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Pension reform in Norway: evidence from a structural dynamic model

Fedor Iskhakov[a]

Abstract: This paper simulates a set of proposed policies from the Norwegian pension reform within a structural dynamic model of health and retirement estimated on the Norwegian labour market data. The paper focuses on the two main elements of the reform, namely the new pension entitlement accrual rules linking benefits more closely to earnings and the new pension benefit drawing rules designed to eliminate the incentives distortions with respect to the time of retirement. The effects of these proposals are investigated in terms of labour market outcomes, social welfare and income distribution. It is shown that while the proposed pension reform succeeds in urging the older workers to postpone their retirement and induces an increase in total social welfare, individuals in good health who retire early experience a negative change in their discounted utility. In addition, an increase in social welfare is accompanied with an increase in income inequality.

Keywords: Pension reform, incentive neutral retirement, pension entitlement accrual rules, labour market outcomes, social welfare, income inequality, structural dynamic model, health, retirement.

JEL: H55, J26, C61

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1. *Introduction*

As most OECD countries Norway is facing an aging population. The combined effect of the increasing life expectancy and a continuing decline in labour force participation among old age workers threatens the stability of the Norwegian PAYGO pension system. As the forecasts show, in the absence of a structural change in the social security system in Norway, expenditure on old age pension is estimated to increase from 9.1 to about 19.7 percent of mainland Norwegian GDP between 2004 and 2050 (Summary of Report to Storting Nr. 12, 2005). Similar conditions lead to pension reforms being undertaken in many OECD countries. For the general discussion of the issue see (Lindbeck and Persson, 2003).

In Norway a Pension Commission was appointed by the Government on the 30th of March, 2001. Commission duties included investigating the principles and objectives of a comprehensible pension system and proposing a new design that would be focused on sustainability, simplicity and a long-term perspective meeting the challenges of the aging population and a tendency for earlier withdrawal from the labour market. In its report (Nou 2004:1, 2004) the commission proposed a transition from the present PAYGO system with rather weak connection between the individual contributions and consequent pension benefits to more actuarially adjusted system secured from the future increase in life expectancy. Main propositions in the Pension Commission report included strengthening the relation between the pension benefits and the contributions paid by a given person during working years, making the pension system less strict with respect to the time of retirement, adjusting the pension benefits to the life expectancy of a cohort of particular pensioner, and establishing compulsory occupational pensions for all workers. Suggestions from the Pension Commission were followed up and to some extent enriched in a series of papers exchanged between the parliament and the Government, and as the discussion continues today, many of the Norwegian pension reform elements are more or less established.

In 2007 Statistics Norway issued for the public a special report (Stensnes, Texmon et al., 2007) displaying the analysis of different elements of the reform which were under consideration and testing. In evaluation of the effects of the reform the report focuses on several dimensions, namely labour market response, state finances, implications for income inequality and social welfare. These issues were specifically addressed in the parliaments requests and the report demonstrates how they are met describing a classical trade-off between equality and efficiency. The analysis is performed within the dynamic microeconomic simulation model (Fredriksen, 1995, 1998) which has been developed by Statistics Norway over the decades specifically for calculating long term projections of population, labour force, education and social security spending. The forecasts produced by this model originate in the simulation of a series of social-economic events for each individual in a given sample population using certain transition probability distributions. Simulated individual event histories may then be used for cross-sectional aggregation and calculation of higher order macroeconomic indicators.

The current paper contributes to the described analysis by presenting a methodologically different approach which yields broader view on the effects of the pension reform. The transition probabilities crucial in the microsimulation approach (because they reflect both the restrictions on the choice sets of the simulated individuals and the choices they make) which have to be calibrated on endogenous historical data, are eliminated. Instead, the structural dynamic programming model imposes a theoretical structure on the decision making process and allows for the factors affecting the choice to be separated from the choice itself. In other words, the choice is modelled within the random utility framework whereas the choice restrictions are addressed explicitly allowing for controlling of individual heterogeneity with respect to choice sets. Transition probabilities are only left responsible for the dynamics of the random events that the decision makers has no control over. Thus, compared to the microeconomic simulation model, the structural dynamic programming approach allows for explicit modelling of the sequences of choices the individuals make throughout their working lives in response to the evolving economic environment affected among other things by the pension reform. Historical data used in the estimation establishes deep structural parameters referring to the individual preferences over income and leisure, and thus (unlike in the microsimulations) granting the freedom for full scale behavioural response to the policy change from the decision makers.

The structural dynamic model applied in the paper is fully described in (Iskhakov, 2008a) along with empirical specifications and estimation. Section 3 therefore contains only a brief description of the model focusing mainly on the implementation of the proposed pension reform. The rest of the paper is organized as follows. Section 2 describes the pension reform proposals in comparison with the existing system. Section 4 presents the results of the pension reform implementations. Section 5 concludes.

2.1. Pension reform chronicle

As mentioned in the introduction, the first step in reforming the Norwegian pension system was taken by the Stoltenberg Government on March 30th, 2001 when the Pension Commission was appointed. In its final report (Nou 2004:1, 2004) the commission analyzed the severity of the threat for the financial and social stability of the social security system and made propositions about specific steps that would have to be taken. Besides the guarantee that the new pension would at least exceed the present level[b], gradual introduction and annual indexation of the new pensions, these steps included:

- including all working years into the calculation of pension,
- directly relating the pension benefit to the wage earnings,
- allowing the unpaid child care as well as care for elderly and disabled to contribute to the future pension,
- introducing a flexible retirement age with actuarial adjustment giving relatively lower benefit for early retirees and relatively larger benefit for delayed retirees,
- introducing longevity adjustment for the pension benefits so that persons with longer expected life span retiring at the same age receive reduced pension,
- establishing supplementary occupational pension schemes as addition for the public old age pension,
- creating a new Government Pension Fund on the bases of the Government Petroleum Fund and the National Insurance Fund.

On the basis of the Pension Commission report the Government issued a White Paper (St.Meld. Nr. 12, 2004) which agreed with the main principles of a modernized National Insurance Scheme as proposed by the commission. The paper discusses the proposed measures in a little greater detail but does not specify any threshold or amounts to be used in calculation of the new pension. Instead, the Government intends to return to the Storting with specific proposal for calculating rules once it votes on the main principles of the reform.

On the 26th of May, 2005 the Norwegian Parliament made a decision No. 354 voting for the financial committee report (Innst. S. Nr. 195, 2005) which thus became an official reply to (St.Meld. Nr. 12, 2004). In this report the financial committee which consisted of the members of the ruling parties suggested certain amounts and specific thresholds to be used in

[b] Given the increase of the normal full working life length from 40 to 43 years.

pension accrual rules (to be described later) and the principles of the pension reform were settled (Quote from the English version of (St.Meld. Nr. 5, 2007).

> "The old age pension of the National Insurance Scheme shall be based on the principle that work shall be rewarded. Therefore, there must be a correlation between the work effort throughout life and the pension benefit, and all occupationally active years must count when calculating the pension. The National Insurance Scheme's old age pension must have a good social profile and contribute to even out differences in income levels.
>
> The contracting Parties agree that the design of a new old age pension in the National Insurance Scheme shall be founded on the following:
>
> - Persons with little or no income shall still be safeguarded with a pension at the same level as the current minimum pension.
> - Persons with low incomes shall get more in return for their pension earning than in the current system, so that there will be fewer minimum pensioners. This implies that those who have had a stable income between 2 and 4 times the Basic amount (B.a.) for 40 years will get a higher pension than with the current National Insurance Scheme.
> - Those who after 40 occupationally active years have had income slightly lower than the average for full time employees, must not get a lower old age pension than with the current system. This means that persons who have had a steady income between 4 and 5 B.a. for 40 years will not get a lower pension than they would have in the current National Insurance Scheme. After 43 occupationally active years these income groups will get a higher pension than with the current scheme.
> - Unpaid care shall result in pension earning. Unpaid care earning shall be designed in such a way that everyone meeting the requirements for care earning will get a minimum pension earning of 4.5 B.a. Pension earning above the minimum level shall be designed so as to reward work effort. Unpaid care earning shall not give overt incentives for an uneven distribution of unpaid care between women and men.
> - The Government continues to work on concrete proposals about retroactive effect for pension earning for unpaid care in the current National Insurance Scheme as well.
> - Conscripts are given pension earning.
> - The Government will be considering pension earning for students in light of choice of model and will return with proposals.
> - The National Insurance Scheme's benefits during illness and unemployment, including involuntary part-time workers who receive unemployment benefits, shall result in pension earning in line with work income."

On October 20th, 2006 the Government issues a new White Paper (St.Meld. Nr. 5, 2007) built on the Storting request and providing yet more details on the pension accrual and drawing rules, provision of pension earnings in case of unpaid care, for conscripts, for unemployed, actuarial and early/postponed retirement adjustment, introduction schedule. The paper summarized:

> "The best guarantee for the pensions of the future is that the overall pension system is economically and socially sustainable. In addition, the Government is of the opinion that the pension system shall have a good income redistribution profile, a good gender profile, and be easy to understand."

The details provided by (St.Meld. Nr. 5, 2007) were essentially finalized with an agreement (Folrik, 2007) signed on March 21st, 2007 by the representatives of the six major parties in Norway. With minor changes the parties agreed to the design of the pension reform elements presented by the government. The agreement itself was substantiated by the April 23rd, 2007 Storting decision on (Innst. S. Nr. 168, 2007) which put the Government proposition into force.

The next sections thoroughly discuss the key elements of the Norwegian pension reform. As the reform proposals are many times formulated in terms of changes, I first describe in necessary detail the current pension system in Norway.

2.2. Existing pension system

Public pension in Norway has taken its modern form in 1967 when the earning based system replaces the old flat rate pension. All permanent residents are covered with the scheme with the general retirement age at 70. The pension can also be taken out at 67 without any reduction but conditional on the earnings test which is in effect between 67 and 70. Therefore most of the workers retire at 67 and only a small fraction of the labour force goes on working beyond 67 in order to earn additional pension rights while the number of individuals working after 70 is neglectable[c].

[c] For quantitative analysis and details see Hernæs and Jia (2007).

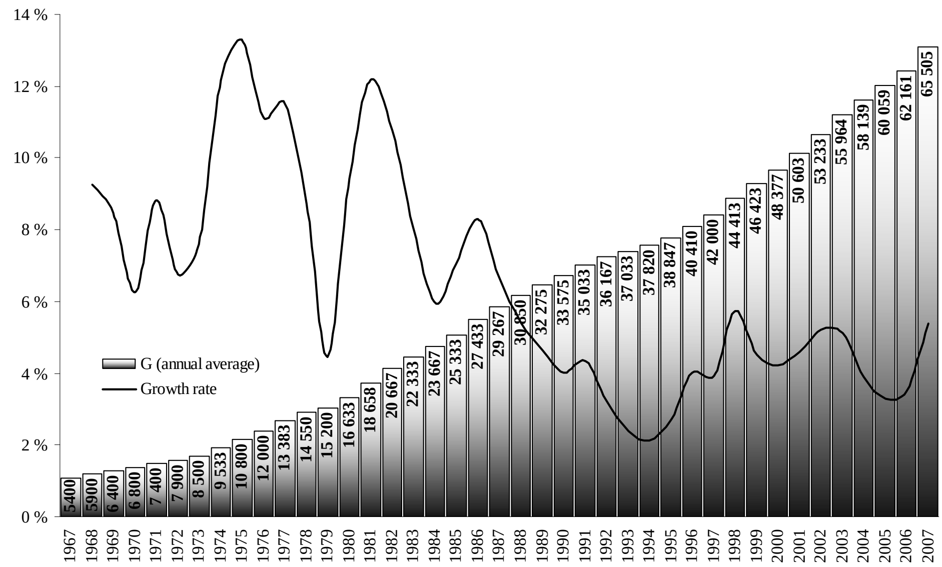

Figure 1. Nominal Basic amount in the Pension system (NOK) and annual growth rate (%).

The pension benefit consists of three components. The first one is the basic pension (*BP*) which is paid to all residents of Norway with at least 3 years of working life. The level of basic pension is adjusted every year (see Figure 1) and is referred to as Basic amount or *G*[d]. From the level of 36 167 in 1992 the basic pension has been rising in both nominal and real terms and reached 62 161 in 2006. It is paid in full to the individuals who have worked at least for 40 years, reduced by 25% for married persons (from 2006 by 15% for those whose spouse is receiving minimum pension), and also reduced proportionally for the individuals with shorter working history.

The second component is an earnings based pension or supplementary pension (*SP*) which level is calculated on the basis of the sequence of so called pension points (pp_t) reflecting the pension accrual history. The way pension points are related to the annual earnings and the method for calculating pension benefits based on the pension points is described shortly.

The third component is a special supplement (*SS*) granting the minimum level of pension. Similar to the Basic amount the supplement is also adjusted on the annual bases and in 2006 is fixed at the level of 0.7933*G*[e] for the individuals with full working history. The special supplement enters the pension equation under the maximum operator affecting the total level

[d] Stands for Grunnbeløpet i Folketrygden (Basic amount, Norwegian).
[e] Detailed tables can be found in Haugen (2000).

of the pension benefit (PB) only for the low values (in other words, the special supplement is fully tested against the supplementary pension):

$$PB = BP + \max(SS, SP)\,. \qquad (1)$$

Thus, the minimum pension benefit for a single individual in 2006 is 1.7933G. Higher levels of pension are calculated from the lifetime annual pension effective earnings (which are roughly equal to the wage earnings) in a rather complicated way through pension points.

The rules for calculating pension points from annual earnings has changed twice since introduction in 1967. Let w_t denote annual pension generating income measured in G and pp_t the corresponding pension point. Then for the period from 1967 to 1970 formula (2) was used.

$$pp_t = \begin{cases} 0, w_t \le 1; \\ w_t - 1, 1 < w_t \le 8; \\ 7, w_t > 8. \end{cases} \qquad (2)$$

In 1970 the upper censoring was altered introducing formula (3):

$$pp_t = \begin{cases} 0, w_t \le 1; \\ w_t - 1, 1 < w_t \le 8; \\ \frac{13}{3} + \frac{w_t}{3}, 8 < w_t \le 12; \\ 8\frac{1}{3}, w_t > 12. \end{cases} \qquad (3)$$

Finally in 1992 the break point was reduced from 8 to 6G:

$$pp_t = \begin{cases} 0, w_t \le 1; \\ w_t - 1, 1 < w_t \le 6; \\ 3 + \frac{w_t}{3}, 6 < w_t \le 12; \\ 7, w_t > 12. \end{cases} \qquad (4)$$

Figure 2 illustrates the functions (2-4) mapping annual earnings into pension points. Here the solid line (*oABm*) corresponds to the period 1967 to 1970, short-dashed line (*oABCn*) to the period 1970 to 1992 and long-dashed line (*oADm*) to the period 1992 and onwards. Pension point calculation is thus “double censored” in all the periods: earnings under lower bound of 1G and above upper bound of 8 or 12G do not influence the value of corresponding pension point and thus as it will be shown lead to no additional pension entitlement.

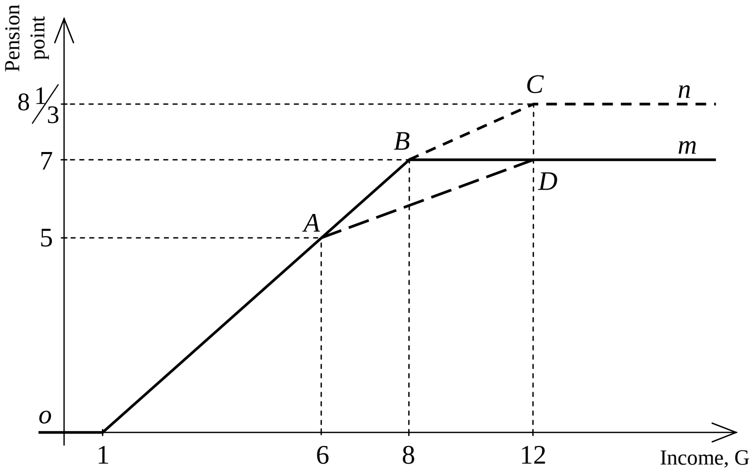

Figure 2. Pension point functions in different time intervals.

Let T denote the length of individual working history, or in other words the number of years with annual earnings exceeding zero ($w_t > 0$). Similarly to the basic pension (the first component in (1)), the supplementary pension is reduced proportionally if T is less than 40. Otherwise it is calculated as a fixed fraction *SPr* of the accumulated pension rights calculated as a final pension point *fpp* which is a function of the entire pension point history.

$$SP = \frac{\min(T,40)}{40} \cdot SPr \cdot fpp\left(pp_1, pp_2, .., pp_T\right) \cdot G \ . \tag{5}$$

The value of *SPr* was lowered from 0.45 to 0.42 in 1991, and thus pension rights accumulated before 1991 and after 1991 have different marginal effect on the supplementary pension. Since accumulated pensions rights (*fpp*) are separable from *SPr,* simple weighted average of different rates denoted SPr_t is sufficient to account for the change:

$$\begin{aligned} SP &= \frac{\min(T,40)}{40} \cdot \sum_{t=1}^{\min(T,40)} \frac{SPr_t}{\min(T,40)} \cdot fpp\left(pp_1, pp_2, .., pp_T\right) \cdot G = \\ &= fpp\left(pp_1, pp_2, .., pp_T\right) \cdot G \cdot \sum_{t=1}^{\min(T,40)} \frac{SPr_t}{40} \ . \end{aligned} \tag{6}$$

Final pension point is calculated as the average of the highest 20 values of pension points throughout life – thus, only the best working years contribute to the pension level. Denote T^{best20} the set of indexes corresponding to the best 20 years[f]. Then *fpp* is calculated according to

[f] If working life is shorter than 20 years (T<20) the set T^{best20} contains all the indexes ($T^{best20}=\{1,...,T\}$).

$$fpp = \frac{1}{\min(T,20)} \sum_{t \in T^{best20}} pp_t \, . \tag{7}$$

Combining formulas (1-7) together the following final expression for the pension benefit is derived (for single individuals according to the 2006 settings)[g]:

$$PB = G + \max\left(0.7933 \cdot G, \left[\frac{1}{\min(T,20)} \sum_{t \in T^{best20}} pp_t(I_t)\right] \cdot \left[\sum_{t=1}^{\min(T,40)} \frac{SPr_t}{40}\right] \cdot G\right), \tag{8}$$

or, if pension benefits are measured in G,

$$PB_G = 1 + \max\left(0.7933, \left[\frac{1}{\min(T,20)} \sum_{t \in T^{best20}} pp_t(I_t)\right] \cdot \left[\sum_{t=1}^{\min(T,40)} \frac{SPr_t}{40}\right]\right)^{\text{h}}, \tag{9}$$

It is obvious that the accrual formula (9) does not meet the specifications for the new pension system listed in the previous section. In particular, the pension benefit does not depend on wage earnings from all the working years, the connection between the pension benefit and the wages is far from being direct, there are no actuarial features in the system, moreover possibility for introduction of the actuarial mechanisms is very limited by the system design itself. These considerations justify the necessity not only to adjust the system for the new demographic challenges, but to redesign its basic elements. Therefore the discussion of the reform proposals starts from the accrual rules and formula (9). This discussion will be carried on in the next section.

In addition to the ordinary old age pension with usual retirement age of 67, an early retirement scheme (AFP[i]) was introduced in 1989 as a result of negotiations between large trade unions and major employers' organization. The government took part in the negotiations as the third party providing the funds necessary to grant the covered workers an opportunity to retire early with no loss in their pension benefits.

The scheme covers the whole public sector and part of the private sector. In order to be eligible an individual must be employed in a participating company and meet certain individual requirements which include:

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[g] Expression (8) also does not take into account minor particularities regarding "phasing in" corrections, additional tax exempt pension amounts which are industry specific, additional special regulations for the public sector employees.

[h] Subscript G for the variables will denote measurement in Basic Amounts throughout the paper.

[i] Norwegian notation for Avtalefestet Pensjonsordning.

- Having been employed in the AFP-company for the last 3 years or having been covered by the AFP scheme for the last 5 years.
- Having earnings of no less than 1G the year AFP is taken up and the year before.
- Not receiving subsidies, social benefits such as disability pension or other payments from the employer without work effort in return.
- Having at least 10 years after the age of 50 with earnings no less than 1G.
- Having the average earnings in 10 best years since 1967 of no less than 2G.

The age of early retirement has been gradually lowered from 66 when it was initially introduced on January 1st, 1989 to 65 from January 1st, 1990, 64 on October 1st, 1993, 63 on October 1st, 1997 and finally to 62 on March 1st, 1998. With the eligibility age going down and more and more companies participating in the scheme, the AFP coverage has grown constantly covering now over 70% of the labour force (Midtsundstad, 2004).

The pension level calculations under AFP scheme are aimed to provide the same pension benefit as if a person continues until the ordinary retirement age instead of retiring early. This implies that the unrealized pension points in the years between the AFP eligibility age and 67 should be substituted with predicted values calculated according to some given algorithm. The one agreed on uses the maximum between the average of the last three earned points and the average of ten highest points from whole working history. Once the 'missing' pension points are predicted, the AFP pension is calculated with usual technique for old age pension as described above.

In formal terms, if an individual takes out AFP at age $67-\tau$, his working history $\{pp_1,..,pp_T\}$ is extended by τ years in which the pension points are calculated as

$$pp_t = \max\left(\sum_{t\in T^{best3}} \frac{pp_t}{3}, \sum_{t\in T^{best10}} \frac{pp_t}{10}\right), t \in \{T+1,..,T+\tau\}, \tag{10}$$

where T^{best3} and T^{best10} denote the sets of indexes corresponding to the years with respectively 3 and 10 highest wage earnings. Minimum operators in (10) as in (7) are not necessary because the AFP eligibility rules ensure the working life of at least 10 years. Once the additional pension points are calculated, formula (9) is used with $T' = T + \tau$ instead of T.

Thus, the AFP pension is exactly the regular public pension under the assumption that workers earn the last pension points according to the described forecasting procedure. It therefore introduces substantial distortion to the pension system subsidizing the AFP-eligible workers and significantly reducing their incentives to remain in the labour force until the ordinary retirement age. With the AFP early retirement scheme the pension system deviates even more from the goals stated in the Pension Commission report.

Besides the described old age pension with the early retirement settlement the Norwegian welfare state provides a variety of social security payments relevant for different life situations. These include benefits to surviving spouse, child allowance, rehabilitation allowance, benefits during vocational rehabilitation, sick leave benefits, cash benefits for maternity and adoption, advance payment of child maintenance, family allowances, cash benefits for families with small children, unemployment benefits, benefits in the case of occupational injury, benefits to single parents, funeral grant. The most important of all is disability pension as it presents the second largest exit route for the Norwegian old age workers. There are reasons to believe its role may become even bigger when old age pension is reformed (Røed and Haugen, 2003; Bratberg, Holmas et al., 2004). Calculation of most of the social security payments is based on the Basic amount *G*, and in many cases is aimed at compensating both the unrealized income and accumulating pension rights. In particular, the disability pension is calculated very similar to the AFP pension when the potential wage income is forecasted up to 67 and the pension benefit is calculated as the usual pension on the bases of the forecast[j].

Finally, occupational pension schemes play an increasingly important role in provision income for the elderly. Occupational pension schemes were in practice established in 1922 when the tax code granted the employers an opportunity to deduct the payments to the pre-funded occupational pensions from the tax base, but the introduction in 1967 of the earnings based public pensions forced occupational pensions to play a minor role. However, the schemes continued to be used as a pathway to favourable tax regime, and their importance had been gradually increasing in the last decades (Pedersen, 2000).

The tax treatment of private occupational pension plans is the following. Contributions both by employer and employee and returns on the accumulated funds are tax-deductible, while the benefits from the scheme are subject to income tax[k] when paid out to the pensioner. In order

[j] See Bratberg (1999) for details.
[k] Income tax on pensions is generally lower and differentiates between single and married individuals and among different types of pension – for details see Haugen (2000).

to qualify for this favourable tax regime private company plans must obey certain rules which include:

- An occupational pension plan must be insured with a life insurance company or established as a separate pension fund.
- If a pension plan is offered, all standard, full-time employees of the company must be included. However, a vesting period of one year is allowed (five years for the workers below 25) and part-time workers with less than 50 percent of full time, temporary and seasonal workers can be excluded.
- Even though there are only soft limits on the replacement ratios, the principle of proportionality must be satisfied. This principle states that private pensions can compensate for the fairly redistributive profile of the old age public pension, but only up to the point where they aim at perfectly proportional total replacement ratios. The total gross replacement ratios can not be higher for employees with higher earning levels than for the employees with lower earning levels.
- Old age private pensions generally cannot start before age 67 and a full accrual period is usually 30 years of work.

Although these rules have to be complied with in order to obtain tax deductions, any company is of course free to operate any other pension arrangements without a tax break. In a company survey , about one quarter of the private sector companies answered that they give occupation pension provisions, but there is no information available on the type or amounts of benefit (Pedersen, 2000). Slightly more information is available about the occupational pension settlements provided for the public sector employees. These are generally aimed at a fixed replacement ratio of 66% filling the gap between the level of old age and AFP pension and the desired level of the pension benefit.

This concludes the description of the existing social security system in Norway which is the subject of the reform proposals described in detail in the next section.

2.3. Pension reform proposals

The Pension Commission reform proposals listed in (Nou 2004:1, 2004) are structured with the principles formulated by the Storting in (Innst. S. Nr. 195, 2005) in two main dimensions. The core reform measures have to provide social and financial stability for the new pension system. This is achieved by making the system more actuarially fair and removing economic incentives to retire at earlier ages, freeing the retirement decision from incentive distortions.

Pension Commission is focused on this core dimension of the pension reform. Secondary reform measures are aimed at making the new pension system reasonably just and redistributive. This dimension primarily consists of considerations about pension accrual for certain activities and social groups (unpaid care work, unemployment, conscripts, students) and the choice of accrual mechanism itself. Apparently, these secondary considerations counteract the effect of the core measures.

There is, however, a third set of the reform proposals which appears non-controversial and can be considered as rather technical. Namely, inclusion of all working years into the calculation of pension and direct link between the pension benefit and the wage earnings are necessary because they provide grounds for actuarial adjustment and incentives free properties of the new pension system. Yet, they are lacking in formula (9). A hypothetical formula with supplementary pension calculation solely built on these two properties would have to simply employ a sum of fractions of annual wages or, under the assumption of time invariant pension accrual rate, fraction of the average wage multiplied by the length of the working history:

$$PB^{(hyp)} = BP + \max\left(SS, \sum_{t=1}^{T} SPr_t \cdot w_t\right) \overset{SPr_t = SPr\ \forall t}{=} BP + \max\left(SS, T \cdot SPr \cdot \bar{w}\right) \tag{11}$$

Instead, existing formula (9) for pension benefits deviates quite a lot from formula (11) introducing several unwanted distortions. These distortions can be revealed in a step by step procedure of simplifying the existing pension accrual formula (as of 2006 with *SPr*=0.42) to the form of (11).

The first distortion is caused by the limited at 40 years accrual time and affects both *fpp* calculation and overall accrual. Relaxing this limitation gives

$$\begin{aligned} PB'_G &= 1 + \max\left(0.7933, \left[\frac{1}{20}\sum_{t \in T^{best\,20}} pp(w_t)\right] \cdot \left[\sum_{t=1}^{T} \frac{SPr}{40}\right]\right) = \\ &\quad 1 + \max\left(0.7933, \left[\frac{1}{20}\sum_{t \in T^{best\,20}} pp(w_t)\right] \cdot T \cdot \frac{SPr}{40}\right). \end{aligned} \tag{12}$$

It is unclear how time limit distortion affects the level of pension benefits while it clearly limits the incentives to continue to work after the full working history of 40 years. In other words, this distortion introduces strong disincentives to remain on the labour market and has to be removed for the pension system to be able to acquire actuarial adjustment or incentive neutral properties.

The second distortion is due to the concavity of the pension point function displayed in Figure 2. If we are to directly relate the pension benefit to the wage, which is equivalent to relating it to the sum of fractions of the annual wages and thus to the average wage, *fpp* calculation in (12) must be reversed.

$$PB''_G = 1 + \max\left(0.7933, pp\left[\frac{1}{20}\sum_{t\in T^{best20}} w_t\right]\cdot T\cdot\frac{SPr}{40}\right) \qquad (13)$$

Due to concavity of *pp* function, this simplification implies increase of PB''_G thus reflecting its relatively lower value in the existing system compared to the benchmark formula (11). In other words, the existing system favours stable wage sequences reducing the pension benefit for the individuals with varying annual wages. This distortion blurs the effect of the actuarial adjustment providing misleading motivation for the old age workers who wish to optimize their pension benefits.

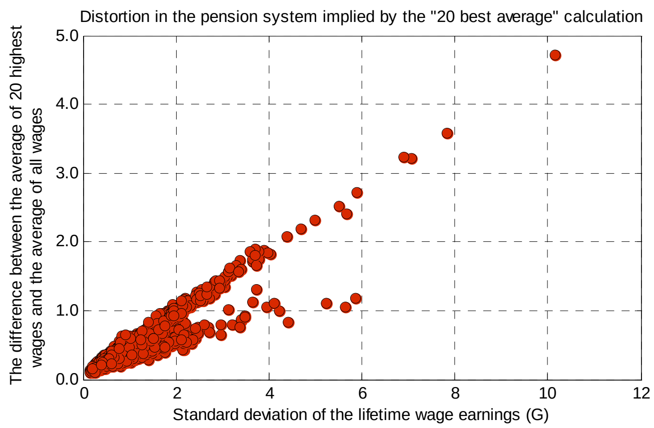

Figure 3. Pension accrual distortion from averaging the 20 highest annual wages.

Finally, the distortion implied by substituting the average wage earnings by the average of highest 20 wage earnings is illustrated in Figure 3. A set of one thousand simulated lifetime annual wage flows[1] is used here to investigate how volatile wage histories are different from stable ones in terms of the difference with respect to average calculation. The graph clearly shows that the more fluctuations the income flow has (the higher is its overall standard deviation measured on the x-axis), the higher is the difference between the best 20 average and overall average (measured on the y-axis). Thus, the distortion of the best average implies

[1] The first five values in each simulated wage flow were independently drawn from a log-normal distribution with positive median while the rest followed a linear growth path with a uniform random annual rate between 0,01 and 0,10 filling the full yearnings history of 40 years.

higher pension benefits for the unstable income flows (which is opposite to the previous distortion making the overall effect unclear). Corrected for best average distortion pension accrual formula becomes

$$PB_G''' = 1 + \max\left(0.7933, 0.025 \cdot pp(\overline{w}) \cdot T \cdot SPr\right), \tag{14}$$

which is now similar to the benchmark formula (11) in all respects except additional multiplication in the second term under the maximum operation and the pension point function applied to the average earnings. The former is neglectable because it can be incorporated into the accrual rate: redefine $SPr = 0.42 \cdot 0.025 = 1.05\%$. The latter is essentially the subject of negotiations about the relative importance of the core measures of the pension reform proposed by the Pension Commission and the secondary justice considerations defended by the Storting.

If the new pension system is to be designed as fully distortion free (in line with (11)), the pension point function would have to be a unitary transformation $pp(x) = x$. The pension point function truncated from both above and below (as illustrated in Figure 2) ensures redistributive properties of the system by making too high and too low earnings not to affect pension benefits and thus compressing the income distribution, while in addition uniformly concave form of the middle section skews the resulting distribution upwards. The trade-off between distortion free and redistributive designs is totally determined by the specification of the pension point function, and thus by political process. Different specifications which were under consideration during the discussion between Government and Storting are described below.

Before discussing different specifications of the accrual formulas, a common framework describing the models should be established in the following way. Bearing in mind that the three distortions implied by the current system are assumed away, it can be represented by (14) or if the 2006 pension point calculation rules (4) are also included, by

$$PB_G''' = \begin{cases} 1.7933, \; \overline{w} \le 1, \\ 1 + \max\left(0.7933, 0.0105 \cdot (\overline{w} - 1) \cdot T\right), 1 < \overline{w} \le 6, \\ 1 + \max\left(0.7933, 0.0105 \cdot (3 + \dfrac{\overline{w}}{3}) \cdot T\right), 6 < \overline{w} \le 12, \\ 1 + \max\left(0.7933, 0.0105 \cdot 7 \cdot T\right), \; \overline{w} > 12. \end{cases} \tag{15}$$

Assuming the full working history of 40 years the pension benefits can be represented by a convenient graph as a function of average wage earnings, see Figure 4 (which also include the case of married individuals whose minimum pension becomes somewhat lower according to the rules described in the previous section).

If T is high enough, so that all the maximums are attained on the second operands, the corresponding average accrual rates (for single) are

$$\frac{1}{T}\cdot\frac{\partial PB_G'''}{\partial \overline{w}}=\frac{\partial PB_G'''}{\partial w_t}=\begin{cases}0,\ \overline{w}\le 1,\\ 1.05\%,\ 1<\overline{w}\le 6,\\ 0.35\%,\ 6<\overline{w}\le 12,\\ 0,\ \overline{w}>12.\end{cases} \tag{16}$$

Although the use of average annual income in the pension formulas allows for intuitive representation of the accrual rules, they require care in interpretation. Here the accrual rates represent marginal effect of changes of wage earnings in *all* the years – per year, and can also be interpreted as marginal effect on the pension benefit of changes in wage earnings in *any single* year.

In real life, however, accrual rates (16) appear only as a limit case when T approaches infinity. Some considerable amount of algebra dealing with all possible combinations of $\overline{w}$ and T essential in (15) leads to a precise but cumbersome formula for marginal effects which is best presented graphically. Figure 9 A (p. 25) plots the areas where accrual rate takes particular values on the $\overline{w}$-T plane[m]. As seen from the plot, contrary to the asymptotic case (16) the accrual rate 1.05% is only in effect on a limited area lying between $\overline{w}\approx 3$ and $\overline{w}=6$ with the lower bound significantly higher for the small number of years worked. All the white area on the map corresponds to the pairs $(\overline{w},T)$ for which the increase in the individual labour supply has no effect on the level of the pension benefits. The pension accrual area is limited by the upper wage limit from above, by full working history constraint from the right and by the minimum pension level from the left and below. In order to depart from the minimum pension level both sufficient number of working years and sufficient average wage are essential, therefore the third border of the accrual domain represents the interplay between these two components and can be viewed as accrual frontier induced by the pension calculation rules. In the present system, as it follows from the plot, the accrual frontier departs quite a lot from the origin forming rather vast area where pension benefits are not related to the wage earnings.

[m] Time limit of 40 years is reintroduced in the graph for comparability to other pension rules.

Figure 4. Current pension system (single and married individuals).

The initial proposal of the Pension Commission (see Figure 5) suggested complete elimination of the basic pension component ($BP = 0$) with the supplementary pension accumulation starting from the first earned krone. Moreover, the accrual rate is kept constant all the way up to the upper wage limit (which is significantly lower than in the present system) virtually making the pension point function a piecewise linear. This makes the link between pension benefit and wage very direct and eliminates all three described incentive distortions opening all the possibilities for fine actuarial adjustment of the system.

The minimum level of pension is guaranteed by the special supplement which similarly to the present setup enters the pension formula under the maximum operation. This component does of course compromise the extent of directness between wage and pension, but only a limited number of persons from the left tail of the income distribution are affected. In addition, the Pension Commission proposes a limited reduction of the special supplement by only 60% of wage earnings in excess of $1G$. As follows from Figure 5 this introduces a kink in the special supplement and gives small increase in pension benefit for the wages around $3G$ thus providing motivation to work and limiting the number of unmotivated low wage earners even more. As a side effect, this measure also reverses the concavity distortion – since the overall shape of the accrual function becomes convex (up to the higher wage restriction), the income flows with large variation result in a slightly higher pension compared to the stable flows. Again, low wage earners are offered a premium for improving their labour situation.

Formally, the Pension Commission proposal can be written as

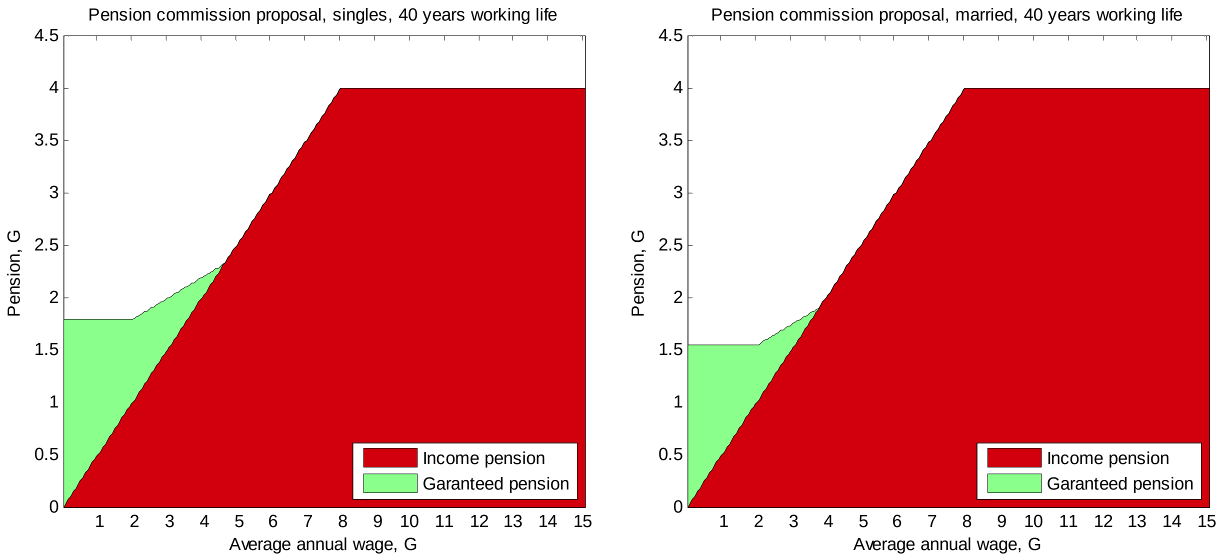

Figure 5. Pension Commission proposal for pension accrual (single and married individuals).

$$PB_G^{(PC)} = \max(SS_G^{(PC)}, SP_G^{(PC)}),$$
$$SP_G^{(PC)} = \begin{cases} 0.0125 \cdot \overline{w} \cdot T, \overline{w} \leq 8, \\ 0, \overline{w} > 8, \end{cases} , \tag{17}$$
$$SS_G^{(PC)} = \begin{cases} \max(0, 1.7933 - SP_G^{(PC)}), SP_G^{(PC)} \leq 1, \\ \max(0, 1.7933 - 0.6SP_G^{(PC)}), SP_G^{(PC)} > 1. \end{cases}$$

Expressing the pension benefit as a function of $\overline{w}$ and T gives rather bulky formula omitted here. The essence of the Pension Commission proposal is seen in the asymptotic average accrual rate:

$$\frac{1}{T} \cdot \frac{\partial PB_G^{(PC)}}{\partial \overline{w}} = \frac{\partial PB_G^{(PC)}}{\partial w_t} \underset{T \to \infty}{\longrightarrow} \begin{cases} 1.25\%, \overline{w} \leq 8, \\ 0, \overline{w} > 8. \end{cases} \tag{18}$$

Thus, in the limit case when the special supplement disappears the pension benefit accumulates with a constant rate up to an upper wage limit.

When the length of the working history is arbitrary, different combinations of $\overline{w}$ and T produce the accrual map shown in Figure 9 B (p. 25). Two most vivid differences from the current system (displayed in Figure 9 A) are much lower upper wage limit (8G instead of 12G) and unlimited number of accrual years. As mentioned above, the latter is necessary for actuarial adjustment, whereas the former can be considered as related measure controlling the maximum pension benefit one can accumulate under this rules. Yet, more important difference is the shift of accrual frontier closer to the origin. This reflects the fact that the Pension Commission proposal provides better incentives for the low paid workers to increase

Figure 6. Storting model B for pension accrual (single and married individuals).

their supply of labour. After 40 years of work the pension benefits are effected by the wages above only 2*G* corresponding to around 3*G* in the current system. The Pension Commission proposal also ensures that as the number of working years grows, all workers irrespectively of wage level uniformly enter the low accrual zone, and then most of them transfer to the high accrual zone. The absence of kinks in the accrual frontier makes the dynamics of the system smother and the link between the wage and the pension stronger compared to the current system.

The initial Pension Commission proposal was opposed by several accrual models suggested by the Storting, two of which are examined below. Expectedly, they put the emphasis at the redistributive properties of the system modifying the existing formula in a less radical way.

The first model referred to as Model B is presented in Figure 6. Most visible change from the current rules is the elimination of the basic pension component which is substituted by the supplementary pension accruing for all levels of wages. Time constraint on the accrual and best average calculation of the final pension point are also removed. Thus, the necessary technical measures are included. But in the same time pension point function retains the concave form and keeps two kinks as before (although they are placed at different points). As described above, this blurs the effects of any actuarial adjustments but improves the income distribution of the pensioners. Redistribution properties of the setup are enforced by the traditional upper wage limit and the guaranteed pension provided by the special supplement which level is such that the minimum pension is unchanged compared to the present pension rules. In formal terms model B suggests the following pension formula (for singles):

$$PB_G^{(mB)} = \begin{cases} \max(1.7933, 0.023 \cdot \overline{w} \cdot T), \overline{w} \le 2, \\ \max(1.7933, 0.023 \cdot 2 \cdot T + 0.007 \cdot (\overline{w} - 2) \cdot T), 2 < \overline{w} \le 8, \\ \max(1.7933, 0.023 \cdot 2 \cdot T + 0.007 \cdot 6 \cdot T), \overline{w} > 8. \end{cases} \tag{19}$$

Marginal effects for sufficiently large T are the actual parameters defining the model in (St.Meld. Nr. 12, 2004).

$$\frac{1}{T} \cdot \frac{\partial PB_G^{(mB)}}{\partial \overline{w}} = \frac{\partial PB_G^{(mB)}}{\partial w_t} = \begin{cases} 2.30\%, \overline{w} \le 2, \\ 0.70\%, 2 < \overline{w} \le 8, \\ 0, \overline{w} > 8. \end{cases} \tag{20}$$

Again, accrual rates (20) are only valid in the asymptotic case, whereas careful consideration of all the cases induces by (19) leads to the marginal effect map shown in Figure 9 C (p. 25). Rather low rate of 0.70% moves the accrual frontier very much to the right making it possible to depart from the minimal pension after as much as 20 working years with the wages over 8G or after at least 38 years with the wages around 2G. In the same time the model succeeds in providing incentives for the low wage earners once they work long enough, especially when the high accrual rate is in effect after 40 years of work with average wage slightly lower than 2G. Thus, model B seems to be aimed at lower tail in the wage distribution providing these workers with incentives to stay on the labour market in order to increase their pension benefit. The big disadvantage of the model comes from the fact that it misses out all the individuals with shorter working histories (rehabilitated, immigrants, etc.) who are left unmotivated to increase their labour force participation.

Similar to model B, the other model proposed by Storting and referred to as model D (see Figure 7) is derived from the existing pension rules by removing a component, but this time the one removed is a special supplement. The basic pension component remains, proving the minimum level of pension benefits to every pensioner. To ensure redistribution properties of the system the accrual starts at a certain positive level of wage, namely the minimum pension (as if accrual up to this level was $\frac{100\%}{T}$). Similar to the previous model, time constraint and the best average calculation are removed, and the upper wage limit is set to 8G. Contrary to the previous model, the pension point function does not contain any kinks, in other words, accrual is uniform with the rate of 0.85%. This makes a huge difference and places model D

Figure 7. Storting model D for pension accrual (single and married individuals).

next to the Pension Commission proposal as they both eliminate all three distortions embedded into the current system. Moreover, comparison of Figure 5 and Figure 7 suggests even closer link between wage and pension in model D. Indeed, put formally, model D is given by the expression

$$PB_G^{(mD)} = \begin{cases} 1.7933, \bar{w} \leq 1.7933, \\ 1.7933 + (\bar{w} - 1.7933) \cdot 0.0085 \cdot T, 1.7933 < \bar{w} \leq 8, \\ 1.7933 + (8 - 1.7933) \cdot T), \bar{w} > 8, \end{cases} \tag{21}$$

which lacks the maximum operator. This implies that when accrual actually takes place (when the wage falls into the given interval) every earned krone and thus every year worked contributes to the pension – the time dimension is taken out of the equation. Thus, in model D the average accrual rate is for any T fixed at

$$\frac{1}{T} \cdot \frac{\partial PB_G^{(mD)}}{\partial \bar{w}} = \frac{\partial PB_G^{(mD)}}{\partial w_t} = \begin{cases} 0, \bar{w} \leq 1.7933, \\ 0.85\%, 1.7933 < \bar{w} \leq 8, \\ 0, \bar{w} > 8. \end{cases} \tag{22}$$

Accrual rate map shown in Figure 9 D (p. 25) becomes trivial reflecting this property, but it is worth comparing this case to the other proposed pension rules. Since the white space on the maps corresponds to the pairs of T and $\bar{w}$ when pension is not dependent on wage, model D clearly provides a better correspondence between the two than all the models considered so far. The model performs especially good in encouraging the late labour market entrants, but the low wage earners are also provided with incentives to work at least as good as by the Pension Commission proposal and the model B up to about 45 working years.

The last and final accrual model (presented in Figure 8) is provided by the Government in (St.Meld. Nr. 5, 2007) and absorbs all the achievements of the described three proposals in respect to eliminating the incentive distortions and providing a strong link between wage and pension. The Government returns to the supplement pension plus a special supplement formula, and builds on the Pension Commission proposal in terms of the former. Again, the accumulation of pension rights starts from the first earned krone, but happens at a slightly higher rate of 1.35%. The upper wage limit important for redistributive properties and originally set in the proposal to 7*G* was later altered by the Storting in (Folrik, 2007) and fixed at 7.1*G*. The accrual time limit, best average calculation and the kinks in the pension point function are removed as in the Pension Commission proposal inheriting distortion free properties. The setting for the minimum pension is however different: the flat part in the pension benefit formula is completely eliminated by extending the rule of partial reduction (80% in this case) of special supplement to all the levels of earned wage. Thus, while all useful properties of the Pension Commission proposal are intact and the redistribution properties only slightly touched, the Governmental proposal provides motivation for even lowest wage earners to improve their labour market position. This is clearly seen from the formal analysis.

Formally, the Governmental proposal is given by

$$\begin{aligned} &PB_G^{(Gp)} = \max\left(1.7933 + 0.2 \cdot SP_G^{Gp}, SP_G^{Gp}\right), \forall \overline{w}, \\ &SP_G^{Gp} = \min(0.0135 \cdot \overline{w} \cdot T, 0.0135 \cdot 7.1 \cdot T). \end{aligned} \tag{23}$$

As in the Pension Commission proposal, asymptotic accrual rate (of 1.35%) can be considered fundamental in the model although it is never achieved. Actual rates are dependent on length of working history and when T is sufficiently high are given by

$$\frac{1}{T} \cdot \frac{\partial PB_G^{(Gp)}}{\partial \overline{w}} = \frac{\partial PB_G^{(Gp)}}{\partial w_t} = \begin{cases} 0.27\%, \overline{w} \le \min\left(\dfrac{1.7933}{0.2 \cdot 0.0035 \cdot T}, 7.1\right) \\ 1.35\%, \min\left(\dfrac{1.7933}{0.2 \cdot 0.0035 \cdot T}, 7.1\right) < \overline{w} \le 7.1, \\ 0, \overline{w} > 7.1, \end{cases} \tag{24}$$

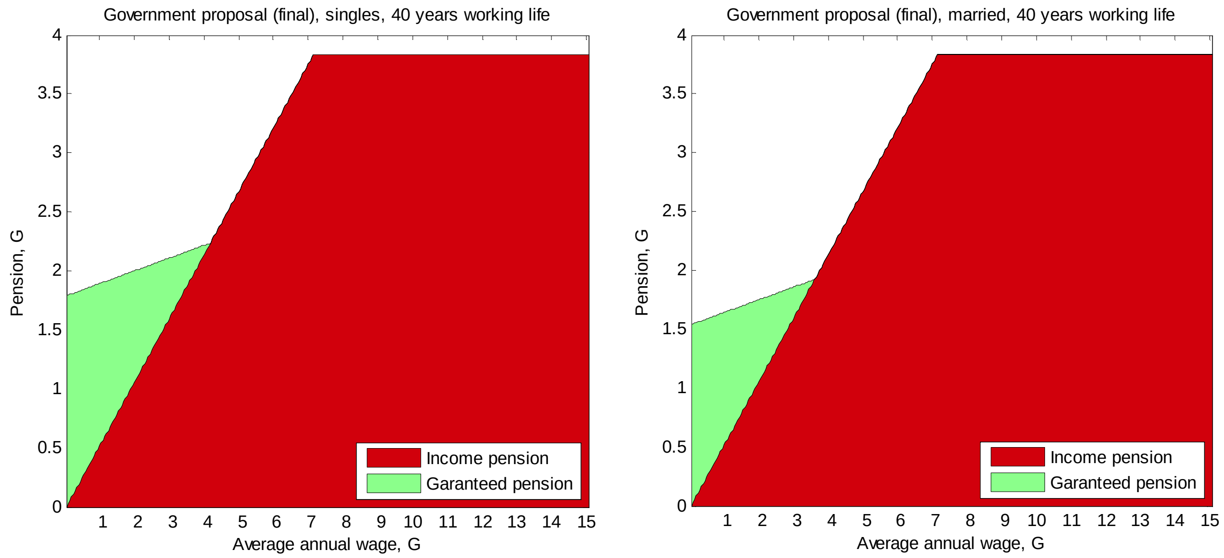

Figure 8. Governmental proposal for pension accrual (single and married individuals).

Figure 9 E (p. 25) provides a detailed map of accrual rates in the Governmental proposal, and shows that (24) is valid for after approximately 24 years of work. Since the pension function is strictly increasing in $\bar{w}$ up to $7.1G$ (as seen from Figure 8), the accrual rate is positive for all the values of T and $\bar{w} < 7.1$ leaving no blank space on the map in this region. Thus, the accrual frontier in the Governmental proposal collapses to the axis indicating that the model motivates both the late entrants on the labour market and lower earners equally well.

Thus, the Governmental proposal for pension accrual succeeds in all the important respects providing technical ground for actuarial adjustment and maintaining redistribution properties of the pension system, introducing strong connection between the wage earnings and resulting pension benefits and eliminating the unmotivated groups of low wage earners and late labour market entrants. At the present state of pension reform discussion which is given by (St.Meld. Nr. 5, 2007; Folrik, 2007; Innst. S. Nr. 168, 2007) the agreement is already achieved to appoint the final Governmental proposal as the pension accrual model of the new pension system.

After the appropriate accrual model is chosen and all necessary technical precautions taken, the central measures aimed at social and financial stability of the new pension system may be implemented. The general idea of making the system more actuarial fair and incentives free with respect to retirement timing was shared by all parties involved in the reform discussion from the very beginning. Therefore these measures were not proposed in several competing variants, instead they were shaped during the dialog between the Government and Storting, and the up to date description is found in (St.Meld. Nr. 5, 2007).

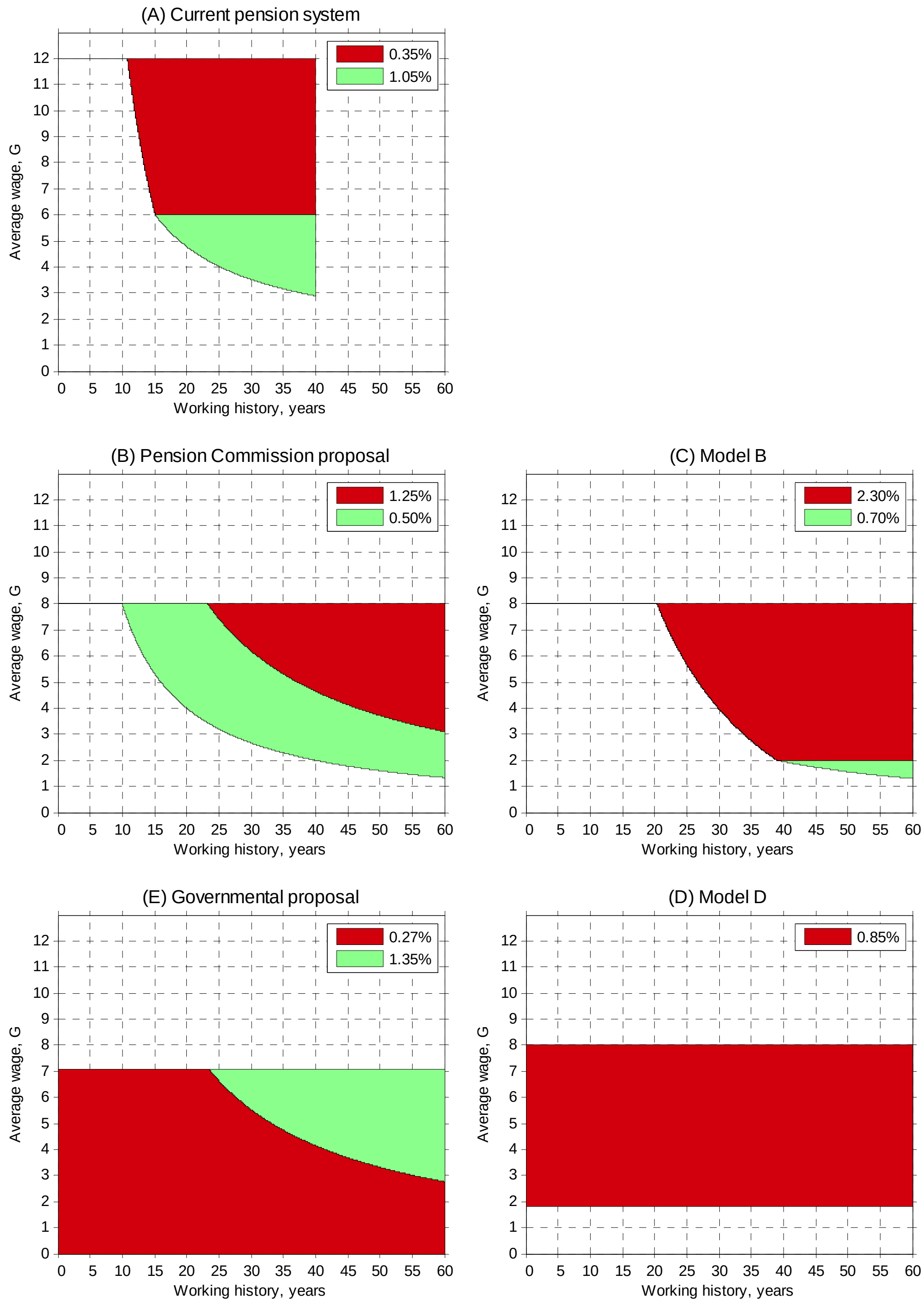

Figure 9. Average accrual rates in different pension rules.

The notion of actuarial fairness in the pension system (see, for example, (Lindbeck and Persson, 2002)) generally reduces to the equal expected net present values of the future pension income streams of different pensioners discounted with the capital market interest rates when the expectations are taken with respect to the corresponding survival probabilities. In other words, if two persons are assigned annuity pensions and the per-period amounts of the two annuities are adjusted in such a way that their net present values when discounted with both the interest rate and survival probabilities are the same, it can be concluded that the actuarial fairness is achieved with respect to these two individuals. The pension system is actuarially fair when the example holds for any two arbitrary chosen pensioners. Correspondingly, actuarial adjustment of a pension system is thought of as moving towards the actuarial fairness. Thus, the essence of actuarial adjustment is contained in a simple rule that pension benefits for the cohorts with longer expected length of life should be lower than for those with shorter life expectancy.

The Governmental proposal, however, extends the notion of actuarial adjustment by adding a second dimension to benefit variability. In particular, (St.Meld. Nr. 5, 2007) states that

> "…a new model for drawing old age pensions in the National Insurance Scheme shall give increased options for the individual compared to the current National Insurance Scheme, both as regards age of retirement and degree of retirement."
>
> "The Government's proposal for a flexible old age pension from the National Insurance Scheme means that:
>
> - It will be possible to draw a pension from the age of 62.
> - The flexible old age pension is designed in such a way that annual pension reflects the expected number of years as a pensioner.
> - It will be possible to draw a full or partial old age pension as long as the pension from age 67 exceeds the level of the minimum pension.
> - It will be possible to combine the drawing of an old age pension with work, without the pension being reduced."
>
> "The Government's proposal for a model for drawing old age pension in the National Insurance Scheme is designed with the aim that earned pension entitlements shall give approximately the same overall pension over the period as a pensioner, irrespective of when the individuals decide to start drawing their pensions."

Thus, on top of the actuarial adjustment, the Government implements a flexible retirement system in which individuals receive smaller pension benefits if they decide to draw their pension earlier and larger benefits if they postpone retirement. The system is declared to give good incentives for work, but everybody should be secured with real possibilities to downscale their work effort and begin to draw either full of partial pension. If pension is drawn earlier or later than 67, the reduction or respectively an increase is calculated within the same framework as the actuarial adjustment by equalizing the net present values of the pension income streams of two individuals retiring at different ages. Thus, assuming that time preferences coincide with the market interest rate (or, alternatively, in presence of a perfect capital market), the system is based on the "incentives-free" decision making, when it is ensured that the influence of the economic factors on the decision about the retirement time is balanced. No special economic stimuli are attached to any particular time of retirement.

There is also a third source for variance of the pension benefits – they are indexed in accordance to the wages and prices. The government fixes both the rate of growth for the pension entitlements up to the time of retirement (at the wage growth rates) and the rate of growth of nominal pension benefits (at the average between the wage and price rates). In their evaluation of the pension reform proposals (Stensnes, Texmon et al., 2007) include all three sources of variability into the construction of special devisor that alters the level of nominal pension benefit. If, however, the calculation of both wages and pensions is performed in terms of the Basic amount G which is itself indexed on annual bases, it is plausible to disregard the described growth of benefit level assuming that it is fully enclosed in the to indexation of the Basic amount. Therefore, I present the following simplified setting.

Assume that survival probabilities are cohort specific and denote $R(C,\tau)$ a reduction coefficient for the pension benefit which is dependent on cohort C and deviation $\tau \geq -5$ from the normal retirement age of 67. Then the expected net present value of the stream of corrected pension benefits $\{R(C,\tau)\cdot PB_t\}_{t\geq 67+\tau}$ calculated at the age of 67 is

$$NPV_{67}(C,\tau) = \sum_{t=67+\tau}^{\infty} \left(\frac{1}{1+r}\right)^{t-67} \cdot \rho_t(C)\cdot PB_t \cdot R(C,\tau)\,, \tag{25}$$

where r is the interest rate and $\rho_t(C)$ is survival probability from age 67 to age t. The reference point is set at the cohort retiring in 2010 at the age of 67, thus

$$NPV_{67}(C_{1943},0) = \sum_{t=67}^{\infty} \left(\frac{1}{1+r}\right)^{t-67} \cdot \rho_t(C_{1943})\cdot PB_t \cdot 1, \tag{26}$$

and the reduction coefficient itself is then:

$$R(C,\tau) = \frac{NPV_{67}(C_{1943},0)}{NPV_{67}(C,\tau)} = \frac{\sum_{t=67}^{\infty} \left(\frac{1}{1+r}\right)^{t-67} \cdot \rho_t(C_{1943})\cdot PB_t}{\sum_{t=67+\tau}^{\infty} \left(\frac{1}{1+r}\right)^{t-67} \cdot \rho_t(C)\cdot PB_t}\,. \tag{27}$$

According to (27), if the pension is taken out earlier and thus τ is below zero, the denominator exceeds the enumerator making the whole expression less than one, and vise versa. If, on the other hand, the cohort in question has shorter life expectancy than the reference cohort, $\rho_t(C) \le \rho_t(C_{1942})$, the denominator decreases and the expression exceeds unity.

For a given individual the reduction of the pension benefit induced by the coefficient (29) can be separated into two effects. The first one is due to the endogenously given cohort specific life expectancy which reduces pension irrespectively of the individual behaviour. On the individual level this reduction can be counteracted by working longer years – as suggested by the new reform regulation – and this is the element of the design that ensures long term sustainability of the pension system on the macro level. The second effect is endogenous – the individual faces a ”pension profile” and simultaneously chooses age of retirement and benefit level. Since pension profile is incentive neutral, the individual choice is totally due to personal preferences (including preferences towards time). The Government further enriches the choices at retirement by providing the possibility to combine pension and work, so that a common approach may be to retire earlier with a reduced pension but keeping some partial work attachment to smooth the transition in terms of income and consumption. The process of withdrawal from the labour force thus becomes completely fluid enriching the concept of phased retirement with the amount of flexibility typical for usual labour market transitions. The only restrictions include the earliest age of retirement (62) and the minimum pension requirement at age 67 mentioned above.

Besides the sections introducing the new pension accrual rules and the new pension drawing rules, Governmental proposal also contains additional redistributive reform measures that were brought forward by Storting. First, a 4.5*G* wage is assigned for pension calculation for the individuals performing unpaid care. Second, a 4.5*G* wage (amount finalized in (Folrik, 2007)) during maximum of 6 years is assigned to mothers caring for a child. Third, a 2.5*G* wage is assigned for pension calculation of the conscripts serving in the military. Students who were also suggested as a special social group were not assigned any additional pension rights in favor of better pension profile on the grounds that higher education certainly result in higher life time wages and thus higher pensions.

Although the White paper (St.Meld. Nr. 5, 2007) specifies in a great detail the core elements of the forthcoming Norwegian pension reform, there are still some areas which are left for further discussions and concretizing. First of all, this concerns the implementation of the reform which is generally planned for the year 2010. The choice of reference cohort and the normal retirement age in the actuarial calculations are set in accordance with this time limit. Still, it remains to be defined how the pension rights already accumulated by the future pensioners have be corrected for the use in the new calculation technique. Even more, it has to be decided how pension rights that would have accumulated under the new regime should be estimated. Disability pension rules and their transformation in connection to the old age pension reform is outsourced into a separate project which is still on the way and which results will influence the final look of the coordinated pension rules. The main questions under consideration are how the disability pensions should earn old age pension rights, when the transfers between the systems should take place, how survival's pension will be coordinated with the spousal properties of the new old age pension. It is also not yet decided how the organizational structure of the Pension Fund will be transformed because of the pension reform.

Among listed issues which will be set in the further discussion by far the most sensitive is the transformation of the early retirement (AFP) scheme. As described in the previous section, the current AFP rules virtually grant a substantial state sponsored subsidy in the form of the pension rights for up to 5 years to more than two thirds of the active labour force approaching the retirement age. Clearly, this introduces a huge distortion into the retirement decision making[n] removing most of the motivation to stay at work after the AFP retirement age. Since this settlement was originally a result in the negotiations between labour unions and the employers' organization, the government may have hard time reorganizing this particular piece in the current pension rules. Yet, in the framework of the planned reform, it is very hardly that an incentive distortion of this magnitude will be maintained. Section 3.2 discusses several possible ways the AFP retirement scheme can be adjusted in light of the principles of the reform.

The transformation of the AFP scheme was started by a letter from the Stoltenberg Government to the Norwegian Confederation of the Trade Unions (LO) on the 31st of March, 2006. The letter stated that the AFP arrangement has to be adjusted in accordance to the

[n] Distribution of the waiting time before taking out AFP pension after becoming eligible is concentrated on zero as shoen by Jia (2000).

principles of the new pension system, in particular, the total annual pension from the National Insurance Scheme and other arrangements has to increase when one continues to work after the age of 62. The White paper (St.Meld. Nr. 5, 2007) also lists the measures to be taken with respect to early retirement program:.

- "The AFP arrangement shall also in the future contribute to a good early retirement system from the age of 62…"
- "The State will continue its total financial contribution to the AFP arrangement…
- "The transition to an adapted AFP arrangement will be considered in light of the Government's proposal for the phasing in of the new old age pension of the National Insurance Scheme…"

The general guidelines for the transformation of the AFP listed in the Governmental proposal can not be considered sufficient in meeting the principles of the pension reform discussed above. In particular, it is not clear how incentives distortion is going to be eliminated. Even if the AFP pension level is similarly to the old age pension made properly dependent on the take up time, entitlement issues still have to be settled. Indeed, because currently the entitlement to early retirement pension is conditional on the take up, AFP eligible workers experience an additional motivation to retire through the scheme – in order not to lose this entitlement.

Occupational pensions design might also be influenced by the reform of the National Insurance Scheme pensions. From the end of 2006 the enterprises are obliged to establish occupational pension plans covering all the employees by the legislation passed as a part of the pension reform. Even closer coordination may yet take place in the future.

3.1. Structural dynamic model of health and retirement

In evaluating the Norwegian pension reform proposals the current paper makes use of the structural dynamic model of health and retirement developed and estimated in (Iskhakov, 2008b). Due to the space limitation the model is only presented in brief with the emphasis on the adaptation of the pension reform proposals for the models terms[o].

Structural dynamic model of health and retirement is finite horizon Markovian stochastic control model in discrete time. The model is developed under the assumption that in order to

[o] See also <Iskhakov, 2008 #589> for detailed description

find the optimal path of transition from work to retirement individuals maximize expected discounted lifetime utility

$$E\left\{\sum_{t=T_0}^{T}\left(\prod_{\tau=T_0}^{t}\rho_\tau\right)\beta^{t-T_0}U(d_t,s_t)+\Lambda\left(s_T\right)\right\}\underset{\delta\in\mathfrak{F}}{\rightarrow}\max, \tag{28}$$

where the vector $s_t \in S$ taking values from the problem state space S and the scalar $d_t \in D_t(s_t, d_{t-1})$ taking values from the choice sets $D_t(s_t, d_{t-1})$ denote correspondingly state and decision variables, $U(d_t, s_t)$ is instantaneous utility discounted with the discount factor β (estimated at the level of 0.91235 with standard error 0.00091), and ρ_τ is sample specific exogenous survival probability from period $\tau - 1$ to period τ. For convenience time index in the model serves as indicator of age, and the limits T_0 and T are chosen such that $T_0 - 1 = 50$ and $T = 70$ covering all main transitions on the labour market before the compulsory retirement age (after which no transfers occur and no decisions are made). The absence of the intertemporal budget constrained is explained by the assumption of constant savings when all current income is assumed to be consumed during the current period. Termination function $\Lambda\left(\tilde{s}_T\right)$ captures the remaining after the age of 70 lifetime utility[p]. A solution to the individual sequential decision problem (28) is found among decision rules $\delta = \left(\delta_{T_0}, ..., \delta_T\right)$ – which define a correspondence between a current state s_t and a chosen control $d_t = \delta_t(s_t)$ – from the class $\mathfrak{F}$ of feasible decision rules. Feasibility conditions are expressed in a family of choice sets $D_t(s_t, d_{t-1})$ that contain the available to the agent options at period *t*. Decision rule $\delta = \left(\delta_{T_0}, ..., \delta_T\right)$ is said to be feasible if and only if for each $t \in \{T_0, ..., T\}$ $\delta_t(s_t) \in D_t(s_t, d_{t-1})$. The expectation is taken with respect to the set of subjective transition probabilities $\left\{p(s_t \mid s_{t-1}, d_{t-1})\right\}_{t\in\{T_0,...,T\}}$ that govern stochastic process $\left\{d_t, s_t\right\}_\delta$ induced by the given decision rule $\delta \in \mathfrak{F}$. Together with the transition probabilities the family of choice sets $\{D_t(s_t, d_{t-1})\}_{t\in\{T_0,...,T\}}$ is sufficient to fully specify the decision problem (28).

When $\left\{p(s_t \mid s_{t-1}, d_{t-1})\right\}_{t\in\{T_0,...,T\}}$ and $\{D_t(s_t, d_{t-1})\}_{t\in\{T_0,...,T\}}$ are determined and the theory of individual choices is thus established, likelihood function can be derived from (28) with the

[p] Termination function failed to be estimated and is assumed to be zero.

technique described in (Rust, 1994). Inevitable discrepancies between theoretical predictions and the data are incorporated into the model by allowing for some "randomness" in the choices that is introduced by inclusion of additional unobservable state vector ε_t which length is equal to the highest number of elements in $D_t(s_t, d_{t-1})$. In this case the utility function in (28) is assumed to gain additional random component so that

$$U(d_t, s_t) = u(d_t, s_t) + \varepsilon_t[d_t], \tag{29}$$

and if $\varepsilon_t[d_t]$ has extreme value distribution (i.i.d. across both *t* and d_t), choice probabilities take the form

$$P_t(d_t \mid s_t) = \frac{\exp\{v_t(d_t, s_t)\}}{\sum_{d' \in D(s_t, d_{t-1})} \exp\{v_t(d', s_t)\}}, \tag{30}$$

$$v_t(s_t, d_t) = \tag{31}$$
$$= \begin{cases} u(d_T, s_T) + \Lambda(s_T), t = T, \\ u(d_t, s_t) + \rho_t \beta \sum_{s_{t+1} \in S} \log\left(\sum_{d_{t+1} \in D(s_{t+1})} \exp\{v_{t+1}(d_{t+1}, s_{t+1})\} \right) p(s_{t+1} \mid s_t, d_t), t < T. \end{cases}$$

Then, given the panel of observations $\{d_t^a, s_t^a\}_{t \in \{T_0,..,T\}, a \in \{1,..,A\}}$ where *A* agents are indexed with *a* the likelihood function can be constructed as

$$L'(\theta) = \prod_{a=1}^{A} \prod_{t=T_0^a}^{T^a} P_t(d_t^a \mid s_t^a, \theta) \cdot p(s_t^a \mid s_{t-1}^a, d_{t-1}^a, \theta). \tag{32}$$

If, however, the only available panel is $\{d_t^a, \hat{s}_t^a\}_{t \in \{T_0,..,T\}, a \in \{1,..,A\}}$, where $s_t^a = (\hat{s}_t^a, \breve{s}_t^a)$, the likelihood function must be modified accordingly to integrate out the unobservables. Define $\breve{S}^a$ as a set of all trajectories of the process $\{\breve{s}_t\}_{t \in \{T_0,..,T\}}$ consistent with the available observations $\hat{s}_t^a$ (so that $\forall (\breve{s}_{T_0}, .., \breve{s}_T) \in \breve{S}^a, \forall t \in \{T_0, .., T\}\ p\{(\hat{s}_{t+1}^a, \breve{s}_{t+1}) \mid (\hat{s}_t^a, \breve{s}_t)\} > 0$) and $p_0(\breve{s}_{T_0^a})$ the probabilities of given initial states of the unobservables. Then the incomplete information likelihood function is given by

$$L(\theta) = \prod_{a=1}^{A} \left[\sum_{(\breve{s}_{T_0}, .., \breve{s}_T) \in \breve{S}^a} p_0(\breve{s}_{T_0^a}, \theta) \prod_{t=T_0^a}^{T^a} P_t(d_t^a \mid \hat{s}_t^a, \breve{s}_t, \theta) \cdot p(\hat{s}_t^a, \breve{s}_t \mid \hat{s}_{t-1}^a, \breve{s}_{t-1}, d_{t-1}^a, \theta) \right]. \tag{33}$$

Maximization of (33) leads to the incomplete information maximum likelihood estimates of the transition and preference parameters incorporated into the parameter vector θ. To make the model presentation meaningful, the rest of this section is devoted to populating the state vector s_t, describing the control variable d_t, defining transition probabilities $\{p(s_t \mid s_{t-1}, d_{t-1})\}_{t\in\{T_0,\dots,T\}}$ and choice sets $\{D_t(s_t, d_{t-1})\}_{t\in\{T_0,\dots,T\}}$. Parameter estimates obtained in (Iskhakov, 2008b) are presented along the way.

State variables entering vector s_t are naturally divided into three groups under the time convention assumed in the model. Two variables are time indifferent (exogenous): the model controls for gender of the individuals and their age of potential early retirement (AFP age). In the beginning of each period four variables determining the current choice set are realized.

First, the choice set depends on the previous labour market state ps_t:

- $ps_t = 0$ – out of labour market (OLM),
- $ps_t = 1$ – full time early or regular pension,
- $ps_t = 2$ – full time disability,
- $ps_t = 3$ – unemployment (including partial unemployment),
- $ps_t = 4$ – employment in non-AFP company[q],
- $ps_t = 5$ – partial employment in non-AFP company, partial disability,
- $ps_t = 6$ – employment in AFP company,
- $ps_t = 7$ – partial employment in AFP company, partial disability.

Retirement and disability are assumed to be absorbing, although transition to disability may happen through partial disability, and all the disabled individuals are forced into pension at the age of 67. Also, the first three labour market states – inactive labour market states – are jointly absorbing reflecting the pattern discovered in the data. Strict empirical definitions of the labour market states can be found in (Iskhakov, 2008a). Labour market state ps_t evolves under the deterministic rule presented by Table 1 below.

Second, choice set depends on the current health $h_t \in \{0,1,2\}$ of an individual. When health is "good" ($h_t = 0$), participation in the disability program is not possible, otherwise when $h_t > 0$ an individual may apply for a disability pension. "Bad" health ($h_t = 1$) may be concealed and

[q] AFP and non-AFP companies differ in their participation in the early retirement scheme.

thus present the widest set of alternatives while "very bad" health ($h_t = 2$) results in full time disability retirement with certainty. Thus, health is thought of specifically as eligibility for disability pension and is modelled as a latent variable only partially recoverable from the data on the occupied labour market states. Within the Markovian nature of the model, health is assumed to evolve as simple Markov chain with the estimated uniform across individuals transition probability matrix[r]

$$\{\pi_{ij}^{(h)}\}_{i,j\in\{0,1,2\}} = \begin{bmatrix} \underset{(0.00011)}{0.97087} & \underset{(0.00011)}{0.02779} & \underset{(0.00016)}{0.00134} \\ 0.0 & 1.0 & 0.0 \\ 0.0 & 0.0 & 1.0 \end{bmatrix}. \quad (34)$$

Third, the choice set depends on the job match variable $m_t \in \{0,1,2\}$ which indicates whether no job ($m_t = 0$), AFP ($m_t = 2$) or non-AFP ($m_t = 1$) job is available for an individual in the given period. The model does not distinguish between individual companies so transfers within the given job types are ignored. This is the second latent variable which is however fully recoverable from the data on occupied labour market states. Job match is also modelled as a Markov chain with uniform across individuals estimated transition probability matrix

$$\{\pi_{ij}^{(m)}\}_{i,j\in\{0,1,2\}} = \begin{bmatrix} \underset{(0.00200)}{0.68750} & \underset{(0.00148)}{0.18709} & \underset{(0.00127)}{0.12542} \\ \underset{(0.00062)}{0.02060} & \underset{(0.00046)}{0.89029} & \underset{(0.00042)}{0.08908} \\ \underset{(0.00038)}{0.00910} & \underset{(0.00026)}{0.05585} & \underset{(0.00028)}{0.93502} \end{bmatrix}. \quad (35)$$

Forth, the choice set depends on the individual AFP eligibility conditions which govern whether an individual working at AFP company can retire through the early retirement system in the current period. The corresponding state variable $e_t \in \{0,1\}$ indicates whether the conditions are satisfied. The complicated design of the early retirement system (see section 2.2) makes it hard to fully replicate individual eligibility conditions, and therefore an approximate motion rule for e_t is used in the model. Namely, AFP eligibility is predicted separately for the AFP eligibility age (when early retirement is possible for the first time) and for other ages up to 67, in both cases most of the predictions are deterministic and based on the information available through the state vector, but when the available information is not sufficient to determine eligibility status, simple logit probabilities dependent on gender and

[r] Standard errors of the estimates are given in prentices.

short term wage dynamics are utilized (estimates of the logit model parameters are given in (Iskhakov, 2008a).

After these four state variables are revealed in the beginning of each period, the agent makes a decision $d_t \in D_t(s_t, d_{t-1})$ which follows as a reaction to the evolving environment $\{ps_t, h_t, m_t, e_t\}_{t\in\{T_0,..,T\}}$. Decision variable $d_t \in D_t(s_t, d_{t-1})$ holds the answers for two questions: whether to stay on the labour market and whether to apply for old age, disability or early retirement pensions. The answer may correspondingly be:

- $d_t = 0$ – the agent remains on the labour market, does not apply for any pension,
- $d_t = 1$ – the agent applies for disability benefits, but remains on the labour market,
- $d_t = 2$ – the agent retires, applies for disability benefits,
- $d_t = 3$ – the agent retires, applies for old age or AFP pension,
- $d_t = 4$ – the agent leaves the labour market, but does not apply for any pension.

Table 1. Evaluation of the current labour market state[s].

<table>
<tr><th colspan="3">Control</th><th colspan="5">Filter</th><th colspan="2" rowspan="2">Resulting labour market state ps_{t+1}</th></tr>
<tr><th>d_t</th><th>Remain on LM?</th><th>Apply for pension?</th><th>ps_t</th><th>h_t</th><th>m_t</th><th>e_t</th><th>Age</th></tr>
<tr><td rowspan="3">0</td><td rowspan="3">yes</td><td rowspan="3">no</td><td rowspan="3">≥ 3</td><td>0</td><td>0</td><td rowspan="3">-</td><td rowspan="3">< 70</td><td>3</td><td>Unemployment</td></tr>
<tr><td rowspan="2">$\neq 2$</td><td>1</td><td>4</td><td>Non-AFP employment</td></tr>
<tr><td>2</td><td>6</td><td>AFP employment</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">yes</td><td rowspan="3">disability</td><td>$\neq 1$</td><td>1</td><td>0</td><td rowspan="3">-</td><td rowspan="3">< 70</td><td>2</td><td>Full time disability</td></tr>
<tr><td rowspan="2">≥ 3</td><td>1</td><td>1</td><td>5</td><td>Partial disability (non-AFP)</td></tr>
<tr><td>1</td><td>2</td><td>7</td><td>Partial disability (AFP)</td></tr>
<tr><td>2</td><td>no</td><td>disability</td><td>$\neq 1$</td><td>> 0</td><td></td><td></td><td>< 70</td><td>2</td><td>Full time disability</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">no</td><td rowspan="3">AFP/NIS</td><td>≥ 6</td><td rowspan="3">-</td><td rowspan="3">-</td><td>1</td><td>$\geq afp$</td><td rowspan="3">1</td><td rowspan="3">Pension</td></tr>
<tr><td>$= 1$</td><td rowspan="2">-</td><td>$\geq afp$</td></tr>
<tr><td>-</td><td>≥ 67</td></tr>
<tr><td>4</td><td>no</td><td>no</td><td>$\neq 1, 2$</td><td>$\neq 2$</td><td>-</td><td>-</td><td>< 70</td><td>0</td><td>OLM</td></tr>
</table>

Thus, the decision variable indicates the intentions of the agent to acquire a certain position on the labour market, which is matched against current state to determine actual outcome (which becomes the current labour market state and is recorded and next period ps_{t+1} variable). Clearly, some intentions are useless in particular situations, for example an

[s] In the forth row the age is compared against the individual early retirement age.

intention to take out pension (either old age or disability benefit) in good health before the early retirement age. A complete set of such exclusions is presented in Table 1. The table shows the correspondence between decision variable d_t and the resulting labour market state in the current period ps_{t+1} which is separated with a "filter" of state variables necessary for the resulting labour market state to occur. In the same time Table 1 defines the collection of choice sets $\{D_t(s_t,d_{t-1}) = D_t(ps_t,h_t,m_t,e_t)\}_{t\in\{T_0,..,T\}}$ such that when a given control d_t for given values of (ps_t,h_t,m_t,e_t) results in some labour market state in the next period, this control does in fact belong to the choice set $D_t(ps_t,h_t,m_t,e_t)$.

After the decision is made and the current labour market state is determined with the rule defined by Table 1, an individual is assigned with the current period utility[t]

$$\begin{aligned} u\left(d_t,s_t\right) = u\left(I,L\right) = \underset{(0.00426)}{0.17147}\cdot \frac{\left(Tx(I)\right)^{\lambda}-1}{\lambda} \\ +\left[\underset{(0.57728)}{29.3224}\cdot \xi\left(h_t=1\right) + \underset{(0.02073)}{0.26551}\cdot sp_t - \underset{(0.01838)}{0.61363}\cdot \xi\left(\text{female}\right)\right]\cdot L \\ +\sum_{k=0}^{7} c_k\cdot \xi\left(ps_{t+1}=k\right) \end{aligned} \qquad (36)$$

dependent on the corresponding income $I = I(d_t,s_t)$, leisure $L = L(d_t,s_t) = L(ps_{t+1})$ and labour market state specific non-pecuniary component c_k (estimates ranging from 3.81 to 18.25). CRRA coefficient λ is estimated at the level of 0.67393 (standard error 0.03001). $Tx(\bullet)$ represents an approximation of the tax function which returns household disposable income used in the model as measure of consumption under the assumption of constant savings.

In the absence of reliable data on leisure, $L = L(ps_{t+1})$ simply assigns three tabulated values (full, partial and little leisure) to relevant labour market states. In contrast, the calculation of income $I(d_t,s_t)$ in different labour market states is a complicated procedure based on the third group of state variables which are revealed after the current period decision is made.

Spouse existence indicator $sp_t \in \{0,1\}$ mentioned in (38) shows whether the agent under consideration is a single individual or a household which by the simplified construction of the

[t] Indicator function $\xi(\bullet)$ returns one if the condition is satisfied and zero otherwise.

model differs from a singe person household (individual) only by additional income source from a spouse. Full households are governed by the same preferences as single households which is justified by the unitary or Stackelberg equilibrium approaches to household preference modelling (Hiedemann, 1998). Household and thus sp_t dynamics include divorce and death of a spouse and are governed by exogenous gender and time specific adjusted death rates while new marriages are assumed away.

Two variables contain information on the long term and short term dynamics of the potential income stream. The aggregated wage $aw_t \in \mathbb{R}_+$ calculated as the average of the highest 20 annual wages earned before year t (in 1000 krone discounted to 1992) represents individual lifetime trend in the wage earnings and serves as a the basis for calculation of potential employment income. The number of last consecutive years with wages over the basic pension amount $nw_t \in \{0,1...10\}$ (truncated at 10) represents recent dynamics in the wage earnings and serves as the basis for calculation of various social security benefits in the current system. Motion rules for these two variables are given in the following estimated recursive equations

$$aw_t = \underset{(0.005)}{0.1440} + \underset{(0.00002)}{1.0002} \cdot aw_{t-1} + \underset{(0.004)}{2.6950} \cdot \xi\left(ps_t \in \{3,4,6\}\right), \tag{37}$$

$$nw_t = \begin{cases} \min(10, nw_{t-1}) \text{ with probability } \dfrac{\exp(\psi)}{1+\exp(\psi)}, \\ 0 \text{ with probability } \dfrac{1}{1+\exp(\psi)}, \end{cases} \tag{38}$$

$$\psi = \underset{(0.00864)}{-0.47346} - \underset{(0.02121)}{5.78533} \cdot \xi\left(nw_{t-1} = 0\right)$$
$$- \underset{(0.09032)}{5.93309} \cdot \xi\left(ps_t \in \{0,2\}\right) + \underset{(0.01415)}{5.64858} \cdot \xi\left(ps_t \in \{3,4,6\}\right) + \underset{(3.78400)}{15.6685} \cdot \xi\left(ps_t \in \{5,7\}\right).$$

The income itself is calculated as a sum of at most four sources which come into play in the relevant states s_t. When an individual is active on the labour market ($ps_{t+1} \in \{3,4,5,6,7\}$), the main source of income is wage income estimated on the bases of gender, age, aw_t, nw_t and current labour market state dummies. When an individual has a right for either disability, old age or early retirement pension ($ps_{t+1} \in \{1,2,5,7\}$ and additional conditions on h_t and e_t), it is likely to be the main income source, but could also be combined with wage. Since the pensions are separable by age, they are predicted with four separate equations on the bases of AFP age, gender, age, aw_t, nw_t, previous and current labour market state dummies. All individuals are entitled with additional incomes comprising various social security payments besides pensions, non-labour or self-employment income. Since the level of this source varies a lot among individuals, it is predicted in two stage procedure where the first stage assesses individual probability of having this income source and the second stage predicts its level. Predictions are made on the bases of gender, age, spouse indicator, aw_t, nw_t and the current labour market state dummies. Finally, an income source from the spouse already mentioned above comes into play only when $sp_t = 1$. Income of a spouse is predicted on the bases of AFP age (cohort proxy), age, aw_t, nw_t and the previous period labour market state of the original spouse. Full reference can be found in (Iskhakov, 2008a).

This concludes the description of individual preferences and the state vector $s_t^a = (\hat{s}_t^a, \breve{s}_t^a) = (ps_t, h_t, m_t, e_t, sp_t, nw_t, aw_t)$ (where $\hat{s}_t^a = (ps_t, e_t, sp_t, nw_t, aw_t)$ is observed and $\breve{s}_t^a = (h_t, m_t)$ is latent). The collection of choice sets is given by Table 1, and a family of transition probabilities $\{p(s_t \mid s_{t-1}, d_{t-1})\}_{t \in \{T_0,..,T\}}$ is comprised from the individual motion rules given for each state variable.

3.2. Reform proposals in the model terms

The general framework of a policy simulation based on the described structural microeconomic model is the following. First, the model is estimated using the data on the observed behaviour of the available sample under the current policy. After the structural preference parameters are obtained, their values are used to construct a hypothetical behaviour of the same sample (in terms of exogenous characteristics as gender, AFP age, etc.) under an alternative policy. Simulated social-economic outcomes under the alternative policy are then compared to the initial observed statistics and the effect of the policy change is analyzed. The logical foundation of such policy simulation is the assumption that the parameters do in fact carry over to the state of nature under the alternative policy, or in other words are policy invariant. Stationarity of the structural parameters is usually a more sensible and realistic assumption than the assumptions about policy invariant relations between processes and variables required in the reduced form framework – this establishes structural modelling as preferred tool for policy analysis. Still, the econometrician should be clear about how much and what kind of exogenous information from the data sample in use is transferred onto the studied behaviour under the alternative policy.

In this respect the policy simulation based on the described structural dynamic model of health and retirement is strictly speaking answering the question: “How would the retirement process differ in the observation window 1992-2003 if the pension reform took place at a corresponding time in the past?" It remains to be shown how the answer to this question is relevant for the discussion of the pension reform being enforced in 2010 which will affect retirees in a rather distant future. To resolve this logical complication, one has to investigate what information besides the structural parameters is implicitly assumed to carry over to the state of nature under the tested policy. In case of pension reform with the effects of the new policy spread over time, the data which is exogenous in the model, in particular earnings histories, will also change. This is partly due to the factors outside of the model, and partly as a result of the policy change as no historical data can be taken completely exogenous and unaffected through the course of the pension reform. A simulation of the potential future development with and without a pension reform requires endogenous modelling of the future earnings histories which is far beyond the scope of the present study.

The simulations that follow are based on the same sample that was originally used in the estimation of the model in (Iskhakov, 2008a). It comprises 210 859 full and single households in which the primary spouse (above referred to as individual) was born from 1933 to 1942 so that the available observations on the interval from 1992 to 2003 cover the life span between the age of 50 and 70. The observations are only included into the sample if the primary spouse is active on the labour market in the first observation (working or officially registered unemployed looking for job), and the household passed a simple earnings test to exclude outliers whose behavior could hardly be explained with the means of the utility function used. The exogenous sample specific data also used in model estimation are death and divorce rates from relevant calendar years, consumer price indexes and basic pension amounts used for measuring income from some sources, and the individual pension point histories used to establish the long term wage dynamic variable aw_t.

In the current version of the paper aggregate measures of individual wages are assumed to be policy invariant and the future development of neither demographic nor macroeconomic factors is used in the prediction of the pension reform effects. Forecasting such development is a complicated task in its own and definitely lies out of scope of the structural dynamic model of health and retirement. To some extent these simplifications can be justified by the fact that the policy simulation focuses on the relative other than absolute changes, for instance, with respect to labour market outcomes, but in general, it should be noted that the adequacy of the policy analysis is limited by them. MOSART model is primarily developed in (Fredriksen, 1998) for the long term demographic and other predictions of this sort, and (Stensnes, Texmon et al., 2007) use this model in their analysis of the pension reform to full extent.

The main disadvantage of the MOSART model in pension reform simulation is its reduced form and consequent inability to endogenously assess the behaviour of the retirees reacting to the new policies. Structural dynamic model of health and retirement on the other hand is an ultimate machinery for precisely this task. Not only is it capable of replicating the effects induced by the shifts of behavioural patterns in adjustment to the pension reform, but also it is capable to reveal the dynamics of this adjustment. How plausible is it that the workers could start increasing their labour supply 10 or 15 years prior to retirement after the pension becomes more directly linked to the wage earnings? The structural dynamic model provides the answer in the sections of the paper that follow. Thus, the structural approach used in the paper for policy simulations complements the existing studies by exposing the effects of behavioral adjustments likely caused by the reform.

In order to facilitate the policy simulation based on the structural dynamic model of health and retirement, the proposed pension reform measures must be transformed into the terms of the model. This is not a trivial task because the model replicates the reality in a rather simplified way (in order to be computationally tractable), and thus the policy measures can not be introduced directly as they are formulated. The core measures (within the classification of section 2.3) of actuarial adjustment and making the retirement decision free of incentive distortions induce changes in the choice sets and alter the utility levels through changes in pension income. New proposed pension accrual mechanisms are presented in the model in reduced form of a pension equation. Secondary reform measures (such as regulating pension accumulation for unpaid work and for certain social groups, as well as enforcing obligatory occupational pension) are the details that are too small to be included into the structural model. In other words, while the structural model is capable of exposing general behavioural response to the pension reform, its small details fall out of the scope of the model and can not be assessed in the simulation.

The most serious drawback of using the available sample for pension reform simulations turns out to be the incapability of this approach to simulate the adjustment of the pension system to the increasing longevity. Indeed, introduction of any specific death rates (dependent not only on age), requires an additional state variable controlling for this additional heterogeneity in life expectancy. This leads to tractability considerations and may easily complicate the model beyond reasonable limit. The only option readily available for such modification is a limited control for cohort expressed as the AFP age state variable[u]. Another approach could be introducing exogenous individual specific death rates[v]. Both of these approaches require forecasted demographic characteristics to be combined with the sample specific exogenous data (as earnings histories) which is not logically sound. Therefore the actuarial adjustment to the increasing longevity is completely left out of the policy simulations in the current paper – leaving for simulations only the part of actuarial adjustment that corresponds to the individually chosen age of retirement. This limitation can be rationalized by the following argument. While other measures of the pension reform are aimed at the retirement decision and retirement motivation itself, and are thus related to the structural shifts in the aggregated retirement patterns, adjustment to the increasing longevity seems to be first of all related to the total amount of pension benefits paid out to the pensioners, and thus to the "scale" of the pension system. Even though these two effects are both dependent on the time of retirement, for a rough approximation they could be taken as independent and two approaches utilized: the structural microeconomic model to simulate the behavioural consequences of the pension reform while more general macroeconomic models – to calibrate its scale.

Thus, the simulation focuses on the two main reform measures: the new pension accrual model and the new pension drawing model described in section 2.3. Still, both of them must be replicated in the model. The first is introduced through a coefficient in the pension equation alone, while the second also requires certain correction in the choice sets at the old ages. Since the model distinguishes between the types of pension benefits entirely through age, introduction of reduced old age pension from the age of 62 leads to a possible confusion between AFP and the new old age pension. Thus, correction of AFP pension is also required for simulations, and it is described at the end of the section.

Pension accrual rules are expressed in the structural dynamic model of health and retirement by a simple pension equation which maps the current age, aw_t, nw_t, previous and current labour market state indicators (controlling for AFP age and gender) into the pension benefit

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[u] The limited control is possible because as described in section 2.2 the AFP age had changed several times during the observation window but different number of cohorts correspond to the same AFP ages, thus making AFP age only a proxy to a cohort indicator.

[v] In contrast to the uniform age and gender specific death rates used in the model.

when applying for old age pension is present in the choice set. Therefore the only way to simulate different alternative accrual rules in the model is to modify this equation, whereas the modification can be introduced as a formula converting the existing pension benefits into the new ones. Under the simplifying assumption of linear relationship between the pension benefits calculated under the new and the old rules (controlling for certain covariates), the required formula was estimated by simple regression analysis in the following way. First, the available sample specific earnings histories were used to reconstruct individual annual wages flows (measured in *G*) using complete information on the relevant pension point formulas (2-4). These wage flows were then used to calculate pension benefits under the current settings and the four proposed accrual regimes (presented in the section 2.3) at a common age of 67 and under common assumption of full working history[w]. The resulted data on 5 predicted individual pension benefits served as the grounds for constructing the needed correction formula. A potential problem is this procedure comes from the fact that inverted pension point formula crops the tails of the wage income distribution which leads to a certain information loss, but (Iskhakov, 2005) shows that this problem is in fact of a very small magnitude relative to the overall prediction error.

Table 2. Correction coefficient for the old age pension under different accrual rules.

Variable	Pension Commission	Model B	Model D	Governmental proposal
Constant	-0.5655	0.0664	0.4064	-0.5492
	(0.0033)	(0.0022)	(0.0016)	(0.0031)
Pension benefit under current	1.1694	1.0506	0.7094	1.3799
rules	(0.0019)	(0.0013)	(0.0009)	(0.0018)
Gender (0 for males)	0.0363	-0.0431	0.0027	0.0247
	(0.0011)	(0.0007)	(0.0005)	(0.0010)
Spouse indicator (1 for full	0.2255	0.2426	0.1853	0.2901
household)	(0.0009)	(0.0006)	(0.0004)	(0.0008)
Aggregated wage	0.0008	-0.0005	0.0030	-0.0013
	(0.00001)	(0.000008)	(0.000006)	(0.00001)
Number of observations	210 859	210 859	210 859	210 859
R-square	95.15%	96.57%	98.46%	95.22%

Table 2 displays the corresponding regressions fitted to these data under the classic distributional assumptions. All the equations are estimated with good precision (R-squares between 0.9515 and 0.9846) and fit the data close enough to be directly installed into the pension income calculation inside the structural model. Thus, the simulation of the effects of

[w] 40 years for the current system and 43 years for the proposed models.

different pension accrual settings is performed by comparing the current output of the structural model of health and retirement with the output obtained when the current pension benefit is corrected according to one of the equations presented in Table 2. The described correction implements one of the new accrual mechanisms and is performed on the first stage before the pension benefit is corrected according to the chosen age of retirement in the procedure described next.

Elimination of the retirement decision distortions is achieved in the final pension reform proposal by relaxing the retirement process to the extent of literally free transition from employment to pension at any time after the age of 62 with the pension benefit dependent on the age of retirement. Three aspects of this transformation are to be replicated in the model with different accuracy. First, an opportunity to take out old age pension is unconditionally included into the choice sets from the age of 62 and is thus accurately introduced into the simulation. Second, phased retirement (combination of work and retirement) is not included into the simulation at all because the model rules out the possibility of combining the labour market states due to the complexity considerations. Third, the correction of the pension benefit conditional on the time of retirement (second stage of pension benefit correction) has to be specifically adopted to the terms of the model. Since there is no state variable holding the information on the age of retirement, this information can not be used in the simulations without introducing additional state variable. However, the Markovian structure of the model, namely the information about the previous labour market state ps_t, does allow for a distinction between the first retirement year and all the rest of the retirement years. This appears to be sufficient for construction of a pension profile that meets the requirement of equal net present values of the induced streams of benefits when retired at different ages.

Figure 10 presents the pension profile developed in (Nou 2004:1, 2004) which introduces certain reductions of the normal pension benefit which is taken as 100% and corresponds to the retirement at the current normal retirement age of 67. Preliminary analysis shows that it is obtained with the average life expectancy of 83 years and capital market interest rate of 4%. Using these parameters in the calculation of the net present values of the expected streams of benefits leads to the adopted pension profile presented in Figure 11.

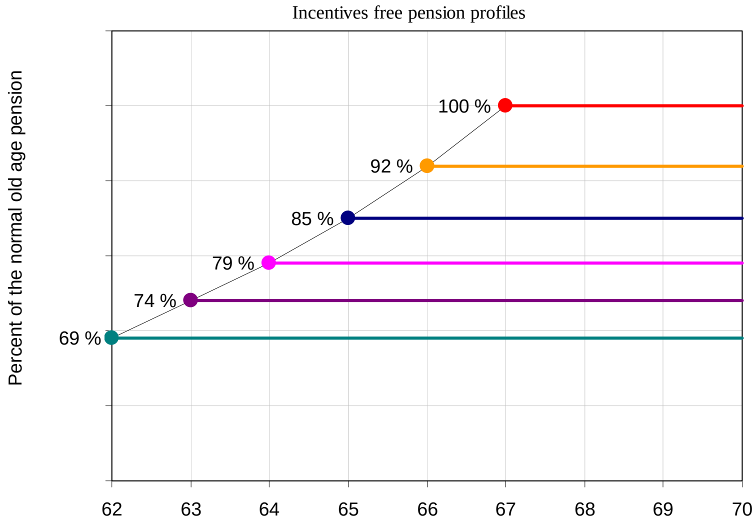

Figure 10. Pension profile as a function of age of retirement proposed by Pension Commission.

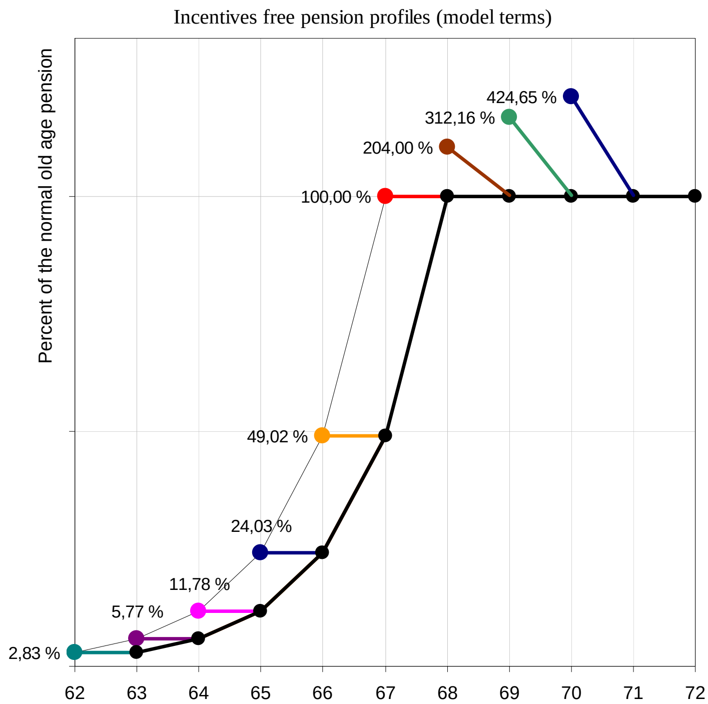

Figure 11. Pension profile as a function of age of retirement adopted for the Markovian structural dynamic model.

Unlike the original profile with the benefits uniformly reduced to a certain percentage dependent on the time of retirement, the adopted profile provides normal benefits after the age of 68. In case of early retirement, the benefit is reduced in the first years and converges to the normal 100% level. In case of late retirement, the first benefit includes a one time premium.

Normal retirement at the age of 67 is assigned uncorrected pension. Reduction and premium levels are calculated as to match the net present values of the induced benefit streams ensuring the absence of the incentive distortions with respect to retirement age. These reductions and premiums are inserted into the pension income calculation in the structural dynamic model of health and retirement on the second stage – after the accrual rules corrections.

As mentioned above, since the structural dynamic model of health and retirement does not distinguish between the AFP pension and the new old age pension in case the decision is made to apply for pension before the age of 67, the effect of old age pension reform can not be separated in the simulations from the effect of changes in the AFP system. Therefore, the reorganization of the AFP scheme must also be incorporated into the simulation even though this reorganization is not yet negotiated. The negotiation itself promises to be very hard because as it was described in section 2.3, the AFP scheme presents a state funded subsidy for those eligible and taking out the early retirement pension. This subsidy is completely lost by those eligible not taking out the AFP pension. In other words, it present a huge incentives distortion for the AFP eligible workers, and does not at all comply with the principles of the new pension system. Yet, the system is a part of the agreement between all the major employer associations and the labour unions with support of the government, and thus must be renegotiated in order to be modified[x].

Under these circumstances of high uncertainty, the following three approaches to the AFP adjustment are simulated. First, the baseline case when the AFP scheme is kept in the current state is simulated to mark out the related distortions. Second, the drastic scenario with complete elimination of the AFP scheme and thus additional pension benefits should indicate the “maximum” effect of direct linking of pension benefits to earnings. Finally, the third intermediate case represents one of the possible outcomes of the renegotiations over the AFP scheme. Let this hypothetic moderate AFP adjustment be based on the following principles:

- The new AFP scheme presents the same amount of flexibility with respect to the age of retirement as the rest of the pension system.
- The new AFP scheme is distortion free with respect to both the retirement decision itself and the time of retirement.
- Governmental spending for the new AFP scheme are kept at the present level.

[x] The renegotiation is under way in the first half of 2008.

The three assumptions simply imply that the members of the labour organization with long working histories (equivalently, AFP-eligible workers) are given an additional pension entitlement that they are free to take out anytime from the age of 62. This entitlement results in the sequence of additional benefits up to 67 if taken out before, or in a lump sum transfer if taken out at 67 or later. The sizes of these entitlements are coordinated according to the present rate of AFP retirement relative to the AFP eligible such that the governmental spending for the AFP scheme is kept at the present level. As such, the new AFP scheme constructed this way becomes similar to an additional savings plan funded by the government and available for the AFP-eligible workers.

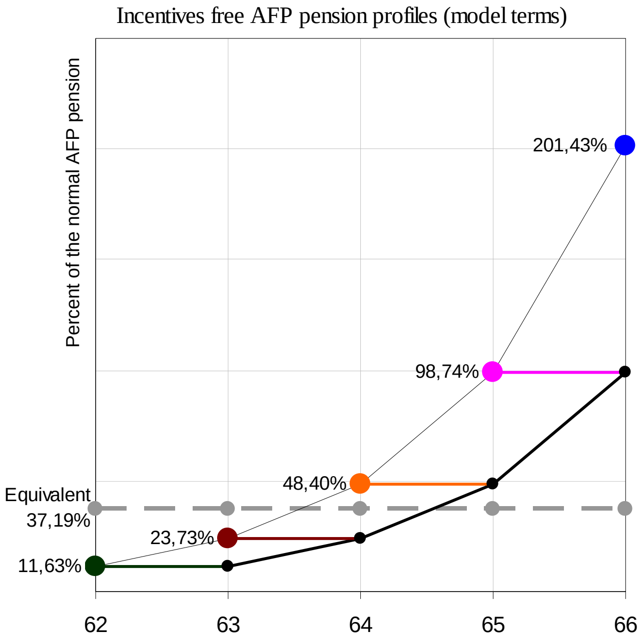

Figure 12. AFP pension profile as a function of age of retirement adopted for the Markovian structural dynamic model.

Table 3. Observed in (Iskhakov, 2008a) fractions of AFP pensioners in relation to the AFP eligible workers.

Age	Number of AFP eligible	Number of pensioners	Fraction
62	84 516	9 046	10.70%
63	64 003	16 918	26.43%
64	43 500	21 099	48.50%
65	27 999	22 167	79.17%
66	17 574	19 127	108,84%[y]
Total and average	69 230	220 018	37.19%

[y] Due to both the inaccuracies in AFP eligibility calculation and special retirement plans allowing retirement before the normal retirement age, at 66 the fraction of AFP takeups exceeds unity.

The described hypothetical setting can be implemented in the structural model of health and retirement with the same procedure as for the regular old age pension, namely with the introduction of a special AFP pension profile which would ensure that the addition pension entitlement does not impose any distortions as of the time of retirement. Such profile is presented in Figure 12. Here two factors identify displayed benefit levels which are calculated with respect to the normal AFP pension benefit at the age of normal AFP retirement (62 in 2006). First, the assumption of the constant governmental spending is used to calculate the equivalent constant AFP pension level which should be chosen so that if all AFP eligible individuals take out the AFP pension at 62, the governmental finances balance. In practice, however, it is hard to achieve the balance with precision because since AFP pension is dependent on one's working history and there are workers who retire with AFP pension at the later ages than 62, it is very hard to assess true current governmental spending for the scheme. Therefore, a much simpler approximate calibration is applied here. Table 3 displays the observed in the sample quantities of the AFP eligible individuals and those who took out the AFP pension. Under the assumption that all the AFP pensioners are receiving an identical average benefit which serves as the reference 100% level, the governmental spending are balanced if all the eligible individuals are assigned the fraction of the average benefit equal to the mean AFP take up rate, namely 37.19%. Thus, pension profile on Figure 12 is built using the 37.19% "normal" benefit level. The second identifying factor for the pension profile is the equality of the net present values of the alternative flows of benefits taken up at different ages (calculated with the same market interest rate of 4%). As before (in Figure 11) the profile displays unequal benefit levels corresponding to the different values of the ps_t state variable in each period. If the entitlement is taken out at any age between 62 and 64, the person is receiving increasing yearly AFP payments, and two identical payments of 98,74% of the normal AFP pension if it is taken at 65. Unfortunately, the AFP eligibility is only tracked by the model up to the age of 66 – therefore if the AFP entitlement is not taken out until then, the individual receives the complete AFP entitlement (experiences a consumption shock) equal to 201,43% of the normal AFP. The latter value is calculated so that its discounted value equals the net present value of the equivalent flow of benefits. This obvious drawback of the presented implementation of one of the possible setups of the new AFP system is both due to the model limitation and the uncertainty about the AFP scheme reformation. Nevertheless, this hypothetical new AFP setting is included into the simulation along with the two extreme cases described above.

Several additional pension reform measures which have not yet been mentioned in this section are left out of the simulation due to either their secondary importance or the small scale which makes them intractable within the structural model of health and retirement. Mainly, these include the measures aimed at particular activities and social groups including special arrangements for unpaid care, unemployment, conscripts, students, etc., but also the supplementary occupational pension plans which are obligatory from 2006 because their simulation within the structural model of health and retirement is impossible.

4.1. Implications for labour market participation

The following discussion is based on seven simulation sets which are chosen from the total of fifteen combination of five accrual models (including the current setting) and three hypothetical AFP reformations:

- Simulation set 1 presents the effects of the incentive distortions correction in the old age pension only. Both AFP scheme and the pension accrual model are unchanged.
- Simulation set 2 presents the effects of the incentive distortions correction in the old age pension system combined with complete elimination of the early retirement (AFP) scheme. Accrual model is kept unchanged.
- Simulation set 3 implements the hypothetical correction of the AFP setting together with the incentives corrected old age pensions. Accrual model is again unchanged.
- Simulation set 4 is similar to the set 3, but implements the Pension Commission pension accrual model.
- Simulation set 5 is the same, but implements the Storting Model B accrual model.
- Simulation set 6 is the same, but implements the Storting Model D accrual model.
- Finally, simulation set 7 is also similar to the set 3, but implements the final Governmental accrual model.

During all of the simulations the parameters of the preferences and the parameters of the transition probabilities are fixed at the estimated in (Iskhakov, 2008b) levels. For a given simulation the model is slightly modified to incorporate the corresponding policy elements, and the new value function and optimal decision rule δ^* are calculated using backward induction. The simulation each of the total of 1000[z] individuals is then started from the initial

[z] Which is enough for the desired accuracy in the calculation of fractions people in different labour market states.

conditions at period T_0 which are randomly chosen from the first period of observations[aa]. The value of the state vector at T_0+1 is simulated by a random draw from the controlled transition probability distribution $p(s_{T_0+1} \mid s_{T_0}, d_{T_0})$ where d_{T_0} is derived from the initial labour market state. The (optimal) decision d_{T_0+1} at T_0+1 is found using the computed optimal decision rule δ^*. This process is then repeated for T_0+2 and so on until the last period T is reached. The recorded sequences of the realized state variables and decisions for each of 1000 individuals form the simulated data set which is then used for calculation of the aggregated characteristics (such as welfare, inequality or fraction of the occupied labour market states) or for analysis on the individual level. In order to clean the simulations from the random noise and thus to expose the slightest changes induced by the policies, the sequence of pseudo-random numbers utilized in the random draws is kept identical across the simulations.

Table 4 gives a complete overview of the labour market implications of the performed simulations. The changes in fractions of the individuals occupying different labour market states (compared to the prior to policy change simulated fractions) are reported by age for all seven simulation sets.

The first result of the simulations which is very clear from Table 4 is the absence of the seen dynamic effects of the policies. Neither of the simulation sets indicate long term behavioural adjustments – the reaction is only present in the years when the distribution of potential incomes among the labour market states was actually modified by the policies. This may be due to three aspects. First, the saving process which is left out of the scope of the model could give potential for some “blurring” of the effects. Second, since the simulations rely on the historical wage histories there is no room for long term labour supply adjustment, in other words the pension level and the attached stimuli are fixed in the simulation. Third and probably the most straightforward explanation is due to the fact that the adjustment is directed from less pension to more work in all the simulation sets[bb] and therefore takes place in the ages when the pension is first time feasible. In this sense, a greater dynamic effect may have been observed after the age of 70 if the model included more time periods.

[aa] Unobserved initial health is randomly distributed with the distribution following from the assumption of certain good health at the age of 49.

[bb] Strictly speaking, except the first one which is however very similar.

Table 4. Changes in labour market occupation fractions in different simulation sets.

Age	60	61	62	63	64	65	66	67	68	69	70
Set 1: Incentives corrected old age pension with current AFP and accrual											
1 OLM	0	0	-0,01961	-0,02391	-0,02634	-0,02885	-0,03152	0,00000	0,00000	0,00000	0
2 Pension	0	0	0,16512	0,19751	0,18862	0,16026	0,09348	-0,19231	-0,22974	-0,22851	0
3 DI	0	0	-0,01858	-0,02911	-0,03056	-0,03098	-0,02935	0,00000	0,00000	0,00000	0
4 Unemp	0	0	0,00000	0,00000	-0,00316	-0,00107	-0,00109	0,00110	0,00222	0,00452	0
5 nAFP	0	0	-0,11455	-0,11954	-0,10011	-0,08761	-0,07717	0,07802	0,10211	0,09842	0
6 nAFP DI	0	0	0,00000	-0,00936	-0,00738	-0,00855	-0,01196	-0,01209	-0,00777	-0,00452	0
7 AFP	0	0	-0,01238	-0,01351	-0,01581	0,00214	0,06522	0,13516	0,13651	0,13009	0
8 AFP DI	0	0	0,00000	-0,00208	-0,00527	-0,00534	-0,00761	-0,00989	-0,00333	0,00000	0
Set 2: Incentives corrected old age pension with current accrual and eliminated AFP											
1 OLM	0	0	-0,01961	-0,02391	-0,02634	-0,02885	-0,03152	0,00000	0,00000	0,00000	0
2 Pension	0	0	-0,13932	-0,17983	-0,23288	-0,27137	-0,34565	-0,63077	-0,67148	-0,59729	0
3 DI	0	0	-0,01858	-0,02911	-0,03056	-0,03098	-0,02935	0,00000	0,00000	0,00000	0
4 Unempl	0	0	0,00206	0,00416	0,00211	0,00534	0,00761	0,00769	0,00999	0,01697	0
5 nAFP	0	0	0,01135	0,02287	0,04320	0,05983	0,06957	0,22747	0,24972	0,21041	0
6 nAFP DI	0	0	0,00000	0,00000	0,00105	0,00321	0,00652	0,00879	0,01554	0,02149	0
7 AFP	0	0	0,16409	0,20062	0,23077	0,24359	0,29674	0,35714	0,34739	0,28733	0
8 AFP DI	0	0	0,00000	0,00520	0,01264	0,01923	0,02609	0,02967	0,04883	0,06109	0
Set 3: Incentives corrected old age and AFP pension with current accrual											
1 OLM	0	0	-0,01961	-0,02391	-0,02634	-0,02885	-0,03152	0,00000	0,00000	0,00000	0
2 Pension	0	0	-0,13209	-0,15593	-0,18335	-0,20299	-0,27609	-0,56154	-0,60155	-0,55090	0
3 DI	0	0	-0,01858	-0,02911	-0,03056	-0,03098	-0,02935	0,00000	0,00000	0,00000	0
4 Unempl	0	0	0,00206	0,00416	0,00211	0,00534	0,00543	0,00769	0,00999	0,01584	0
5 nAFP	0	0	0,00413	0,00208	0,00421	0,00962	0,02935	0,18681	0,20755	0,18891	0
6 nAFP DI	0	0	0,00000	0,00000	0,00105	0,00214	0,00217	0,00330	0,00888	0,01471	0
7 AFP	0	0	0,16409	0,19751	0,22023	0,22650	0,27717	0,33736	0,32963	0,27489	0
8 AFP DI	0	0	0,00000	0,00520	0,01264	0,01923	0,02283	0,02637	0,04550	0,05656	0
Set 4: Incentives corrected old age and AFP pension with Pension Commission accrual model											
1 OLM	0	0	-0,01961	-0,02391	-0,02634	-0,02885	-0,03152	0,00000	0,00000	0,00000	0
2 Pension	0	0	-0,13106	-0,15073	-0,16754	-0,17308	-0,24565	-0,53187	-0,57159	-0,52715	0
3 DI	0	0	-0,01858	-0,02911	-0,03056	-0,03098	-0,02935	0,00000	0,00000	0,00000	0
4 Unempl	0	0	0,00206	0,00416	0,00211	0,00534	0,00543	0,00769	0,00999	0,01584	0
5 nAFP	0	0	0,00310	-0,00312	-0,00316	0,00214	0,01957	0,17582	0,19645	0,18213	0
6 nAFP DI	0	0	0,00000	0,00000	0,00105	0,00214	0,00217	0,00330	0,00888	0,01357	0
7 AFP	0	0	0,16409	0,19751	0,21180	0,20513	0,25761	0,31978	0,31521	0,26471	0
8 AFP DI	0	0	0,00000	0,00520	0,01264	0,01816	0,02174	0,02527	0,04107	0,05090	0
Set 5: Incentives corrected old age and AFP pension with Storting accrual model B											
1 OLM	0	0	-0,01961	-0,02391	-0,02634	-0,02885	-0,03152	0,00000	0,00000	0,00000	0
2 Pension	0	0	-0,13209	-0,15281	-0,17492	-0,18269	-0,25543	-0,54176	-0,58158	-0,53620	0
3 DI	0	0	-0,01858	-0,02911	-0,03056	-0,03098	-0,02935	0,00000	0,00000	0,00000	0
4 Unempl	0	0	0,00206	0,00416	0,00211	0,00534	0,00543	0,00769	0,00999	0,01584	0
5 nAFP	0	0	0,00413	-0,00104	0,00105	0,00534	0,02391	0,18022	0,20089	0,18552	0
6 nAFP DI	0	0	0,00000	0,00000	0,00105	0,00214	0,00217	0,00330	0,00888	0,01357	0
7 AFP	0	0	0,16409	0,19751	0,21496	0,21047	0,26196	0,32418	0,31853	0,26810	0
8 AFP DI	0	0	0,00000	0,00520	0,01264	0,01923	0,02283	0,02637	0,04329	0,05317	0
Set 6: Incentives corrected old age and AFP pension with Storting accrual model D											
1 OLM	0	0	-0,01961	-0,02391	-0,02634	-0,02885	-0,03152	0,00000	0,00000	0,00000	0
2 Pension	0	0	-0,13209	-0,15489	-0,18230	-0,19658	-0,26957	-0,55495	-0,59489	-0,55430	0
3 DI	0	0	-0,01858	-0,02911	-0,03056	-0,03098	-0,02935	0,00000	0,00000	0,00000	0
4 Unempl	0	0	0,00206	0,00416	0,00211	0,00534	0,00543	0,00769	0,00999	0,01584	0
5 nAFP	0	0	0,00413	0,00104	0,00316	0,00855	0,02826	0,18571	0,20644	0,18891	0
6 nAFP DI	0	0	0,00000	0,00000	0,00105	0,00214	0,00217	0,00330	0,00888	0,01471	0
7 AFP	0	0	0,16409	0,19751	0,22023	0,22115	0,27174	0,33187	0,32408	0,27828	0
8 AFP DI	0	0	0,00000	0,00520	0,01264	0,01923	0,02283	0,02637	0,04550	0,05656	0
Set 7: Incentives corrected old age and AFP pension with final Governmental accrual model											
1 OLM	0	0	-0,01961	-0,02391	-0,02634	-0,02885	-0,03152	0,00000	0,00000	0,00000	0
2 Pension	0	0	-0,12693	-0,14345	-0,15490	-0,15598	-0,22826	-0,51429	-0,55383	-0,51471	0
3 DI	0	0	-0,01858	-0,02911	-0,03056	-0,03098	-0,02935	0,00000	0,00000	0,00000	0
4 Unempl	0	0	0,00206	0,00416	0,00211	0,00534	0,00543	0,00769	0,00999	0,01584	0
5 nAFP	0	0	-0,00103	-0,01040	-0,00948	-0,00321	0,01522	0,17143	0,19312	0,17647	0
6 nAFP DI	0	0	0,00000	0,00000	0,00105	0,00214	0,00217	0,00330	0,00888	0,01357	0
7 AFP	0	0	0,16409	0,19751	0,20548	0,19444	0,24565	0,30769	0,30189	0,25905	0
8 AFP DI	0	0	0,00000	0,00520	0,01264	0,01709	0,02065	0,02418	0,03996	0,04977	0

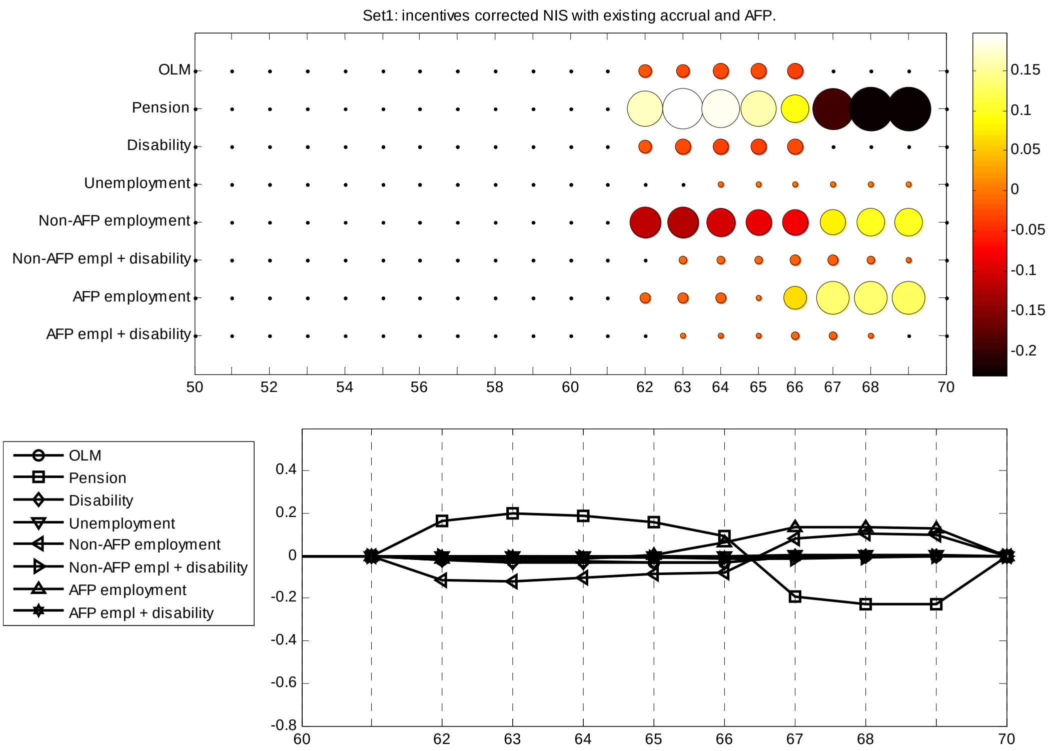

Figure 13. Labour market implications of the policy simulations for simulation set 1.

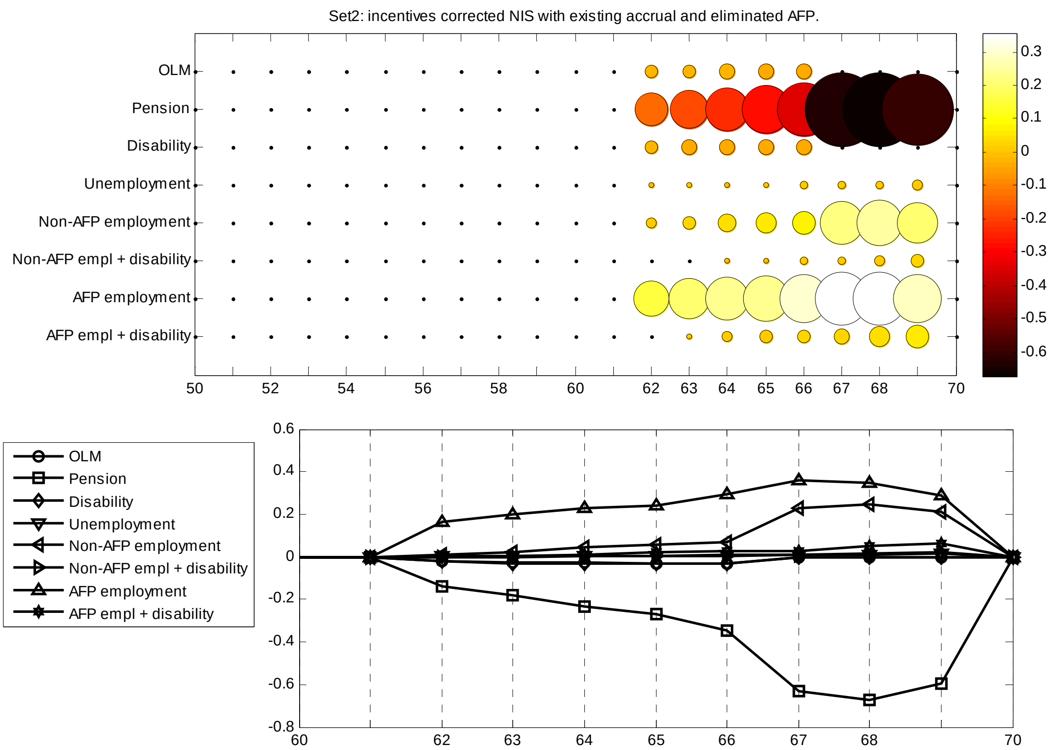

Figure 14. Labour market implications of the policy simulations for simulation set 2.

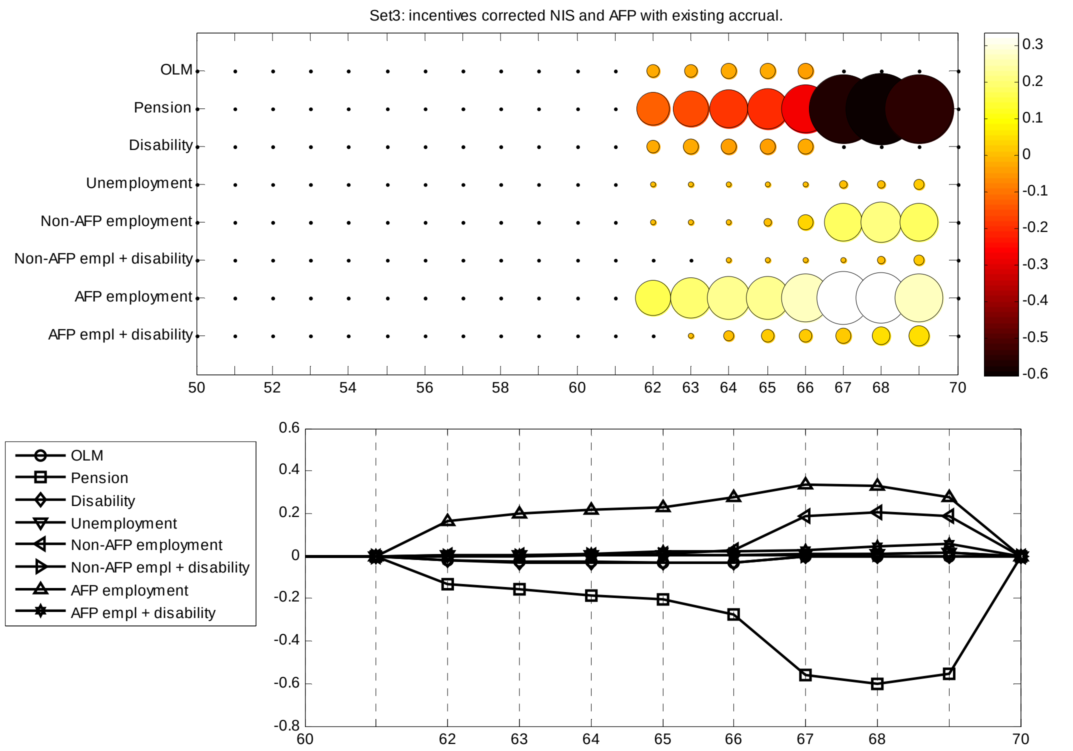

Figure 15. Labour market implications of the policy simulations sets 3 to 7 (changes in fractions of the occupied states between the pre- and post-policy simulations).

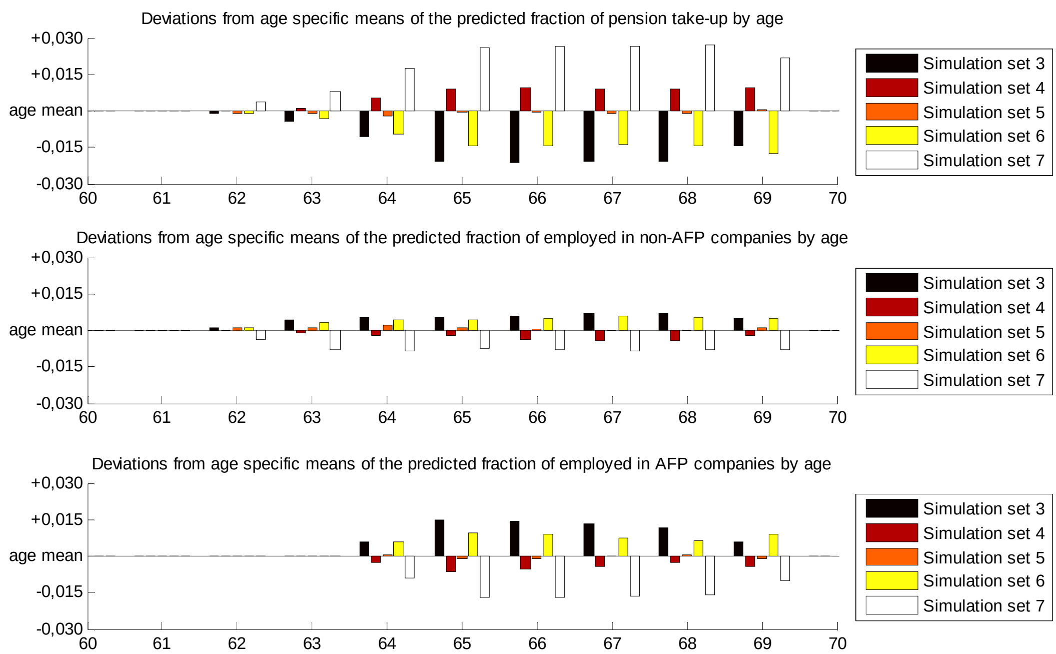

Figure 16. Comparison of the five pension accrual models with respect to selected labour market outcomes (pension, employment in non-AFP and AFP companies).

The simulation results in all the simulation sets indicate the substantial increase in labour supply between ages 62 and 69 which is accompanied with drastic reduction in the number of pensioners. The set 1, however, substantiates the argument that the AFP scheme must be taken into the common framework of ensuring the distortions free retirement decision. If the distortions caused by the present setup of the early retirement scheme are left in place (set 1), the outcome of the reform simulation is quite different from the rest of the simulation sets. Figure 13 displays the corresponding part of Table 4 graphically. The AFP eligible individuals facing the unchanged AFP pension at ages between 62 and 66 are offered additional benefits from the corrected old age pension and therefore prefer to retire earlier more often. In the same time, the rest of the labour force is effected by the introduced pension profile and postpone their retirement after 67 which brings the take up rates in this period down. Combined, these two tendencies produces a sort of a “butterfly” pattern in the lower graph. The maximum absolute magnitude of the implied redistribution among the labour market states is around 23 percent points.

Numerical results for the simulation set 2 are presented graphically in Figure 14 indicating a drastic change of the implied effects compared to the precious simulation set. When the distortions corrected pension system is combined with complete elimination of the AFP scheme and the distortions caused by it, the effect of the pension reform is given by a substantial shift of the otherwise retired individuals back to employment. In the period of early retirement the reduced retirement naturally corresponds to the increased employment at the AFP companies whereas after 67 the workers at the non-AFP companies also contribute to the overall redistribution. The maximum absolute changes of over 67 percentage points (in the reduction of retirement at 68) should be interpreted as a consequence of radical income reduction implied by the elimination of the AFP. Still, after the age of 68 employment and retirement lines (at the lower graph in Figure 14) start to converge again indicating the bounds of the magnitude of the policy implications. Compared to the three most affected labour market states (pension and two kinds of employment), the changes in the simulated fractions of the rest (observed in the upper graph in Figure 14) appear to be of a minor scale.

Figure 15 displays the simulation results for the simulation set 3 when the AFP scheme is transformed to a distortion free form under the assumptions described in the previous section. The main change from the simulation set 2 is a mild reduction of the magnitudes of the effects (about 5 percent points negative correction of the pension take up and about 1,5 percent points positive correction for the rest of the labour market states) in spite of the fact that the hypothetical new AFP arrangement assigns the AFP eligible individuals with additional benefits (which may result in a considerable consumption shock at 66 if the retirement is postponed beyond this age). This provides an indication that the income effect with respect to the labour supply at the considered ages is rather small – additional income and consumption assigned to nearly randomly chosen part of the labour force hardly alters the outcome of their decision making.

Simulations of the effects of the different pension accrual models for the labour market outcomes constitute a second layer of the simulation results which are numerically of a much smaller scale. These simulations show that the large shifts from retirement to employment (when compared to the initial pre-reform simulation) are provided by the incentives corrected pension profiles while various accrual models provide the means of the fine tuning the implied effects. The graphs similar to Figure 15 drawn for the simulation sets 4 to 7 are visually undistinguishable from Figure 15 itself and omitted. Instead Figure 16 compares the predicted fractions of pension and employment (both at AFP and non-AFP companies) induced by the simulation sets 3 to 5. To make the sets better distinguishable, the bars indicate deviations from the age specific means of the predicted fractions. The largest deviations (not exceeding 3 percent points) are observed for the pension state at the ages between 65 and 68, deviations of about 1.5 percent point correspond to the employment states while for the rest of the labour market states they do not significantly differ from zero. Yet, while different accrual mechanisms have rather limited variability and impact on the labour market outcomes, the models can be ranked in their relation to the existing pension system. Storting model D (set 6) appears to be the closest to the current setting, Storting model B (set 5) leads roughly to the mean impact for the labour market outcomes, Pension Commission accrual model (set 4) deviates further, and at last the final Governmental accrual (set 7) model deviates by as much as 4.78 percent points in pension, 3.21 percent points in AFP and 1.54 percent points in non-AFP employment (also by 0.11 and 0.68 percent points in employment combined with disability).

The direction of the deviations of the set 7 frequencies indicates further mitigating of the effects of the pension reform when compared to set 3 and set 2. Compared to Figure 15 the reduction in pension take up is slightly decreased as well as the increase in employment in both AFP and non-AFP companies is slightly decreased. The final frequencies simulated for the simulation set 7 indicate that under the new policy of incentives corrected early retirement and old age pension, and the final Governmental accrual model only 5.26% of the labour force is retired at age 62 (17.96% before the reform) and only 20.33% at the age of 67 (71.76% before the reform). Overall about $\frac{2}{3}$ of the retirees remain working at each age after 62. Even though the results of the simulation may be somewhat exaggerated due to the steep pension profiles which are calculated with a unified market interest rate, it can be concluded that the pension reform definitely succeeds in providing the old age workers with motivation to stay longer in the labour force, and that correcting for incentives distortions has almost the same behavioural effect as complete abolishing of the early retirement program.

4.2. Implications for welfare and income inequality

Besides the labour market states the simulation technique described in the previous sections allows for simulation of all the state and decision variables for the simulated 1000 individuals, and thus also for assessment of some of the aggregate measures implied by the simulated behavior. This section is devoted to the analysis of the simulated values of two such measures – the social surplus which gives ground for welfare calculation and the total household disposable income which serves as the basis for calculation of the implied income inequality. As described in sections 2.1 and 2.3, both the government and the Storting consider these two aspects to be particularly important in the design and the implementation of the Norwegian pension reform.

For the purpose of this study I identify the social welfare with the social surplus calculated as the sum of individual consumer surpluses, each of which is represented by the expected maximum of the random utility function (29) in the current point of the state space (McFadden, 1981). Under the distributional assumptions made for the random component ε_t of the utility, the consumer surplus in the decision problem (1) is given by

$$CS(s_t) = E_\varepsilon\left(\max_{d_t \in D(s_t)} U(d_t, s_t)\right) = \log\left(\sum_{d_t \in D(s_t)} \exp\big(u(d_t, s_t)\big)\right). \tag{39}$$

(McFadden, 1999) shows that when the utility function is linear in income, the scaled difference of the consumer surpluses (39) before and after the policy change calculated for a representative consumer coincides with the mean willingness to pay in the whole population of the consumers, and thus represents an ultimate welfare measurement. In the current setting with concave utility function (36), these conditions are clearly not satisfied, and the welfare measurement based on the consumer surplus (39) can only be considered as an approximation. Nevertheless, such approximation is plausible because with the estimated coefficient of constant relative risk aversion (0.32607, see section 3.1) the utility of income could roughly be represented with a linear function[cc], and furthermore, because the calculation of social welfare is based on the whole population of the simulated consumers.

Formally, the welfare implications of the Norwegian pension reform are judged with the following welfare change function.

$$\begin{aligned}\Delta W = W^1 - W^0 &= \sum_{a=1}^{A} \sum_{t=T_0^a}^{T^a} \beta^{t-T_0} CS(s_t^{a,1}) - \sum_{a=1}^{A} \sum_{t=T_0^a}^{T^a} \beta^{t-T_0} CS(s_t^{a,0}) \\ &= \sum_{a=1}^{A} \sum_{t=T_0^a}^{T^a} \beta^{t-T_0} \left(CS(s_t^{a,1}) - CS(s_t^{a,0}) \right),\end{aligned} \tag{40}$$

where the simulation of $A = 1000$ household before and after the policy change yield the simulated data sets $\{s_t^{a,0}, d_t^{a,0}\}_{a=1,..,A;t=T_0^A,..,T}$ and $\{s_t^{a,1}, d_t^{a,1}\}_{a=1,..,A;t=T_0^A,..,T}$ representing the states occupied by the these households and the decisions taken by them correspondingly before and after the policy change. Individual social surpluses are discounted with the estimated discount factor $\beta = 0.91235$ (see section 3.1) while the events of deaths of the decision makers are simulated explicitly redefining the termination age T^a as the minimum between 70 and the simulated age of death. The initial ages T_0^a are drawn on random from the observed sample along with the rest of the initial conditions. It should be noted that the simulated decisions $d_t^{a,\bullet}$ are used in (40) implicitly for the simulation of the next period states $s_{t+1}^{a,\bullet}$ while the consumer surplus is calculated for each individual at each age independently in accordance to (39).

The upper half of Table 5 displays the numerical result of the welfare analysis. Here the changes in total welfare ΔW when moving from the existing pension system to one of the sets of the new policies are presented by age[dd]. Figure 17 and Figure 18 plot these changes. Similar to the effects on the labour market outcomes, implications for the welfare can be naturally separated into large and small which differ by approximately the order of one.

[cc] In fact, the correlation coefficient between the sequence of incomes counted up to 0.1 on the interval from 0 to *X* and the sequence of corresponding utilities exceeds 98% and approaches 99.25% when *X* is large.

[dd] The unit of measurement for these numbers can only be interpreted nominally as an imaginary measure of expected utility.

Large scale effects are due to the introduction of pension profiles and freeing the retirement decision from incentives distortions and are plotted in Figure 17. Small scale effects are due to the different accrual models used for pension calculations and are plotted separately in Figure 18 as deviations from the age specific means which represent the small scale effects in Figure 17.

Table 5. Changes in predicted welfare and inequality in different simulation sets[ee].

Age	60	61	62	63	64	65	66	67	68	69	70	
Changes in welfare (total social surplus)												Total[ff]
Set 1	0	0	458,40	337,67	287,64	284,18	268,07	-15,69	97,09	131,49	23,46	1872,32
Set 2	0	0	439,41	499,76	484,97	493,22	469,98	210,87	342,48	364,55	98,87	3404,10
Set 3	0	0	442,27	501,95	485,25	493,18	523,27	179,50	309,88	333,72	90,85	3359,87
Set 4	0	0	442,65	501,89	482,71	487,68	508,92	165,08	295,01	318,33	91,93	3294,19
Set 5	0	0	442,53	502,53	483,99	489,40	512,09	168,32	296,20	318,96	89,55	3303,57
Set 6	0	0	442,48	502,38	485,37	493,87	520,84	177,83	306,68	330,02	99,27	3358,73
Set 7	0	0	443,07	500,31	480,51	483,92	504,78	159,69	289,82	313,85	98,14	3274,08
Changes in inequality (difference between the top and bottom deciles of the income distribution, 1000NOK1992)												Mean
Set 1	0	0	48,60	4,00	-4,00	0,30	4,50	38,00	137,20	154,00	527,00	82,69
Set 2	0	0	20,20	25,60	45,20	39,50	41,50	41,00	88,60	252,10	532,00	98,70
Set 3	0	0	24,60	38,70	49,60	27,30	268,00	51,50	130,40	275,70	557,90	129,43
Set 4	0	0	25,00	43,00	49,60	24,50	265,50	48,50	145,20	267,10	635,70	136,74
Set 5	0	0	24,60	39,70	49,20	25,40	264,50	50,50	141,60	277,20	579,00	131,97
Set 6	0	0	24,60	38,70	49,60	27,30	268,50	52,50	134,40	260,40	597,80	132,16
Set 7	0	0	27,20	44,70	47,80	22,40	264,00	41,50	147,20	255,30	668,00	138,01

As it follows from the last column of Table 5 and from Figure 17, the change in social welfare implied by the pension reform is positive almost everywhere. This results is quite anticipated because as the pension reform proposals aim at expansion of the choice sets faced by the decision maker, consequently the utility maximized on these larger sets should not decrease. The only negative change in welfare is predicted in the simulation set 1 at the age of 67. In whole, the elimination of the incentives distortions in the old pension system alone (leaving the AFP pension in place) leads to such a distorted behavioural response to the pension reform that in all ages except 62 the welfare increase is smaller compared to the other simulation sets. Intuition under this rather interesting result hinges on the fact that the consumer surplus (39) is dependent on the number of alternatives in the choice set, and thus when myopic agents prefer higher current income (AFP benefit at 62) to the wider choice set next period, they end up with lower future welfare[gg]. The fact that the simulation set 2 leads

[ee] Similar to labour market implications, both welfare and inequality effects are located at the ages when the income sources are directly affected.

[ff] Discounted to age 60 with the estimated discount factor.

[gg] If instead of consumer surplus I compare attained levels of utility, the simulation set 1 yields overperforms the other simulation sets at ages before 67 and leads to greater losses after 67, thus indicating myopic behavior.

to a greater increase in welfare compared to the average of the sets 3 to 7 after the age of 67 can also be explained by the implied wider choice sets faced by the still working agents (see Table 4) at these ages. . At the age of 66 the sudden increase in consumption experienced by the AFP eligible individuals (which is the artefact of the current simulation) clearly shows under the incentives free AFP simulations sets 3 to 7.

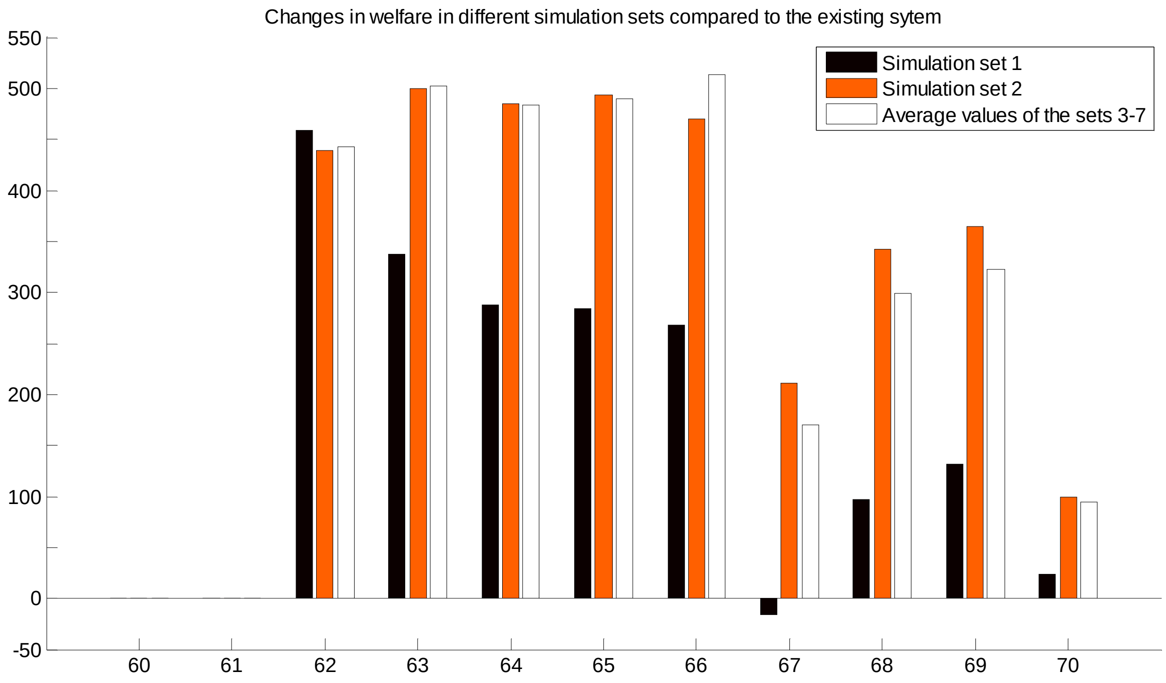

Figure 17. Welfare implications of the pension reform (large scale effects)[hh].

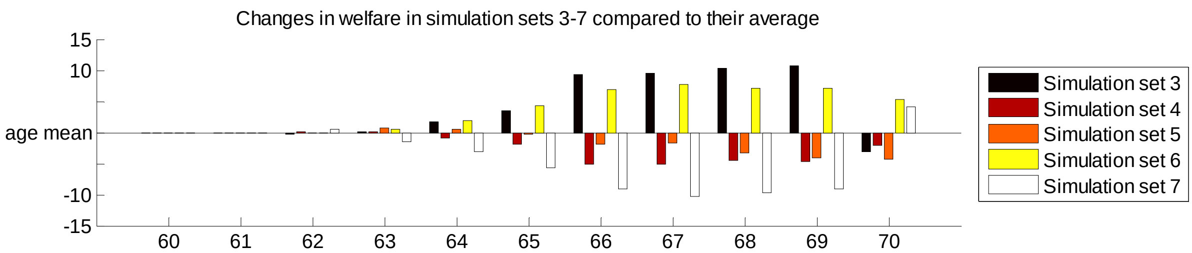

Figure 18. Differences among the simulation sets 3 to 7 with respect to the welfare implications (small scale effects).

The comparison of the small scale effects on the welfare induced by the different pension accrual models (simulation sets 3 to 7, Figure 18) does not reveal any particular patterns except the increase of their variability around ages 67-68.

[hh] Vertical scales in this and the next figure are given for comparison only as they can hardly be interpreted.

Table 6. Welfare analysis on the individual level.

Age	60	61	62	63	64	65	66	67	68	69	70
Losers: 6% of households with negative changes in discounted social surplus (average -289.54)											
Change in welfare	0,00	0,00	160,43	45,48	-131,27	-118,65	-73,95	-234,68	-108,35	-110,20	-63,20
Before reform incomes	292,98	284,72	255,38	252,26	249,65	223,59	218,54	220,16	242,00	249,68	222,59
After reform incomes	292,98	284,72	244,17	179,66	189,95	195,63	297,35	169,88	64,85	58,16	52,24
% of healthy (h=0)	88,3	86,7	81,7	61,7	51,7	46,7	35,0	33,3	25,0	25,0	20,0
% of job loss (m=0)	5,0	3,3	1,7	*23,3*	*45,0*	*45,0*	*41,7*	*41,7*	*33,3*	*31,7*	*28,3*
% of full households	68,3	66,7	61,7	63,8	65,0	62,5	61,5	48,0	40,0	31,6	23,5
% of AFP eligible	0,0	0,0	63,3	72,3	100,0	100,0	100,0	0,0	0,0	0,0	0,0
OLM (%)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pension (%)	0,0	0,0	20,0	57,4	67,5	84,4	96,2	100,0	100,0	100,0	100,0
Disability (%)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Unemployement (%)	5,0	3,3	1,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
nAFP employment (%)	26,7	26,7	18,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
nAFP empl + DI (%)	0,0	0,0	0,0	0,0	2,5	0,0	0,0	0,0	0,0	0,0	0,0
AFP employment (%)	56,7	56,7	41,7	25,5	15,0	9,4	0,0	0,0	0,0	0,0	0,0
AFP empl + DI (%)	11,7	13,3	18,3	17,0	15,0	6,3	3,8	0,0	0,0	0,0	0,0
Even: average change in discounted social surplus 15.39, income level (aw at 60) 271,87											
Change in welfare	0,00	0,00	4,05	2,58	5,21	-2,89	23,76	-12,21	-0,73	-0,61	4,05
% of healthy (h=0)	41,4	28,6	*3,6*	*2,9*	*2,1*	*2,1*	*2,1*	*1,4*	*1,4*	*1,4*	*1,4*
% of job loss (m=0)	2,1	1,4	0,0	0,0	0,0	1,4	1,4	2,1	2,1	2,1	2,1
% of full households	53,2	44,8	45,5	36,4	31,8	18,2	18,2	11,1	5,9	0,0	0,0
% of AFP eligible	0,0	0,0	86,4	90,9	90,9	100,0	100,0	0,0	0,0	0,0	0,0
OLM (%)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pension (%)	0,0	0,0	0,0	0,0	9,1	9,1	9,1	16,7	17,6	27,3	100,0
Disability (%)	1,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Unemployement (%)	2,5	3,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
nAFP employment (%)	24,1	22,4	9,1	9,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0
nAFP empl + DI (%)	3,8	3,4	0,0	0,0	0,0	0,0	9,1	11,1	11,8	0,0	0,0
AFP employment (%)	46,8	43,1	13,6	9,1	4,5	4,5	4,5	0,0	0,0	0,0	0,0
AFP empl + DI (%)	21,5	27,6	*77,3*	*81,8*	*86,4*	*86,4*	*77,3*	*72,2*	*70,6*	*72,7*	0,0
Winners: average change in discounted utility 289,03, income level (aw at 60) 277,43											
Change in welfare	0,00	0,00	355,92	495,04	459,06	652,02	828,13	618,96	894,91	822,54	174,26
% of healthy (h=0)	*100,0*	*100,0*	*100,0*	*100,0*	*100,0*	*99,0*	*98,0*	*95,0*	*89,0*	*72,0*	*63,0*
% of job loss (m=0)	3,0	3,0	3,0	2,0	2,0	3,0	5,0	5,0	3,0	5,0	13,0
% of full households	51,0	48,0	46,0	42,0	35,0	32,0	25,0	23,0	20,0	18,8	17,1
% of AFP eligible	0,0	0,0	27,0	36,0	58,0	63,0	67,0	0,0	0,0	0,0	0,0
OLM (%)	1,0	1,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pension (%)	0,0	0,0	0,0	1,0	1,0	1,0	1,0	1,0	1,0	12,9	100,0
Disability (%)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Unemployement (%)	2,0	2,0	2,0	1,0	1,0	2,0	4,0	4,0	2,0	4,7	0,0
nAFP employment (%)	*38,0*	*35,0*	*33,0*	*33,0*	*27,0*	*26,0*	*32,0*	*27,0*	*29,0*	*28,2*	0,0
nAFP empl + DI (%)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	3,0	5,9	0,0
AFP employment (%)	*59,0*	*62,0*	*64,0*	*65,0*	*71,0*	*70,0*	*61,0*	*63,0*	*57,0*	*38,8*	0,0
AFP empl + DI (%)	0,0	0,0	0,0	0,0	0,0	1,0	2,0	4,0	8,0	9,4	0,0

Notation for the labour market states: OLM=out of labour, OLM=out of labour, nAFP=employment in non-AFP companies, nAFP+DI=employment in non-AFP companies combined with disability, AFP=employment in AFP companies, AFP+DI=employment in AFP companies combined with disability.

Table 6 illustrates the results of a short analysis of the welfare implications induced by the simulation set 7 on the individual level and yields the answer to the question who gains and who looses from the new policy. The table presents some descriptive statistics for the individuals having a negative change in discounted welfare (40), the individuals with no or small positive change (corresponding to the first decile in the simulated distribution of the changes in the discounted welfare), and individual from the tenth decile in this distribution.

Table 6 reveals the systematic differences in these three groups of correspondingly winners, even breakers and losers in the Norwegian pension reform. The first result clearly indicated by Table 6 is that the initial income level does not differ much among the three groups, on the contrary, its slight variability displays negative correlation with the welfare change. The differences among the three groups lie in other dimensions. Those who lose welfare in the course of the reform (top part in Table 6) do so on the later ages, and this loss is accompanied by sufficient loss of income. High pension take-up rates along with high job loss rates indicate their being forced from the labour market into involuntary retirement. The second group containing the individuals whose welfare is unchanged during the reform (middle part of the table) appear to be generally unhealthy who presumably counteract the otherwise decreasing welfare by continued to the termination age partial employment combined with the disability pension. The winners of the reform (bottom part in Table 6) are clearly those healthy individuals who postpone their retirement.

The inequality is assessed in a simpler manner compared to the welfare calculation. The simulated states and decisions serve as the ground for the income predictions which results in a certain distribution across the simulated agents. The inequality coefficient is then represented by a decile range of the simulated household disposable incomes. The bottom half of Table 5 displays the numerical outcome of the simulations which is expressed in the changes by age of the decile range induced by the policies in different simulation sets. Unlike in the comparison of the welfare changes the numbers here have certain meaningful scale – they are measured in 1000 Norwegian krone in 1992 prices.

Again, the implications of the policy simulations can be separated into the large and small scale effect. Large scale effects are due to the elimination of the incentives distortions from the retirement decision and are plotted in Figure 19. As it follows from the plot, all simulations indicate an increase in income inequality with the magnitude which is also growing with age. Simulation set 3 (current pension accrual model) deviates the least from the pre-reform income distribution, although after 66 all the simulations sets exhibit very similar implications for income inequality. Rather sharp increase in the income inequality at 66 under the simulation sets 3-7 reflects the income shock experienced at this age by those AFP eligible individuals who is not yet retired at this age.

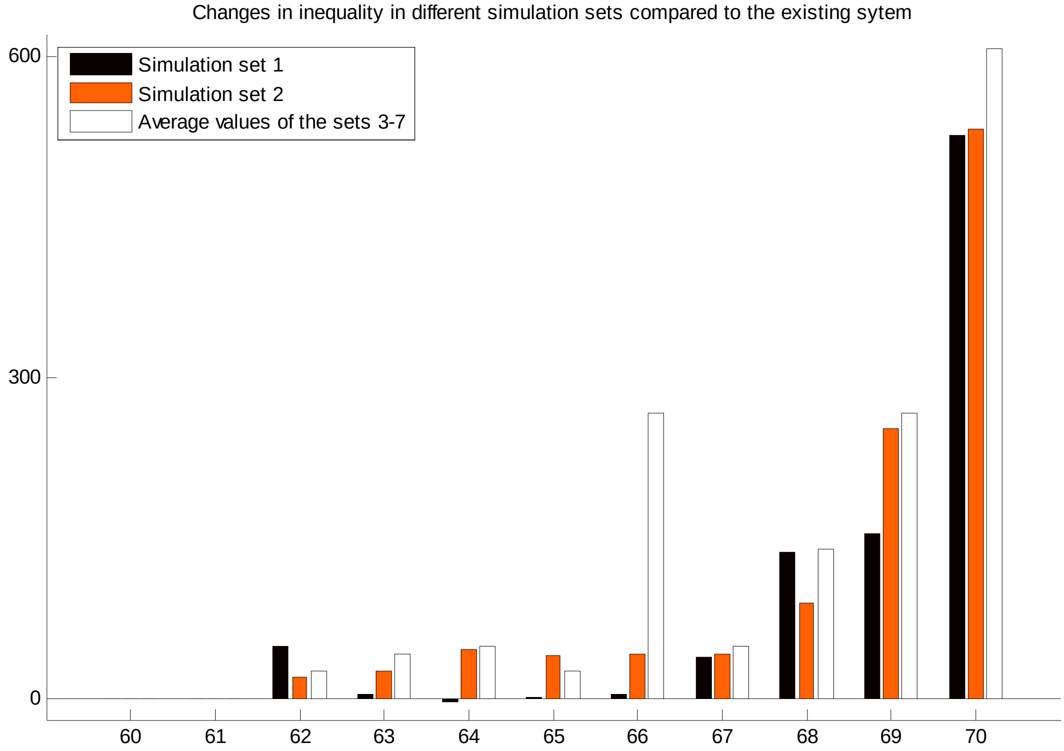

Figure 19. Inequality implications of the pension reform (large scale effects).

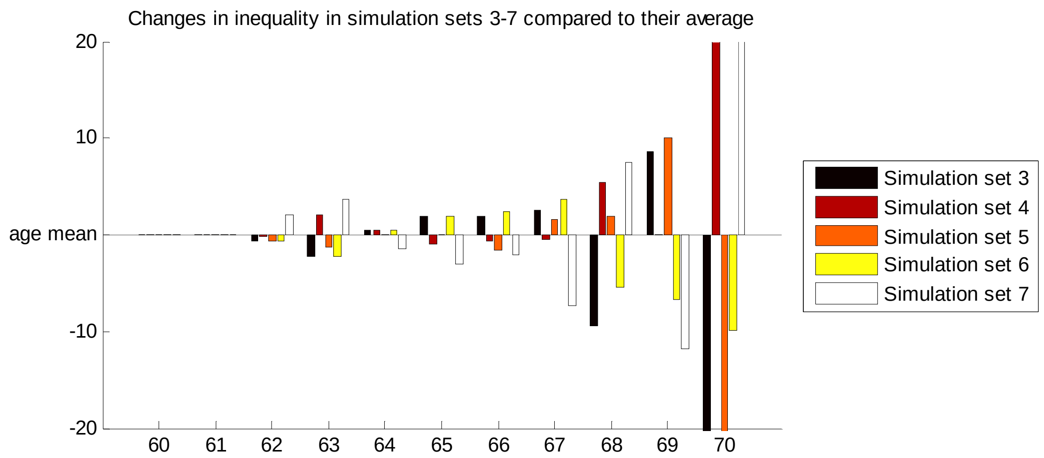

Figure 20. Differences among the simulation sets 3 to 7 with respect to the inequality implications (small scale effects).

Comparison of small scale effects on income inequality induced by the different accrual models (see Figure 20) again does not reveal any specific pattern other than the fact that magnitude of the effects grows quite substantially with age – the rich become richer while the poor become poorer. Here again simulation sets 4 and 5 (Pension Commission proposal and the Storting model B) seem to be close to the average at least in the earlier ages whereas the final Governmental model (set 7) is again deviating the most from the existing setting. The last column of Table 5 related to income inequality indicates that the most inequality increase is in fact introduced by the set 7 while set 1 is the closest to the initial simulation.

5. Conclusions

Using the structural dynamic model of health and retirement developed and estimated in (Iskhakov, 2008b), the paper simulates the effects of the Norwegian pension reform proposals through a series of policy simulations replicating the core principles of the ongoing reform. The outcomes of the simulations lead to the following main conclusions:

- The proposed pension reform succeeds in proving the older workers with the stimuli to increase labour supply by more than 40 percent points after 67 compared to the present situation.
- In addition to the increase in labour supply, the proposed pension reform leads to the pronounced increase in social welfare which can be explained by the broader choice sets available for the decision makers under the new flexible pension system.
- At the same time, growth of social welfare is accompanied with increase in income inequality, which is on anticipated when pension benefits become more closely related to wages. The final Governmental model of pension rights accrual in combination with the planned transformation of the old age pension and a hypothetic transformation of AFP result in the highest inequality among all other considered policies.

In order for these general results on labour market implications as well as implications for welfare and income inequality to be robust and predictable all elements of the new social security system must be reformed within the same proposed framework of flexible withdrawal setting with no incentive distortions as of the age of retirement. Simulations predicted very different behavioral response to a policy regime with old age pension transformed to the incentives free form while leaving the early retirement (AFP) system intact. Simulations did not include possible modifications of the existing system of occupational pensions, but there is enough evidence to suggest that the occupational pensions also have to be reformulated on the incentives free principles in order for the described effects of pension reform to hold.

Performed simulations of complete elimination of AFP system as well as assigning all AFP eligible individuals with a consumption shock at age 66 indicated that the income effect of additional pension entitlements is very limited in terms of labour market outcome although more expressed in the welfare and income inequality changes.

Different accrual models simulated in the paper induced small behavioural adjustment in labour market outcomes, welfare and income inequality. Thus, there is evidence to suggest their use only for fine tuning of the reform effects. As a consequence, no evidence is found for large responses with respect to the labour market outcomes if the previously earned pension entitlements are recalculated with the new proposed accrual models. Applying different accrual models does however lead to the set of the outcomes different in social welfare and income inequality which displays nearly proportional relationship between these two characteristics (on the chosen measurement scale).

Abbreviated analysis of the individual changes in the discounted lifetime utility lead to the conclusion that the welfare implications of the reform are to a considerable extent heterogeneous. Healthy individuals continuing to work beyond usual retirement age gain the most from the proposed pension reform while the unhealthy and displaced individuals lose from it.

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