No country for old men? Increasing the retirement age in the Armed Forces

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Abstract:

An ageing workforce due to low fertility rates and higher life expectancies challenges modern industrialized economies. To secure economic welfare and the balance of public budgets, governments worldwide implement reforms to increase the retirement age. This trend towards higher retirement age confronts a defense sector that for centuries has been in search of an age structure characterized by 'youth and vigor'. We study the economic gains to society from increasing the special retirement age for military personnel in the Norwegian Armed Forces. By combining the literatures on pension, personnel, and military economics, we identify mechanisms crucial to the outcome of a special retirement age reform. Monte Carlo simulation is applied to illustrate the potential impact on the economic net gains of uncertain variables. We find that an increase in the retirement age provides substantial net benefits to society, even under fairly negative assumptions about the consequences for retention, motivation and efforts, and the value of elderly personnel in the Armed Forces.

KEYWORDS: Cost-benefit analysis, retirement age, military personnel, productivity, labor economics, human resources.

JEL CLASSIFICATION: **D61**, **H55**, **J08**, **M50**.

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Introduction

An ageing workforce due to low fertility rates and higher life expectancies challenges modern industrialized economies. To secure economic welfare and the balancing of public budgets, governments worldwide implement reforms to increase the actual retirement age, by adjusting the statutory retirement age and incentivize work over retirement (OECD 2015; Lindbeck and Persson 2003).[2] This trend towards higher statutory retirement age confronts a defense sector that for centuries has been in search of an age structure characterized by 'youth and vigor'.

The Norwegian Armed Forces (NAF) have since 1885 employed versions of special retirement age regulations to secure a relatively young age structure. Today, the maximum retirement age for military personnel on long-term contracts is 60 years, 12 and 10 years earlier than the statutory retirement age in the private and public sector, respectively. While many find work post-retirement in the civil sector, on average, special retirees offer only half of their former labor supply (Strand et al. 2018). Forcing employees to resign at a time when many still are healthy and eager to work, yet with few potential years left in the labor market, sounds economically inefficient a priori. From a societal point of view, this system is only justifiable if NAF is 'no country for old men'.

The need for change in the special retirement age in Norway has propelled in the aftermath of major reforms of the public pension system for the private and partly public sector (2011) and the public sector (2018). The reforms aspired to increase the incentives to stay longer in the workforce by allowing employees to combine pension receipts and continued work with no reduction in pension payments. One key facet of the 2011-reform was the establishment of a principle of life expectancy adjustments. As long as the life expectancy in the Norwegian society continues to rise, the principle of life expectancy adjustments generates the need for younger cohorts to work longer to achieve the same pension level as older cohorts. The principle thus introduces an issue of a growing discrepancy between the pension contributions of employees with special retirement age and the rest of the labor force.

In this article, we conduct a cost-benefit analysis (CBA) of a potential increase in the special retirement age among military personnel in NAF. The alternatives investigated involve increasing the special retirement age from (0) 60 years to (1) 62 years, (2) 65 years, (3) 67 years, and (4) 70 years. As an input to the cost-benefit model, we first estimate the age structure in equilibrium in NAF

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[2] We define the following concepts this way: *actual retirement age* is the age an individual retires from work; *statutory retirement age* is the age private and public sector employers have the right to retire their employees (but not necessarily enforced to do so); *special retirement age* is similar to statutory retirement age, but enforces the employer to retire its employees; *pension age* is the age an individual can at earliest retire with pension benefits.

under the five alternative special retirement age systems. Equilibrium means that the personnel entering NAF equals the number exiting, and results therefore in a stable and identical age structure over time. Further, we develop a pension economics cost-benefit model that subsequently produces the fiscal consequences of reform for the Ministry of Defense (MOD) and the Ministry of Finance (MOF), and the economic effects for the Norwegian society. The model calculates wages, value added, taxes, pension allowances, other public benefits, and leisure value per labor and pension group. In total 11 groups are included in the model: young and old employees in NAF, young and older employees in the private sector, work able and disabled special retirement retirees, disabled benefits recipients from NAF and private sector, early retirees and retirees from NAF and the private sector, and finally disabled former special retirees from NAF.[3] We find evidence for substantial net benefits to the Norwegian society from an increase in the special retirement age. To our knowledge, we are the first to calculate the net gains to society from reforming the retirement age in the military.

The results presented in this paper rely on a number of assumptions about labor participation rates, wages and value added among various labor and pension groups, as well as the disability propensity and retirement decisions. We derive the parameters in our model from historical rates among military personnel in NAF and the general work force. Three key assumptions are however difficult to assess empirically: the effect of a special retirement age increase on (i) retention rates and (ii) motivation and efforts, and (iii) the value of older employees in NAF. The two former assumptions could be studied empirically if a reform of the special retirement age is executed, while the latter assumption will, by the nature of defense production, always be difficult to assess.[4] The fact that military personnel currently retires at the maximum age of 60 adds additional complexity to the assessment about the productivity effect of expanding military personnel's careers into their 60s. The productivity of older employees is indeed unknown terrain for NAF. These assumptions are however treated in-depth theoretically in the economics literature.

Hence, our second contribution is to combine findings from pension, personnel, and military economics in order to identify possible theoretical outcomes of a proposed reform. The pension economics literature stresses the importance of pension reform for labor supply. Empirical studies show that an increase in pension and retirement age increases labor supply (Staubli and Zweimüller, 2013; Vestad 2013; Strøm et al. 2015). But higher pension and retirement age could also result in higher enrollment in social insurance programs, in particularly disability benefits (Duggan, Singleton, and Song 2007; Atalay and Barrett, 2015). The relationship between the pension system and the capacity of military organizations to attract competent personnel is studied in Asch and Warner (1994a), Asch, Johnson, and Warner (1998) and Warner (2006). The contributions show that the pension system plays a prominent role in the total incentive package offered to military personnel. We argue that raising the retirement age, while holding the number of both military personnel and positions in each rank constant, will increase the time each person will spend in each rank. This means, as suggested by the Lazear and Rosen's (1981) tournament theory, that the discounted, expected returns from future rank tournaments will shrink, possibly affecting retention and efforts decisions negatively.

[3] In this paper, we define 'older' as persons between 60 and 69 years old, and 'young' as those between 20 and 59 years old.

[4] There is indeed substantial information asymmetry between the employer and employee about efforts and productivity in the defense sector (Hanson 2016, 2019; Førsund 2017).

Furthermore, by raising the special retirement age we question the value of older military personnel. The standard assumption in cost benefit analysis is that wages equal workers marginal product (Bartik 2012). Labor economics are however burgeoning with theories that challenge the simple competitive wages theory: 'human capital' theory (Becker 1962, 1964), 'deferred compensation' theory (Lazear 1979, 1981), and 'tournament' theory (Lazear and Rosen's 1981). These theories lead us to suggest that the productivity of older personnel is lower than their wages.

It is outside the scope of the present study to estimate the impact of the mechanisms found in the literature empirically. However, we apply a Monte Carlo simulation to investigate the impact on the sample space of economic gains with various means and variances for the model's assumptions.

With a budget of around 6.2 billion USD and around 20,000 employees, NAF (together with the other defense institutions[5]) is one of Norway's largest enterprises in terms of budget and manpower. A change in the pension system has therefore significant effects for public finances and efficiency in the Norwegian economy. Thus, we argue that there is a substantial need among policymakers, defense personnel and the general public to improve the understanding of the economic consequences of an increase in the number of older military personnel. While this paper does not provide all the answers needed in order to accurately estimate the effects of policy reform (which perhaps can only be done post-reform), it contributes by illuminating important mechanisms behind the outcomes, the main sources of uncertainty – and thus also crucial areas for further research – in addition to estimating the sample space for fiscal and economic effects of reform of the special retirement age. Our aim is to contribute to the defense economics literature by applying a cost-benefit analysis framework to the crucial – in both a fiscal and an economic sense - field of retirement systems for military personnel.

The article is structured as follows: first, we review the economics literature on pension age and systems, incentives and value of older employees, and shortly comment upon how we exploit theoretical and empirical findings in our modeling. We introduce the underlying demographic inputs and our model of economic gains from pension reform in the Methodology section. In the Results section we present the effects for MOD, MOF and for the Norwegian society by increasing the retirement age and the life expectancy of the population, as well as the impact from varying the model's assumptions in Monte Carlo simulations. Finally, we conclude the study and suggest topics for further research.

Literature review

Pension economics literature

Pension economics is a sub-branch of labor economics. The effect of pension and retirement ages, financial incentives, and public benefits constitute three key areas for pension economics. The literature distinguishes mainly between two effects of labor incentives of pension systems (see Atalay and Barrett 2015): first, the *wealth* effect concerns how the (expected) lifetime income of a person is affected by the pension system. A system induces more work if it provides less benefits than the person's contributions (as long as leisure is a normal good) because it reduces the lifetime

[5] MOD has five defense institutions under its command: NAF, Forsvarsbygg, FMA, NSM, and the Norwegian Defence Research Establishment; military personnel (with special retirement age) are employed in these institutions, including MOD.

income, and vice versa. Second, the *accruals* effect takes place if benefits increases with contributions, and the magnitude is expected to be affected by accrual calculation method. Recent Norwegian pension reforms have sought to enhance this latter effect, and we expect therefore that that a potential reform of the military pension system will promote a higher accruals effect than today.

Staubli and Zweimüller (2013) find that an increase in pension age has a strong effect on labor supply, but also leads to an increase in unemployment. (Atalay and Barrett 2015) also find that an increase in the early retirement age has significant impact on labor supply, but that it leads to higher enrollment in social insurance programs, particularly disability benefits. Evidence from pension reforms in Norway in the 1990s show that an increase in pension age will increase labor supply but also to increased utilization of disability benefits (Vestad 2013). The same effect is shown for the United States (Duggan, Singleton, and Song 2007). Strøm et al. (2015) argue, however, that there is a smaller leakage over to disability benefits than what Vestad (2013) find.

Employees also react to economic incentives. Hanel (2010) exploits changes in the German pension system that reduced the pension payments to younger cohorts: the reduction led to significant postponement of retirement among these cohorts. Moreover, Hanel and Riphahn (2012) study a gradual increase in normal retirement age in the Swiss pension system, where employees at the same time could retire at former NRA, but at a benefit discount. They find that a reduction in benefits by 3.4 percent reduces the retirement probability by over 50 percent. The 2011-reform in Norway changed the labor supply as well; prior to the reform, employees with early retirement pension scheme (AFP) in the age between 62 and 67 could retire prior to 67 but with full income testing, resulting in a severely high effective tax rate. When this was reformed in 2011 to the extent that labor income had no impact on pension benefits, the labor supply increased between 30 and 46 percent, most of the increase being explained by the *extensive* margin (Hernæs et al. 2016).[6] Likewise, Hernæs, Sollie, and Strøm (2000) argue that economic incentives can partly explain the increased early retirement age once such a system was in place in the 1990s.

The design and relative economic magnitude of welfare benefits also play a role in the supply of labor. Rege, Telle, and Votruba (2009) have shown that job loss led to a substantial increase in the likelihood to exit the labor force and utilize disability benefits in Norway. In fact, they find that employees in companies where a major share of the employees experienced job loss have 24 percent higher likelihood for receiving disabled benefits than employees in comparable enterprises without major job cuts. Bratsberg, Fevang, and Røed (2013) support this finding, arguing that one quarter of male entries into disability benefits in Norway can be explained by job loss.

From the pension economics literature, we derive the following key findings: increasing the special retirement age will increase the labor supply significantly, in particular since the pension reforms in 2011 and 2018 have eliminated disincentives in the earlier versions of the public pension system in Norway and since the military work force is relatively healthy at age 60. The literature has however established a causal link between job loss and disability benefits enrollment, and we expect some spillover effects on the use of disability however. The modeling of the military labor force is done in a state of equilibrium and personnel in NAF have no probability of being fired. This means that the likelihood of becoming disabled is higher in the private sector.

[6] See endnote 11 for more on extensive margin.

Pension and military personnel

A number of relevant contributions to this article lies in the intersection between the defense/military economics literature and the labor/personnel economics literature, in particular those that study the relationship between the pension system and the capacity of military organizations to attract competent personnel (Asch and Warner 1994a; Asch, Johnson, and Warner 1998; Warner 2006). The contributions show that the pension system plays a prominent role in the total incentive package offered military personnel. Specifically, Asch and Warner's (2001) seminal piece on compensation and personnel policy in the United States' military goes to the core of some of our assumptions in this article.[7] Their model of the compensation and career system explains three features of the U.S. military that are different from its (large) counterparts in the private sector: flat pay structure, relatively generous pension systems and emphasis on up-or-out system. Fundamental to military organizations is the lack of lateral recruitment; most, if not all, military personnel are recruited at a young age, receive education in the organization and have their military career within the organization. In their model, the likelihood to advance in the system depends on one's competency and efforts. Since it is hard for the employer to observe these two inputs, the competition for advancement is characterized by a random factor. The level of effort depends both on the probability to win the competition (i.e. the level of competition matters) and one's preferences for military work. The competition depends not only on the person's competency and efforts, but also on the other candidates' competency and efforts, as well as the number of positions available at the level above in the military hierarchy. Asch and Warner's (2001) model is based on the same intuition as in Lazear and Rosen's (1981) tournament theory: employees in lower positions are motivated by the prizes of tournaments in ranks above, and an expensive pension system is *one* way to reward senior personnel, motivating the vast majority of the organization's employees.

Raising the retirement age, while holding the number of both military personnel and positions in each rank constant, will increase the time each person will spend in each rank. Given the trend in military organizations of advancing by experience and age, the senior positions will on average be employed by older people than before. This means that the discounted, expected returns from future rank tournaments will shrink, possibly affecting retention and efforts decisions negatively.

Compared to the pay structure in the United States' military, NAF exhibits an even more flat pay structure.[8] Our argument goes beyond pay structure however. While Asch and Warner (2001) model effort and retention decisions based on monetary incentives in the hierarchy, there are reasons to believe that the desire for higher rank in military hierarchies is not only related to higher wages/pension but also to the desire for prestige. With prestige we mean status that is freely deferred by others based on achievement (Henrich and Gil-White 2001). In a military organization, advancing in the military hierarchy is one obvious way for personnel to achieve status among peers. We therefore point out that the raising of special retirement age may have negative impact on retention rates and efforts among personnel because of lower discounted expected monetary and prestige values of climbing the military ladder. Specifying the exact magnitude of retention is difficult pre-reform, and we make no such effort. We do however test the results' sensitivity to a possible reduction in retention rates as well as motivation and efforts. This is done by treating these

[7] The article is based on two reports from RAND Corporation, see Asch and Warner (1994a, 1994b).
[8] This holds generally for Norwegian market incomes compared to the situation in the United States (Aaberge et al. 2002; A. B. Atkinson 2007).

variables as stochastic and normally distributed, and evaluate the financial and economic results in several scenarios with variation in mean and standard deviation by applying Monte Carlo simulations.

Value of older personnel

Can older personnel add value to defense production as military personnel in the Armed Forces? NAF have currently no experience in employing military personnel aged 60 years and older. The special retirement age of 60 years was established in 1976 to preserve an age structure of the military workforce able to defend Norway. Lately, however, expert groups commissioned by the government to evaluate the pension system and the labor supply in Norway have questioned whether the special retirement age is ripe for reform, since technological developments, introduction of new tasks and general changes to the labor market have reduced the need for physical fitness in occupations with special retirement age, including NAF (NOU 2004, 2019). Furthermore, it has been pointed out that we have seen a large increase in life expectancy and improvements in the health condition in the population, and that the occupations with the lowest special retirement age (policy force, military personnel, fire fighters, ambulance personnel) have much better health status and work capability than the average person of the same age (NOU 2019). Hyggen (2008) investigates occupations with special retirement age, and finds that military personnel are rarely tired after a day's work, have the highest life expectancy among such occupations, and are exposed to fewer work situations that worsen their physical health condition. In addition, military personnel are much less prone to be on sickness leave and apply for disability benefits. Despite these positive developments, MOD maintains the need to be able to manage the age structure in NAF.

The retirement system in the United States constitutes an interesting comparison to the Norwegian case. The American up-or-out system where military personnel periodically apply for new appointments offers a higher degree of management flexibility than in the Norwegian system with its T35 or T60 contracts (the number representing retirement age). In the United States, the retirement system is also relatively generous in that personnel who are employed for 20 years or more are entitled to a life-long pension after retirement, making the retention rate among personnel with 10 years or more experience very high. Warner (2006) admits that the U.S. retirement system is costly, unfair to those not serving for fully 20 years, but most importantly, not able to distinguish between the personnel the U.S. Forces should retain and those which should be separated from the forces. According to Warner (2006: 2), the U.S. should institute a system that enables the Department of Defense to separate those in tasks characterized by "youth and vigor" earlier than after 20 years while retaining those with "human-capital intensive skills".

Other comparable countries also apply a special retirement age for military personnel. In Denmark, Sweden, Germany and the Netherlands, the retirement age in the civilian sector and among militar personnel is close to the system in Norway (see Table 1). The special retirement age in Germany depends on rank, yet the highest retirement age there (62 years old) is together with the other countries higher than in Norway. Moreover, the special retirement age in the selected countries has recently been increased. Sweden is the exception since the retirement age is the same for military personnel as for civilian employees. All countries attempt to increase the actual retirement age,

either by increasing the statutory retirement age (Denmark and Germany) or economic incentives (Sweden).

Table 1: General retirement age and special retirement age in selected countries

Country	General retirement age	Special retirement age
Norway	70	60
Denmark	70	63
Sweden	67	67
Germany	67	55-62
Netherlands	67	62

Although the U.S. Armed Forces retire senior personnel earlier than in Norway, we still think there are reasons to believe that military personnel can make contributions in NAF even after turning 60 years old. Most military personnel on T60 contracts (retirement at 60 years old) are transferred to supporting positions over time. They are trained in new tasks and encouraged to acquire civil educations needed in NAF. This encourages them to develop "human capital" intensive skills in addition to military specific skills. The combination of defense specific skills and general skills should contribute to their relevance even when they are too old to participate in a combat theatre. That said, we have not studied specifically the exact value older military personnel may add to defense production in Norway.

The issue from a societal point of view is that separating relatively old people from the industry they have worked for their whole career can have detrimental effect on their post-military labor market opportunities. Does it make sense for society to keep a relatively young age structure if it means that older retirees have substantial potential labor supply but with nowhere to offer it? Few military economics treatments of the retirement system concern themselves with overall societal surplus, yet a full-scale CBA needs to go beyond the military sector's perspectives. It is telling that Warner's main concern is to be able to separate those specialized in combat tasks and keep those with more human capital skills; the former faces relatively low demand in the civil sector labor market, while the latter faces relatively high demand. To ensure a scientifically accurate discussion of these retirement issues, we turn our gaze below to labor economics theories that indeed tell us that older personnel probably produce less than what they are paid. These theories shed therefore light on some of the resistance in the MOD (and the U.S. Armed Forces) in retaining older employees.

Labor economics take on older personnel in a CBA perspective

A standard assumption in cost-benefit analyses is to assume equality between the value of a person's labor and the wage received.[9] As Bartik (2012: 1) states: 'If labor market cleared, with no involuntary employment and no other distortions… [w]ages equal the marginal product of labor and the opportunity cost of the marginal worker's time.' This assumption makes sense when age is irrelevant since such reforms or investments affect the population at large.

[9] This assumption is based on the competitive wage theory, i.e. the theory that states that firms pay the competitive wage in the labor market; deviation from this wage is irrational either for the firm or the employee.

Labor economics are however burgeoning with theories that challenge the simple competitive wages theory. Several of them – in particular human capital theory, deferred compensation theory and tournament theory - carry specific predictions about seniority wages and age that differ significantly from the competitive wage theory (and hence are relevant for our calculation).[10] Human capital theory (Becker 1962, 1964) distinguishes between firm specific and general human capital, and argues that employers are only willing to invest in firm specific capital. Alternative employers will be willing to let the employee harvest the whole investment in general capital, leaving the former employer with only the costs. Regarding firm specific capital, Becker suggested that employers and employees will invest together, with increased seniority[11] wages as a result. Such seniority wage increase will be in accordance with productivity increase.

Deferred compensation theory challenges human capital theory (Lazear 1979, 1981). If there is asymmetrical information between the employer and the employee about the employee's effort level, then Lazear proposed that employers will offer wage contracts where the employee earn less than her productivity in the first half of the career and more than the value in the second half. Such a contract induces effort and deter shirking. This theory predicts three phenomena for jobs where efforts are hard to observe: a) the growth in wages will be higher than the growth in productivity, b) compulsory retirement: the employer loses money on the older employees and need to have an agreement about retirement, c) firms employ older people but rarely hire older people. If this theory fits the reality of NAF, we would overestimate older employees' contribution to defense production when applying the standard assumption derived from competitive wages theory.

Tournament theory is a third challenger to the standard competitive wage perspective (Lazear and Rosen 1981). As mentioned above, according to this theory, compensation is decided by the employee's performance relative to others in the same rank in the firm. The relative game motivates people in the same rank and in ranks below. Wages do not therefore reflect (only) the employees' productivity, but also the production of employees below in rank. The prizes in the tournament may however be small in NAF In their study of compensation in the U.S. military, Asch and Warner (2001) claim that the wage spread is relatively low (yet higher than in NAF), and that this is justified by a generous pension system for employees staying for 20 years and above. In any case, the total compensation in the tournaments will reflect more than the individual's productivity for personnel in higher ranks, that is, older military employees. If this tournament mechanism is present in NAF, the standard assumption about equality between productivity and wages is prone to errors.

We do not know which of the labor economics theories that best defines the relationship between wages and productivity among young and older employees in NAF. Human capital theory and deferred compensation theory have however been subject to substantial amounts of empirical studies. Many empirical findings indicate that deferred compensation is an important mechanism in

[10] Other prominent theories on the relationship between productivity and wages are 'efficiency wages' (Krueger and Summers 1988) and 'fairness wages' (Akerlof and Yellen 1988, 1990), but these do not offer specific predictions about the relationship between older employees' wages and productivity. 'Matching' (Jovanovic 1979) could potentially explain older people's relatively high wages (because they have had more time to find a good job match than younger people), but nearly all military employees have matched with NAF early in their careers and can therefore not explain the relationship between wages and productivity (except that those who have stayed may be more skilled and prefer NAF more than those who left the organization).

[11] Seniority wage refers to wage that stem from staying in the same company over time, in addition to the wage increases from gaining general experience and skills in the labor market.

labor markets (Frimmel et al. 2018; Hutchens 1987; Medoff and Abraham 1980, 1981; Shaw and Lazear 2008; Zwick 2011). A study on the Norwegian labor market also point to that deferred compensation can explain the relationship between wage and age, in industries with assymmetrical information (Barth 1997). The above-mentioned study by Asch and Warner (2001) showed that tournament theory can explain peculiar traits of the U.S. military, some that is shared by NAF. We believe therefore that there are major reasons to question the application of standard competitive wages in this cost-benefits anaysis of employing older military personnel in NAF.

Specifically, the question about value of employees is accentuated as NAF as of today does not employ military personnel over 60 years old. After a potential reform, military personnel will work in NAF into their 60s, reducing the need for new recruits, which again will take up work in the private sector. This has implications also for older people in the private sector, but, if deferred compensation is used as a wage strategy there, we can assume that the wage structure is adjusted already when it comes to the individuals' lifetime careers. The often-claimed need for 'youth and vigor' and a relatively young age structure among military organizations also leads us to question the assumption about the value of older military personnel. The technological development has however countered the extreme need for young soldiers on the battlefield in the total work force of military organizations. Today, experience and knowledge about military affairs (defense specific human capital) and about more general affairs (general human capital) among older personnel should at least have some value for NAF.

In order to take into consideration the possibility that the productivity of older personnel is lower than the wage, we add this variable to the Monte Carlo simulation, and treat the value of old military personnel as random and Gaussian in nature. We discuss the inputs and scenarios in the Methodology section below.

The ordinary and special military retirement pension systems

Pension systems in Norway

All citizens in Norway are members in the National Insurance Scheme (NIS), which provides pension benefits. In addition, employees in the state and municipalities receive an additional pension component. Furthermore, all public sector employees and about half of private sector employees receive AFP that currently is a life-long top-up benefit for private sector employees and is likely to be implemented also for public sector employees. Today, the general pension system in Norway is characterized by being 'actuarial fair' up to a certain income level. This means that there is a clear link between contributions and pension benefits (see Lindbeck and Persson (2003)). This strengthens the accruals effect. The general pension system is also actuarially neutral, in the sense that take-up age of pension does not affect the total pension wealth (equal to the discounted value of take-up age, discounted at a real annual rate of interest of 2 percent). See more information about the general pension system in Appendix A. The information about the current general pension system and trends in the recent pension reforms are used here to establish a potential special retirement age pension system for military personnel.

The special retirement age pension system is different from the general pension system in Norway. Employees with special retirement age are forced to retire at the special retirement age, but can according to the 85 years principle, retire when the sum of their age and number of years in work

exceeds 85 years, at 57 at the earliest. Thus 57 is the minimum age in NAF while it is 62 for many private sector and all public sector employees with normal retirement age. In NAF, the special retirement age is 60 years, while the maximum retirement age is 72 and 70 for private sector and public sector employees, respectively. Between 60 and 67 years, military personnel receive 66 percent of the wage at retirement. After turning 67, special retirees are transferred to the general pension system. The principle of life expectancy adjustment will however increase the number of years a cohort needs to work in order to maintain the same pension payments, and thus, military personnel needs to be compensated for the life expectancy increase or face reduced pension payments. If the former option is chosen, the special retirement age pension system becomes increasingly expensive for MOD and the Norwegian society. We conduct the standard analysis with the expected lifetime at reform time (2011), but add a sensitivity check where the cohort is required to work 3 more years to maintain payment value.

The special retirement age pension system has yet to be reformed, and thus we have to make assumptions about a likely future pension system for military personnel in NAF There are a number of considerations the government, MOD and the labor unions need to agree upon. Here, we deduce the potential military system by looking at the trends in the pension reforms the past decades. This points to a system that is actuarially neutral in terms of take-out age and induces work incentives. It is also likely with a military pension system that secures the special retirees a comfortable pension, because this deters negative effects on retention rates and efforts. We define the actual and hypothetical pension systems applied in our modeling in the Methodology section.

Methodology

The value of increasing the special retirement age to society: Cost-benefit analysis

CBA is a 'systematic process of calculating the benefits and costs of policy options and projects' (Atkinson et al. 2018: 3).[12] The method calculates the effects – i.e. the benefits and costs for a society - and goes thus beyond the expected profit analysis that for instance corporations conduct. While increased net profits in the private sector in many cases are equal to societal gains, the presence of market failures certainly erases the equality sign. The core concern of a CBA is the efficient use of society's scarce resources. CBA is much used when analyzing the effects of public investments in infrastructure projects (Department of Transport 2011; Venables 2007; Calthrop, De Borger, and Proost 2010; Eliasson 2009), the health sector (McIntosh et al. 2010; Wang et al. 2003; Bleichrodt and Quiggin 1999) and for environmental policies (Nordhaus 2006; Stern 2006; G. Atkinson et al. 2018).

This study concerns how Norwegian society's resource allocation is improved and/or deteriorated by an increase in the special retirement age. Lindbeck and Persson (2003) point out that pension systems have effects along three important aspects: economic efficiency, distribution, and financial stability. This means that pension systems affect behavior in terms of labor supply and saving/consumption (economic efficiency), the distribution of lifetime income between and across generations, and the financial soundness of public budgets (stability). Here, we focus solely on economic efficiency. We comment, however, on the specific ways the pension reforms in Norway, in

[12] In Norway, Finansdepartementet (2014: 1) defines CBA as a method that 'clarifies and illuminates the effects of reforms, regulations, investments, service production or other actions' (our translation).

addition to the potential increase in special retirement age, move the Norwegian pension system along these three aspects. The focus on economic efficiency means that we are concerned with how alternative pension reforms affect individuals and households' decision-making given the existing institutional framework (labor laws, regulations about pension and other public transfers, taxation system, etc.). An important point in this regard is that our study concerns non-marginal changes: cost-benefit analysis is normally applied to marginal changes in behavior, and the values of labor supply etc. can thus be derived from existing wage levels etc. (see Bartik 2012). In our case, however, employees may increase their labor supply from 0 or 30 or 50 percent to 100 percent. This means that we deal with decisions along the *extensive* margin as well as major changes along the *intensive* margin.[13]

A cost-benefit analysis has several analytical cousins, such as cost-effectiveness analysis, cost-utility analysis, risk-benefit analysis. Specifically, a cost-benefit analysis calculates both benefits and costs in monetary terms, making it possible to compare the benefits and costs in the same currency. Sometimes certain benefits or costs are difficult (perhaps impossible) to valuate and are incorporated into the analysis through a qualitative assessment. In this study, however, we have translated all costs and benefits to USD and are thus able to complete the comparison.

An economic efficiency perspective on the CBA means that we are, in the economic analysis, not interested in the face value of changes to public finances. Instead, we calculate the efficiency effects of the lower or higher need for taxation. Higher (lower) tax income and/or lower (higher) public transfers lead to a more (less) efficient economy, when distortionary taxes are levied on the citizens, because the government can reduce (need to increase) the tax rate and still collect the same revenue. Unless taxes are of a lump-sum kind or reduce negative externalities (i.e. of a Pigovian kind), they inhibit optimal allocation of resources in an economy. The reason is that taxation introduces a wedge into optimal production and consumption decision-making compared to a no-taxation situation, resulting in a social loss – termed marginal cost of public funds (MCF) - even when individuals behave rationally. The MCF is therefore the marginal efficiency reduction of taxation and is operationalized in a CBA as a multiplier to be applied to the direct resource cost.

This argument stems from a strand in public economics – initiated by Pigou (1947) - that study the relationship between financing public goods and the distortionary character of taxes (see also Atkinson et al. 2018; Diamond and Mirrlees 1971; Stiglitz and Dasgupta 1971; Ballard and Fullerton 1992; Fullerton 2003; Mayshar 1990). The main argument here is that the benefits of public goods must be at least equal to the direct cost of the project plus the cost of distortionary taxes, and involves a a critique of the Samuelson rule[14] (Samuelson 1954). Some, however, have raised concern with this one-sided perspective on public projects. Hylland and Zeckhauser (1979), and then Christiansen (1981), showed the conditions that need to be satisfied for the Samuelseon rule to apply, despite avoidance of pure lump sum taxation. Sandmo (1998) argues that the tax system is distortionary for a specific reason, namely to achieve a certain distributional effect (the most efficient tax system is hard to justify in terms of equality or equity). Kaplow (1996, 2006) shows that the analyst needs to take into account the distributional incidence and labor supply impact of the public good itself too, in the sense that one also has to be concerned with the effects of the public

[13] For conceptual definitions, see e.g. Chetty et al. (2011).

[14] The Samuelson rule states that the optimal level of provision of public goods is when the marginal cost equals the marginal benefit.

goods, not only the effects of the financing mechanisms. In our case, the policy itself does not impose any use of resources (as in an investment), but the increase of special retirement age will affect both public revenues and expenditures. The net effect will reduce the government's need for taxes, and the distortionary character on the margin in the Norwegian tax system should determine the level of MCF. That said, we agree with the critique of the Pigovian strand in that the MCF should be considered in distributional terms rather than as a pure efficiency consideration.[15]

In Norway, MOF has defined the MCF to be 20 percent of the change in need for taxation (Finansdepartementet 2014). For comparison, Sweden applies a 30 percent MCF for use in the transportation sector (Trafikverket 2016). In Denmark, the Ministry of Transportation recommend to use 20 percent MCF (Transportministeriet 2015). Parry and Small (2009) recommend 15 percent MCF Christiansen (2015) has suggested that the MCF should be set lower in a CBA conducted in Norway.[16] We follow here, however, MOF's recommendations of a 20 percent MCF.

While our cost-benefit analysis concerns economic efficiency for the Norwegian society, we also derive the financial effects of increase in the special retirement age for both the public finances of MOD and MOF. Financial effects are of interest to policy-makers in budgeting and as proxy measure of the importance of defense relative to other sectors. Of course, such allocative issues are also of interest to defense personnel and the public in general. The main difference between the financial and economic analysis is that in the former, MOD and MOF's cash flow is the most relevant variable, while the labor supply plays the primary role in the economic cost-benefit analysis (and changed cash flow only plays a secondary role through the MCF).

Demographic structure in NAF

The CBA is based on an estimate of the age structure in NAF in equilibrium (see Gisnås, Åmot, and Reitan (2016)). This means for instance that today's 'age wave' stemming from the cuts in the manpower in the post-Cold War period has come to an end in the estimate. The dynamic transformation from today until the structure is in balance is outside the scope of the article, meaning that we only look at the comparative statics of an increase in the special retirement age. We use today's recruitment and retention rates to estimate the demographic structure. Individuals in their 20s constitute the pool of recruits to NAF In equilibrium, the number of retirees and employees moving to the civil sector perfectly offsets the number of new recruits. Another important feature of the age structure estimate is that in equilibrium, the age structure does not vary between years. The costs and benefits estimated in the analysis are therefore the same each year. Thus, it is straightforward to calculate the long-term effects simply by applying the annual values and apply preferred discount rates.

The Advisory Council of the Norwegian Chief of Defence has suggested a military personnel structure of 12 000 military employees in 2035 (Forsvarssjefen 2015). While the special retirement age is different in alternative 0 – 4, the suggested number of military personnel is the fundamental constant in each of the alternatives. Other major assumptions in the age structure estimate concern the work and retirement behavior of older individuals (age > 59), both in the military and the private

[15] Moreover, this CBA concerns the labor supply effect of a potential reform, and in this sense, we do respond to the Kaplow critique (1996, 2006).

[16] Dagsvik, Strøm, and Locatelli (2019) calculate the MCF based on a labor model, where labor supply depends on the taxation system. They estimate the MCF in Norway to be 15 percent.

sector. We estimate the retention rates among older military personnel to rely on two channels: the propensity to take-up early retirement pension and leave NAF ('early retirees – NAF') and the propensity to exit the force to receive disability benefits ('disabled – NAF').[17] Since we assume a work-inducing pension system to be in place also for military personnel, we expect the propensity to exit the force, take-up early retirement and partly continue working in the private sector to be similar to those employed in the private sector. In the private sector, about 10 percent of the male workforce retire at the pension age (62 years) (Strøm et al. 2015). In alternative 2 (special retirement age = 65), it is not likely that personnel leave NAF for early retirement and hence lose out on the opportunity for 2 years special retirement pension from 65 to 67 years. In this alternative, therefore, we expect the number of early retirees to be zero.

Selection on physical abilities among military recruits makes it likely that they have better health conditions in their 60s than the general population. Some evidence for this argument may be found in the negligible disability benefits take-up among military personnel, despite substantial take-up rates in the general population (15.1 percent among males aged 55-59[18]). We have no information about the health status of special retirees, and we apply therefore the marginal increase in disability use among male employees in their 60s in the general population, and discard the recipients of disability benefits in their 50s, in the calculation of disability propensity among military personnel.[19]

In alternatives with increased special retirement age (1 – 4), NAF employ older military personnel, reducing the need for young personnel. The reduction is spread relatively even over the young personnel structure (20 – 59 years old), resulting in similar retention rates in all the alternatives. The age structure in alternative 0 is shown in Figure 1. The figure shows that the personnel is recruited in their 20s, a substantial share is employed in the T35 system (contract ending at age 35), and a relatively high retention rate among those on long-term contracts (T60) in their 40s and 50s. In Figure 2, the age structure among personnel aged 55-69 is shown for all five alternatives. In alternative 1 and 2, the reduction in number of personnel in their 60s is based on the disability rates for personnel aged 60 to 65. In alternative 3 and 4, an additional reduction in personnel stems from 20 percent early retirement at age 62.

[17] The mortality rate in the model is 0.

[18] https://www.nav.no/546063/mottakere-av-uf%C3%B8retrygd-som-andel-av-befolkningen.etter-kj%C3%B8nn-og-alder.pr.31.12.2009-2018.

[19] Data on male use of disability benefits are derived from the Norwegian Labour and Welfare Administration.

Figure 1: Age structure in NAF, alternative 0, age 20 – 59 (x-axis), number of military personnel in each age cohort (y-axis)

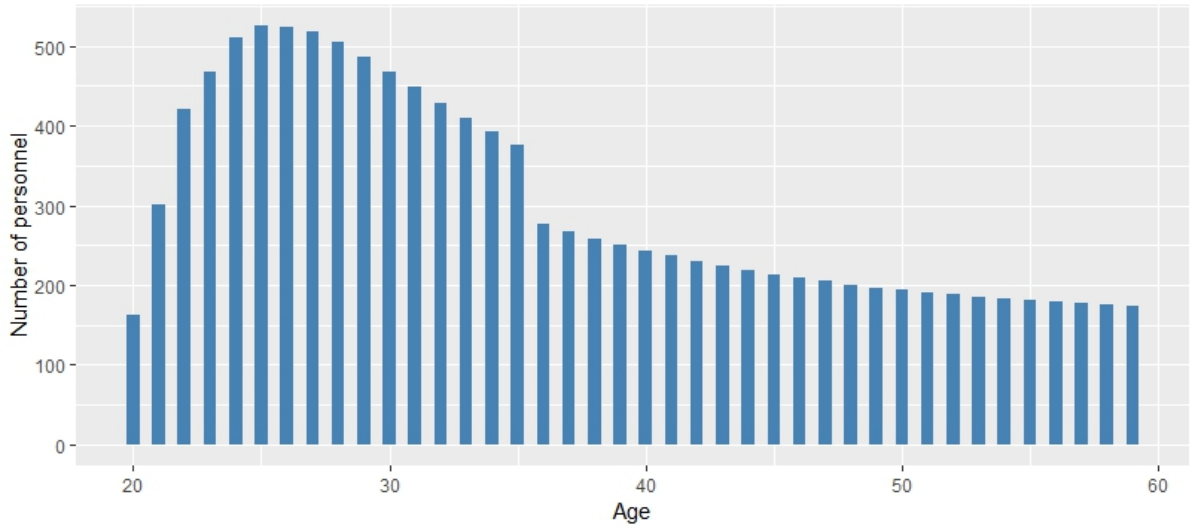
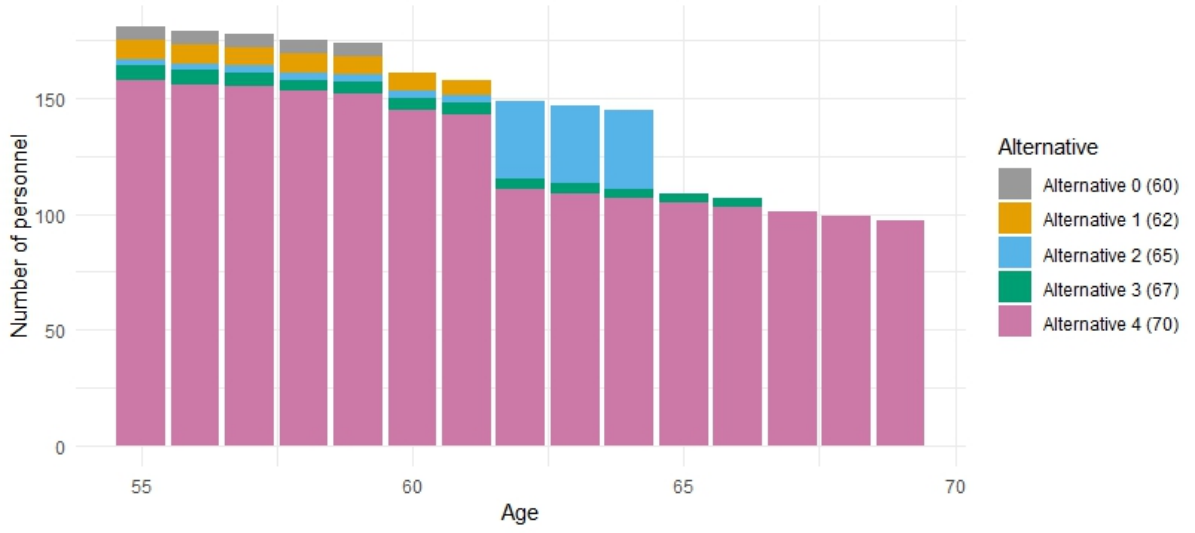


Figure 2: Age structure in NAF, alternative 0 – 4, age 55 – 69 (x-axis), number of military personnel in each age cohort (y-axis)



Calculation of financial and economic effects: the pension model

We calculate the financial and economic effects of an increase in the special retirement age by comparing the results for alternative 1 – 4 with results for alternative 0 (no increase in special retirement age). Below we specify a model for the financial and economic effects, the model's assumptions and values on important parameters.[20]

The number of employees continuing to work in NAF there in their 60s reduces the need for recruits in NAF. These individuals will instead find employment in the civil sector. The size of the public

[20] The model is the second generation of its kind (PEMOD 2.0) at FFI. The first generation is applied in Lindgren and Hanson (2018, 2019a, 2019b) and Hanson and Lindgren (forthcoming). Compared to the first generation model, PEMOD 2.0 is able to calculate stochastic variables. The model is developed in Excel 2016, with use of SQL coding.

sector is held constant in all alternatives. Thus, the net increase in labor supply in the civil sector is all channeled into the private sector.[21]

The model calculates wages, value added, taxes, pension allowances, other public benefits, and leisure value per labor and pension group. 11 groups are included in the model (see Table 2). The number in each group is shown per alternative. Note that Alternative 0 has zero employees in the private sector, and zero disability recipients, since disabled personnel from NAF are all receiving either special or normal retirement pension. Alternative 3 and 4 have no special retirement recipients since the special retirement age is too high to receive special retirement age pension.

Table 2: Number of persons per labor and pension group, alternative 0 – 4.

Category	Alt. 0	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Young employees - NAF	12 005	11 685	11 259	11 152	10 885
Older employees - NAF	0	319	745	853	1 120
Young employees – private sector	0	319	746	853	1 120
Older employees – private sector	0	43	98	118	156
Work able special retirees	1 119	760	287	0	0
Disabled special retirees	102	81	34	0	0
Disability benefits recipients – NAF	0	17	56	92	156
Disability benefits recipients – private sector	0	9	20	24	32
Early retirees and retirees – NAF	445	430	409	559	243
Early retirees and retirees – private sector	0	10	22	27	36
Disabled former special retirees - NAF	78	75	72	70	0
Sum	**13 749**	**13 749**	**13 749**	**13 749**	**13 749**

The wages are based on average gross wages in 2012, adjusted for wage increase in the defense sector. The wage data are given per age cohort and distinguish between base wage and total wage. The difference between base and total wage is explained by bonuses, overtime payments and other additional wage. This means that we are able to calculate average wages among young personnel per age structure, and can calculate correct pension allowances (e.g. NIS is based on total wage while public service pension is based on base wage). We do not have empirical data on wages for the personnel in the private sector, because such individuals are currently working in NAF. One alternative could be to use average wages in the private sector. We expect, however, that military personnel in NAF have specific characteristics different from the average worker in the private sector since they are recruited based on specific mental and physical abilities. At the same time, people with preferences and skills for the military profession may self-select there. The other obvious alternative is to use the wages in NAF as a proxy for the wage level of those who will work in the private sector after an increase in special retirement age. This choice seemed more reflective of

[21] It is irrelevant whether the personnel otherwise recruited to NAF are employed in the private or public sector (by pushing others into the private sector), as long as the net increase in labor supply is demanded by the private sector and the relative prices and wages are unaffected.

the personnel's earning potential, and we opted for this alternative, although it is not without weaknesses. For instance, people recruited to NAF today may have strong preferences for defense work (and willing to work for less pay), and may therefore be able to demand higher wages outside the defense sector.[22]

An increase in the special retirement age will change the wage structure in NAF While the total budget to base wages increases, the total overtime and exercise budget is reduced. We want to hold the the latter budget identical in all alternatives. More exercise time and wage is thus distributed to young military personnel. This increases the total defence budget marginally.[23] Since the age structure among those not recruited to NAF is slightly older than in NAF after the special retirement age increase, the average wage in private sector is higher. The gross wage is around 93,000 USD for young personnel in NAF, and 97,000 USD for young personnel in the private sector. Older personnel in NAF and the private sector earns the same as a 59 year old military employee (gross wage 92,500 USD). On top of these gross numbers we add the employer's NIS contributions and employer's pension contributions. Taken together, we estimate this top-up on gross wage as 15.2 and 16.4 percent for young and older personnel, respectively.

Strand et al. (2018) have shown that former military employees receiving special retirement pension have on average a 50 percent labor market participation rate. We expect early retirees to have the same participation rate. However, we have no empirical data on the wages of these groups. Based on the fact that these individuals are not able to capitalize on their firm-specific human capital, we assume a 15 percent pay cut if the personnel take up work elsewhere in that age.

In the economic analysis, we are not interested in wages per se but in the economic values the labor force produces. The wages give an indication of value added because they state what the public and private sector are willing to pay for the labor. Taken across the whole organization and across all ages, it may be a reasonable assumption. Thus, in the standard scenario – scenario 0 - gross wages including employer's NIS contribution and pension allowances constitute the estimate of value added for labor in the various labor and pension groups. However, due to the possible existence of deferred or tournament compensation, the equality between productivity and wages does not necessarily hold (see literature review). Since the labor supply is the primary variable in the CBA, and the value of the additional labor supply (stemming from older workers) is uncertain, the results are also uncertain. We test the sensitivity of the results when we relax this assumption of equality between wages and value added in the Monte Carlo simulations in the results section.

Taxes on gross income in Norway comprise mainly income taxes, employers' NIS contributions and value added taxes (VAT). We have estimated the total tax rate for labor income and pension income based on a tax calculator from the Norwegian Tax Authorities. We have calculated the share of disposable income that will end up as VAT based on the country's disposable income (from Statistics Norway), total VAT revenues (from MOF), and an employers' NIS contribution estimate of 10

[22] See Prendergast (2015) for arguments on professionalism and (the lack of) financial incentives in the public sector.

[23] We assume that a social planner would prefer an increase in the defense budget financed by e.g. increased tax revenues or transfers from other sectors, in order to gain the increase in labor supply.

percent.[24] The total tax rate on gross income including pension allowances is estimated to 50 percent for labor income and around 40 percent for pension income and disabled benefits. The difference in tax rate between labor income and pension income is due to that tax on pension is lower than labor income and that the pension payments are lower than labor income, and thus have lower average tax rate (due to the progressivity of Norwegian income taxes).

The actuarial neutral pension system both in the private and the public sector induces employees to supply labor into their 60s and 70s. We expect a future reform of special retirement age pension system to follow this trend. At the same time, we expect the system to be a generous system if today's special retirement age is maintained (alternative 0). This means that we expect that in addition to keeping the current calculation for special retirement pension (66 percent of wage at take-up age), special retirees will receive pension savings into their pension accounts *as if* they continued working in NAF. We term this pension payment for special retirement pension allowance.

We model the effects of pension systems on public budgets to occur at the time of pension savings, not at the time of take-up. When employees work, they pay taxes and earn pension allowances, equivalent to the government saving money in an account. The key issue is therefore whether individuals in the model supply labor in the formal labor market, not whether they receive pension benefits. The pension credit earnings can take three forms: pension allowance (for employees), special retirement pension allowance (for special retirees), and disability pension allowance (for disability benefits recipients). Disability benefits recipients are eligible for the latter allowance until age 62. For simplicity, we model the public financing of private sector employees' pensions to be identical to the financing of pensions to public sector employees. The values of these pension allowances and the disability benefits can be found in Appendix A.

In scenario 0, we have assumed no increase in life expectancy, in effect, canceling the principle of life expectancy adjustment. The reason is that we calculate for a year when the effect of the pension reform has reached equilibrium, and this is hard to nail down to a specific year. We conduct, however, a sensitivity test where we adjust for a 3-year increase in life expectancy.

Results

Scenario 0 (standard)

In scenario 0, we assume that an increase in the special retirement age has no effect on the retention rate and motivation and efforts among the military personnel. Furthermore, we equate the productivity (value added) among older military personnel with their wages. These strong assumptions are relaxed in the Monte Carlo simulation in the next sub-section.

In Table 3, the budget effect for MOD of increasing the special retirement age is presented. The results show a 29 and 94 million USD reduction in the MOD budget in alternative 1 – 4. Due to changes in the age structure among those aged 20 – 59 years the wages are reduced for the young but increased for the older personnel. As noted above, the budget for overtime payments, bonuses and various types of additional wage is held constant for all alternatives. Thus, the difference is that the older personnel have a higher base wage, and higher pension allowances. The main component

[24] The normal rate is 14.1 percent, but zero in the northermost parts of Norway, where NAF has several military bases. We assume an average employers' contribution to NIS of 10 percent for NAF.

for MOD's budget is, however, the reduction in special retirement age pensions and the attached pension allowances. In alternative 3 and 4, the special retirement age pension system is removed, resulting in approximately 100 million USD in reduced expenditure. In addition, the number of recruits is reduced, translating into lower educational costs.

Table 3: Changes in MOD budget surplus, alternative 1 – 4 relative to alternative 0, million USD

Type	**Difference**			
	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Young employees - NAF				
Wage	29	67	77	101
Older employees - NAF				
Wage	-32	-76	-87	-114
Speical retirees				
Special retirement pension	23	55	75	75
Special retirement pension allowance	7	18	24	24
Education costs				
Financial costs	2	5	6	8
Sum	**29**	**69**	**95**	**94**

The potential reform of the special retirement age is less dramatic, yet negative, for MOF. In Table 4, we see that MOF reduces its budget with between 2 to 13 million USD. The reduction in special retirees reduces both labor income taxes and the taxes on the special retirement pension. In addition, the number of young employees in NAF is reduced and hence net contributions are down. On the positive side, MOF receives net benefits from older NAF employees and young employees in the private sector. The reason alternative 4 is better than alternative 3 is that while the loss of special retirement age pension is identical, the tax payments (net of pension allowances) from older workers in NAF and the private sector is bigger than the loss of increased costs of young employees in NAF. We conclude that MOF's budget is not very sensitive to the changes in special retirement age, as long as the expenses to special retirement pension is levied on MOD's budget.

Table 4: Change in MOF budget, alternative 1 – 4 relative to alternative 0, million USD

Labor and pension group	**Difference**			
	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Disabled - NAF & private sector	-1	-2	-4	-4
Early retirees - NAF & private sector	0	0	3	-3
Special retirees	-19	-44	-59	-59
Young employees - NAF	-11	-26	-30	-39
Older employees - NAF	13	31	35	46
Young employees – private sector	14	32	37	49
Older employees – private sector	2	4	5	6
Sum	**-2**	**-5**	**-13**	**-4**

Table 5 shows the economic costs and benefits in scenario 0 for the Norwegian society. Taken together, the net benefit equals 33, 78, 91, and 116 million USD when increasing the special retirement age with 2, 5, 7, and 10 years, respectively. This estimate represents a substantial increase in efficiency in the Norwegian economy.

Special retirees and young employees in NAF are labor and pension groups contributing with net loss to the economic results. The reason is that these groups shrink in size in alternative 1 – 4. Older employees in NAF, and young and older employees in the private sector increase in number and thus contribute with substantial economic benefits for society, between 80 and 283 million USD when taken together. The reduction in costs for society, resulting from a lower demand for military education, is estimated to between 2 and 7 million USD. The reduction is, however, lower than the financial effect as some of the financial expenditure is related to payment of wages to students at military schools. Only the MCF of the expenditure represents a cost in an economic sense.

All results rely on some uncertain assumptions that an increase in the special retirement age has no effect on the retention rate and motivation and efforts among the military personnel, and that the productivity (value added) among older military personnel is equal to their wages. In the next section, we test the sensitivity of these assumptions through the application of Monte Carlo simulations.

Table 5: Economic benefits and costs, alternative 1 – 4 relative to alternative 0, million USD

Labor and pension group	**Difference**			
Type	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Disabled - NAF & private sector				
Disabled benefits and Disabled benefits allowance	0	-1	-1	-2
Taxes	0	0	0	1
Leisure	0	0	0	1
Early retirees - NAF & private sector				
Value added	0	-1	6	-8
PA (gross)	0	0	0	0
Taxes	0	0	1	-1
Leisure	0	0	1	-1
Special retirees				
Value added	-16	-38	-51	-51
PA (gross)	1	1	2	2
Taxes	-4	-10	-13	-13
Spec. retir. pension and spec. retir. pension allowance	6	15	20	20
Leisure	-2	-6	-7	-7
Young employees - NAF				
Value added	-30	-70	-81	-106
PA (gross)	1	3	3	5
Taxes	-4	-8	-9	-12
Older employees - NAF				
Value added	34	80	92	121

PA (gross)	-1	-3	-4	-5
Taxes	4	9	11	14
Young employees – private sector				
Value added	36	83	95	125
PA (gross)	-1	-3	-3	-5
Taxes	4	9	11	14
Older employees – private sector				
Valueadded	5	11	13	17
PA (gross)	0	0	0	-1
Taxes	1	1	1	2
Education costs				
Economic costs	2	4	5	7
Sum	**33**	**78**	**91**	**116**

Sensitivity analysis: Monte Carlo simulation

In this section we elaborate on the findings from the literature review, which suggests that three assumptions are critical to our calculations: the effect of special retirement age increase on (i) retention rates and (ii) motivation and efforts among military personnel, and (iii) the value of older military employees in NAF. The standard assumption (as applied in scenario 0 (standard scenario)) is that the retention rates and motivation and efforts are unaffected, and that the value is equal to the wages. We use Monte Carlo simulations to test the sensitivity of the results with varying assumptions for these three variables.

The stochastic variables are modeled to be Gaussian in nature, with reasonable means and standard deviations. We use these distributional assumptions in the Monte Carlo simulations. The simulations are executed 1,500 times per scenario. This means that we draw one outcome from each random variable and then calculate the results. The retention rates affect the input data from MDM, the effort and motivation variable affect value added for young personnel, while the variable for the value of older personnel obviously affect their value added. It is only the retention rate that affects the financial results for MOD and MOF. All three variables affect the economic net benefits for the Norwegian society.

The values of the stochastic variables in the three additional Monte Carlo scenarios are shown in Table 6. The mean in scenario 1 – 3 is defined relative to the values of the inputs in scenario 0 (standard scenario). Thus, in scenario 1 – 3, we add negative mean change with a certain standard deviation to the three stochastic variables. Each of scenario 1 – 3 are designated a high negative change in one of the three variables, to be able to present high variation in the sample space. The three stocastic variables are assumed to be independent.

The retention rate variable in Table 6 is modeled as a multiplicative constant to the original retention rates in MDM. This means that the retention rates are adjusted equally in a relative sense. An alternative was to adjust the retention rates in an absolute sense, that is with an additive percentage point change. We believe the most reasonable effect of lower retention is a relatively equal change per age cohort. Moreover, the reduction in retention rates is modeled to affect personnel in the age between 42 and 59 years old. Reduced manpower in this age increases the

number of personnel in the age 20 – 41 years old. The increase is distributed among the cohorts 20 – 41 with a linear function with maximum share among cohort 20 (8.1 percent) and minimum among cohort 41 (1 percent).

Table 6: Assumptions about stochastic variables, percentages refer to difference from scenario 0 (standard scenario), scenario 0 - 3

Scenario name	**Scenario 1**		**Scenario 2**		**Scenario 3**	
Stochastic variable	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
Retention	-45 %	30 %	-15 %	30 %	-15 %	30 %
Motivation and effort	-1 %	1 %	-2 %	1 %	-1 %	1 %
Value of older mil. empl.	-20 %	20 %	-20 %	20 %	-60 %	20 %

Figure 3 shows the results from the Monte Carlo simulation for the Norwegian society. In scenario 0, there is no variation in outcomes and hence the results have zero standard deviation. In scenario 1, the reduction in retention is particularly high. This has a partial effect that is negative only in alternative 4, and is positive in alternative 1 (see appendix E). The total impact of the three variables is, however, negative in scenario 1. The standard deviation increases with the number of years the special retirement age increases, and only alternative 1 suffers from having a potential for a negative effect for the Norwegian society, within two standard deviations from the mean.

Alternative 1 performs worst under a large reduction in motivation and efforts in NAF (scenario 2). The gains from increasing the retirement age further is however large in this scenario. Figure 3 shows that for instance the elimination of the special retirement age (alternative 4) is better off under scenario 2 than a large decrease in military personnel value (scenario 3). The reason is that the gross benefits are limited by only a two-year increase in retirement age in alternative 1, while all the young employees suffer from less motivation and reduce their efforts with two percent (on average), resulting in a large loss of production of defense services. In alternative 3 and 4, however, the gross gain from increasing the retirement age from 62 years to 67 and 70, respectively, counter the negative effects on retention, motivation and value of older personnel. Also, in the latter three alternatives, the number of young personnel is smaller than in alternative 1, reducing the loss from motivational reduction among young employees. Scenario 3 is characterized by a smaller spread in the means than the other scenarios. The reason is that the main variable – value of older military employees – is multiplied directly with the number of such personnel. The number increases with retirement age increase and is largest in alternative 4. By this reason, the standard deviation also grows with the increase in retirement age. Note that all alternatives are potentially negative in scenario 3, within the boundaries of minus two standard deviations from the mean.

The Monte Carlo simulation provides a fruitful sensitivity test of the economic benefits for the Norwegian society by a potential increase in special retirement age in NAF. Even under substantially negative outcomes on the three most uncertain variables, the effect on the economic efficiency in Norway is most likely positive. The most critical variables are the effects on motivation and efforts in the workforce and the value of older military personnel.

We have simulated the effects on MOD's budget by varying the retention variable (efforts and value of older personnel do not affect the budget). Figure 4 shows the financial effect of the potential

reform of special retirement age. Reduced retention rates have a positive effect on MOD's budget due to fewer special retirees and smaller increases in the bonus and exercise budget (albeit higher education costs).

Figure 3: Mean and standard deviation for economic benefits for society, four scenarios (scenario 0-3), million USD

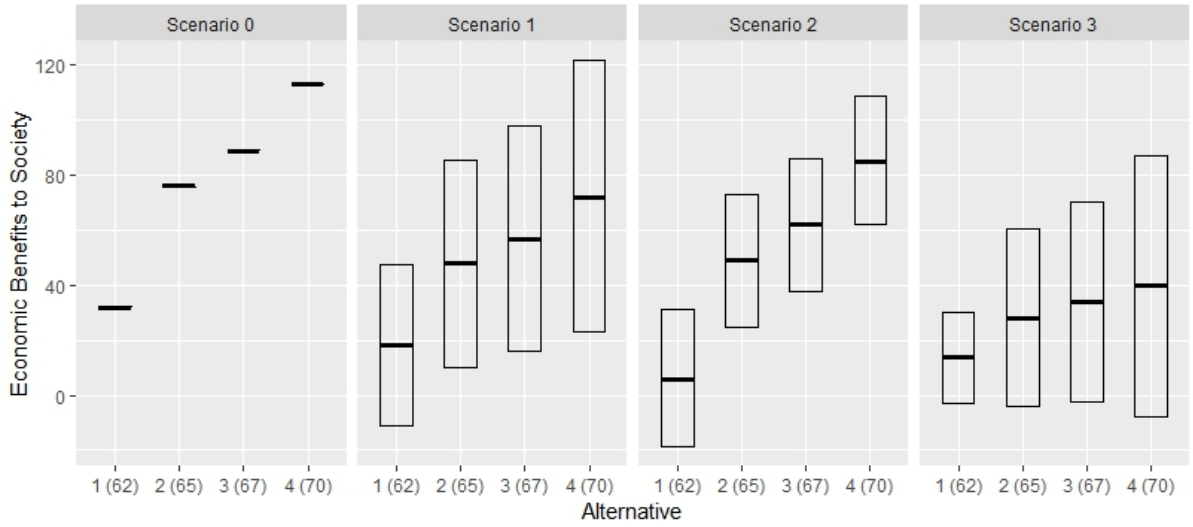
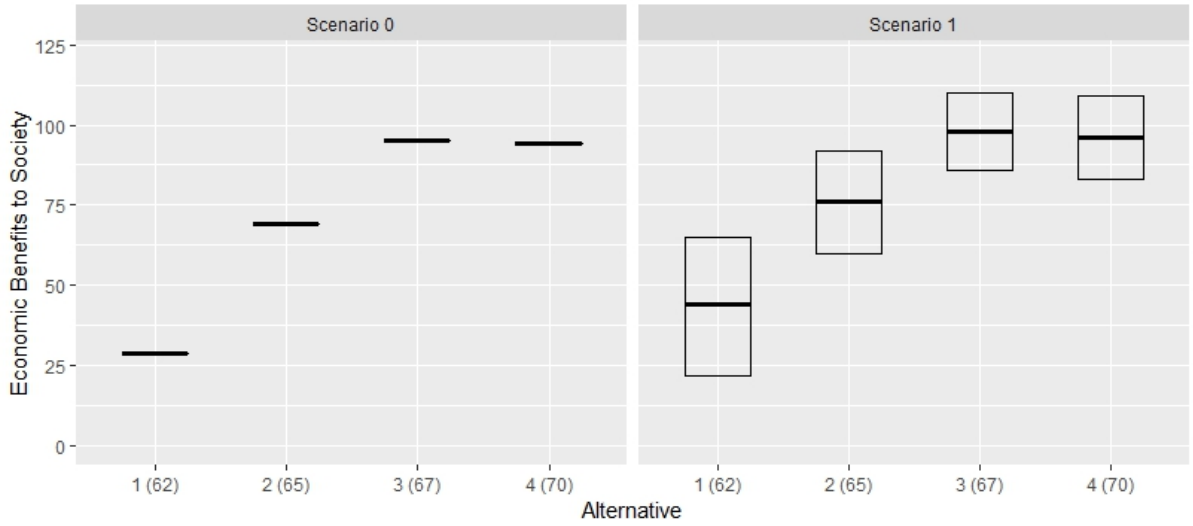


Figure 4: Mean and standard deviation for MOD's financial situation, two scenarios (scenario 0 and 1), million USD



Increase in expected remaining lifetime

As discussed in the section about the Norwegian pension system, the 2011 reform introduced the principle of increased life expectancy. This principle increases the denominator in the pension calculation function, and thus, younger cohorts (as long as the life expectancy increases) need to postpone their pension age in order to receive the same pension benefits as older cohorts. In scenario 0, we kept this age at 67, similar to the retiring cohort at reform time (born in 1943). As a

comparison, however, the youngest author is expected to have to work until he is 71 years and 9 months in order to maintain pension payments due to the principle of increased life expectancy.[25]

Increasing the age one needs to stay employed to 70 years old, and yet securing the pension payments to special retirees, means that the government pays special retirement pension and pension allowances instead of transferring the personnel to the ordinary pension system (at age 67). The financial costs are here modeled to be MOD's responsibility, while MOF receives higher taxes. The effects are largest in alternative 0 but almost identical in alternative 1-3, with a net expenditure for public institutions equal to about 25 million USD and around 5 million USD for the Norwegian society. In alternative 4, however, the special retirement pension is terminated and thus have no effect on public budgets. The difference between alternative 0 – 3 is due to a small change in the number of military employees reaching special retirement age.

The principle of adjusting the pension system according to increases in life expectancy means that the continuous increase in life expectancy will have large effects on public finances, in particular MOD's budgets. Increasing the special retirement age without terminating it does not shield MOD from the financial costs involved with this principle. The above results hold, however, only if the ministry seeks to secure its military personnel hundred percent from the pension loss from being forced to leave NAF at a certain age. A higher increase in life expectancy than 70 implies even higher financial cost of the special retirement pension system, unless the special retirement age is terminated.

Table 7: Economic benefits and costs of 3 years life expectancy increase, alternative 1 – 4 relative to alternative 0, million USD per year

Institution	**Value change**				
	Alt. 0	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Financial effects:					
MOD	-42,3	-40,8	-38,9	-38,1	0,0
MOF	16,5	15,9	15,2	14,9	0,0
Economic effects:					
Norwegian society	-5,2	-5,0	-4,7	-4,7	0,0

Conclusion

In this article, we study the economic net gains to society from increasing the special retirement age for military personnel in the Norwegian Armed Forces. We find that a reform of the special retirement age will result in large economic benefits for Norway, between 33, 78, 91, and 116 million USD annually, depending on the number of years the retirement is increased (2, 5, 7, and 10 years, respectively). The main effect is increased labor supply in the economy, resulting in lower need for recruits to NAF, and thus a larger labor supply in the private sector. The reforms will also increase the taxes received, which has a value to society equal to the MCF.

[25] https://www.nav.no/no/Person/Pensjon/Alderspensjon/Uttak%2C+regulering+og+levealdersjustering/levealdersjustering-av-alderspensjon.

The reform is also shown here to have significant positive financial effect on MOD's budget, mainly due to reduced expenditure to special retirement age pension. In alternative 3 and 4, the special retirement age pension system is removed, resulting in approximately 100 million USD in reduced expenditure. In addition, the number of recruits is reduced, translating into lower educational costs. The reform has small negative effect on MOF's budget.

Our calculation methods include an estimate of the age structure of NAF in equilibrium and a pension model that is based on insights from the literatures on pension, personnel, and military economics as well as parameter estimates from both NAF and the general population in Norway. We use a Monte Carlo simulation to test the three most uncertain variables: reform effect on retention rates, motivation and efforts, and the value of elderly personnel in NAF The Monte Carlo simulation showed that the reform is robust against low values on these variables.

Finally, we conduct a sensitivity analysis of the effects of increased life expectancy in Norwegian society. We assume a future military pension system to adopt to the principle of life expectancy adjustment that has been implemented in the general pension system. This principle will levy MOD's budget with around 40 million USD per year with a 3 year increase in life expectancy. However, the effects for public budgets in total is lower, since 40 percent will return as taxes (but on MOF's budget).

An accurate assessment of pension reform is perhaps only possible post-reform as in all the empirical studies in the pension economics literature. We have conducted this cost-benefit analysis without such post-reform knowledge of how military personnel behaves when facing a changed pension system. In particular, we argue that effects on the retention rate and motivation and efforts among military personnel constitute key areas for future research. Also, future research should strive for comprehensive understanding of the value of older military personnel. This would provide military economics more definite answers to what kind of country military organizations are for old men (and women).

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Appendix A: The trend in recent reforms of the pension systems

In Norway, the government provides membership in NIS for all its residents. NIS contains a pension component, based upon earnings level but with a minimum level that secures all residents a base pension. In addition, the Norwegian state and municipalities provide the Public Sector Pension to public sector employees, which simultaneously provides pension benefits and various types of insurances for sickness, injuries, disability, and death. The Public Sector Pension is currently based on wage level at take-up age but as we state below (2018-reform) it is about to be reformed into earnings level throughout work life. In the private sector, companies and employees are enforced by law to have a Compulsory Occupational Pension Scheme. Most commonly, this pension is based on the amount of money paid into the system (and not e.g. the wage at take-up age). Furthermore, all public sector employees and about half of private sector employees receive AFP that currently is a life-long top-up benefit for private sector employees and is likely to be implemented also for public sector employees (see 2011 and 2018 reforms below). The state covers 1/3 and all of the AFP expenditure in the private and public sector, respectively.

In 1989, AFP was introduced in Norway, reducing the minimum retirement age in Norway from 67 years to 62 years over the following decade.[26] Prior to this reform, only quasi-voluntary or informal exit routes existed, i.e. unemployment, sickness leave and disability pensions (Vestad 2013). Initially, AFP was a temporary benefit paid out from (early) retirement age up to the general retirement age. AFP was earnings-tested, and reduced significantly if the retiree earned labor income, resulting in strong disincentives to continue working. As Vestad (2013: 100) points out, employees optimized the 'peak value' (see Gruber and Wise 2002) by retiring as early as possible.

Newer reforms have attempted to strengthen labor supply incentives instead of introducing disencentives. The reason behind the reforms of the 2010s was the dramatic increase in future pension payments due to the combination of increasing share of older citizens and higher mean pension payments. The government's estimate of public expenditure to pension and disability insurance would be doubled from 9 percent to 18 percent of the Gross Domestic Product (excluding offshore petroleum activity) in 2050.[27] Thus, drawing upon the terminology in Lindbeck and Persson (2003), the reforms sought to provide a more sound financial stability in the pension system. At the same time, the reforms of the 2010s increased the economic efficiency of the pension system, by making it more actuarial neutral. The reforms had distributional effects as well, by linking pension payments more closely to income, and thus taxation, over the lifetime. We do however delimit further details about the reforms to the efficiency aspect. The reason for the focus on efficiency

[26] Read more about this reform in the two empirical studies mentioned in the literature review that exploits this new program to estimate the effects on the labor supply (Hernæs, Sollie, and Strøm 2000; Vestad 2013).
[27] https://www.regjeringen.no/no/tema/pensjon-trygd-og-sosiale-tjenester/pensjonsreform/sporsmal-og-svar/id86829/#Hvorfor_pensjonsreform.

below is that we use the main characteristics in the 2010s reforms to identify a likely hypothetical pension system for military personnel. As of today, there is no agreement about the specifics for personnel with special retirement age in Norway.

The 2011 pension reform introduced a mechanism that acturially adjust the pension benefits by take-up age, meaning that early take-up leads to lower annual benefits, and vice versa (Hernæs et al. 2016). Employees are free to choose partial pension (20, 40, 50, 60, 80, and 100 percent of the full annual pension) but cannot opt for pension payments beyond 100 percent. Moreover, the 2011 reform introduced the principle of expected lifetime adjustment. In theory, in the current pension system, workers accumulate a pension account when active in the labor force, and withdraw from this account after retiring. The calculation is defined by the following equation (for cohort 1963 and after):

(1) $P_t = A_t / D_c$,

where $P_t$is pension per year, t, A_t is the accumulated pension account in year t, and D_c is the life expectancy divisor, defined per cohort, c. Higher A_t increases annual pension payment, while higher D_c reduces annual. The longer one postpone the retirement decision, the higher the annual pension payment (up to 75 years) as it reduces the life expectancy divisor, but the expected accumulated payment is the same, meaning that the system is actuarially neutral.

As long as the life expectancy of younger cohorts is continuing to increase, these cohorts need to work longer in order to receive the same pension benefit (as the denominator grows). This principle has made it more difficult to justify economically the special retirement age in public professions. Furthermore, a reform adjusting the AFP system in the private sector was also introduced in 2011: first, AFP was made into a life-long top-up benefit that can be taken out in combination with NIS. Second, it removed the above-mentioned earnings test for early retirees, thus strongly inducing retirees to continue the participation in the labor market.

In 2018, a new reform of the public sector pension system was introduced. The main components of this reform are: public employees accumulates pension in an account - increasing with the wage increases in Norway, the pension take-up age is chosen by the employees (between 62 and 75 years), the pension benefits are not earnings-tested, and all income years up to 75 years count towards pension calculations. This resembles the system introduced in 2011 for the private sector. Furthermore, AFP was made into a life-long top-up benefit, similar to AFP in the private sector.

While the future special retirement age pension system is unknown, we use this trend in the pension systems to construct a hypothetical pension system for military personnel that induce labor supply incentives, as well as securing their pension payments in the case the special retirement age is kept at age 60.

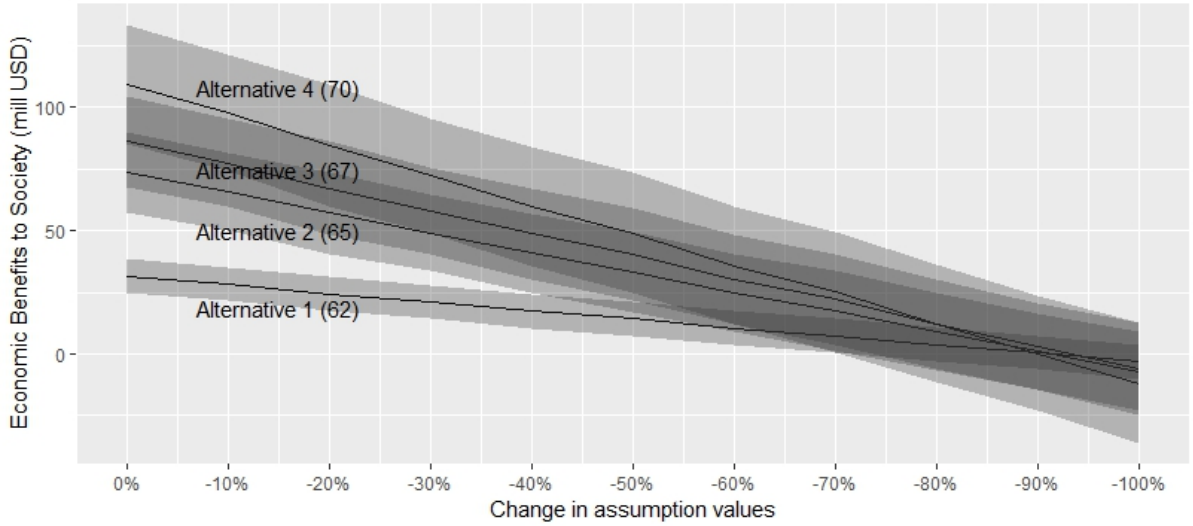
The value of the pension allowances for young and older personnel in NAF is about 20k and 21k USD, respectively. The difference stems from that older personnel have higher base wage than young. The value of the special retirement age pension allowance is calculated exactly like the normal pension allowance: 18.1 percent plus 5.7 percent up to 7.1 G and 23.8 percent up to 12 G. The average value of special retirement age pension allowance is estimated to be around 20k USD. The disability pension allowance is calculated as 18.1 percent of gross wage at take-up age, up to 7.1 G (9,100

USD).[28] The Norwegian government provides disability benefits to people who are no longer able to work due to illness and injuries. The benefit level is calculated as 66 percent of earnings at take-up time (maximum 6 G), meaning an annual gross benefit level of 46,500 USD. Disabled receive the disability benefits pension allowance mentioned above. Disabled are transferred to the pension system when turning 67.

Appendix B: Additional results from the Monte Carlo simulation

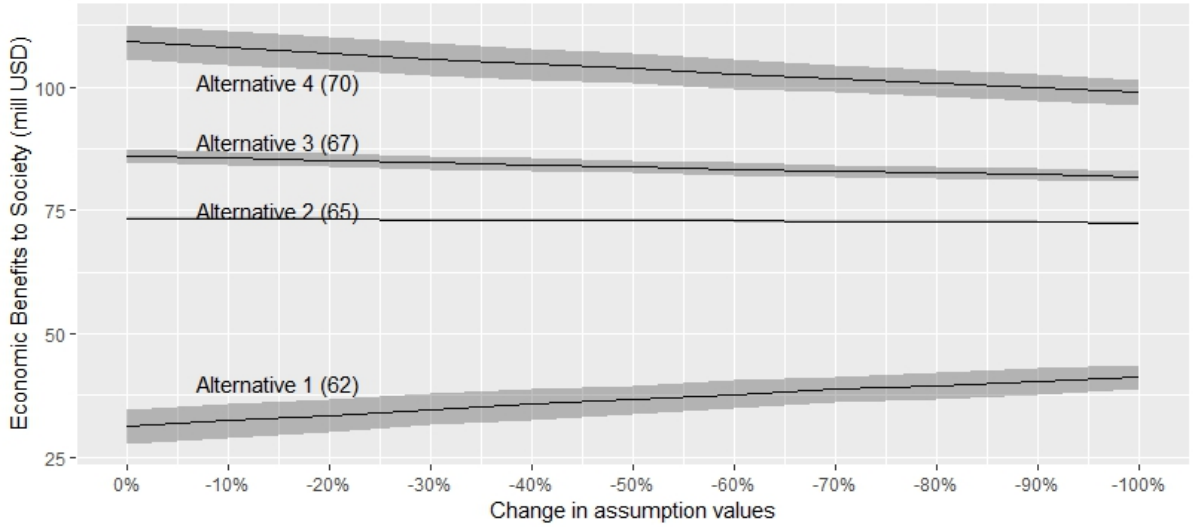
In this appendix, we provide additional results from the Monte Carlo simulation. Figure 5 presents a Monte Carlo simulation of the economic benefits to society when changing the assumptions about the value of older personnel in the Armed Forces. The figure shows that the value of older personnel need to be fairly small (around ten percent of the standard assumption of identity between wages and societal value) in all alternatives. The reason the reform is robust towards a low value of older military personnel is mainly i) the increase in labor supply among old people, ii) that special retirees is assumed to have a lower wage than non-retirees, and iii) that the increase in older personnel in NAF increases the Defense Budget but only burdens the project with the MCF

Figure 5: Monte Carlo simulation results for economic benefits for society in million USD (y-axis), only the value of older personnel in NAF is modeled as random, change to this value (x-axis).



[28] Employees earn pension allowance from NIS at the rate of 18.1 percent of gross wage (including overtime and additional payments). Annual NIS earnings are limited to a maximum of 7.1 G[28] (83 300 USD). Employees in the public sector receive an additional 5.7 percent (up to 7.1 G) and 23.8 percent for earnings between 7.1 and 12 G (140 800 USD) through the public service pension system. Public employers deduct 2 percent of the gross earnings (prior to taxes) as payment into the public service pension system. A.F.P. is valued to 4.21 percent of base gross income.

Figure 6: Monte Carlo simulation results for economic benefits for society in million USD (y-axis), only retention rates are modeled as random, change to retention rate (x-axis)



Appendix C: Number of iterations in the Monte Carlo simulation

What number of iterations in the Monte Carlo simulation is sufficiently large to capture the likely spread in the random variables? Barreto and Howland (2006: 227) suggest that 1,000 iterations 'usually generate a fairly good approximation, but that 10,000 will make the simulation 'even closer to the truth'. In general, the required number of iterations depends on both the input and the specific accuracy need of the simulation. The three random variables in this simulation test is fairly simple. Moreover, we only demand a fair accuracy, in the sense that we allow for some deviation between two 1,500 iteration samples.

In Figure 7 the standard deviation of the economic benefits to society with increasing number of iterations is presented. The figure shows that the standard deviation quickly grows with the first few iterations, then converges towards a stable standard deviation around 300 iterations. There are still some movement in the standard deviation until around 2,000 iterations. In Figure 8 the first 1,500 iterations is shown. This is the number of iterations applied in the sensitivity analysis in the paper. This test illustrates that the choice of iterations in this Monte Carlo simulation – with only three random variables - is sufficient for capturing the spread in the variables. Table 8 shows the assumptions about the three random variables in the iteration test.

Figure 7: Standard deviation (y-axis) of economic benefits to society, based on number of iterations (x-axis), 10,000 iterations

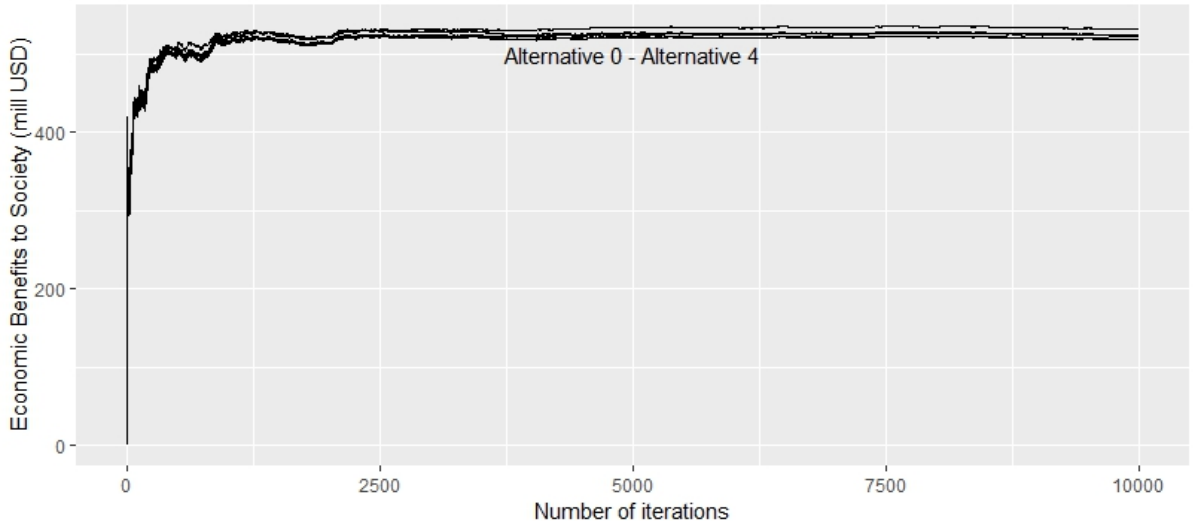


Figure 8: Standard deviation (y-axis) of economic benefits to society, based on number of iterations (x-axis), 1,500 iterations

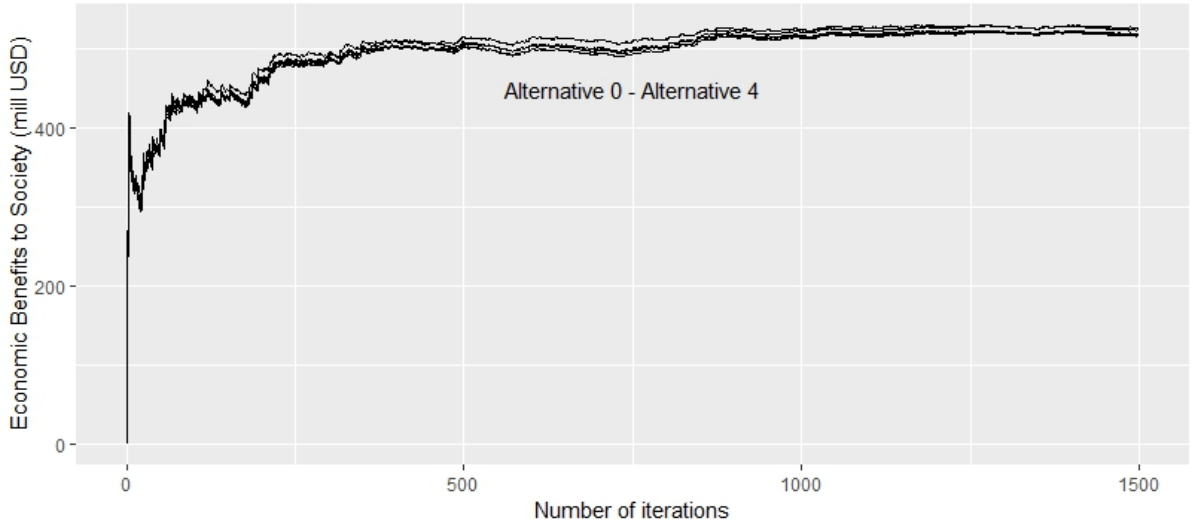


Table 8: Assumptions on the distribution of three random variables in the Monte Carlo iteration test, percentages refer to difference from assumptions in scenario 0 (standard scenario)

Scenario name	**Base**	
Stochastic variable	Mean	St.dev.
Retention	-15 %	30 %
Motivation and effort	-5 %	5 %
Value of older mil. empl.	-20 %	20 %

Appendix E: One-variable Monte Carlo simulation:

In this section, we show the results for economic benefits for the Norwegian society when varying one random variable at the time. In scenario 1, 2, 3 we adjust only retention rates, motivation and efforts among young military employees, and the value of older military personnel, respectively (see Table 9). Figure 9 presents the results. Changing the retention rates negatively have small impact on the economic benefits for society. It has a slight positive effect in alternative 1, negligible effect in alternative 2 and 3, and small negative effect in alternative 4. The reason is that a smaller retention rate has a negative effect on education costs, but a positive effect due to a smaller number of special retirees. Adjusting the motivation and effort variable has a close to additative constant effect on the mean. The standard deviation is also similar in all alternatives. This is different from reducing the value of older military personnel, where the negative effect varies with the number of older personnel (lowest in alternative 1, highest in alternative 4). Te standard deviation also grows in value with the number of older personnel.

Figure 9: Mean and standard deviation for economic benefits for society, four scenarios (scenario 0 – 4), economic benefits to society in million USD (y-axis), adjusting retention rates

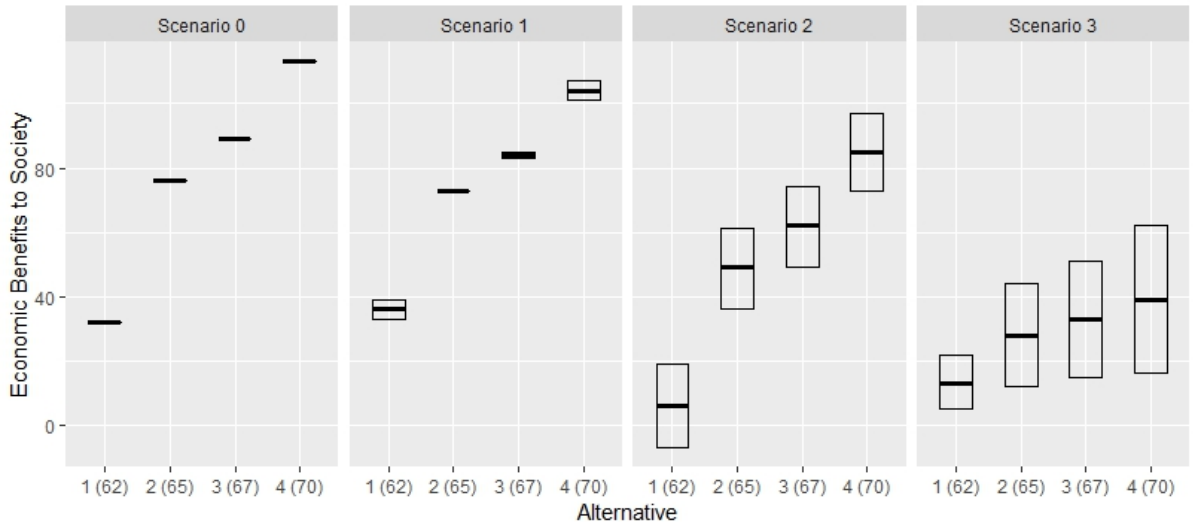


Table 9: Assumptions on the distribution of three random variables in the Monte Carlo iteration test, percentages refer to difference from assumptions in scenario 0 (standard scenario)

Scenario name	Scenario 1		Scenario 2		Scenario 3	
Stochastic variable	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
Retention	-45 %	30 %				
Motivation and effort			-2 %	1 %		
Value of older mil. empl.					-60 %	20 %