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The Impact of a Lower School Leaving Age and a Later Retirement on the Financing of the Norwegian Public Pension System

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Abstract:
We analyse how an extended working life could affect the sustainability of the Norwegian public pension system. Particular emphasis is given to a younger school leaving age. The school reform investigated lowers the school leaving age by two years, one by compressing primary and secondary schooling and another by lowering the school entrance age. Graduating at a younger age shifts the timing of subsequent events in adulthood toward younger ages. Individuals enter the workforce earlier, initiate childbearing at a younger age and cohort fertility may increase. This is achieved with minimal losses to human capital: Swiss and Swedish evidence suggest that such variation in the length of schooling and in the school entrance age have negligible effects on adult productivity. Using a large scale, micro-based dynamic model for the Norwegian public pension system, MOSART, we find that the school reform can play a substantial role in increasing the sustainability of public pension systems.

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[1] The Document is based on parts of Skirbekk's Ph.D from Rostock University, defended February 17, 2005. The analyses with the MOSART model were carried out during a stay at Statistics Norway, September and October 2003.

Contents

Strengthening Public Pension Systems through Educational Reforms

Dependency ratios that grow rapidly in the coming years will challenge the sustainability of public pensions systems in most industrialized countries.[1] This is a particular problem for European countries with relatively generous pension systems and prospects for large increases in the size of the elderly population (Gruber and Wise 2001, UN 2001). Unless pension benefits decrease, the growing number of pension receivers will require that more contributions are paid to the pension system. One relevant policy option to achieve this, in addition to increase tax levels, is to raise the share of contributors in the economy.

In order to increase the proportion of the population that contributes to the pension system, one could attempt to extend the work life span. Increasing the age of labour market exit by raising the retirement age has been suggested as a way to achieve this (Council of Europe 2003, OECD 2002). In addition to looking at the impact of increasing the age of labour market exit, we study another approach that similar to the later retirement could increase the number of years in the labour market: whether shifting the timing of education towards younger ages and compressing school duration would decrease the age of labour market entry and ease the pension burden.

Although life expectancy has increased in recent decades, the work life in European economies has tended to become shorter. While retirement ages decreased, the labour market entry age increased. In Norway, OECD estimates suggest that the average age of transition[2] to inactivity for males dropped from 68 to 64 years in the period 1950-1995, while for women it was reduced from 69 to 62 years (Blöndahl and Scarpetta 1998). Conversely, the median age of entering full time work had, also according to OECD estimates, reached 25 years in Norway by 1996 (OECD 1999).

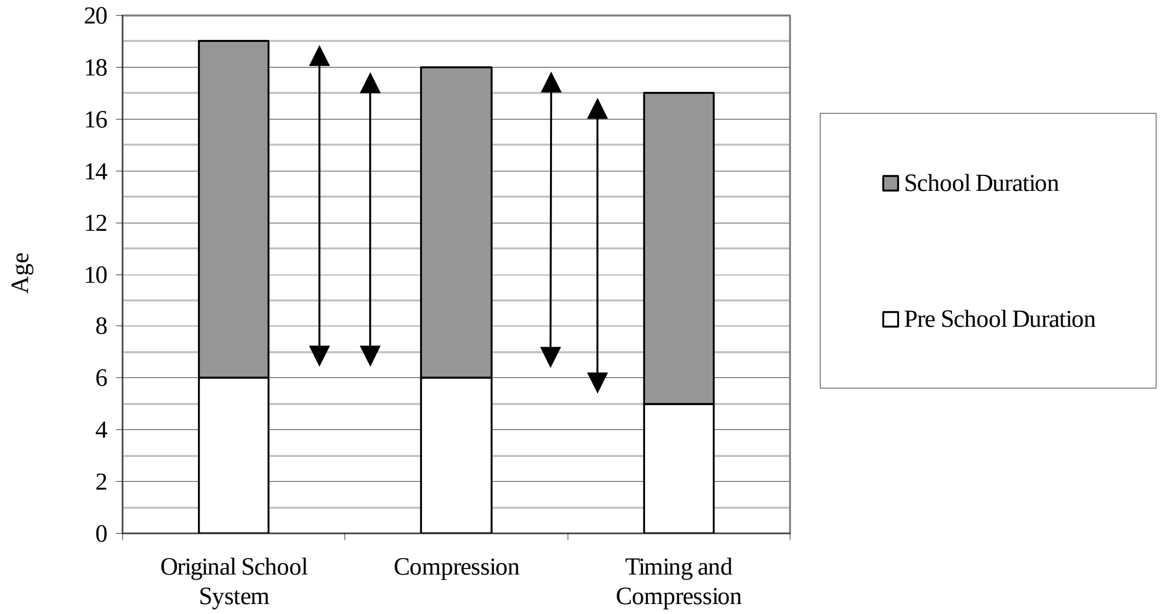
Retirement reforms represent the main way of extending the working life. However, also possibilities to extend the working life from the other end could by lowering the age of labour market entry should be investigated. The sincerity of the economic challenge and the potentially alleviating effect of such school reforms calls for an investigation into whether an accelerated school system, a school reform that lowers the age of labour market entry, can increase the stability of the public pension system. We evaluate the outcome of such a reform by projecting the development of the Norwegian public pension system using the micro-based simulation model, MOSART.

A lower school exit age is likely to extend an individual's working life. This holds true when the transition process from education to work remains largely unaffected by changes in the school graduation age. Consequently, introducing an educational reform by compressing school duration and decreasing the school entrance age, as shown in Figure 1, expands the working life duration and increases the proportion of the population that contributes to public pensions.

[1] Public pension systems based on the pay-as-you-go principle, where pensions are financed by current workers' contributions, are highly sensitive to changes in the age composition of the population. In comparison, some estimates suggest that the effects on economic growth of a change in age-composition is expected to be relatively moderate, as European annual growth per capita is projected to decline from 1.7% today to 1.1% by 2050 which would mean that per capita GDP is expected to double (Turner et al. 1998).

[2] Retirement is defined as complete withdrawal from work, as recorded in labourforce surveys.

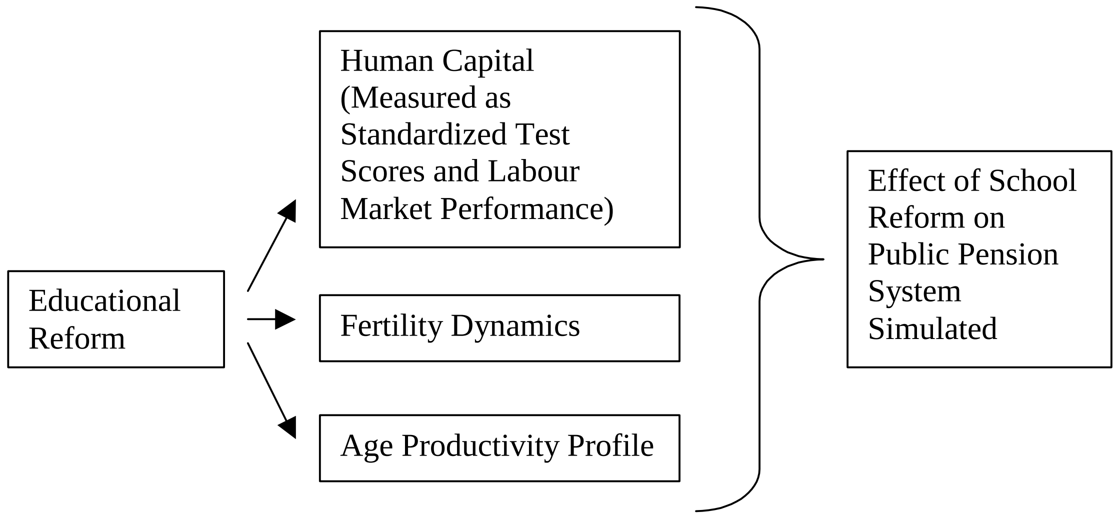
Figure 1. Outline of a school reform where the duration of primary and secondary school is compressed by one year and the timing is shifted downwards by another



A further issue relevant to the ages of entering and exiting the work life is that individuals may be more productive relatively early in their working careers (Crépon et al. 2002, Hægeland and Klette 1999, Lazear 1988). Structural changes in the labour market induced by high rates of technological change increase the demand for individuals who are able to quickly adjust and to absorb new knowledge, and these changes could favour younger individuals who tend to learn faster and to be more flexible than older persons (Autor et al. 2003, Skirbekk 2004a, Waldman and Avolio 1986). Rejuvenating the labour force by lowering the age of labour market entry could allow individuals to participate in the labour force in more of their most productive years.

In Figure 2 we outline the main issues this article focus on, the effects of a shift in the timing and duration of schooling on fertility and human capital, as well as the shape of the age-productivity profile. These findings are used to calibrate the impact the reform will have in MOSART.

Figure 2. Outline of Investigation of the Effects of a School Reform



The Norwegian School Duration and Entrance Age in Comparison with International Educational Systems

The way the school system is organised in terms of the formal age of school entry and the duration required to reach an educational degree, is the outcome of a country's traditions and historical decisions. Varying ideas on when a child is ready for school, changes to parental roles as well as new ways of organising work and family life have all influenced both the school entrance age as well as the duration of primary, secondary, and tertiary schooling in Norway (Høigård and Ruge 1947, Jørgensen 1997, Levin 1995). The Norwegian school system was, however, not designed with the current levels of educational attainment in mind, where a high share of each birth cohort pursue tertiary educations and remain in the school system at least until their mid-twenties.

Universal schooling was introduced in Norway about 250 years ago. From 1889, 7 years of compulsory education were provided and in 1969 it was raised to 9 years. The most recent extension of compulsory schooling took place in 1997 and extended mandatory education to 10 years by lowering the school entrance age from 7 to 6 years. The students now finish compulsory lower secondary school the year they turn 16, though most continue with further education. Students who complete upper secondary school after an additional 3 years in the school system graduate the year they turn 19.

The age of school entry has been lowered in some regions and countries over the last decades. In the US, in 1965 only seven states required enrolment in school below the age of 7, while in 1992, 25 states did so (U.S. Department of Health, Education and Welfare 1965, Education Commission of the States 1994). In Germany, an industry-sponsored research project proposed lowering the school entrance to 4 years, 2 years lower than the current 6 years age of school entry (Lenzen 2003). In Sweden, the rules for school entrance age have been liberalised in the 1990s. Parental choice on when children should enter school has now become more important, which has had the effect of decreasing the age of school entrance.

Several recent political attempts aim at reducing the required number of years that is needed to attain a specific educational degree. Educational reforms that cause a decrease in the school duration are either in the planning process or are already taking place in many European countries, at both the national and federal state level. In Germany, Norway and Switzerland, a shortening of the school duration is being considered. In 2001, the German Bundesland Saarland shortened primary and secondary school duration (Gymnasium) from 13 years to 12 years, and other Bundesländer are in the process of implementing similar reforms.

The relatively long school duration in Norway has led public committees to suggest compressing the Norwegian primary and secondary school duration in order to allow a younger exit age, although so far it has not taken place (NOU 1991:28, NOU 2000:21). At the tertiary level, the Bologna Declaration (1999), which aims to harmonise the duration of tertiary education in Europe, has been implemented in Norway. It had the effect that the most common Norwegian university degree, the four-year *cand.mag* degree was replaced with a three-year bachelor degree (NOU 2000:14).

The Length of Primary and Secondary School in Norway

By international standards, there seems to be scope for a shift in the duration of Norwegian education. Several countries have school systems that allow 1-2 years earlier exit from secondary school than Norway, without having a lower human capital level (Mullis et al. 1998). The reasons as to why the same human capital level can be achieved at a younger age are not well known, although the way education is organized is likely to play a role. Efficiency gaps may be caused by the weight given to different subjects in school, the role of the educational system in realizing egalitarian aims and the type of teaching strategies applied.

One reason why there is variation in within-degree school length can be that school systems with shorter durations have more intense learning schedules with more instructional hours per year. At the age of 7, Norwegian pupils receive only 570 hours of instruction per year; the EEA (European Economics Area) pupils receive around 740, while Scottish pupils receive 950 hours of instruction annually. At the age of 10, Norway’s average is 770 hours, the EEA’s average is 830 and Scotland’s average is 950 hours. In secondary education, Norway’s average is 855 hours, the EEA’s is about 900, and Scotland’s is 1045 instructional hours per year (Eurydice 2000).

A relatively later age of separation of students into practical and theoretical study tracks may also imply inefficiencies in the school system and low study progress, which can lead to unnecessarily long school durations. Braathe and Ongstad (2001) argue that the late separation age in Norway -currently Norwegian students have to choose their study track at ages 15 and 16- is intended to increase social equality but its unintended consequence is a school system that slows the study progress, decreases the amount of learning and postpones age of labour market entry.

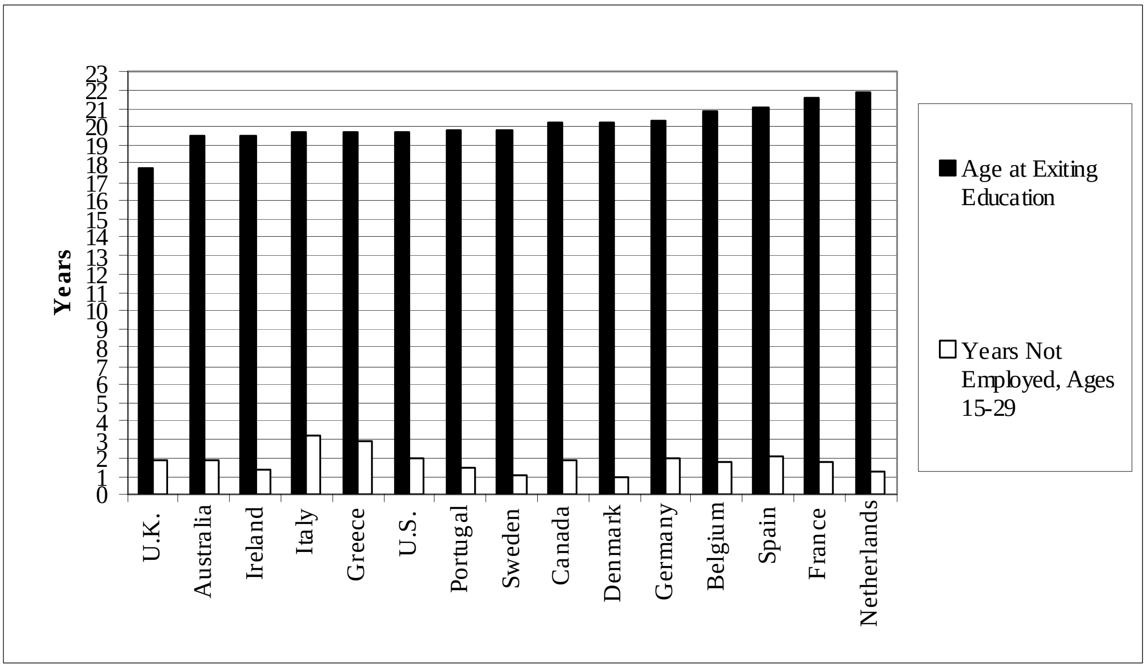
If students would enter school one year earlier and have one shorter year of schooling, they will need to make choices about specialisation 2 years earlier than has been the case up to now. They would have to choose at the ages of 13-14 whether they would continue in an academic or vocational study track, a choice they now make at the ages of 15-16. Whether this would affect the quality of their choice is uncertain. By international standards, a separation age of 13-14 is not particularly young. For example, in the Netherlands, the choice of study track is made after primary school at the age of 12; while in Germany and Austria, an important separation between academic and vocationally-oriented schooling is made already when the students are 10 years old.

School Leaving Age and the Timing of Events in Adulthood

Variation in the school leaving age can affect the timing of demographic and labour market events. Studies on the timing of events in adulthood tend to find that that individuals sequence events in adulthood according to rigid schemes, where a change in the timing of one event will affect subsequent ones. Leaving school tends to precede entrance into parenthood and labour market, and increases in the age of graduation have been associated with increases in the age of labour market entrance, age of childbearing and other events in adulthood (Blossfeld and De Rose 1992, Gustafsson 2001, Hogan 1978, Marini 1984, Rindfuss et al. 1980).

If the graduation age changes, this can alter the age of labour market entrance, the age of childbearing and the timing of other events in adulthood. International comparisons suggest that the length of the period from finishing education to entering the labour force is not affected by the age of leaving school (OECD 2003b, UNESCO 2004). Figure 3 shows that the countries' school leaving ages are not associated with years spent in inactivity.[3] In Figure 4 we observe that the age of completing compulsory education (which tend to include ISCED levels 1 (primary school) and 2 (lower secondary education)) is also unrelated to the time out of employment. School systems that have younger school leaving ages do not have a longer transition from school to work than school systems with a higher school leaving age[4]. This suggests that variation in the school leaving age (whether finishing highest school attainment or completing compulsory school) does not affect the speed of the transition to the labour market, and that a shift in the school leaving age would lead to a similar shift in the labour market entrance age.

Figure 3. Graduation age and years spent not employed, ages 15-29. Data source: OECD (2003b), UNESCO (2004)



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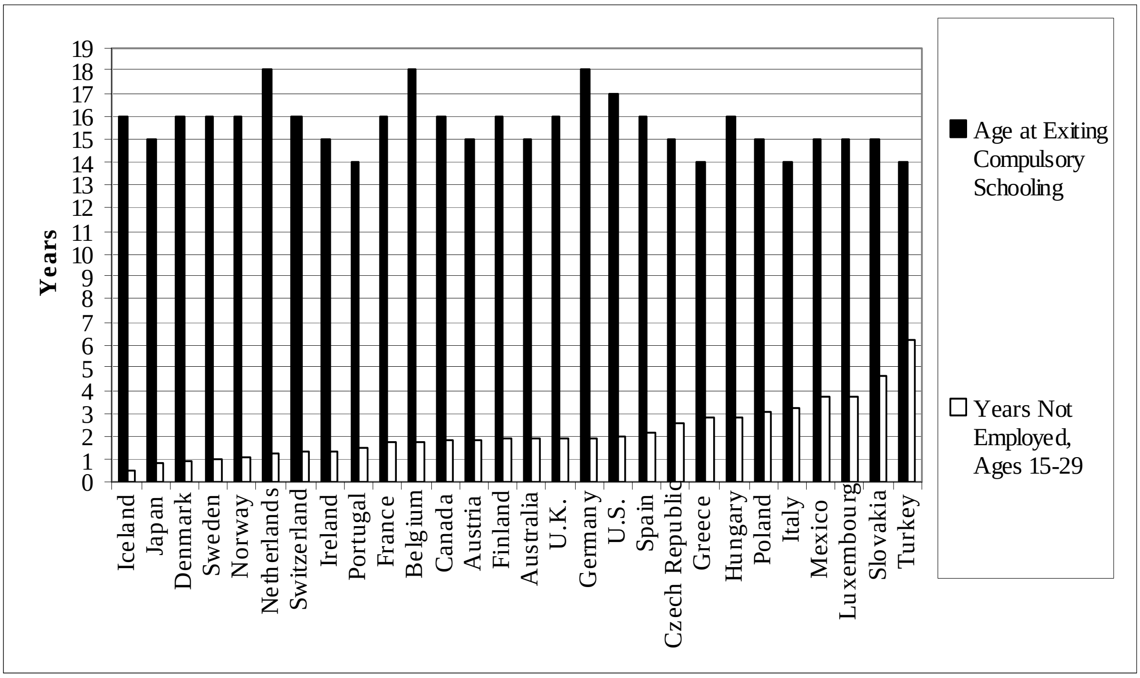
[3] All OECD countries where relevant data (school leaving age, length of compulsory schooling, years not employed) are available are included in Figures 3 and 4.

[4] For the age group considered (15-29 year olds) in Figures 3 and 4, a younger school leaving age implies that there are more post-schooling years where one potentially could not be working. Thus, for a given employment rate, a younger school leaving age would imply a longer period of not being employed. The lack of an association between the school leaving age and the period spent out of the labour force for the 15-29 year olds could therefore imply that the transition from school to work is somewhat shorter in countries with a younger school leaving age, if any such relation should exist.

Figure 4. Age at exiting compulsory schooling and years spent not employed, ages 15-29. Data Source: OECD (2003b), UNESCO (2004)



The speed of the transition from school to the labour market is, however, likely to be influenced by a number of other institutional factors. We discuss these in order to investigate which settings, possibly in addition to a change in the school leaving age, that may affect the length of the transition to adulthood. One example of a policy that can affect the spacing between events in adulthood is parental entitlement to public transfers. In Norway, a parent's entitlement and level of public support depends on the parent's income in six of the last ten months (Odelstingsinnstilling 2001, Trygdeetaten 2003). This legislation may increase the duration from leaving school to entering parenthood, as it provide an important incentive to get work experience before having children in order to get a higher benefit level during maternity leave.

Norms of whether marriage and leaving the parental home should accompany the labour market entrance and the role of the family in providing financial support also affect the spacing of events in adulthood (Bentolila and Ichino 2000, Planas 1999). Other examples of influences on the transition from school to work include individuals' deliberate choice to take a year off to travel, whether young men are required to enrol in military or community service, the effectiveness of the educational systems in easing the transition from school to work and the degree of labour market flexibility (OECD 1999, 2000, 2003a).

If one should introduce a reform that would lower the graduation age, this may lead to a temporary increase in the number of new labour market entrants as several cohorts will graduate at the same time. This could decrease employment opportunities if the growth in new labour market entrants could lead to temporary increases in youth unemployment, as some studies of cohort size of new labour market entrants might suggest (Easterlin 1978, Martin and Ogawa 1988). Easterlin compares the time trends in American employment rates with variation in cohort sizes from the 1940s to the 1970s and argues that there is an inverse relationship. Martin and Ogawa consider the Japanese case, and find that the wage ratios of 20-29 to 40-49 year olds in Japan is reduced by 1% when the share of the former increases by 10%.

More recently, Shimer (2001) considered detailed evidence from geographic entities in the US that suggest that cohort size is positively related to employment rates. He finds that larger youth cohorts in a region are associated with higher labour force participation rates and decreased unemployment levels. Shimer argues that firms tend to relocate to where labour supply is expected to increase, given that the increase in the number of labour market entrants is foreseen. The school reform investigated in this study will be known several years in advance, so that firms and labour markets regulators have time to prepare and adjust to it.

The relation between cohort size and unemployment is also likely to be influenced by labour market flexibility. Cohort size may increase unemployment when wage-setting systems are rigid (Jimeno and Rodriguez-Palanzuela 2002). When real wage flexibility is high, as some evidence suggest is the case for Norway (Layard et al. 1991, p. 407), labour markets adjust to larger labour market inflows in a shorter time span. Due to differences in educational attainment of those affected by the reform, the increase in labour market supply is likely to be spread over a number of years, softening the shock to the labour market.

Based on what the cross-country evidence provided here suggest, a marginally younger school leaving age may lead to a parallel shift in the age of entering the labour market, at least over time as labour markets adapt to the change in the supply of labour. In the simulations where a lower school leaving age is considered, the time horizon is until the year 2100, and any possible short-term labour market adjustment problems are not likely to determine unemployment rates over this long time horizon.

Effects of Schooling on Human Capital and Productivity Levels

In order to estimate whether educational standards can be kept constant for a variation in the length of schooling, one needs a valid and reliable measure of human capital. The most precise and economically relevant estimate is provided by standardized subject test scores. Economic growth levels are closely linked to such human capital output measures, while being only weakly correlated with human capital input factors such as the number of years of schooling (Barro 1999; Hanushek and Kimko 2000; Temple 2001) or educational expenditure (Hanushek et al. 1996). Also on the individual level, test scores tend to be a better predictor of labour market performance than other measures of education, like educational length. It relates to individual income levels through its effectiveness in improving job performance (Currie and Thomas 1999; Tyler et al. 2000). Tests of ability levels tend to predict individual productivity better than other measures, such as formal educational attainment (Schmidt and Hunter 1998) and the predictive power of such ability tests have increased over time (Juhn et al. 1993; Murnane et al. 1995).

Although the literature suggests that longer schooling is associated with higher income (see, for example, Harmon et al. 2001 for a review), this is in part because those with higher innate abilities are more likely to attend higher education. The positive relation between schooling and productivity is in part likely to be attributed to the self-selection of the individuals with higher abilities, who complete higher education in order to signal their higher innate abilities (Arrow 1973; Weiss 1995) in addition to increasing their scholastic abilities.

Findings have lent support to both signalling and human capital theories, where the association between schooling and earnings is caused by selection as well as learning. Variation in schooling outcomes can to a large extent be attributed to differences in inherited abilities (Ashenfelter and Rouse 1998; Barret and Depinet 1991; Plomin and Bergeman 1991; Plug and Vijerberg 2003). Environmental influences also affect ability levels, such as education (Ceci 1991), particularly the first years in school (Hansen et al. 2002; Psacharopoulos 1994). Other environmental influences have strong effects as well, including smoking and drinking behaviour during pregnancy (Streissgut et al. 1989), infant nutrition (Andersson et al. 1999), socio-economic status, family type and income (Verploeg 2002; OECD 2001).

A range of influences determines human capital, where schooling length is one out of many input factors. Large variation in the schooling length is likely to affect schooling outcomes, though it is doubtful if limited variation in the timing and within-degree duration of schooling matters. Marginal changes in educational length do not seem to have any significant impact on economic growth (Barro and Sala-I-Martin 1995; Benhabib and Spiegel 1994).

School Entrance Age and Adult Productivity

The timing of formal learning can affect the formation of an individual's skills and adult job performance. Initiating education at a too young age harms individuals who are too immature: If faced with educational demands for which they are developmentally unprepared, they may become frustrated at their lack of understanding. This may create an aversion against further learning, and a feeling of helplessness at one's perceived shortcomings. The teaching of too complex material at a too early age could, therefore, be a waste of time and may negatively affect the individual's social development and eventually adult labour market performance.

On the other hand, the ability to learn is highest at relatively young ages, and a too late initiation of schooling implies that some of the child's best learning years are foregone. Entering school late reduces a child's human capital at a given age relative to what the case would have been if the child would have an earlier school attendance. This delay in the onset of learning can have long-lasting effects on a student's achievements throughout the school years, and is likely to delay the attainment of a given educational standard, which may also decrease the outcome of human capital.

These theories, that both a too early and a too late entrance can harm the child's development, do not exclude each other. Children should enter school at the age where they are mature enough to benefit from school attendance. A school entrance age that is too early or too late can reduce the children's learning and abilities. Would children learn more between the ages of 5-17 rather than between the ages of 6-18 or 4-16? The timing of schooling depends on school readiness and should be initiated at an age where children are developmentally prepared and can benefit from systematic learning and not later.

Which age is optimal for entering school? Although this is subject to debate among researchers, variation in the school entrance age within common entrance ages (5-7 years) does not seem to have much effect on the student's performance. Studies by Dietz and Wilson (1985) and Gredler (1980) show that there are no significant effects of the student's entrance age on subsequent achievement in school. Elley (1992) investigates the ability to read and write at certain ages for pupils in 32 countries, and finds that the average school starting age for the best 10 countries is 5.95 years, while the 10 poorest achievers start at the age of 6.4 years, when controlling for social and economic variables. This suggests that a gain from starting school early and a younger school entrance age are good for human capital formation.

In several studies, the performance in early grades is found to be positively correlated with a higher school entrance age. Miller and Norris (1967) give evidence that pupils who entered school late do better in the fourth and fifth grades than younger classmates. Supportive evidence is provided by Breznitz and Teltsch (1989), who find that among Israeli first graders, those oldest in class achieve better results in subject tests and are more socially adjusted than classmates who are born later in the year. Some evidence suggests that children who enter at young ages do worse throughout the school years (Uphoff and Gilmore 1985; Sharp 1995) and may receive lower wages as adults (Plug 2001). Other studies find that initial differences attributed to age tend to diminish or disappear in later grades (Langer et al. 1984; Shepard and Smith 1986). Further, postponing school entrance by one year does not seem to improve the individual's performance relative to other students (Shepard and Smith 1986, 1988; Gredler 1984).

Some studies have found that entering school at an older age can also be associated with a decrease in performance levels (Langelak 1960; Bellins 1963). Furthermore, although the majority of studies find that older students tend to perform somewhat better, the differences between older and younger students tends to be small in relation to other variables (Davis et al. 1980; Jones and Mandeville 1990; Shepard and Smith 1986). Jones and Mandeville found that socio-economic and ethnic factors were 13 times as important as the pupil’s school entrance age in a study of reading failure.

The majority of studies that analyse the effect of the school entrance age upon achievement investigate within-class effects of age variation. When those who due to their birth month entered school later perform better, this is typically attributed to the individual’s age and maturity at the time of school entrance. Such observations could also be prescribed to the relative class age effect; those who are older when they enter school are also the oldest in their social reference group – the school class – and this could increase self-confidence levels and performance in comparison to the classmates. The older pupil’s higher performance can therefore be attributed to the student’s relative age position, rather than absolute age at school entrance.

Alberts et al. (1997) criticise much of the entrance age research for methodological mistakes and a lack of control for background. They suggest that evaluating the students at the beginning and end of a school year would more accurately measure the progress of younger and older students. They apply this method and find that although older students perform better at both tests, the amount of learning during the year is equal for young and old school starters.

In Skirbekk and Kohler (2004) the effect of the school entrance age on adult earnings is investigated, using a dataset many times larger than what any previous investigation has allowed, with 850,000 individuals. Information on income and unemployment is available for the 1946-1962 cohorts for the years 1980 to 1998, so that the cohorts’ earnings are observed through a 19 year window. Consequently, income levels from all cohorts are observed for the ages 34-36.

The study identifies an income gain of 1% from entering school at an 11 month older age. This income effect is mediated by the slightly higher educational attainment of those who are oldest in class – an 11 month later entrance age increases attainment by one twelfth of a school year. If the lower education and reduced income among the youngest in class are due to negative influences of a too young school entrance age, then lowering the school entrance age by one year is likely to lead to a slight decrease in productivity levels. This effect of higher productivity of those who are oldest in class could also be due to the relative class age effect rather than the student’s biological age when entering school. If this were the case, then a shift in the school entrance age would not affect adult productivity levels.

School Duration and Productivity

Evidence from national and international studies suggest that marginal variation in the school entrance age and the duration required to reach a degree have small or negligible effects on the student’s performance levels. The differences in the duration and timing of schooling observed between countries seems to matter relatively little for the formation of human capital, or for productivity later in life. Compressing schooling by a year would not affect the screening mechanism, since selection and signalling effects are likely to remain constant. These studies consider the effect of schooling upon observable outcomes, such as test performance, educational attainment or adult income.

Hungerford and Solon (1987) study how education affects adult earnings and identify a non-linear effect. Also other studies support the existence of a diploma effect (Frazis 2002, Jaeger and Page 1996), and its existence has been shown to be valid for different education levels (Park 1999) as well as across gender and ethnicity (Chatterjji et al. 2003).

A study by Pischke (2003) analyses the effects of a shock to the duration required to attain a degree. He studies a German school cohort that lost 2/3 of a primary school year in 1966-67, due to a school reform that altered the length of the school year. Despite a slight increase in grade repetition, no negative effects of removing the school year were found on subsequent educational attainment or wages. Those who lost schooling did not attain less higher education, nor did they receive any lower earnings later in life than those who completed the full school year, which suggests that variation in school duration does not reduce the individual's human capital levels.

Meghir and Palme (2003) analyse the effects of an educational reform in Sweden from 1949 to 1962. The reform implied that all children had to finish a higher educational degree, with nine years of schooling, rather than seven or eight years, which previously had been the case. This reform was found to significantly increase adult income and subsequent educational attainment for only some groups, in particular, individuals with high cognitive abilities from poor social backgrounds. This, however, does not seem to be evidence that a compressed education could harm productivity levels. Meghir and Palme compare individuals with different degrees; the wage differences could be due to the new degree's signalling effect as well as that the holder of the degree will have an easier progress towards higher education.

A similar study by Aakvik et al. (2003) investigated an expansion of compulsory schooling (from seven to nine years) in Norway. They analysed the earnings of 38-47 year olds in 1995, comparing individuals who were affected by the reform with those who were not. They found that the reform increased the propensities to complete subsequent schooling, and gave 5%-10% returns to education for those affected by the reform, dependent on model specifications. However, in contrast to Meghir and Palme's analysis, Aakvik et al.'s dataset lack control variables for cognitive abilities. This can skew the results due to issues of selection and variation in the returns to schooling. In addition, those affected by the reform received a higher educational degree, which can mean that at least parts of the earnings gain can be attributed to the signalling effect rather than human capital gains.

A longer mandatory schooling increases the age at leaving education and this means that the reform is correlated with issues that influence income but are unrelated to schooling. Being marginally older at normal school graduation ages involves cognitive and physical maturity, higher self-confidence and work motivation, and a broader social network, all of which can increase income levels. Furthermore, the workers' wages can be affected by a large scale school reform that postpones the age of entering the workforce since this leads to a relative scarcity of new labour market entrants (for an example of this effect, see Oosterbeek and Webbink 2003).

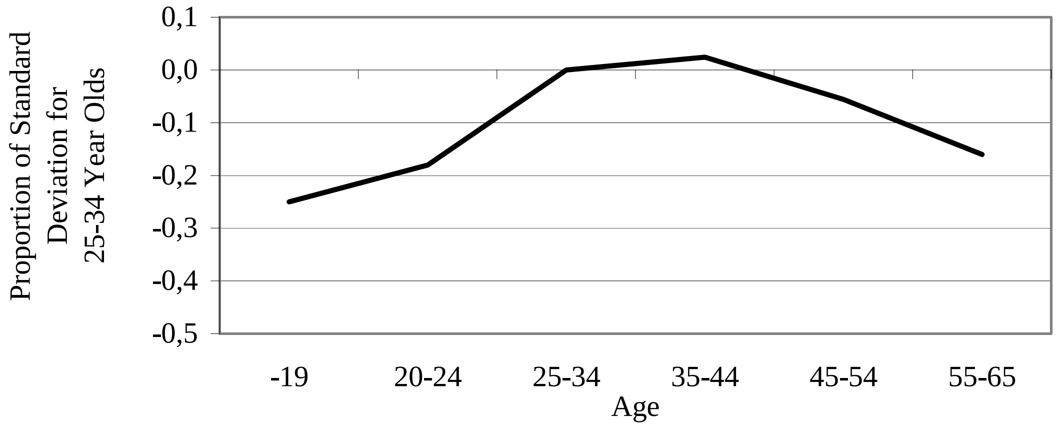
How the school duration affects human capital accumulation is investigated in Skirbekk (2004b), in a setting that overcomes many of the problems related to period, cohort and selection effects that previous research can be affected by. Student performance at the end of secondary school is investigated in Switzerland, where regional variation in the duration of primary and secondary school – 12, 12.5 and 13 years – leads to the same school diploma. The TIMSS/III dataset is investigated in the study; the final year of secondary school test results for all academic track students is analysed, controlling for background variables relating to family status and socio-economic indicators, as well as Kanton-specific variables such as expenditure to education and selection of students. None of the model specifications revealed any statistically significant impact of the student's school duration on human capital levels.

The Shape of the Age Productivity Profile

Both physical fitness and certain cognitive abilities tend to decline from early adulthood on (Avolio and Waldman 1994; WHO 1993). The ability to learn tends to decrease with age (Rybash, Hoyer and Roodin 1986; Smith 1996), and in a rapidly changing workplace this can imply that older workers are becoming increasingly less productive. In industries with fast technological change, early retirement is common (Bartel and Sicherman 1993; Ahituv and Zeira 2000) and peak productivity may be reached at relatively young ages (Dalton and Thompson 1971). Although experience increases productivity, it does so only for a given duration, often estimated to be up to about 10-years, and further experience may be irrelevant for productivity (Phelps and Shanteau 1978, Lehman 1953, Lesgold 1984).

A study on the quality and quantity of goods produced in a broad selection of American industries found that workers' performance increased until the age of 35, before slowly declining until the age of retirement (U.S. Department of Labor 1957). Analyses of the output of manual workers (Mark 1957; Kutscher and Walker 1960) and medical doctors (Eva 2002) found productivity declines at least as of 50 years of age, which is consistent with analyses of employer-employee datasets (Hægeland and Klette 1999; Crépon, Deniau and Perez-Duarte 2002). Skirbekk (2004c) estimates differences in productivity by age by considering "potential productivity", an estimate based on age-variation in causal factors (e.g. numerical skills, finger dexterity) and finds that peak productivity could occur in ages 35-44 years (see Figure 5). This estimate is based on how the relative labour market importance of different skills is conceived, and may shift accordingly. E.g. if abilities which decline strongly by age, such as numerical skills, become increasingly important in the labour market, peak productivity shifts towards younger ages.

Figure 5. Age Differences in Productivity Potential. Source: Skirbekk (2004c)



Age-productivity patterns start declining relatively earlier in life than age-earnings profiles, which peak late in one's career and only decline slightly thereafter (OECD 1998, McEvoy and Cascio 1989, Skirbekk 2004a).[5] This suggests that there exists a discrepancy between productivity and wages, where wages are lower than productivity levels at younger ages and higher at older ages[6].

Several theories have emerged to explain the rationality of why age earnings profiles tend to peak later than age productivity profiles. One important reason is employers' initial uncertainty about new employees' productivity levels (Hutchens 1989). Older workers are paid above their marginal productivity, since upwards sloping wage profiles strengthen the employees' work effort by raising their shirking costs, lower the firms' need to train new workers, acts as a reward for past productivity and decreases the risk of sensitive firm information being shared with competing firms if workers leave the company. However, as Lazear (1988) contests, population ageing challenges the financing of

[5] For theoretical reasoning why the shape of age earnings profiles differ from age productivity profiles, see Lazear (1979) and Hutchens (1989).

[6] Alternatively, one could argue that wages and productivity levels match at all ages. Age-earnings profiles indisputably slope upwards, while there is uncertainty about the shape of the age-productivity curve. One could therefore assume that wages reflect current productivity, that the age-productivity profile is incorrectly estimated, and that the true productivity profile is identical to the age-earnings profile.

such systems. As the workforce ages, a firm's profits will be reduced and eventually turn negative. To avoid losses, firms will either dismiss older workers or adjust the individual wages to their productivity levels. Attempts to increase labour force participation among the elderly could imply that there is a shift in the age earnings profile towards younger ages.

Graduation Age and Timing of Fertility

The mean age at childbirth has increased in a number of European countries (Council of Europe 2001), which is important since the timing of childbearing influences both period as well as cohort fertility rates. In Norway, the mean age at first birth increased from 25.8 (1991) to 27 (2001), while the total fertility rate (TFR) dropped from 1.92 to 1.78. For Sweden, the mean age at first childbirth increased from 26.3 (1990) to 27.9 (2000), while the TFR fell from 2.14 to 1.54.

The delay in the fertility timing is likely to be partly caused by the increase in the length of schooling. In Sweden, women above 25 years had about eight years of education in 1975, and 11 years in 2000, while in Norway, schooling increased from about eight years in 1980 to almost 12 years in 2000 (Barro and Lee 2000). The increased educational length is likely to have contributed to a higher childbearing age as well as to a decrease in completed fertility levels. Women usually postpone having children until they have completed their educational careers (Blossfeld and Huinink 1991) and the incompatibility between education and childbearing seems to have become increasingly strong over time, at least in the U.S. (Rindfuss et al. 1996).

The increase in the length of education occurred simultaneously to other fundamental cultural and societal changes, known as the Second Demographic Transition. This reinforced the effects of educational enrolment toward delaying childbirth and resulted in a different status for women, a shift from traditional to individualistic values, and an increased focus on self-realization (van de Kaa 1987; Lesthaeghe 1998; Lesthaeghe and Meekers 1996).

In spite of this emphasis on the role of education and human capital investments, very few studies have succeeded in establishing the causal effects of "years in education" or "age at graduation" on fertility patterns. In particular, analyses of this question are hampered by the fact that many unobserved characteristics that affect marriage and fertility are likely to affect the opportunities or incentives to invest in human capital. Standard analyses of the relation between education and fertility are, therefore, likely to be distorted. Analyses that can overcome this problem need to rely on instrumental variable techniques, fixed effect models or "natural experiments" (Rosenzweig and Wolpin 2000).

In Skirbekk et al. (2004), the last approach, natural experiments, is pursued in a study of 863,304 non-immigrant Swedish women born 1946-62. The authors utilise the fact that all children in Sweden are enrolled in school in the calendar year in which they become seven years old, so that children who are born during two consecutive months, December and January, graduate in two different calendar years. Hence, they differ by 11 months in the age at graduation from schooling, despite the fact that they are born merely one month apart on average. Under the assumption that parents cannot time the births of their children very accurately to the exact month, this characteristic of the Swedish school system results in an exogenous variation in the age at completing compulsory education or higher educational levels among those who continue after compulsory schooling.

Skirbekk et al. find that variation in the school leaving age has a strong and consistent effect on the timing of demographic events in adulthood. An 11 months higher school leaving age, that is the difference between women born in December and January the following year, results in a 4.9 months later age at first birth. The timing of the second birth is also affected by this natural variation in the school leaving age, where the graduation age of 11 months later for those born in January involves a four month delay in the timing of the second child. The timing between the first and second child changes remarkably little in response to the changes in the age at first birth caused by different years of graduation for women born in December and January, indicating the absence of a conscious compensation for birth-month induced variation in the age at first birth. Finally, the school cut off date affects the age at marriage, where those born in January are 3.5 months older than those born in December when they marry. This suggests a strong rigidity in the time between leaving school and entering formal unions. These findings suggest that important timing aspects of fertility are much less related to specific age patterns, but rather to a) the time since leaving school and b) norms set by the individual's peer group, in this case the school cohort.

Graduation Age and Fertility Outcomes

Women with higher education tend to be older when entering motherhood (Marini and Hodson 1981; Morgan and Rindfuss 1999) and have fewer children (Bongaarts 2003; Lutz and Goujon 2001). Increased educational attainment postpones and lowers fertility due to several factors (Becker 1991; Schultz 1993; Oppenheimer 1988), including (a) the incompatibility of education and childrearing, (b) the increased risk of not completing education due to a birth and the high opportunity costs of failing to complete education, (c) the high life cycle costs of delaying completing education and delaying the entrance into the labour market, especially in developed countries with high returns to human capital, (d) the desire to "establish" oneself in the career after completing education and before having a child, and (e) social norms that discourage childbearing while women (or couples) are still in school.

Several previous studies have shown that women with higher education receive fewer children, but since education is correlated with other factors, such as abilities and socio-economic status, it is difficult to establish causal relations. One attempt to overcome the problems induced by selectivity in abilities and preferences is a study by Kohler et al. (2001) using 2,390 monozygotic (MZ) pairs born 1945-1960 in Denmark. By comparing MZ twins with different educational attainment, the study compares individuals with identical biological endowments, identical parental households and similar socialization experiences. It is found that a one-year postponement in the age at first birth reduces completed fertility by 3% for women and 3.4% for men.

Using within-MZ pair estimates allows one to control for important sources of heterogeneity, including genetic endowments and parental influences. Nevertheless, even these within-MZ estimates remain potentially affected by unobserved individual-specific shocks that are correlated with both an individual's educational attainment and fertility behaviour. For instance, matching in the marriage market, partner characteristics, and related aspects of household bargaining may systematically differ even between MZ twins; these aspects continue to be problematic even in within-MZ pair estimation. Several other econometric approaches have been used to overcome the endogeneity problems associated with education in analyses of fertility behaviour (Neiss et al. 2002; Retherford and Sewell 1989), but often the studies need to rely on strong assumptions in order to identify "causal influences" of education on the timing and level of fertility. The presence of these factors renders standard analyses of the relation between fertility and education biased.

In summary, because education and fertility behaviour are likely to be correlated with similar observed and unobserved individual characteristics, the causal relation between education and fertility behaviour has proven to be difficult to disentangle. In particular, the estimation of causal education effects requires either exogenous shocks in the level of education or instrumental variables that can predict variation in educational attainment without being correlated with relevant unobserved individual characteristics.

In the study of the effects of the Swedish school entrance cut off date (Skirbekk et al. 2004), the birth month provides a source of exogenous variation, where the school leaving age differs by up to 11 months. This study finds that these differences in the age of exiting school have relatively profound effects on the timing of fertility and marriage, while they do not seem to affect fertility outcomes.

However, the social interaction group, the school class, is independent of birth month, which could make this study less relevant for investigating the effects of yearly differences in the school leaving age, where the peer group's social age differs. In the study of monozygotic twins (Kohler et al. 2001), this bias is overcome. Here, one studies yearly differences in the school leaving age, controlling for a range of other influences, both family and inherited ones. It is found that delaying the onset of childbearing by one year translates into about a 3% lower fertility outcome.

Projections

To project the effects of education reforms on the Norwegian public pension system, we apply MOSART, a large-scale dynamic micro-simulation model constructed by Statistics Norway. MOSART bases its projections on a representative cross-sectional sample of the Norwegian population. It entails detailed information for every individual in the sample and simulates each person's life course. For each passing year the individuals are exposed to risks (transition probabilities) of experiencing a set of events, and these events include migration, deaths, births, marriages, divorces, educational activities, retirement, and labour force participation. Whether an individual will experience an event depends on his or her personal characteristics. Transition probabilities are based on empirical observations from recent periods. For a detailed description of MOSART, see Fredriksen (1998).

MOSART takes into account a number of characteristics affecting an individual's status as a contributor or receiver of public pensions. These characteristics include education and labour market characteristics, age, marriage status, number of children, and a range of other variables. Individual pension rights are based on relevant information, including the number of working years, age-earnings profiles, health, and household status.

Pension payments are financed through a share of the working population's earnings, referred to as the *contribution rate*. Public pension benefits are calculated from labour market earnings and other characteristics included in the simulation. As ageing takes place, a larger population share will be entitled to pensions and the average pension eligibility increases. This increases pension expenditure and raises the contribution rate, given that the pension benefit levels cannot be adjusted.

This model is designed to give precise estimates of the long-term development of public pension expenditures in Norway and the corresponding tax burden for people in the labourforce. It is therefore well suited to evaluate specific research questions like the kind we address here, that is changes to the length of the working-life through educational reforms. It uses micro-level units (single individuals and households) as its basic units of analysis, which allows predictions to be made with a high degree of detail. By basing the simulation on individuals rather than aggregated entities, it gives exact projections for each individual's pension status according to the laws and regulations of the Norwegian public pension system (National Insurance System). An overview of the model is provided here. A more technical description and an explanation of the model's assumptions can be found in the Appendix.

Making a model more focused, and thereby concentrating on a more limited set of research questions, can provide more detailed insight compared to analysing broader aspects of the economy. Models that attempt to predict the functioning of a whole economy need to rely on a large number of assumptions and simplifications. This increases the risk of commencing errors, either by wrongly calibrating the model, falsely specifying behavioural functions, or incorrectly postulating economic interdependencies.

A micro-based model such as MOSART can simulate behavioural shifts and individual level changes in characteristics and entitlements, in a way that would be difficult to do with a macro-based model. Micro-model approaches can, with a very high degree of accuracy and detail, capture changes in for example productivity levels, labour force participation rates and fertility outcomes at the individual level.

On the other hand, our micro-based approach means that we cannot take certain macro-economic phenomena into account. As MOSART is not a general equilibrium model, we cannot for example model the effect of changes in the capital stock and real business cycles and their effects on wage levels. Such effects, however, may be of second order importance for our specific research question. Wage variations will, due to the risk-sharing nature of the Norwegian pension system, be shared by pensioners and income receivers and will not have any first order effects on many of the most important outcome variables we primarily are interested in, such as the contribution rate.

The trade-off over time between the gains of a longer working-life, higher fertility and costs of lower productivity can be estimated with MOSART. The model provides sufficient demographic detail to reproduce the effects of variation in the timing and outcome of fertility, changes to individual human capital and labour market behaviour that comes from a younger school graduation age.

The choice of Norway as our country of investigation has been made for several reasons. Norway has a relatively generous pay-as-you-go public pension system, with high pensions and an extensive coverage of the population. In addition, Norway has a relatively high life expectancy (at birth), 76.3 years for men and 81.6 years for women, which implies that individuals spend a long duration as pension receivers (Statistics Norway 2003). These facts make demographic ageing a substantial challenge to the Norwegian public pension system.

Assumptions

The projections with MOSART are based on a number of assumptions regarding retirement laws, net immigration, fertility, mortality, education, and the skill composition of the labour force. For example, new births and immigrants are added to the population every year and those who die are removed. Some of the most important of these variables are summarized in Table 1, and a more detailed description is found in the Appendix.

The demographic variables, including immigration, fertility and mortality estimates, are to a large extent based on the "medium" scenario from Statistics Norway's population forecasting model (NOS 2002). The formal retirement age as well as income and the size of the basic pension unit come from the current pension laws, while educational transition rates come from Norwegian administrative register data.

The estimates for the pension benefits (which the contribution rate finances) include major pension types covered by the National Insurance Scheme: Early retirement schemes, old age pension systems, widowhood pensions, and disability pensions.

Table 1. Assumptions of the MOSART Projections

Net immigration per year	13 000 persons
Life expectancy at birth	Men 76.3 years, increasing to 84.2 years in 2050, and increasingly linearly thereafter Women 81.6 years, increasing to 88.1 years in 2050, and increasingly linearly thereafter
Total fertility rate	1.75 increasing until 1.8 in 2005, constant thereafter
Average number of years as pupil or student after 9 years primary school	Men 6.6 years Women 8.2 years
Average number of years as disability pensioner	Men 5.6 years Women 7.0 years
Formal Retirement age	67 years for both genders
Average number of years in the labour force	Men 41.7 years Women 38.2 years
Average labour market earnings	Men 239 000 NOK Women 145 000 NOK
Basic Pension Unit	50 603 NOK

Public education expenditure is in our projections assumed to remain constant and not to decrease despite the reduction in the number of years of schooling. This assumption is made due to several reasons. In order to keep the school quality output constant, one may need to increase the intensity of learning per school year. A greater learning intensity can require more resource use per school year, which could imply that the net school expenditure is constant. Moreover, the proposition to compress schooling is more likely to be ratified in a political setting when school worker employment is guaranteed, which would be the case when there are no reductions in schooling resources.

Childbearing is assumed to influence parental labour supply, in accordance with empirical observations of labour market behaviour and Norwegian laws (a couple in Norway is allowed a net parental leave of at least 42 weeks). It will particularly affect the labour force participation of the mother in the simulation model. A mother’s labour force participation depends on the age of the youngest child and the total number of children she has.

Transition Probabilities

The transition probabilities are shown in Table 2. It is based on the level and distribution of demographic events. For example, the level and distribution of mortality is determined by sex, age, marital status, educational attainment, and disability status.

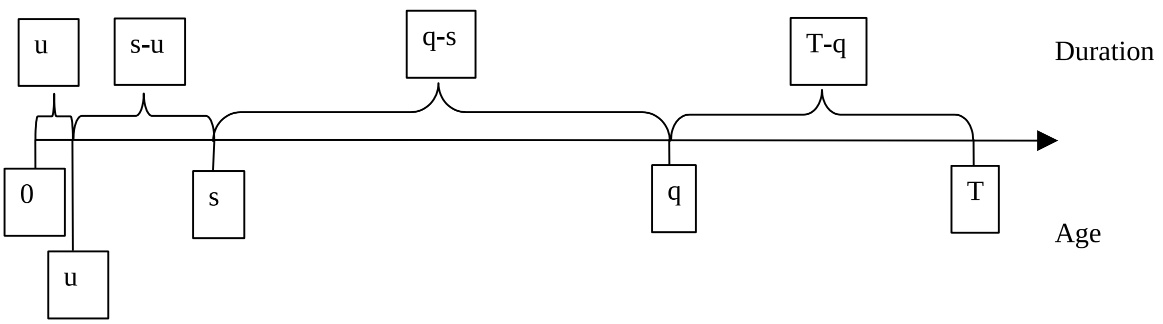
Table 2. Explanation of Estimation Periods and Covariates for Each Event

Event	Estimation methods and periods	Covariates
Migration	Based on observations 1990-2001	Sex and age
Mortality	Based on observations 1970-2000	Sex, age, marital status, educational attainment and disability pension
Fertility	Based on observations 1980-2000	Mother's age, number of children and age of youngest child
Household status (nuptiality/divorce)	Observed 1989 rates	Woman's age, children and marital status
Educational activities	Observed 1999-rates, distribution from 2001	Sex, age and educational activities and attainment
Entry into disability pension	Logit function, 1986-1989, distribution from 2001	Sex, age, marital status, educational attainment, pension status and labour force participation
Other transitions in pension status	Observed rates, 1986-1989, distribution from 2001	Sex, age, pension status, educational attainment, labour force participation, widowhood/widowerhood
Labour force participation	Logit function, etc. 1985-1988, 1991, distribution from 2001	Sex, age, children, marital status, educational activities and attainment, pension status, and previous year's labour force participation

The Effects of Educational Reforms on the Pension System

Figure 6 gives an example of an individual's life course as simulated in MOSART. The variable *u* represents the school entrance age, *s* the school leaving age, *q* the age of retirement, and *T* the age at death. The schooling period is *s*-*u*, the working-life is *q*-*s*, and the retirement duration is *T*-*q*.

Figure 6. Stylised Diagram of an Individual's Life Course in the MOSART Model. Variable Description:
***u* = Age at Entering School, *s* = School Leaving Age, *q* = Retirement Age, *T* =Age at Death.**



If a person should enter the labour market at a younger age due to a decrease in graduation ages, then *s* would decrease and the working-life, *q*-*s*, is extended. This could increase the lifetime income and the amount of taxes that are paid. Extending the working-life could, however, also raise pension benefit eligibility as a longer working-life can increase pension entitlements. The use of the simulation model MOSART allows to estimate the net impact of a longer working life, by taking into account pension-related effects, such as variation in pension eligibility as well as lifetime income.

In the simulations where the education reform is considered, the first individuals who are subject to the reform are those born in 1994, who will exit secondary school in 2011. This birth cohort, and all subsequent ones, finishes school two years earlier than previously: one year due to a lower school entrance age and another year due to a shorter length of primary and secondary education.

If the school reform, with a change in the timing and duration of education, influences the amount of learning, this could have consequences for wages and pension levels. The analysis presented in this study suggest that human capital may be unaffected by the school compression, while the younger entrance age may imply a 1% lower productivity level[7]. A lower productivity level could, as the pensions are wage-indexed, decrease both income and pensions. Norwegian public pension benefits depend on the current wages of the working population, since the laws regulating the National Insurance Scheme pension benefits intend to raise/decrease pensions at the same rate as the wage level. This means that marginal variations in productivity levels are not likely to cause any substantial effects on the contribution rate (the share of the income that workers pay in order to finance pension benefits).

The earlier graduation age of the reform cohort is assumed to cause a parallel shift in the childbearing age or age of entering the labour market. The spacing of events in adulthood is taken to be of a rigid character, where a shift in the school leaving age would lead to a parallel shift in the timing of subsequent events.

Whether a lower school exit age increases the number of children individuals have is uncertain. Our study does not identify any higher fertility outcome for those who graduate at younger ages. However, our study is based on within-class evidence of individuals with the same social age. A school reform that reduces the age of school exit would affect the social age for those affected by the reform, as the whole class would graduate at a younger age, and this could have the effect of raising fertility levels. We base our projections on two fertility scenarios, one where only the timing of fertility changes and one where the outcome of fertility also changes. In the scenarios where the fertility outcome is assumed to be affected, exiting school two years earlier leads to a 6% increase in fertility outcome. This is based on estimates by Kohler et al. (2001), who analyse the fertility patterns of monozygotic twins. This research approach allows holding a wide range of genetic influences on both educational and fertility outcomes constant. For every earlier year of entering parenthood, fertility outcome levels are found to increase by 3%.

The retirement reforms discussed are within limits of what is internationally observed. Countries such as Japan or Iceland do follow retirement patterns with roughly 5 years later retirement than what is the case in Norway (Scarpetta and Blöndahl 1998).

Variable Names

Where monetary outcomes are used, we use the price level from the year 2001.

Contribution Rate = The Norwegian pension system is essentially a pay-as-you-go system, where the workforce pays for current pensions through taxes. The contribution rate – the part of the worker's income that is transferred to pay for the pensions – is calculated as:

$$\text{Contribution Rate} = \frac{\sum \text{Pension Benefits}}{\sum \text{Labour market earnings} + 0.5 * \sum \text{Pension Benefits}}$$

The pensioners pay lower taxes from their pension benefits because of special tax rules intended to compensate for lower income, old age, and health problems (see Arneberg and Gravningsmyhr 1994).

[7] This finding was based on the female population, and we assume that a similar effect is valid for the male population as well.

Labour Force Size = Population by age multiplied with age-specific labour force participation rates.

Person-years = The number of full person-years that is carried out in the economy per year. A full person-year is counted as 1687.5 working hours in Norway.

Pensioners = Number of old age pensioners.

Pension = Average pension benefit for a pensioner. The pension benefit depends on the individual's work history, marital status, and widowhood status.

Population Size = Number of individuals in the country.

Total Income (in billions) = Sum of the income for 16-74 year olds. This measurement is sensitive to whether the cohorts affected by the educational reform are less productive than those who are not subject to the educational reform.

Description of Scenarios

A set of scenarios has been selected to estimate the effects of a school reform and a later retirement age on variables related to the public pension system in Norway. The scenarios vary in their assumptions regarding the reform's effects on fertility, human capital levels and age-productivity profiles. The outcome variables we investigate include the age structure and size of the population. We also look at the effect on the workforce, pensions and income. Particular focus is given to understand to which extent the school reform affects the balance between the working and the retired share of the population, and the impact on the contribution rate.

A brief description of the scenarios is given in Table 3, and a more detailed description follows. S 1 refers the benchmark case, while S 2 to S 4 consider the impact of the education reform with different assumptions regarding fertility and productivity levels. Scenarios S 5 to S 7 applies to the case where the retirement age increases, where labour supply and productivity varies and S 8 to S 10 consider the combined effects of the education reform and a later retirement age.

Table 3. Scenario Description

Scenario (S)	Educational reform	Younger worker's productivity level	Fertility level	Retirement reform	Older worker's Labour Supply	Older worker's productivity
S 1	No	Not affected	Not affected	No	Not affected	Not affected
S 2	Yes, 2 years	Not affected	Not affected	No	Not affected	Not affected
S 3	Yes, 2 years	Not affected	Increases	No	Not affected	Not affected
S 4	Yes, 2 years	Decreases	Not affected	No	Not affected	Not affected
S 5	No	Not affected	Not affected	Yes, 2 years	Not affected	Not affected
S 6	No	Not affected	Not affected	Yes, 2 years	Increases	Not affected
S 7	No	Not affected	Not affected	Yes, 2 years	Not affected	Decreases
S 8	Yes, 2 years	Not affected	Not affected	Yes, 2 years	Not affected	Not affected
S 9	Yes, 2 years	Not affected	Increases	Yes, 2 years	Not affected	Not affected
S 10	Yes, 3 years	Not affected	Not affected	Yes, 5 years	Not affected	Not affected

Scenario 1: Benchmark Scenario– acts as a reference case. It shows the situation where the school leaving ages and retirement ages remain constant, and no reform is introduced. This scenario is used to compare the effects of an extended working-life with the situation where no reforms would take place.

Scenario 2: Educational Reform, Fertility Stable – the school leaving age is lowered by two years. This is achieved through a school reform that lowers the school entrance age by one year and compresses the duration of primary and secondary schooling by another year. The earlier school exit age leads to a parallel decrease in the labour market entrance ages and the ages of childbearing. There are no effects on the cohort fertility level. The school reform expands the working life and consequently increases the size of the labour force.

Scenario 3: Educational Reform, Fertility Increase – identical to Scenario 2, except that fertility levels are assumed to rise. In accordance with the findings in Kohler et al. (2001), the school reform leads to a 6% increase in completed fertility levels. The higher fertility resulting from the school reform will increase the size of the population and lead to a somewhat younger age structure. This will have a cumulative fertility effect in the longer run, since the larger cohorts also have higher fertility. In effect, the difference in the scenarios with and without a fertility effect on the population's size and structure increases over time.

Scenario 4: Educational Reform, Negative Productivity Effect – if the earlier school reform adversely affected human capital formation, a lower productivity level among those affected by the reform would be expected. The lower school entrance age may slightly decrease productivity levels. Assuming that the adverse human capital effect of lowering the school entrance age from 7 years to 6 years is the same as lowering it from 6 years to 5 years, we find that wage levels are reduced by 1%. The compression of schooling from 13 to 12 years, on the other hand, is not likely to decrease human capital accumulation.

Scenario 5: Retirement Reform – considers the effects of a two year later exit from the workforce. The retirement age increases from 2010. Both the risk of entering old age pension status, as well as the transition risk to disability pension (which is the highest pensioner status for those below the minimum old age retirement age) is shifted two years later. The later entrance into retirement status decreases the number of pensioners, increases the number of taxpayers and consequently lowers the contribution rate.

Scenario 6: Retirement Reform, Labour Supply Increases – predicts that the later retirement age will be accompanied by higher labour force participation rates. The assumptions for this scenario are similar to Scenario 5, except that there is an increase in the amount worked among older age groups. It is assumed that all individuals aged 45 and above work more and that they behave on the labour market as if they were two years younger.

Scenario 7: Retirement Reform, Older Workers Less Productive – assumes that the relative labour market performance of older individuals substantially drops and their wages are reduced as a result. This is reflected by the income characteristics for those above 45 years, whose wages shift as if they were 8 years older. This means that the current relatively late age when wages peak can shift towards earlier ages, so that income levels for senior workers drop markedly.

Scenario 8: Educational and Retirement Reform – shows the combined effect of extending the working-life at both ends. Individuals enter the labour market two years earlier (due to the educational reform) and exit two years later (due to an increase in the retirement age).

Scenario 9: Educational and Retirement Reform, Fertility Increases – identical to Scenario 8, except that there is an increase in fertility levels for the cohorts affected by the school reform.

Scenario 10: Educational Reform (3 Years) and Retirement 5 Years Later – to illustrate the potential capacity of extensions to the working-life, we include a scenario with a five-year increase in the age of retirement, and an educational reform that leads to a three year lower school exit age. Fertility, labour supply, and productivity levels are assumed to remain constant.

Results

Here, the forecasts up to the year 2100 of the dynamic micro based projection model, MOSART is presented. Findings for population characteristics, workers and the number of pensioners and workers are presented first. Thereafter, forecasts for pension related variables are shown, including the average pension size and the development of the contribution rate.

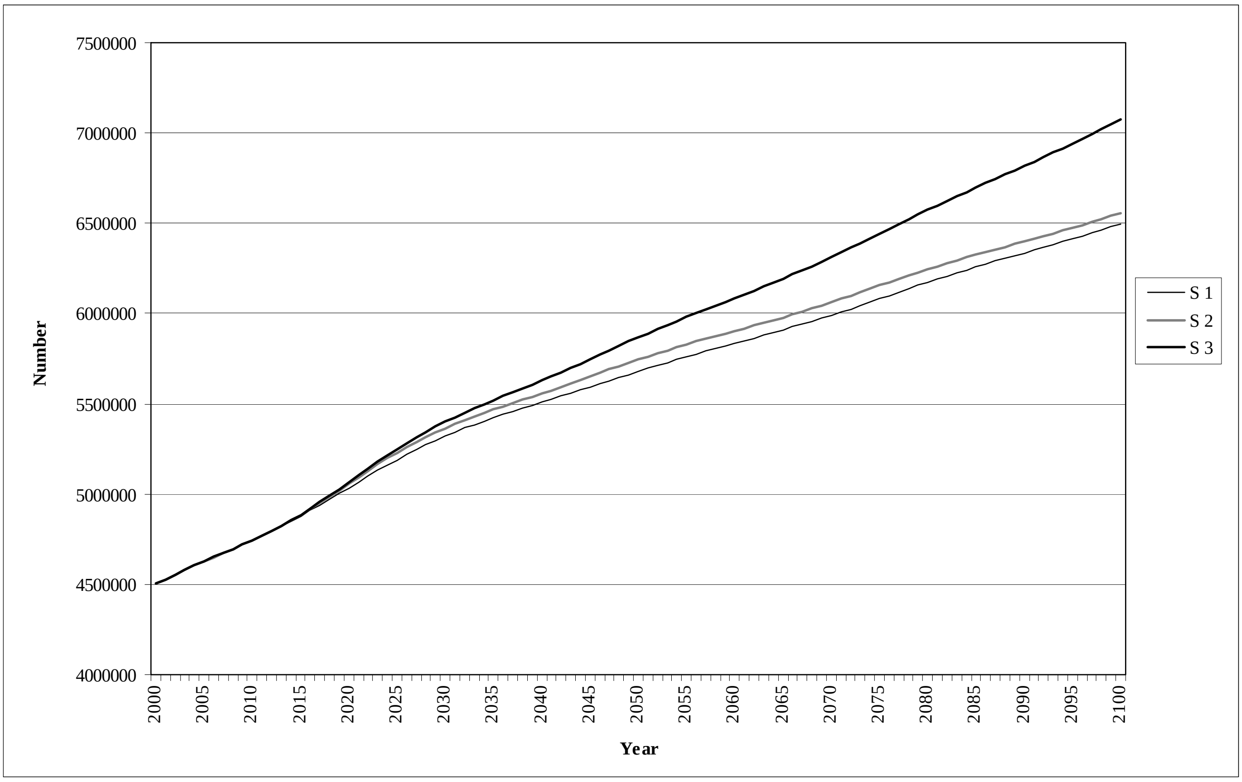
Population Size

The size of the population is affected by the educational reform if the timing of fertility or the fertility outcome changes. Even relatively small changes in fertility levels have large effects on future population sizes. The population is estimated to increase substantially by the year 2100, as demonstrated in Figure 7, although fertility lies below reproductive levels. This is a result of increases in life expectancy and positive net immigration.

If the educational reform is implemented, the population increases to 6 556 000 (S 2) while without the educational reform, the population rises to a level of 6 498 000 in 2100 (S 1). Most of the increase in the population size due to the school reform takes place until 2030, as the impact of a younger childbearing age on fertility outcome is strongest for this period (as shown in Figure 8).

If the school reform should increases fertility outcome levels (S 3), the population size increases to 7 072 000. This means that the school reform increases the size of the population by a number in the range of 58 000 to 574 000 individuals by 2100, depending on whether the younger school leaving age affects the timing of fertility or also fertility outcome.

Figure 7. Population size of Norway from 2000-2100. Source: Projections with the MOSART model



Age Composition of the Population

In addition to increasing the size of the population, the school reform also affects the age composition of the population. In Figure 8 one can observe the number of births throughout the projected period. The school reform (S 2) leads to a temporary increase in the number of births from 2011 (when those affected by the reform start to graduate from school) relative to the reference case (S 1). A few decades after the school reform is implemented, the timing of childbearing has stabilized at younger ages, which means that fertility levels are similar in the two scenarios S 1 and S 2. However, if fertility levels should increase as an effect of the school reform (S 3) it would, by 2100, lead to 15.6% more births than in the reference case (S 1).

Figure 8. Number of births in Norway from 2000-2100. Source: Projections with the MOSART model

In Figure 9a and 9b, the population's age structure is shown. The population is divided into five age categories, 0-19, 20-29, 30-54, 55-74, 75-120. These age categories would roughly equal the potential number of, pre-labour market individuals, young workers, prime age workers, senior workers and retirees.

In the reference scenario there is a sharp increase in the number of individuals in the two oldest age categories (S 1). The number of prime age workers increases slightly throughout the period, while the two youngest age groups remain relatively constant in size. When the school reform is introduced (S 2), this increases the size of the different age groups, starting with the younger cohorts. The increase in the size of the different age groups is to a large extent temporary and is weakened in the years following the implementation of the school reform.

If the school reform raises fertility outcome levels (S 3), the size of the different population groups grows accumulative and the population size increases more over time relative to the reference scenario (S 1). Furthermore, the increase in the size of the population first takes place for younger age-groups, while the size of the older age-groups is only affected towards the end of the simulated period.

Figure 9a. Age structure of the population of Norway from 2000-2100. Source: Projections with the MOSART model

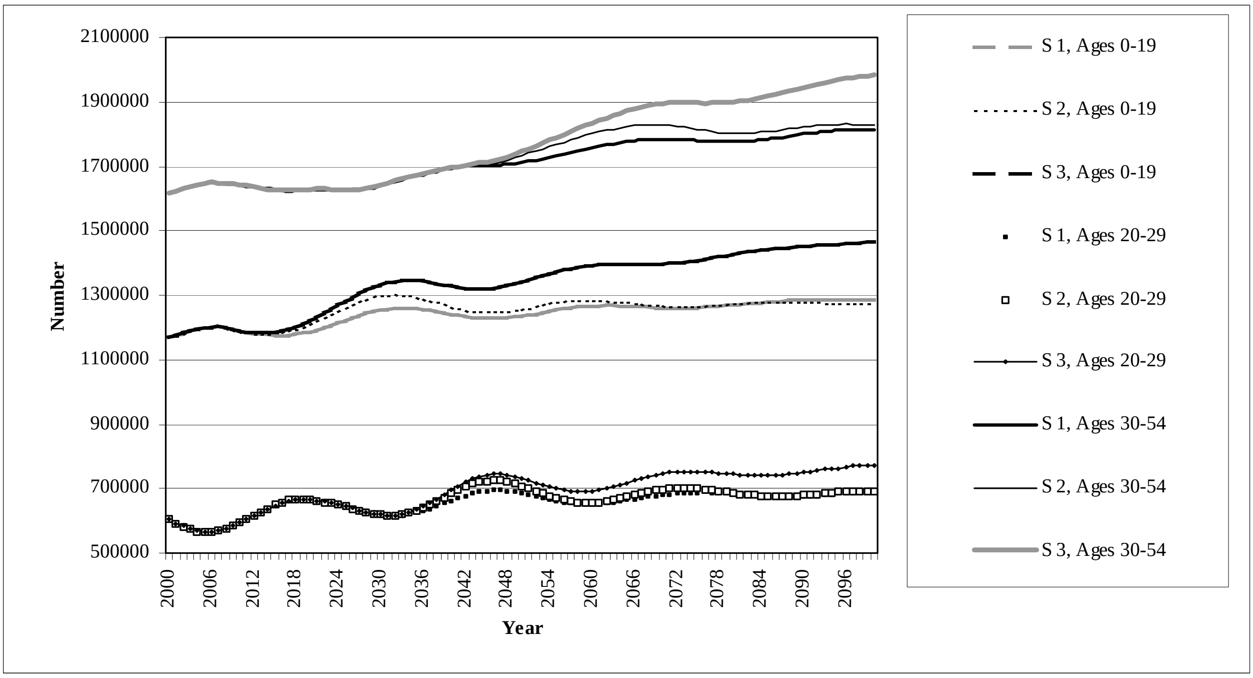
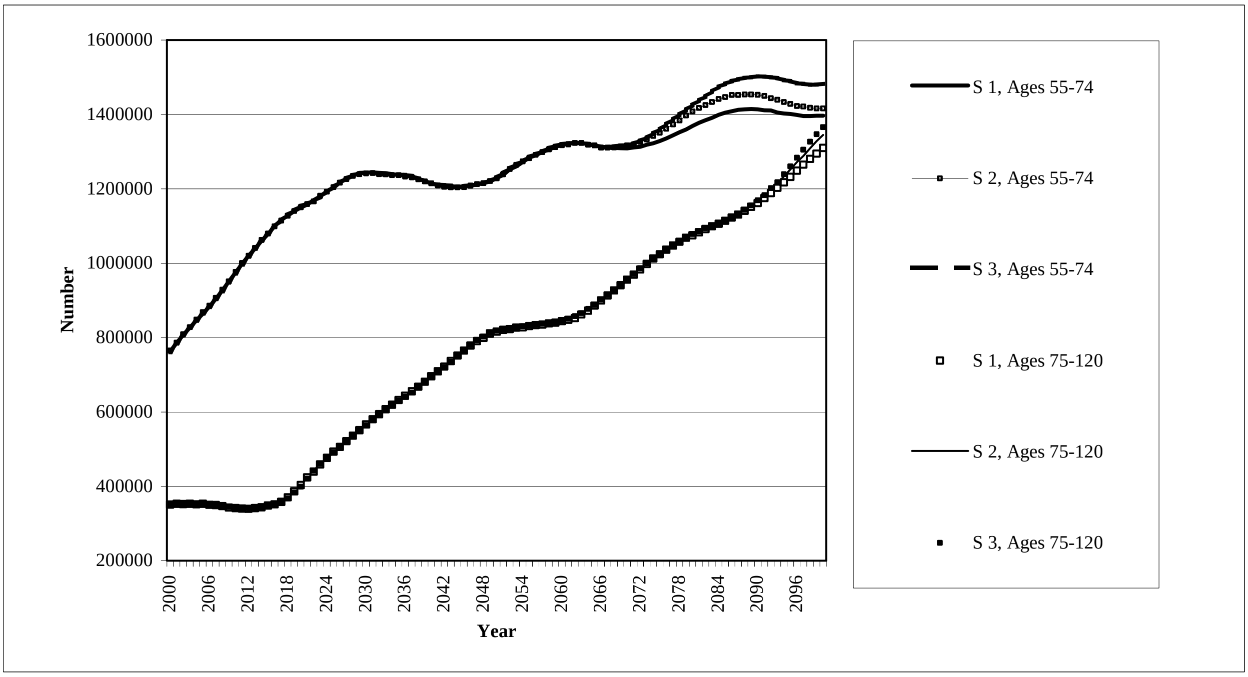


Figure 9b. Age structure of the Population of Norway From 2000-2100. Source: Projections with the MOSART Model

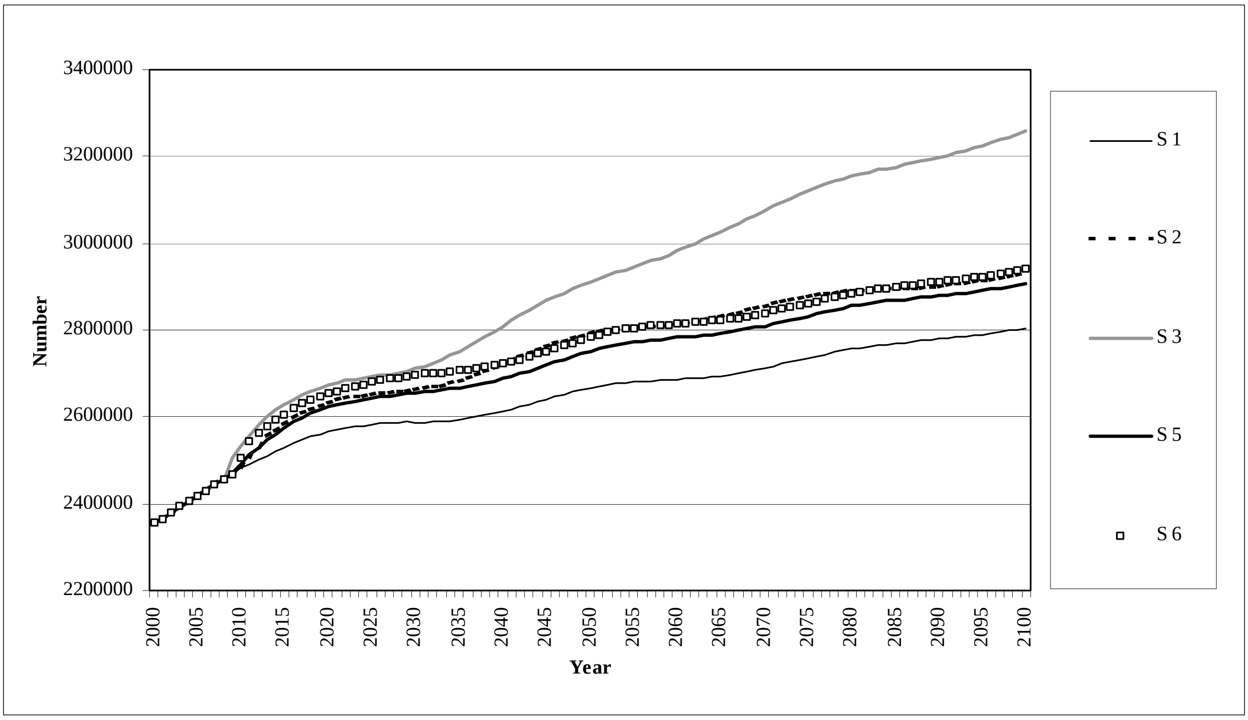


Workforce Size

The evolution in the size of the workforce is shown in Figure 10. Given that no school reform is implemented, the reference scenario predicts that the labour force increases up to a number of 2 805 000 workers (S 1) by the year 2100. Implementation of the educational reform would increase the number of workers to 2 929 000 (S 2) in 2100. If fertility levels should increase in effect of the school reform (S 3), then the workforce size increases up to a level of 3 257 000 individuals in 2100.

This is a slightly higher number than the effect of retiring two years later, which leads to 2 907 000 workers by 2100 (S 5). However, should the retirement reform be accompanied by higher rates of labour supply among older workers (S 6), the effect would be similar to that of a younger labour market entrance and the number of workers would be 2 941 000 in 2100.

Figure 10. Size of the workforce in Norway from 2000-2100. Source: Projections with the MOSART model

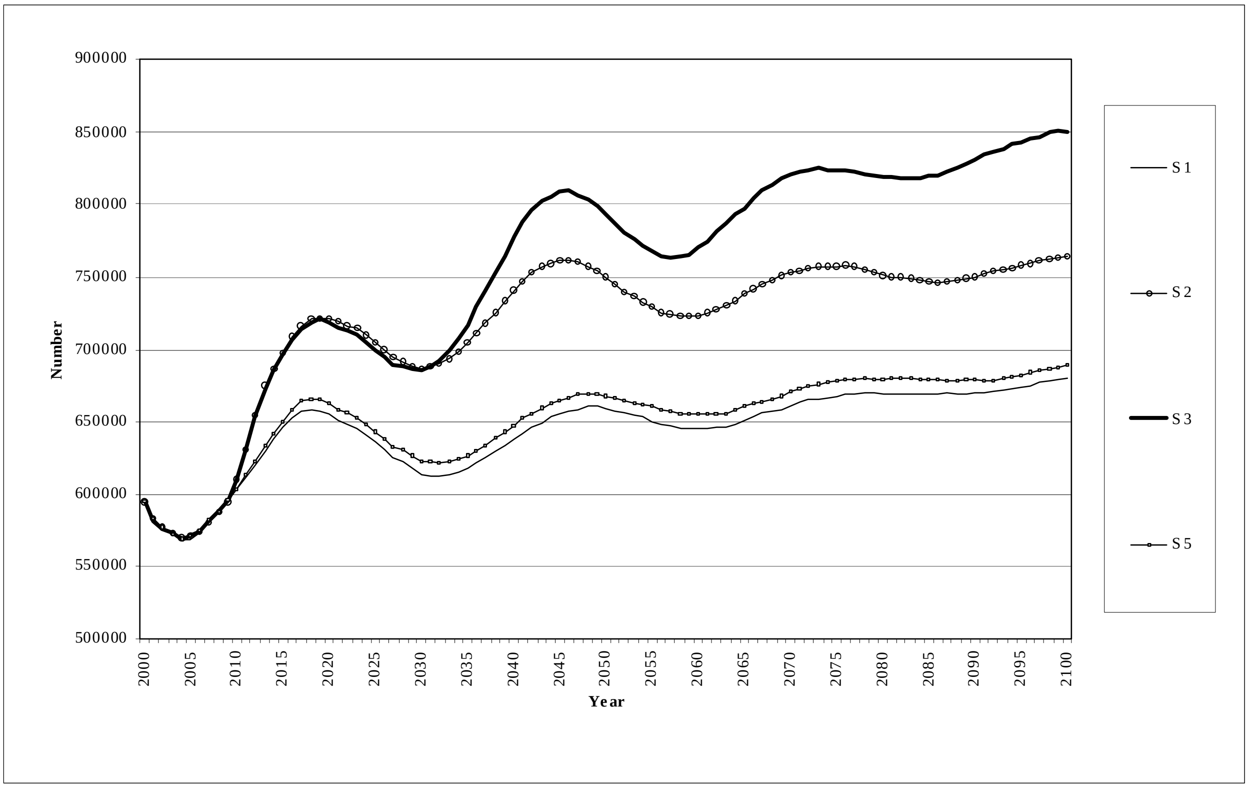


Workforce Age Composition

The number of 16-29 year old workers will remain relatively constant in the reference scenario and will reach 680 000 by 2100 (S 1), as shown in Figure 11. Increasing the age at retirement (S 5) has only a very modest effect, since there are only a limited number of pensioners in this young age group (among the few that belong to this category are mainly disability pensioners).

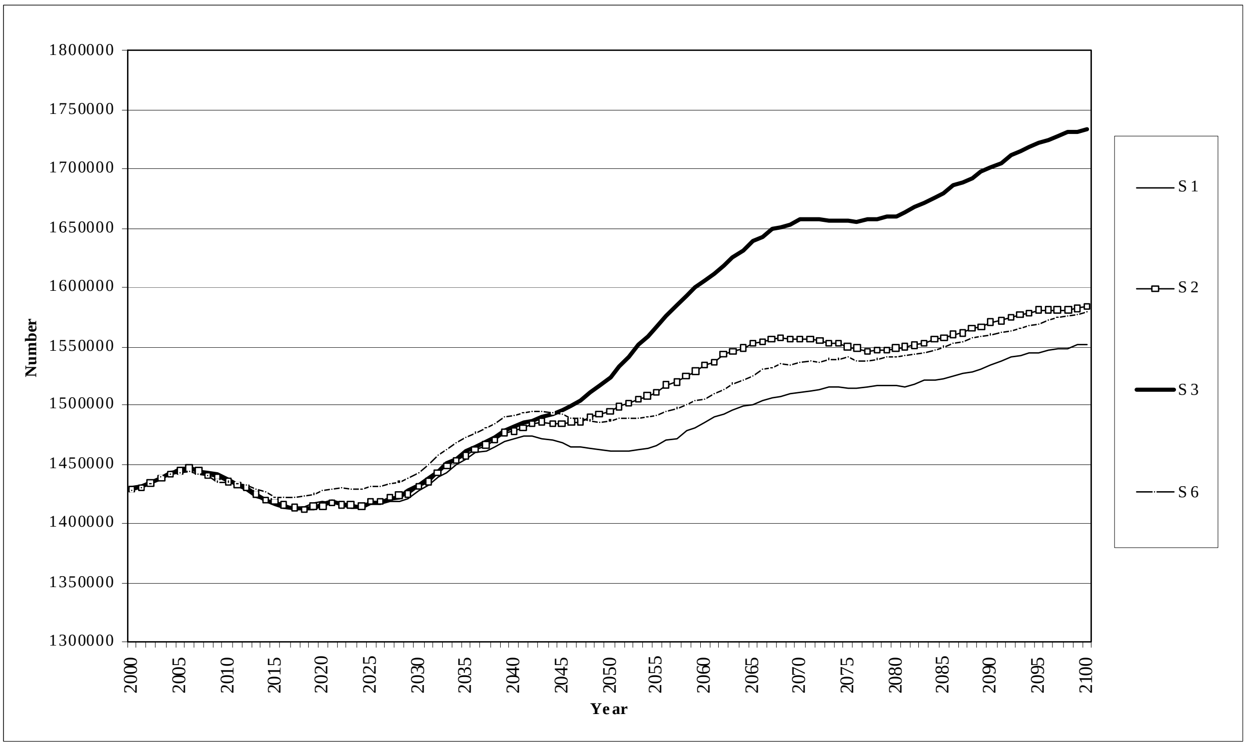
The educational reform, however, considerably increases the number of 16-29 year old workers. By 2100, the educational reform has increased the size of this category to 764 000 assuming constant fertility (S 2). If the school reform should imply that fertility levels increase, the number of 16-29 year old workers would be 850 000 by 2100 (S 3).

Figure 11. Number of workers aged 16-29 years in Norway 2000-2100. Source: Projections with the MOSART model



The development in the size of the 30-54 year-old age group of workers is shown in Figure 12. In the benchmark case (S 1) it is projected that a modest increase in the number to around 1 551 000 takes place by 2100. Starting earlier in the labour market (S 2) and increasing the retirement age when labour supply increases (S 6) have about the same effect on the labour force, which increases to around 1 580 000 prime age workers in 2100. If the school reform is leads to an increase in fertility levels (S 3), the size of this age category increases to 1 734 000 workers by the year 2100.

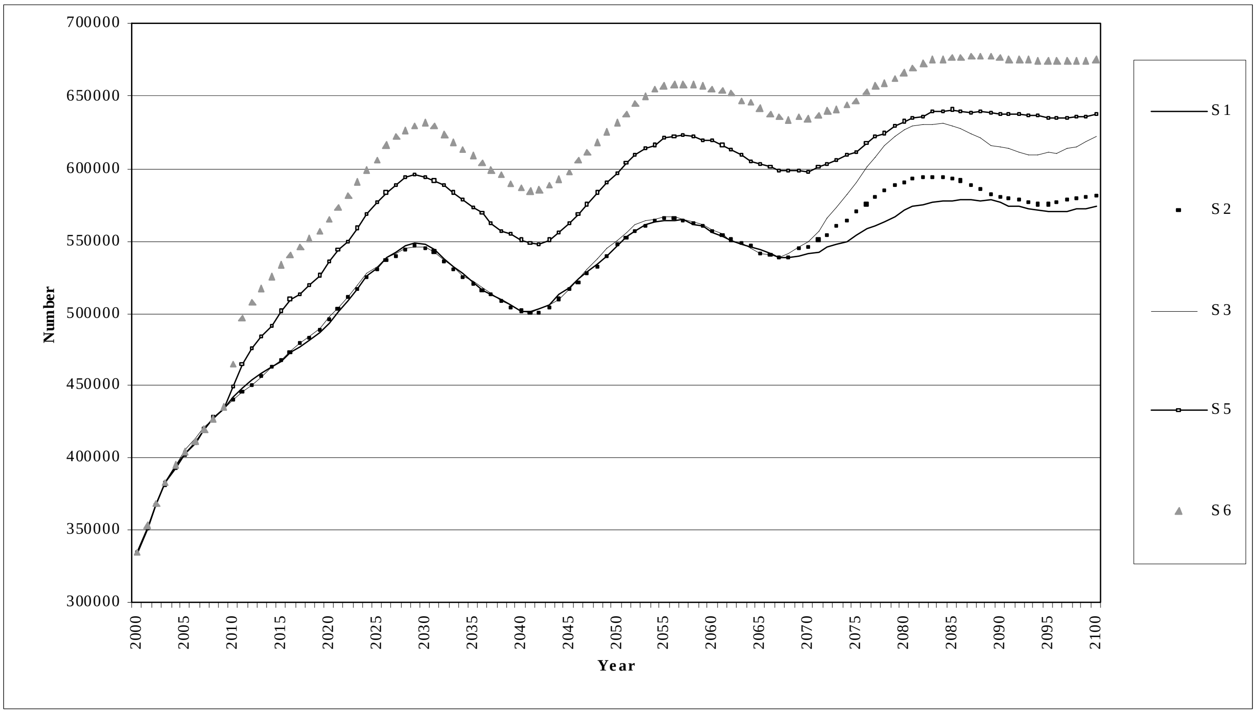
Figure 12. Number of workers aged 30-54 years in Norway from 2000-2100. Source: Projections with the MOSART model



The number of workers in the 55-74 year-old age group increases due to population ageing, as seen in Figure 13. The reference scenario predicts that the number of workers will increase to 574 000 by 2100 (S 1). The school reform has a very small effect on the number of workers in this category, and results in 582 000 individuals by 2100 (S 2). However, if the educational reform should lead to higher fertility levels this would imply the number of individuals in this age group to 623 000 by 2100 (S 3).

A later retirement age has a strong effect on the number of workers in this age-category, and would increase the number to 637 000 workers (S 5) by 2100. If the later retirement is combined with an increase in the labour force participation rates of older workers, the number of workers in the 556-74 year old age group increases to 676 000 (S 6).

Figure 13. Number of workers aged 55-74 years in Norway From 2000-2100. Source: Projections with the MOSART model

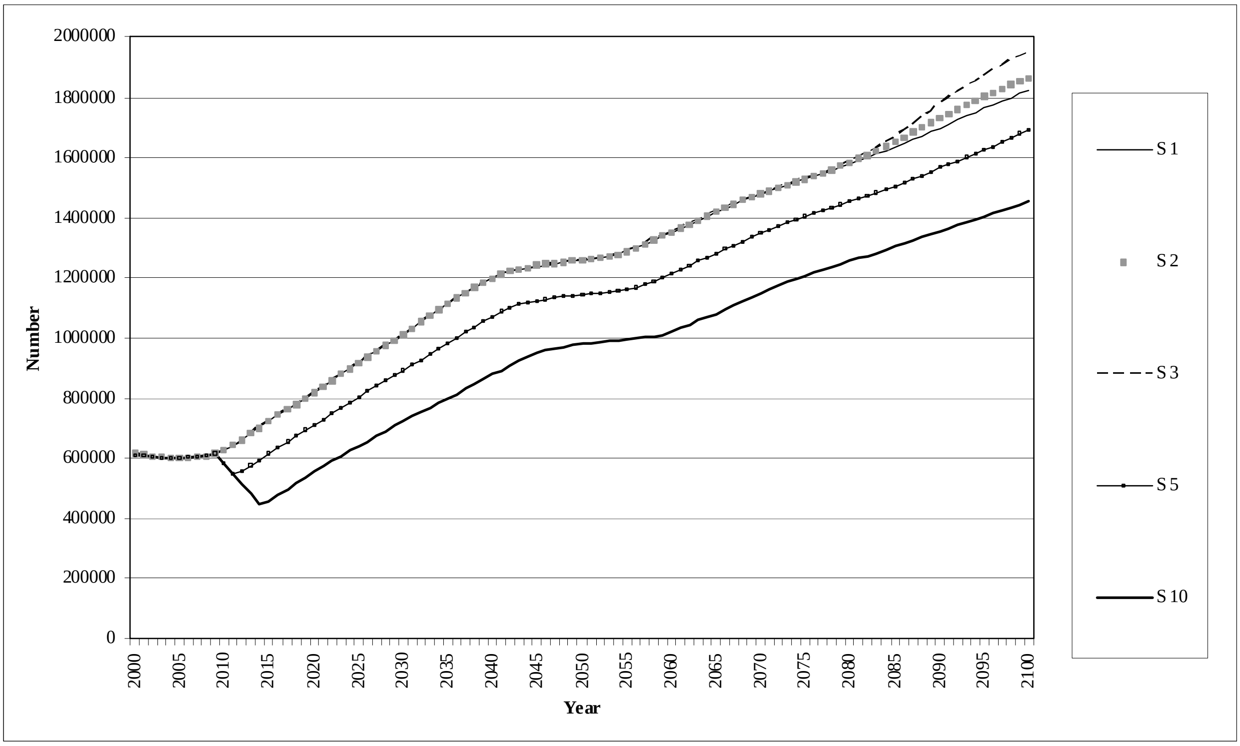


Old Age Pensioners

Figure 14 portrays the number of old age pensioners in Norway until 2100. The reference scenario shows an increase from 619 000 pensioners in 2000 to 1 822 000 by 2100 (S 1). If the school reform is introduced, the number of old age pensioners increases to 1 864 000 (S 2) by 2100, while a stronger effect is found if fertility increases, when the number of old age pensioners rises to 1 949 000 (S 3).

As we can see, the effect of higher fertility only matters from a late stage in the forecasting period, from around the year 2080. If the age of retirement is postponed by two years, the number of pensioners is reduced to 1 691 000 (S 5). If retirement increases by five years, and the school leaving age drops by three years, there would be 1 453 000 pensioners in 2100 (S 10).

Figure 14. Number of old age pensioners in Norway from 2000-2100. Source: Projections with the MOSART model



Average Pension Size

Figures 15a and 15b show the development of the average size of pensions until 2100. These figures show that there will be a massive increase in the average pension until 2030 because the pension system "matures", where younger cohorts had higher labour force participation and higher wages are entitled to higher pension levels. To highlight the differences between the different scenarios, Figure 15b shows in detail the development from 2030 to 2100, a time period when pension benefit levels have stabilised.

In the benchmark case the pension payments stabilise around 140 000 NOK (S 1). Given that the educational reform is implemented, pensions increase to 141 000 NOK (S 2) because of the longer working-life leads to higher pension benefit entitlements. If the school reform should decrease human capital and productivity levels, it will lead to a slightly lower pension benefit level of 141 000 NOK (S 4) in 2100. If one extends the working life by increasing retirement ages, then pension benefits will increase to a level of 141 000 NOK (S 5) or to 141 000 if the labour supply of senior workers increase as well (S 6).

Figure 15a. Average pensions (in NOK) in Norway from 2000-2100. Source: Projections with the MOSART model

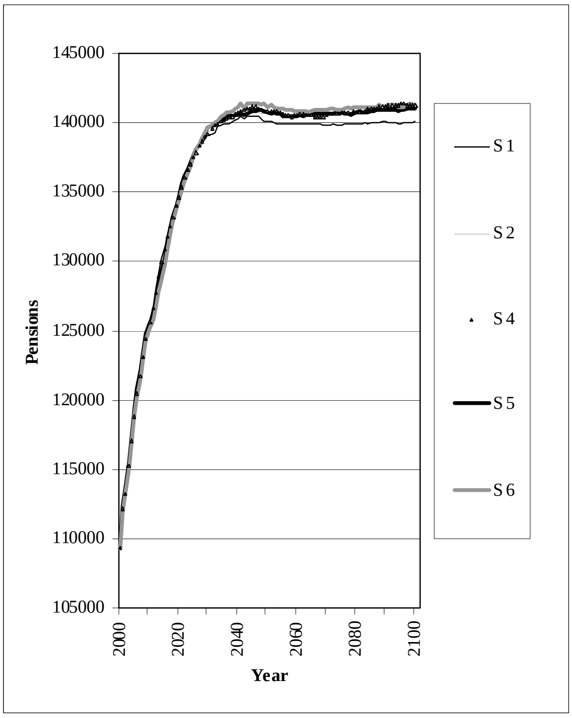
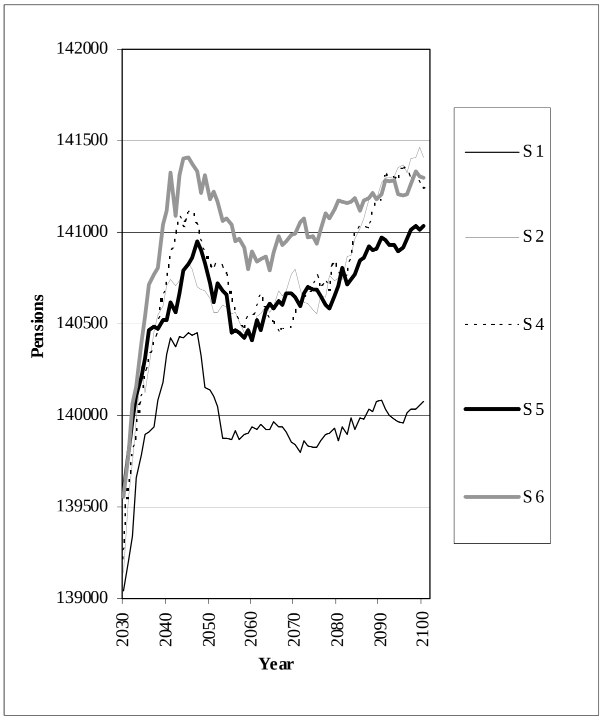


Figure 15b. Average pensions (in NOK) in Norway from 2030-2100. Source: Projections with the MOSART model

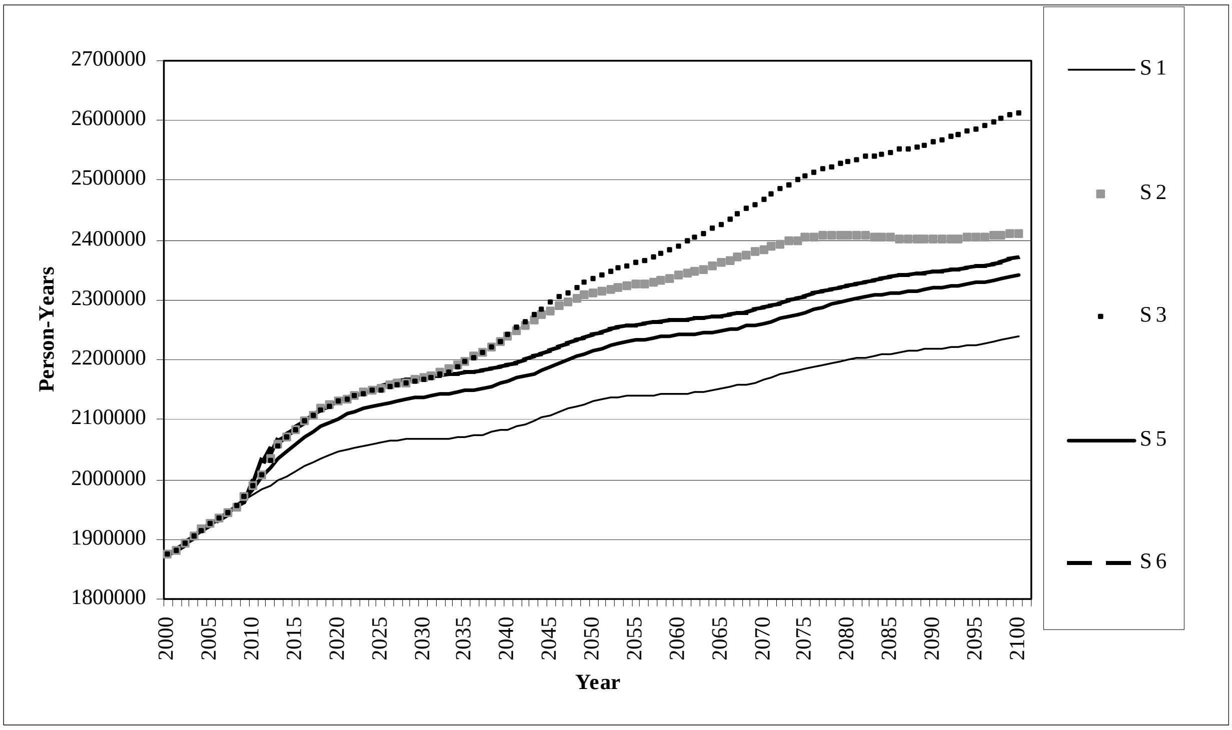


Person-Years

The number of person-years worked increases in all scenarios, as shown in Figure 16. The reference scenario predicts that there will be 2 238 000 person-years in 2100 (S 1). An educational reform increases the number of person-years to 2 412 000 (S 2) in 2100. If fertility outcome levels should increase, the number of person-years increases to 2 613 000 (S 3) in 2100.

If the retirement age increases by two years there will be 2 341 000 individuals by the end of the projection period (S 5). If a later retirement is accompanied by a higher labour force participation of older workers, the number of person-years reaches 2 371 000 (S 6) in 2100.

Figure 16. Average number of person-years worked in Norway from 2000-2100. Source: Projections with the MOSART model

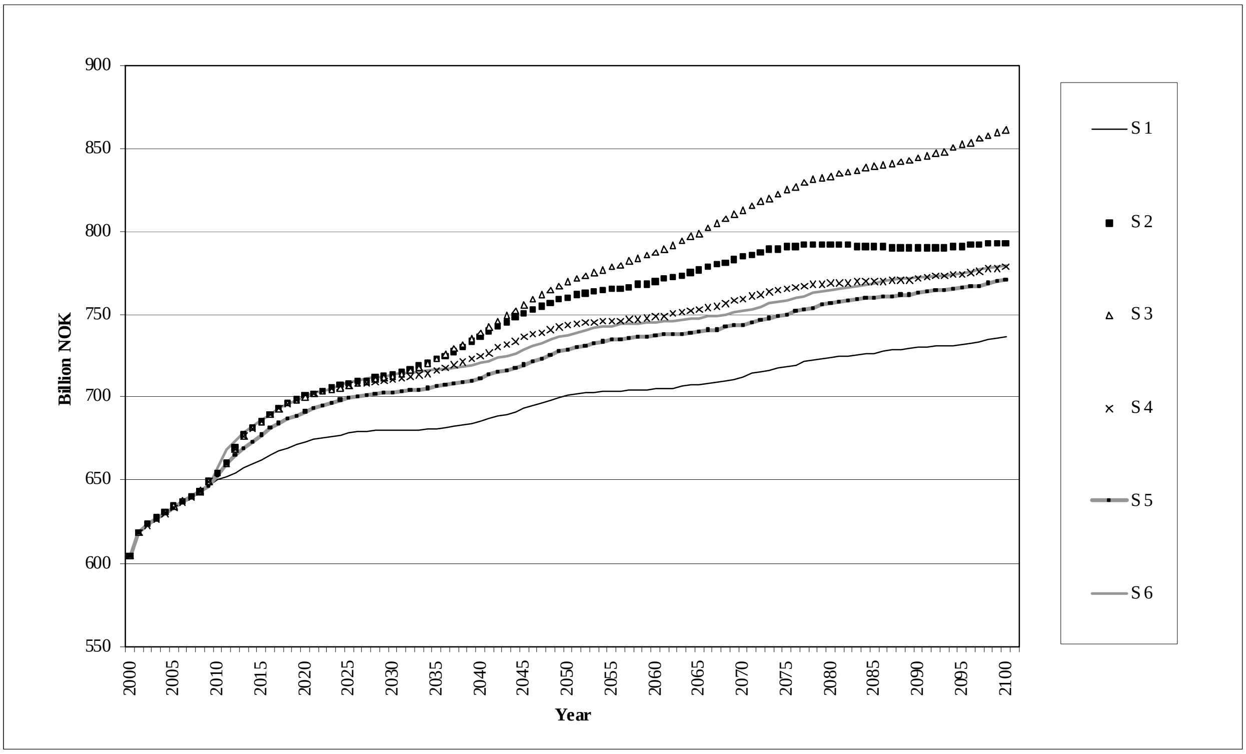


Total Income

The total labour income in the economy increases slowly in the benchmark case to a level of 736 billion NOK (S 1) in 2100 (Figure 17). The school reform increases income to a level of 793 billion NOK (S 2). If the school reform leads to a higher fertility, it results in an increase to around 861 billion NOK per year (S 3). Should the productivity of the labour market entrants decrease after an educational reform, the income increases to only 779 billion NOK (S 4).

An increase in the age of retirement of two years produces a total income value of 770 billion NOK (S 5). The later retirement age increases income to a level of 780 billion NOK (S 6) if the labour supply increases.

Figure 17. Development of the total income in Norway from 2000-2100. Source: Projections with the MOSART model



Contribution Rate

The development of the contribution rate until 2100 under a range of different scenarios is shown in Figure 18. The contribution rate is projected to increase considerably as the population ages and more people enter retirement. The relatively large cohorts born in 1945-1965 increase the numbers of pensioners up until around 2030. At the same time, the national insurance scheme matures, which means that those who become pensioners have acquired more pension rights and are entitled to higher pensions. This causes a sharp upward shift in the contribution rate. Continued increases in life expectancy and fertility levels that remain below replacement, exacerbate the increase in the contribution rate until 2100.

The contribution rate increases to 38% in the benchmark case in 2100 (S 1). When a school reform is implemented, the contribution rate increases by less and reaches a level of 36.9% (S 2) by 2100. However, the greatest relative impact of the school reform is found on a shorter time horizon, where for example in 2040 the reference scenario gives a contribution rate of 30.7% and the school reform scenario a contribution rate of 28.7%. The gap between the reference case and the school reform becomes somewhat narrower towards the end of the period, as the larger cohorts -those born in the years after 2011- retire.

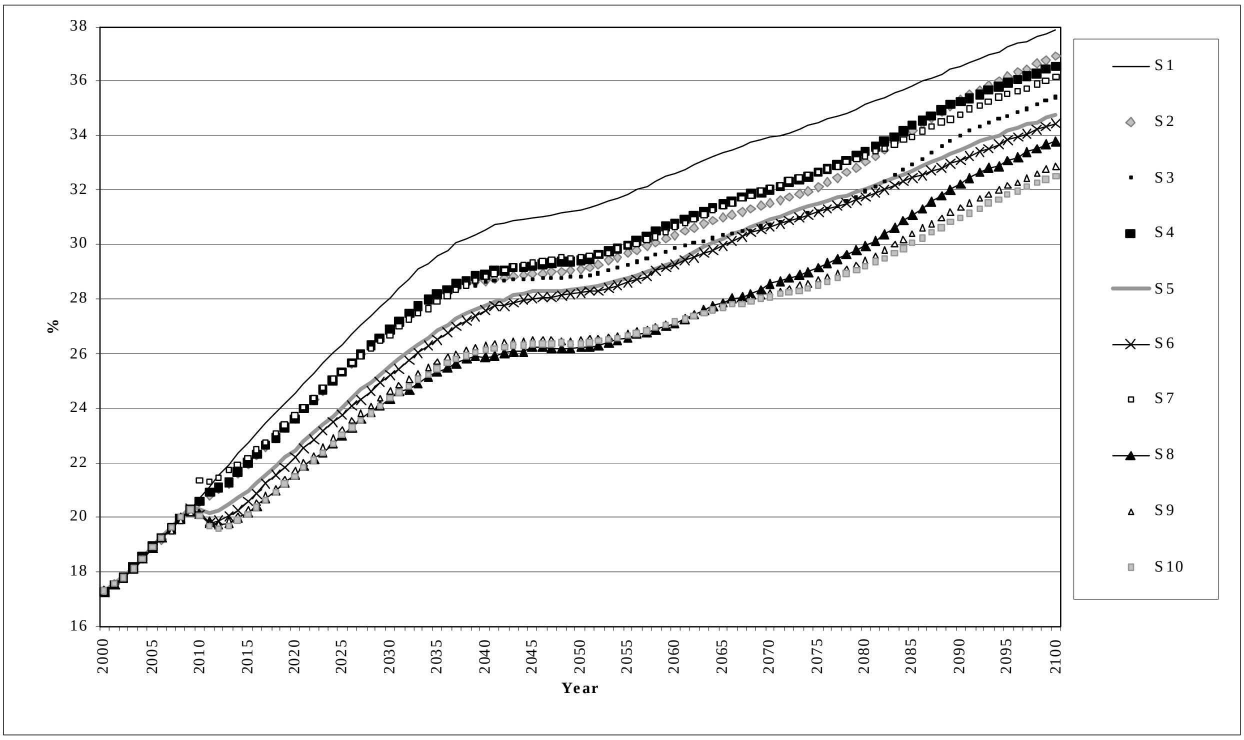
Changes in the worker's productivity do not have significant effects on the contribution rate, since pensions are wage-indexed and pension levels adjust to productivity shocks. When the school reform decreases productivity, the contribution rate reaches 36.6% by 2100 (S 4).

Given that the school reform leads to an increase in fertility, the contribution rate is substantially lower at the end of the period, and reaches a level of 35.4% (S 3) in 2100. A retirement age reform can have a stronger effect on the contribution rate than the school reform. A two years later age of exiting the workforce leads the contribution rate to a level of 34.8% (S 5) in 2100 or to 34.5% (S 6) if the labour supply decreases.

The combined effect of a two year later retirement age and a two year earlier entrance into the labour market is also analysed (S 8), and it is found to lead to a contribution rate of 33.8% in 2100. If both the educational and the retirement reforms are implemented and fertility levels increase, the contribution rate drops to 32.9% (S 9). A two year later retirement age when the older workers are less productive leads to an increase in the contribution rate of 36.2% in 2100 (S 7).

In the scenario with a five-year increase in the age of retirement, and an educational reform that leads to a three year lower school exit age, the contribution rate is 32.5% in 2100, given no effects on fertility outcome (S 10).This implies that if such a change took place, where the working-life is extended at both ends, the contribution would only increase by half as much as the reference scenario from 2005 to 2100.

Figure 18. Development of the contribution rate for Norway from 2000-2100. Source: Projections with the MOSART model



Discussion

An ageing population increases the dependent share of the population and raises the contribution rate needed to sustain pension levels. This paper focuses on the effects of reforms that increase the size of the workforce by lowering the school exit age, by compressing school duration, and by lowering the school entrance age. Graduating at a younger age is likely to shift the timing of subsequent events in adulthood toward younger ages: Individuals would enter the workforce earlier, initiate childbearing at a younger age, and may have more children. This would in turn ease the burden of a growing dependency ratio, and increase the sustainability of pay-as-you-go pension systems.

The school leaving age in Norway has increased substantially in recent years, as increasing shares of the population attain secondary and/or tertiary education (Statistics Norway 2001). Moreover there are large international differences in the number of years required to attain different schooling levels in different countries, and the late school leaving ages in Norway can at least in part be explained by the long durations required to complete different educational levels (UNESCO 2004). A late labour market entrance involves social costs, and could adversely affect the sustainability of public pension systems. However, it can also involve individual costs, in form of a shortened work life span, fewer years to realize fertility intentions and a later timing of childbearing that may be sub-optimal in terms of the health of the mother and child.

The individual and social costs associated with a late school leaving age raise the question of whether similar educational standards could be achieved at a younger age. We consider the impact of a reform that lowers the age of graduation by two years, by decreasing the age of school entry from 6 to 5 years and compressing the duration of primary and secondary schooling from 13 to 12 years. The reform is likely to lower the school leaving age and, at least over time, lower the age of labour market entry. This could expand the working life, lower the timing of fertility, and thereby increase the worker-pensioner ratio over time. According to our estimates, student performance effects of marginal variations in the timing and duration of schooling are likely to be either non-existent or very small.

In order to analyse the effects of the reform, we run projections with MOSART, a large-scale micro-based dynamic model that has been designed to forecast the development of the Norwegian public pension system. We find that the reform can have an alleviating impact on the sustainability of the public pension system, and could soften the increase in the contribution rate by 1-2% relative to the case without the reform. This implies that the reform could reduce the ageing-induced growth in the contribution rate by one tenth in the period from 2000 to 2100. If fertility also would increase, the beneficial effect would be about twice as strong.

In summary, policies aimed at lowering the school leaving age while maintaining school quality could play a role in expanding and rejuvenating the labour force and may represent an important contribution to the sustainability of public pension system in Norway.

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