally occur about 20 years before old age pensions.

Figure 5.Gross discounted pension wealth at age 62 by level of education and pension system. NIS. Mill NOK in 2011 amounts



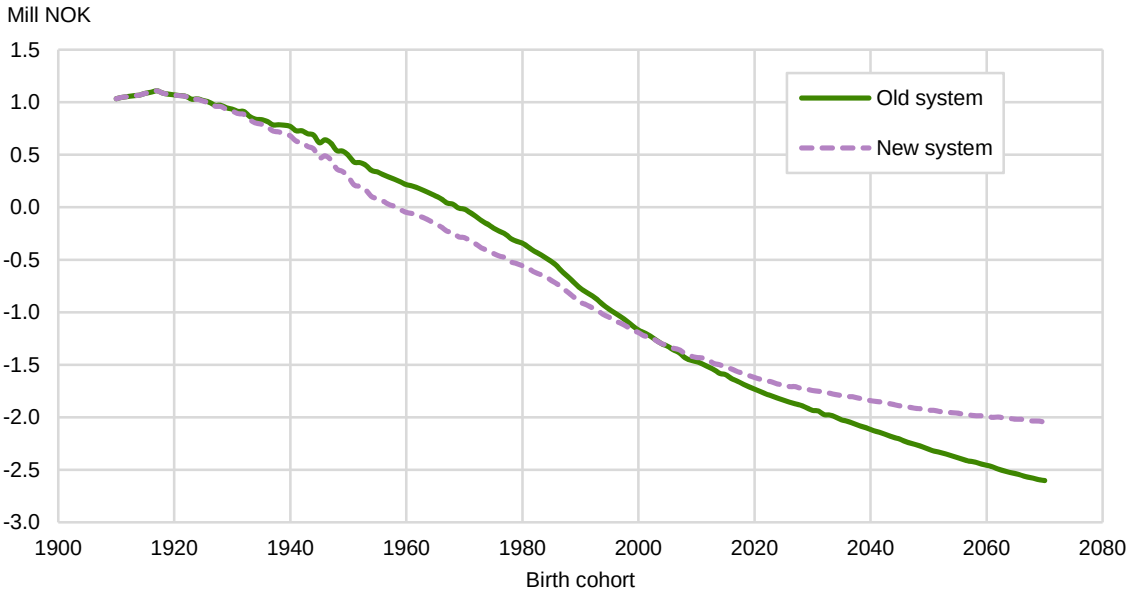
5.2. Net pension wealth

Net discounted value of pension wealth is obtained by subtracting estimated discounted value of contributions from the estimated discounted value of pension benefits, and this is shown for all inhabitants in different cohorts in Figure 6. There is a minor weakness in the calculations (and the figure) that it has not been possible to collect data for contributions to the old age pension system up to 1960 for cohorts mainly born before 1940. Beyond that, the graph shows the expected course. The cohorts who established the pay-as-you-go system experienced a substantial gain by letting future generations pay. For later cohorts discounted value of benefits received is lower than discounted value of contributions mainly because each person contributes to the system first and receives old age pensions afterwards. These results are to some degree congruent with the result for the Netherlands by Nelissen (1995), showing a smaller positive effect of the old-age pension system for the younger cohorts compared to the older. One reason for the difference compared to Norway is that the old-age pension system in the Netherlands was established in 1957, earlier than the Norwegian system. In the overall analyses of distributional effects between generations from all governmental revenues and expenditures in Sweden by Pettersson et al. (2006), differences in net benefits between different cohorts naturally are much lower compared to what is the case when focus is limited to old age

pension system. But also in Sweden persons born in the 1930s seem to have a more positive net gain from governmental revenues and expenditures than younger generations. Pettersson et al. also point at the fact that larger generations commonly are worse off than smaller regarding net benefits received from the government over the life cycle.

Measured by net discounted value, the cohorts who decided the Norwegian pension reform in 2011, i.e. cohorts born between 1930 and 2000 lose from the reform mainly because the reform reduces their future benefits. Younger cohorts gain from the reform mainly because discounted value of future contributions is reduced more than discounted value of future benefits.

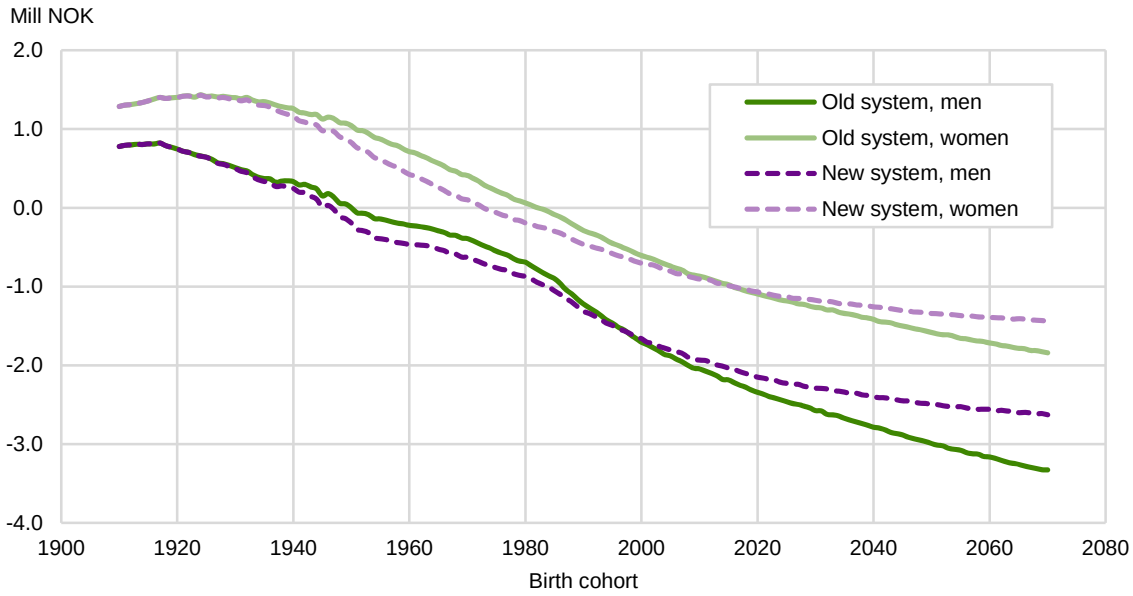
Figure 6. Net discounted value at age 62 for old age pension benefits and contributions, all inhabitants. Mill NOK in 2011 amounts



Net discounted values for old-age pension benefits and contributions by gender are presented in Figure 6. Women get a higher return from the old-age part of NIS than men because they live longer and benefit more / are less hurt by the redistributive elements like minimum pensions, ceiling on accumulation of entitlements and accumulation of pension rights for unpaid care. This result is largely congruent with the results reported for Norway by Christensen et al. (2012) and with the findings for the Netherlands by Nelissen (1995). Because of smaller redistributive elements in the Dutch pension system, the difference between men and women regarding net benefits from the old-age-pension system is lower than in Norway. If we had included disability pension, redistribution from men to women in the Norwegian pension system would have shown up to be even stronger because a greater

share of women than men receives this pension. However, men are somewhat better off than women as a result of the pension reform mainly because the ceiling for full accumulation of pension entitlements is somewhat increased. This is especially the case in the long run for the younger cohorts. But also the new system means a considerable redistribution of incomes from men to women over the life course.

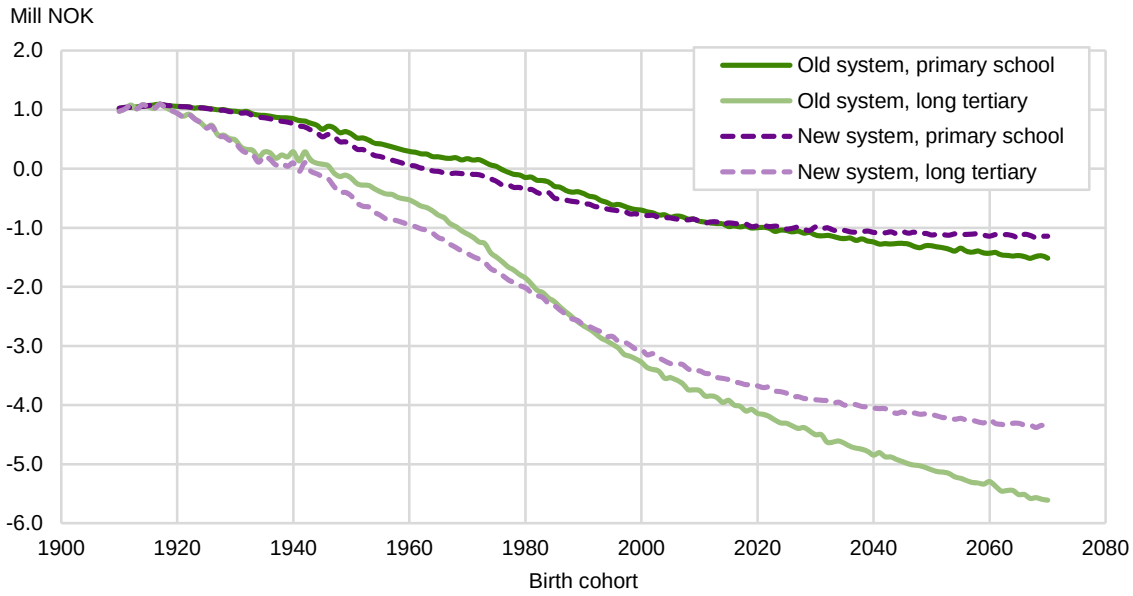
Figure 7: Net discounted value at age 62 for old age pension benefits and contributions by gender. Mill NOK in 2011 amounts



From figure 8 it is evident that the old age pension system over the life cycle causes a significant redistribution from high educated to low educated, corresponding to a significant redistribution from persons with high incomes to persons with low incomes. By cohort this effect is strengthened during the maturing of the old system and is mainly caused by redistributive elements like minimum pension, ceiling on yearly incomes for accumulation of entitlements and entitlements for unpaid home care. Although Nelissen (1995) reports that the Dutch old age pension system over the life cycle redistributes incomes from high educated to low educated, the degree of redistribution seems to be much higher in Norway. Compared to most other countries, distributional elements in the Norwegian pension system are probably stronger. And because the old age pension system is an integrated part of the government budgets there is no ceiling on financial contributions in the tax system which is quite common in countries where the system is autonomous. Inclusion of disability pensions in the figure would have strengthened the picture of redistribution.

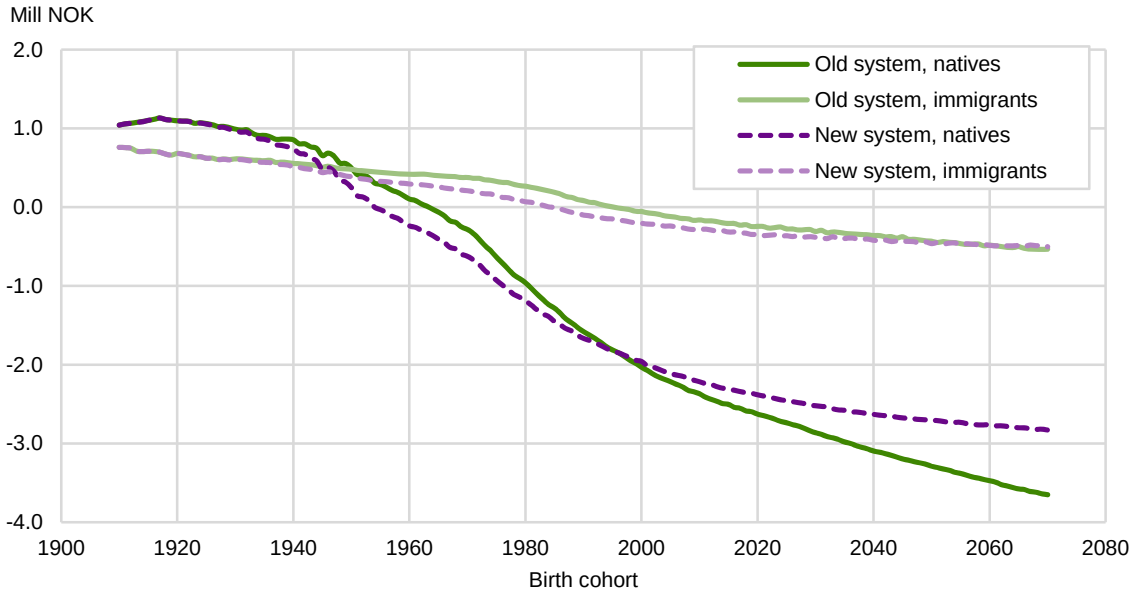
A smaller distance between high and low educated (and thereby between high and low incomes) regarding net discounted value for old age pension benefits and contributions when the new pension system has matured for the younger cohorts, indicates a somewhat smaller redistribution over the life cycle between high and low incomes in the reformed pension system compared to the old. Higher accumulation of entitlements for incomes somewhat above average with the new system as discussed in connection with figure 1 is probably the main reason. But even with the new system there is still a significant redistribution over the life cycle between high and low educated.

Figure 8: Net discounted value at age 62 for old age pension benefits and contributions by level of education. Mill NOK in 2011 amounts



If the population is divided into natives and immigrants as shown in Figure 9, we see that net discounted value for old age pension benefits is much more positive for immigrants than for natives. An average immigrant contributes less than an average native because of fewer years of work and lower labour incomes. As an old age pensioner many immigrants only will receive minimum pensions, eventually adjusted for a lower period of residence than necessary to achieve a full minimum pension. By same reasons several cohorts of average immigrants lose from the pension reform measured by net discounted value of old age pension because minimum pension also is assumed to be somewhat affected by life expectancy adjustments. However, for the cohorts born in the 1960s, who are the ones that lose most from the reform, the loss for an average native is significantly larger than the loss for an average immigrant. For younger cohorts born after 2000 natives benefit more from the reform than immigrants because of smaller contributions to the system.

Figure 9. Net discounted value at age 62 for old age pension benefits and contributions, natives and immigrants. Mill NOK in 2011 amounts



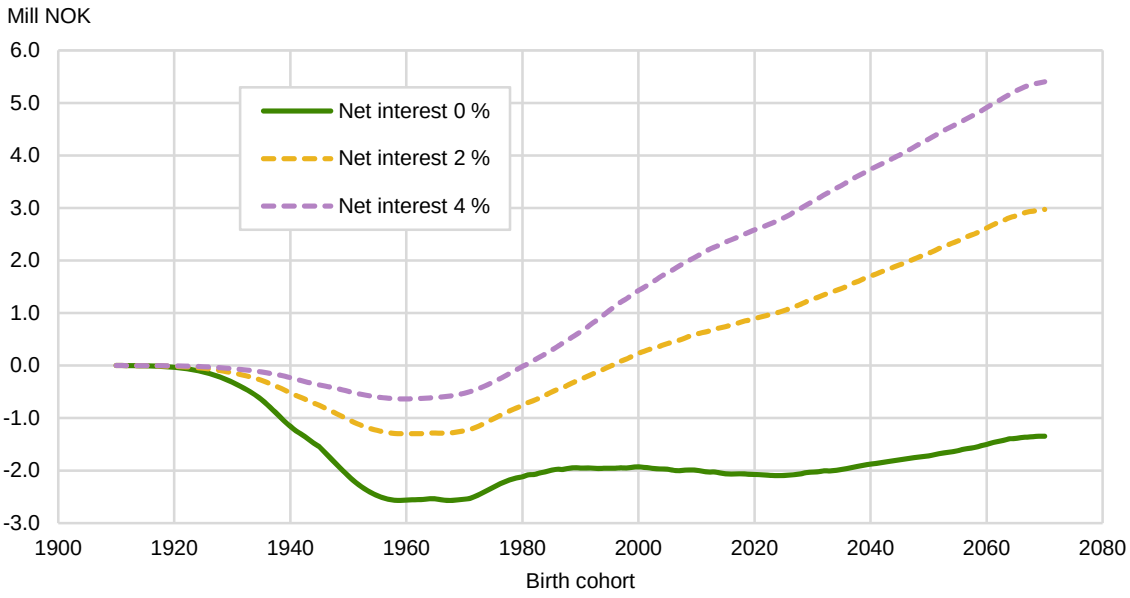
5.3. Implicit net gain from the pension reform relative to labour incomes over the life cycle

The net discounted value of contributions to and benefits from old age pensions for each cohort relative to the cohort's total discounted labour incomes over the life course may be interpreted as an average net tax rate the cohort pay to finance the system. By comparing these cohort-specific net tax rates for old age pensions with the old and the new system we obtain information on the impact of the reform relative to each cohort's discounted labour income. The effect on the net gain of the reform in per cent of labour incomes for an average native in each cohort is presented in Figure 10.

As discussed in an earlier section, results from calculations of discounted values are heavily dependent on the choice of net rate of interest, and effects from alternative assumptions are presented in the figure. With the standard assumption of a net rate of interest of 2 per cent that is quite common in the economic literature, cohorts born between 1950 and 1980 are those who are most hurt by the reform. But even for these cohorts the implicit net loss is not larger than 1.3 percentage points compared to the cohort's discounted average labour income over the life course. The estimated loss is, however, based on the assumption that the old system could have been preserved without any problems. Estimated growth in contribution rates with the old system shown in Figure 3 indicates that this assumption is far from obvious. Figure 10 also shows that cohorts born after 2000 will gain from the reform with a net

rate of interest of 2 per cent because the value of contributions as young is more worth than the corresponding value of benefits received as old.

Figure 10. Change in net value for old age pensions for natives as a result of the pension reform. Change in per cent relative to labour incomes over the life course.



With a net rate of interest of 4 per cent, discounted gain of lower contributions increases compared to discounted loss of lower old age benefits. Fewer cohorts lose from the reform, and the loss is smaller compared to the calculations based on a net rate of interest of 2 per cent. Cohorts born after 1980 gain from the reform, and the gain is larger compared to calculations based on a smaller rate of interest. On the other hand, based on an assumption of a zero net rate of interest, no cohort gains from the reform during the period showed in the figure. Only natives are included in the presented series, and by prolonging the calculations we have checked that this group will experience a positive net gain from the reform in a longer perspective even with a zero net rate of interest. Also with a zero net rate of interest cohorts born between 1950 and 1980 are those who lose most. In the real world a situation with net rate of interest equal to zero is not sustainable in the long run. In this case there will be no budget constraint for the government. A large deficit now could be transferred into infinity.

References

Auerbach, A., Glokhale, J. and Kotlikoff, L. (1991): Generational Accounts: A Meaningful Alternative to Deficit Accounting. *Tax Policy and the Economy, 5,* 55-110.

Bettendorf, L., van der Horst, A., Draper, N., van Ewijk, C., de Mooij, R., and der Rele, H. (2011): Ageing and the Conflict of Interest between Generations. *De Economist 159,* 257-258.

Christensen, A.M., D. Fredriksen, O.C. Lien and N.M. Stølen (2012): 'Pension Reform in Norway: Combining NDC and Distributional Goals'. In Holzmann, Robert; Palmer, Edward; Robalino, David (2012): *Nonfinancial Defined Contribution Pension Schemes in a Changing Pension World: Progress, Lessons, and Implementation*. © Washington, DC: World Bank, 129-154. https://openknowledge.worldbank.org/handle/10986/9378.

Coronado, J.L., D. Fullerton and T. Glass (2000): The progressivity of social security. NBER Working Paper 7250, Cambridge Massachusetts: National Bureau of Economic Research.

Creedy, J., R. Disney and E. Whitehouse (1993): The earnings-related state pension, indexation and lifetime redistribution in the U.K. *Review of Income and Wealth 39 (3),* 257-277.

Disney, R. (2004): Are Contributions to Public Pension Programmes a Tax on Employment? *Economic Policy 19,* 267-311.

Feldstein, M. and J.B. Liebman (2002): Social Security. In Auerbach. A.J. and M. Feldstein (2002): *Handbook of Public Economics, Vol. 4,* Elsevier Science B.V., 2245-2324.

Fredriksen, D. 1998: *Projections of Population, Education, Labour Supply and Public Pension Benefits – Analyses with the Dynamic Microsimulation Model MOSART.* Social and Economic Studies 101, Statistics Norway.

Fredriksen, D., K.M. Heide, E. Holmøy and I.F. Solli (2005): *Makroøkonomiske virkninger av pensjonsreformer (Macroeconomic effects form reforms of the Norwegian pension systems)*. Reports 2005/2, Statistics Norway.

Fredriksen, D. and N.M Stølen (2011): *Utforming av ny alderspensjon i folketrygden (Design of the old-age pension in the National Insurance System for Norway)*. Reports 22/2011, Statistics Norway.

Gustman, A.L. and T. Steinmeier (2001): How effective is redistribution under the social security benefit formula. *Journal of Public Economics 82 (1),* 1-28.

Heckman, J. (1993): What has been learned about labour supply in the past twenty years? *American Economic Review, 83,* 116-121.

Holmøy, E. and K. Stensnes (2008): Will the Norwegian pension reform reach its goals? An integrated micro-macro assessment. Discussion Papers No. 557, Statistics Norway.

Hærnes, E, Markussen, S., Piggott, J. and Roed, K. (2015): Pension Reform and Labor Supply – Flexibility vs. Prescription. CEPAR Working Paper 2015/03.

Immervoll, H., Kleven, H.J., Kreiner, C.T. and Saez, E. (2007): Welfare Reforms in European Countries: A Microsimulation Analysis. *Economic Journal* 117, 1-44.

Liebman, J.B. (2002): "Redistribution in the current U.S. Social security system". In Feldstein, M. and J.B. Liebman (eds): *The distributional aspects of social security and social security reform.* University of Chicago Press.

Miles, D. and A. Iben (2000): The Reform of Pension Systems: Winners and Losers Across Generations in the United Kingdom and Germany. *Economica, Vol. 67,* 203-228.

Nelissen, J. (1995): Lifetime income redistribution by the old-age state pension in The Netherlands. *Journal of Public Economics 58,* 429-451.

Nelissen, J. (1998): Annual versus lifetime income redistribution by social security. *Journal of Public Economics 68,* 223-249.

Orcutt, G.H., Merz, J. and Quinke, H. (1986): *Micro analytic Simulation Models to Support Social and Financial Policy*. New York: North Holland.

Pettersson, Th., Pettersson, To. and Westerberg, A. (2006): *Generationsanayser – Omfordelning mellan generationer i en växande välfärdsstat* (*Generational Analyses – Redistribution between Generations in an expanding Welfare State).* Rapport til ESS, Expertgruppen för Studier i Samhällsekonomi, 2006:.6, Finansdepartementet, Sverige.

Stensnes, K. (2007): Equity versus Efficiency in Public Pension Schemes. Microsimulating the Trade-off. Discussion Papers No. 515, Statistics Norway.

Wolfson, M.C. (1979): The lifetime impact of the retirement income system, a quantitative analysis. In: *The Retirement System in Canada: Problems and Alternative Policies for Reform.* Report of The Task Force on Retirement Income Policy to the Government of Canada, Appendix 5, 5.2-5.41.

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