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

Abstract:

Ageing workforces due to low fertility rates and higher life expectancies challenge modern industrialized economies. In order to secure economic welfare and to balance public budgets, governments worldwide implement reforms to increase the retirement age. The trend towards a higher retirement age confronts defense sectors that for centuries have been in search of an age structure characterized by 'youth and vigor'. In this article, we study the economic gains to society when the special retirement age for military personnel in the Norwegian Armed Forces is increased. 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 Norwegian 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

Ageing workforces due to low fertility rates and higher life expectancies challenge modern industrialized economies. In order to secure economic welfare and to balance public budgets, governments worldwide implement reforms to increase the actual retirement age, by adjusting the statutory retirement age and incentivizing work instead of retirement (OECD 2015; Lindbeck and Persson 2003).[1] The trend towards a higher statutory retirement age confronts defense sectors that for centuries have been in search of an age structure characterized by 'youth and vigor'.

The Norwegian Armed Forces have employed versions of special retirement age regulations to secure a relatively young age structure since 1885. 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. Although 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 are still 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 the Armed Forces are 'no country for old men'.

The need to change the special retirement age in Norway was 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. Without any reform of the military pension system, military personnel will suffer economically, with deteriorating effects on recruitment and retention.

With a budget of around 6.2 billion USD and around 20,000 employees, the Armed Forces (together with the other defense agencies[2]) are one of Norway's largest enterprises in terms of budget and workforce. In fact, the Armed Forces constitute 1.6 percent of the GDP and 3.4 percent of public spending in Norway. A change in the pension system will lead to significant effects for public finances and efficiency in the Norwegian economy. Thus, 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.[3]

In this article, we conduct a cost-benefit analysis (CBA) of a potential increase in the special retirement age among military personnel in the Armed Forces. Our aim is to contribute to the defense economics

[1] We define retirement age concepts as follows: *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.

[2] The Ministry of Defence (MOD) has four defense agencies under its command: The Armed Forces, The Norwegian Defence Estates Agency, The Norwegian Defence Material Agency, and The Norwegian Defence Research Establishment; military personnel (with special retirement age) are employed in these institutions, including the MOD.

[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.

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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. We do this by investigating the consequences of four alternatives of increasing the special retirement age: from (0) 60 years to (1) 62 years, (2) 65 years, (3) 67 years, and (4) 70 years. We develop a pension economics cost-benefit model that produces the fiscal effects of reform for the Ministry of Defense (MOD) and the Ministry of Finance (MOF), and the economic effects for Norwegian society. The model calculates value added, taxes, pension allowances, other social insurance benefits, and leisure value per labor and pension group. The first contribution of our study is to 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 disability propensity and retirement decisions. We derive the parameters in our model from historical rates among military personnel in the Armed Forces and the general work force. Three key assumptions are however difficult to assess empirically, namely, the effect of a special retirement age increase on: (i) retention rates, (ii) motivation and efforts, and (iii) the value of older employees in the Armed Forces. The two former assumptions could be studied empirically if a reform of the special retirement age is executed, while the latter assumption will, due to 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 the Armed Forces. The economics literature deals however with these assumptions theoretically and empirically.

Hence, our second contribution is to combine findings from pension, military and labor economics to identify likely outcomes for the most uncertain variables of the proposed reform. The pension economics literature stresses the importance of pension reform for labor supply. A higher retirement age increases not only the labor supply, but also enrollment in social insurance programs. The military economics literature highlights the important role of pension programs in recruitment and retention. Raising the retirement age, while holding the number of both military personnel and positions in each rank constant, will increase the time personnel spend in each rank. This reduces the discounted expected returns of the military career, possibly affecting retention and efforts decisions negatively, unless mitigated by other monetary incentives. The labor economics literature addresses with the value of workers, including older workers, in-depth. While the standard assumption in CBAs is that wages equal workers' marginal product, labor economists have proposed a variety of theories that challenge this simple competitive wage approach.

The third contribution is to test the sensitivity of the results to the key assumptions on retention rates, motivation and efforts, and the value of older employees. We apply a Monte Carlo simulation to investigate the impact of the sample space of economic gains with various means and variances for the pension model's assumptions. This exercise identifies important mechanisms affecting personnel behavior and the main sources of uncertainty of the reform. Even under strong pessimistic assumptions, the results are positive for the Norwegian society.

[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).

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

Literature review

Pension economics literature

The pension economics 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 income, and vice versa. Second, the *accruals* effect takes place if benefits increases with contributions, and the accrual calculation method is expected to affect the magnitude of the effect.

Empirical evidence for effects of pension reforms can be summarized as follows. Increase in pension age has a strong effect on labor supply, but also leads to increase in higher enrollment in social insurance programs, such as unemployment and disability benefits (Staubli and Zweimüller 2013; Atalay and Barrett 2015; Vestad 2013; Duggan, Singleton, and Song 2007; Strøm et al. 2015). Reduction in the pension payments, either directly or through introduction of benefit discounts, lead to postponement of retirement (Hanel 2010; Hanel and Riphahn 2012; Hernæs, Sollie, and Strøm 2000). Improving the relationship between labor effort and pension benefits, i.e. improving the accruals effect, has strong effect on labor supply (Hernæs et al. 2016). From the pension economics literature, we can therefore derive the following key findings for the Norwegian context: higher 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.

Pension and compensation of military personnel

A number of scholarly works study the importance of the pension system on military recruitment and retention in the U.S. (e.g. Asch and Warner 1994; Asch, Johnson, and Warner 1998; Warner 2006). In their seminal piece on pension and military compensation regimes, Asch and Warner (2001) explain three features of the U.S. military that are different from its (large) counterparts in the private sector: (1) flat pay structure, (2) relatively generous pension systems and (3) 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. Their economic model is based on the same intuition as in Lazear and

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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.

Monetary compensation schemes play a significant role in incentivizing recruitment and retention. We believe however that the desire for higher ranks in military hierarchies is not only related to higher wages (including pension) but also to a desire for prestige.[5] In a military organization, advancement in the military hierarchy is one obvious way for personnel to achieve status among peers. 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 advancement by experience and age, the senior positions will on average be employed by older people than before. Therefore, an important lesson from the literature on military compensation is that the discounted, expected returns from future rank tournaments will shrink, possibly affecting retention and efforts decisions negatively. This may happen even if the monetary compensation is constant between the pre- and post-reform pension systems because military personnel value the prestige invested in higher ranks. We add this variable – a decrease in discounted value of ranks impacts retention rates – to the sensitivity analysis with Monte Carlo simulations in the Results section.

Labor economics and the value of older personnel in military organizations

In the current special retirement system in Norway, military personnel must retire by the age of 60. The system, which was established in 1976, intends to preserve an age structure in the military workforce that is able to defend Norway. Expert groups commissioned by the Norwegian government to evaluate the pension system and the labor supply have indicated that 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 the Armed Forces (NOU 2004, 2019). Indeed, according to a survey conducted by Hyggen (2008), military personnel in Norway are rarely tired after a day's work, have the highest life expectancy among occupations with special retirement, and are exposed to fewer work situations that worsen their physical health condition. In addition, military personnel are much less prone to be on sick leave or apply for disability benefits (Hyggen 2008).

Yet, for the MOD, what matters is not *how* healthy military personnel is at age 60 and older relative to same-age personnel in other industries, but *to what degree* such employees can add value to the production of defense in Norway, including contributions to international operations. The Norwegian Armed Forces currently have very little experience in employing military personnel who are 60 years and older. Consequently, the organization has little knowledge about older personnel's productivity levels and their optimal use. Moreover, what matters in a CBA is what value individuals with a life-long career in the Armed Forces can offer the organization compared to the civil sector in their 60s.

[5] By "prestige" we mean status that is freely deferred by others based on achievement (see Henrich and Gil-White 2001).

A standard assumption in CBAs is to assume equality between the social value of a person's labor and the wage received.[6] As Bartik (2012: 1) states: 'If labor market clears, 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 public reforms or investments most often affect the population at large.

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).[7] 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 suggests that employers and employees will invest together, with increased seniority[8] 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, Lazear proposes that employers offer wage contracts where the employee earn less than his/her productivity in the first half of the career and more than the value in the second half. Such a contract induces effort and deters shirking. This theory predicts three phenomena for jobs where effort is hard to observe: 1) the growth in wages will be higher than the growth in productivity, 2) compulsory retirement: the employer loses money on the older employees and needs to have an agreement about retirement, and 3) firms will continue to employ older people but rarely hire older people. If this theory fits the reality of the Armed Forces, 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. If this tournament mechanism is present in the Norwegian Armed Forces, the standard assumption about equality between productivity and wages is prone to errors.

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

[7] 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 the Armed Forces 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 the Armed Forces more than those who left the organization).

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

We do not know which of the labor economics theories best defines the relationship between wages and productivity among young and older employees in the Armed Forces. 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 labor markets (Frimmel et al. 2018; Hutchens 1987; Medoff and Abraham 1980, 1981; Shaw and Lazear 2008; Zwick 2011), including in studies of the Norwegian labor market (Barth 1997).

The question of the value of older employees is accentuated since, at present, the Norwegian Armed Forces do not employ military personnel over 60 years old. We can assume that older personnel's wages will be similar to employees in their late 50s, but the wage level may not easily be translated to the value of their work. First of all, employees in their late 50s may be overpaid due to deferred compensation. The wage system can be assumed to be optimized for compensation throughout their careers until retirement at the statutory retirement age of 60 but hardly for employees above 60 years of age. Second, their contribution to the defense production may decrease rapidly into their 60s. The value of older employees depends on how well the Armed Forces exploit their military personnel over their lifetimes. While the 'youth and vigor' aspect of military work is particularly related to deployment in combat, older employees offer competence and skills in leadership, administration and other support functions, perhaps even more than their young counterparts, due to their long experience in the Armed Forces. Still, the deferred compensation theory posits that older employees will deliver on average lower value to the economic production than their wages.

In order to take into consideration the possibility that the productivity of older personnel is lower than their wages, 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.

Pension systems in Norway and other NATO countries

In this section, we present the reformed general pension system as well as the not-yet-reformed special retirement pension system in Norway. The information about the reform trend in the general system allows us to define a likely reformed military pension system. We also compare the military special retirement system in Norway with several NATO countries in order to add an international perspective on the likely Norwegian military pension system.

The Norwegian pension system

All citizens in Norway are members in the National Insurance Scheme, which provides pension benefits.[9] Employees in the public sector (the state, counties, and municipalities) receive an additional pension component. Furthermore, all public sector employees and about half of private sector employees receive early retirement pension scheme (AFP: AvtaleFestet Pensjonsordning) that currently is a life-long, top-up benefit. After the pension reform in the 2010s, the general pension system in Norway is 'actuarially fair'[10] up to a certain income level, strengthening the accruals effect.

[9] See more information about the general pension system in Appendix A.

[10] This means that there is a clear link between contributions and pension benefits (Lindbeck and Persson 2003).

The general pension system is also actuarially neutral, in the sense that take-up age of pension does not affect the total pension wealth.[11]

One key facet of the 2011-reform was the establishment of a principle of life expectancy adjustment, meaning that a cohort's pension benefits is dependent on the development in the life expectancy of the cohort. As long as the life expectancy in Norwegian society continues to rise, the principle of life expectancy adjustment generates the need for younger cohorts to work longer to achieve the same pension level as older cohorts.

Special retirement system in Norway

The special retirement age pension system differs from the general pension system in Norway. In the Armed Forces, the special retirement age is 60 years, with the opportunity to retire from 57 years old if the sum of the age and the years serving is 85 or more.[12] The ordinary statutory retirement age is 72 and 70 for private sector and public sector employees, respectively. Between 57-60 years old and 67 years old, military personnel receive 66 percent of the wage level at retirement. After turning 67 years old, special retirees transfer 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 the MOD and the Norwegian society. The standard calculation in this paper assumes a life expectancy per cohort in line with the expected lifetime at reform time (2011). But we also perform a sensitivity check (in Appendix F) where the cohort is required to work three more years to maintain payment value to illuminate the effect on the MOD's budget.

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 the Norwegian Armed Forces. We deduce trends from pension reforms over the past decade and apply them to the military system. As shown above, the trends point to a system that is actuarially neutral in terms of take-out age and induces work incentives. It is also likely to result in 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.

Military pension systems in a comparative perspective

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 the Norwegian system with its T35 or T60 contracts (the number representing retirement age). The United States has recently

[11] Equal to the discounted value of take-up age, discounted at a real annual rate of interest of 2 percent
[12] Military personnel serving for at least 28 years at the age of 57 can choose to retire with full special retirement pension.

reformed the military pension system from Legacy High-36 to the Blended Retirement System.[13] In the former system, personnel received annual pay for life after retirement equaling number of years times average of highest 36 months' pay times 2.5 percent. In the new system, the multiplier is reduced to 2.0 percent. Under the new system, however, the government matches up to 5 percent of personnel's basic pay to the Thrift Savings Plan. Moreover, personnel are fully vested after only 2 years, whereas military personnel had to be enrolled for minimum 20 years under the former system. Also, in the Blended Retirement System, personnel receives a one-time payment after 12 years. The reformed system is therefore more closely related to actual contributions and is more equitable to personnel who serves less than 20 years. In comparison, the Norwegian military pension system only pays special retirement pension to personnel serving until the special retirement age (57-60). However, regardless of how long they serve, military employees save up for the general pension scheme just as those employed in the public sector. Consequently, the new military pension system in the United States is more similar to the Norwegian military pension system than the former American system was.

As a general rule, the United States military retirement age was also reformed, up to age 62 from age 55 for active duty soldiers and from age 34 to age 39 for maximum enlistment age. The branches of the Armed Forces have slightly differing policies regarding mandatory retirement age. Other NATO countries also apply a special mandatory retirement age for military personnel. In the UK, the statutory retirement age of 65 in the general labor market was fully abolished in 2011,[14] and the military special retirement age was increased from 55 to 60 in 2015.[15] In Denmark, Sweden, Germany and the Netherlands, the retirement age in the civilian sector and among military personnel is similar to the system in Norway (see Table 1). The special retirement age in Germany depends on rank, yet the highest retirement age (62 years old) is 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 civilian retirement age, either by increasing the statutory retirement age (Denmark and Germany) or economic incentives (Sweden).

[INSERT TABLE 1 HERE]

Methodology

In this section, we present the CBA, the calculation of the demographic structure in the Norwegian Armed Forces under the unreformed and reformed pension schemes, and finally the pension model for estimating the financial and economic consequences of pension reform.

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

[13] Personnel hired prior to January 1, 2006, remain in the Legacy System. Personnel hired between January 1, 2006, and December 31, 2017, had the option of enrolling into the new system (until December 31, 2018). Personnel joining after January 1, 2018, are automatically enrolled in the Blended Retirement System.
[14] https://www.ageuk.org.uk/information-advice/work-learning/retirement/retirement-age/
[15] https://www.moneywise.co.uk/pensions/manage-pension/lowdown-armed-forces-pensions

CBA is a 'systematic process of calculating the benefits and costs of policy options and projects' (Atkinson et al. 2018: 3). The method calculates the effects – i.e. the benefits and costs for a society – and thus goes beyond the expected profit analysis that corporations may conduct. Although in many cases increased net profits in the private sector are equal to societal gains, the presence of market failures certainly erases the equality sign. The core concern of CBA is the efficient use of society's scarce resources. CBA is frequently 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 environmental policies (Nordhaus 2006; Stern 2006; 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 dimensions: 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 on economic efficiency in terms of labor supply and financial soundness for the MOD and the MOF.

To concentrate 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: CBA is normally applied to marginal changes in behavior, and the values of labor supply etc. can in such circumstances be derived from existing wage levels etc. (see Bartik 2012). In our case, however, employees may increase their labor supply from 0, 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.[16]

CBA has several analytical cousins, such as cost-effectiveness analysis, cost-utility analysis, and risk-benefit analysis. Specifically, CBA 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 estimate and are incorporated into the analysis through a qualitative assessment. In this study, however, we have translated all costs and benefits to US dollars (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. When distortionary taxes are levied on the citizens, higher (lower) tax income and/or lower (higher) public transfers lead to a more (less) efficient economy. The reason is that the government can in such a situation 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 (Diamond and Mirrlees 1971; Stiglitz and Dasgupta 1971). 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

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

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the marginal efficiency reduction of taxation, and is operationalized in CBA as a multiplier to be applied to the direct resource cost.[17]

In Norway, the Ministry of Finance defines 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 recommends to use 20 percent MCF (Transportministeriet 2015). Parry and Small (2009) recommend 15 percent MCF. Christiansen (2015) suggests that the MCF should be set lower in a CBA conducted in Norway.[18] Here, we follow MOF's recommendations of a 20 percent MCF.

Although this CBA focuses on economic efficiency for Norwegian society, we also derive the fiscal effects of increase in the special retirement age for both the public finances of the MOD and the MOF. Fiscal effects are of interest to policy-makers in budgeting. The ratio of defense spending to other public spending functions as a proxy measure of the importance of the defense sector relative to other sectors, and changes to the defense spending may impact government priorities. Of course, such allocative issues are also of interest to defense personnel and the public in general. The main difference between the fiscal and the economic analysis is that in the former, the ministries' cash flow is the most relevant variable, while the value of increased labor supply plays the primary role in the economic cost-benefit analysis. Alterations to the cash flow to and from the ministries play only a secondary role in the economic CBA through the MCF.

Demographic structure in the Armed Forces

The CBA is based on an estimate of the age structure in the Armed Forces in Norway (derived from Gisnås, Åmot, and Reitan 2016). The estimate is a comparative static estimate of the age structure in equilibrium. The dynamic transition from today's age structure to the future equilibrium situation is outside the scope of this article. We use today's recruitment and retention rates to estimate the demographic structure. Individuals in their 20s constitute the pool of recruits to the Armed Forces. In equilibrium, the number of retirees and employees moving to the civil sector perfectly offsets the number of new recruits. Moreover, 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, calculating the long-term effects can be simply performed by applying the annual values and 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 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 the Armed Forces ('early retirees – Armed Forces') and the propensity to exit the force because of deteriorating health status and thus transfer to disability benefits ('disabled – Armed Forces').[19] Since we assume a work-inducing pension system to be in place

[17] For more details on the MCF, see Appendix B.
[18] 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.
[19] The mortality rate in the model is 0.

also for military personnel, we expect the propensity to exit the Armed forces, take-up early retirement and partly continue working in the civil 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 the Armed Forces 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[20]). We derive estimates for older military personnel's disability rates from the marginal increase in disability take-up among individuals aged 60 years and older in the general population.[21] The distinction between work able and disabled is important for the estimates on participation in the labor market (earning wages, paying taxes, etc.). Employees in the private sector are expected to have a slightly higher probability of take-up of disability benefits due to higher likelihood of losing their jobs.[22]

In alternatives with increased special retirement age (1 – 4), the Armed Forces 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 identical retention rates per cohort in all the alternatives. The age structure in alternative 0 is shown in Figure 1. The figure shows that the military personnel is recruited in their 20s, a substantial share is employed in the T35 system (contract ending at maximum age 35), and that there is 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 military personnel in their 60s is based on the propensity to take-up disability benefits for personnel aged 60 to 65. In alternative 3 and 4, an additional reduction in military personnel stems from 20 percent early retirement at age 62.[23]

[INSERT FIGURE 1 HERE]

[INSERT FIGURE 2 HERE]

[20] 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.
[21] Data on male use of disability benefits are derived from the Norwegian Labour and Welfare Administration.
[22] The economic literature has shown that unemployment leads to higher propensity to end their work career on disabled benefits in Norway (Rege, Telle, and Votruba 2009).
[23] This estimate stems from the knowledge that military special retirees on average exhibit 50 percent work supply (described below) and that ten percent of male early retirees in the private sector have withdrawn completely from the formal labor market. We thus estimate 20 percent of the workforce in the private and defense sector to retire early and continue working on average 50 percent of the available time.

Calculation of financial and economic effects: the pension model

In this section, we describe the pension model.[24] We start by defining the 11 work and pension groups, *i*, that partake in the model. In Table 2, the number of personnel per work and pension group, n_i, is shown in each alternative.[25] The two first groups – (1) and (2) – are young and older employees in the Armed Forces. These groups always sum up to 12 000 individuals. In alternative 1 – 4, the need for recruits are slightly lower than in alternative 0, because in those latter alternatives, the Armed Forces employ older military personnel (2). Hence, in alternative 1 – 4, many individuals are instead employed in the private sector – (3) and (4).[26]

Increasing the retirement age may lead to increased use of social insurance schemes as discussed in the literature review. This is operationalized in this study by employing the historical take-up of early retirement plans from Strøm et al. (2015) and disability benefits take-up rates by individuals in their 60s from the Norwegian Labour and Welfare Administration. We use these disability numbers to distinguish between work able and work disabled special retirees – group (5) and (6) – and estimate the number of individuals who due to sickness have to leave the Armed Forces (7) or the private sector (8) during their 60s. Work disabled individuals have zero labor market participation. We can also derive the number of early retirees in the Armed Forces and the private sector including retirees (which wait until age 67 to retire), that is group (9) and (10). In alternative 4, military personnel work till age 70 and thus the number of retirees is very low. The number of individuals receiving disability pension will increase, however, because in this alternative, military personnel with severe health issues will have to be on disabled benefits until they are 70 years old before they can retire. Group (11) consists of retirees from the Armed Forces that are disabled (yet receive ordinary pension) in the age 67-70 years old.

[INSERT TABLE 2 HERE]

The economic effects, *EE*, per group *i* is defined by equation (1):

[24] 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; 2019c; Hanson and Lindgren 2019; Lindgren, Hanson, and Strand 2019). Compared to the first generation model, PEMOD 2.0 is upgraded with more detailed pension calculations and is able to calculate stochastic variables. The model is developed in Excel 2016, with use of SQL coding.

[25] The scope of the study is limited to individuals up to 70 years of age. Any additional labor supply from individuals above 70 years will have positive effects beyond the results presented in this article.

[26] The size of the public 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. It is irrelevant whether the personnel otherwise recruited to the Armed Forces 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.

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$$EE_i = \overbrace{\sum_{i=1}^{11} MCFt_i l_i w_i n_i}^{\text{Tax}} + \overbrace{\sum_{i=1}^{11} l_i v_i n_i}^{\text{Value added}} + \overbrace{\sum_{i=1}^{11} MCFp_i n_i}^{\text{Pension}} + \overbrace{\sum_{i=1}^{11} MCFb_i n_i}^{\text{Social benefits}} + \overbrace{\sum_{i=1}^{11} (1 - l_i) f_i n_i}^{\text{Leisure}} + \overbrace{U_{EE}}^{\text{Education}} + \overbrace{\sum_{i=1}^{2} MCFw_i n_i}^{\text{MOD budget}}, \quad (1)$$

where i = 1, 2, …, 11, *MCF* is the marginal cost of funds, t is the tax rate, l is the labor participation rate, w is the wage, n is the number of individuals, v is the value added, p is the pension contributions saved by the government for the individuals, b is social insurance expenses, f is the value of 1 full year of leisure, U_{EE} is the economic reduction in education expenditure, and the last term is the economic effect of a reduction in the MOD's budget. All variables except MCF and U_{EE} is group-specific. p_i is defined by group i's wages and pension status. b_i is zero for everyone except recipients of disabled benefits. Only participants in the formal labor market pay taxes and add value to the national economy.

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Table 3 sums up whether t_i, v_i, p_i, b_i and l_i are positive or zero for each group *i*.

[INSERT TABLE 3 HERE]

The calculation of the fiscal effects for the MOD, FE_{MOD}, per group *i* consists of wages and pension contributions:

$$FE_{MOD} = \underbrace{\sum_{i=1}^{2} w_i n_i}_{\textbf{Wage}} + \underbrace{\sum_{i=1}^{11} p_{si} n_i}_{\textbf{Pension}} + \underbrace{U_{FE}}_{\textbf{Education}}, \quad (2)$$

where *i* =1, 2, 5, and 6, p_{si} is the special retirement pension savings, and U_{FE} is the fiscal effects of reduction in the need for education due to lower cohorts of military personnel. The MOD pays for wages for young and older military personnel in addition to general pension savings for its special retirees. Today, the MOF does the pension savings, but we assume here that the pension burden of the special retirement pension is levied on the responsible ministries (in this case, the MOD). Older military personnel has a higher base wage, but smaller payments related to activity (military training), overtime pay, etc. We assume that the total budget spent on bonus and overtime payments remains the same in all alternatives, demanding a small increase in efforts from young personnel when the special retirement age is increased. On the one hand, the overall effect of involving older military personnel in the work force is a small increase in personnel expenditure on wages. On the other hand, the expenditure for special retirement pensions is reduced considerably.

The calculation of the fiscal effects for the MOF, FE_{MOF}, per group *i* consists of wages, taxes, and pension contributions:

$$FE_{MOF} = \underbrace{\sum_{i=1}^{11} t_i l_i w_i n_i}_{\textbf{Tax}} + \underbrace{\sum_{i=1}^{11} p_{si} n_i}_{\textbf{Pension}} + \underbrace{\sum_{i=1}^{11} b_i n_i}_{\textbf{Social benefits}}, \quad (3)$$

where *i* = 1, 2, …, 11 and p_{si} is all public pension savings with the exception of special retirement pension (National Insurance Scheme pension, public service pension and AFP to public sector employees, and disability pension allowances). The MOF receives taxes from all individuals active in the labor market, including taxes on pension savings.[27] It also saves the standard National Insurance

[27] Pension is considered an expense the year that pension rights are earned, not when they are paid out. We also consider future tax payments on pensions as paid the year the pension right is earned. Thus, employees earn their rights and pay their pension taxes when they are active in the labor market.

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Scheme pension for all tax payers and the public service pension and AFP for personnel in the Armed Forces.

Model assumptions and data

Wages in the Armed Forces are based on wage data in 2012 (Hove 2013). We adjust for wage increases in the defense sector with information from Statistics Norway. We are able to separate between base wage and total wage (including activity based and overtime payment, etc.). This is important for the correct calculation of pension contributions.[28] We assume older military personnel to have the wage of today's military personnel aged 59, i.e. one year prior to special retirement age.

We do not have empirical data on wages for the personnel in the private sector, because such individuals are currently working in the Armed Forces. One alternative could be to use average wages in the private sector. We expect, however, that military personnel in the Norwegian Armed Forces have specific characteristics different from the average worker in the private sector since they are recruited based on specific mental and physical abilities. The other reasonable alternative is therefore to use the wages in the Armed Forces 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 better reflects the personnel's earning potential, and so we opted for this alternative. To use the Armed Forces' wage is not without weaknesses. For instance, people recruited to the Armed Forces today may have strong preferences for defense work (and are willing to work for less pay), and may therefore be able to demand higher wages outside the defense sector.[29]

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 less able to capitalize on their firm-specific human capital, we assume a 15 percent pay cut if the personnel take up work elsewhere as special and early retirees.

Taxes on gross income in Norway comprise mainly income taxes, pension taxes, employer's National Insurance Scheme contribution, 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. Further, 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 the MOF), and an employers' National Insurance Scheme contribution estimate of 10 percent.[30] The total tax rate on gross income including pension allowances is estimated to be 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 stem from both lower marginal tax rate on pension income and lower average tax rate on smaller incomes (due to a progressive labor income tax regime).

[28] The pension contributions from the National Insurance Scheme are based on total wage, while the public service pension is based on base wage.

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

[30] The normal rate is 14.1 percent, but zero in the northernmost parts of Norway, where the Armed Forces have several military bases. We assume an average employers' contribution of 10 percent for the Armed Forces.

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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. What matters economically and fiscally is therefore whether individuals in the model supply labor in the formal labor market, not whether they receive pension benefits.

In our standard approach below, 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 in Appendix F.

Results

The Results section comprises the standard approach – termed scenario 0 – where we do not adjust for potential negative effects on (i) retention rates and (ii) motivation and efforts, and (iii) the value of older employees in the Armed Forces. We relax these strong assumptions and delve into the sample space by applying a Monte Carlo simulation in Scenario 1-3 below.

Scenario 0 (standard)

In Table 4, the fiscal effects for the MOD of increasing the special retirement age is presented. The results show a 2.4 percent (29 million USD) and 7.7 percent (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 military personnel. The overall wage budget is increased slightly because of older personnel's higher base wage, representing a loss for the MOD. The main component for the 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 almost 100 million USD in reduced expenditure. In addition, the number of recruits is reduced, translating into lower educational costs.

[INSERT TABLE 4 HERE]

The potential reform of the special retirement age is negative, yet with a relative small magnitude, for the MOF. In Table 5, we see that the MOF increases its net expenditure with between 2 to 13 million USD. This is equivalent with 0.2 to 1.1 percent of the military workforce wage payments, and a very negligible share of the total government expenditure (less than 0.01 percent) 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 the Armed Forces is reduced and hence net contributions are down. On the positive side, the MOF receives net contributions from older military 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 the Armed Forces and the private sector is bigger than the loss of increased costs of young employees in the Armed Forces. We conclude that the 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 the MOD's budget.

[INSERT TABLE 5 HERE]

Table 5 shows the economic costs and benefits in scenario 0 for the Norwegian society. Taken together, the net benefit equals 2.6 (32 million USD), 6.1 (76 million USD), 7.2 (million USD), and 9.1 percent (113 million USD) of the total MOD budget to military workforce wage payments when increasing the special retirement age with 2, 5, 7, and 10 years, respectively. The modeled reform of the special retirement age system in the Armed Forces represents a substantial increase in efficiency in the Norwegian economy. Relative to the military spending of Norway anno 2018, the efficiency effect equals between 0.5 and 1.7 percent. Furthermore, when compared to the total GDP of Norway (excluding the offshore petroleum sector), the special retirement reform has an economic value between 0.01 and 0.03 percent. The reform of the special retirement age is therefore a potentially valuable reform for the Norwegian society, predominantly because of the increase in labor supply.

[INSERT TABLE 6 HERE]

All results above rely on some uncertain assumptions: an increase in the special retirement age has no effect on the retention rate and motivation and efforts among the military personnel, and the productivity (value added) among older military personnel is equal to their wages.

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 the Armed Forces. 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 negative means and relatively large standard deviations. We use these distributional assumptions in the Monte Carlo simulations. The simulations are executed 1,500 times per scenario. The retention rates (i) affect the input data we derived from Gisnås, Åmot, and Reitan (2016). We modify the age structure shown in Figure 1 and Figure 2 per simulation according to the consequences for retention rates. Changes in the retention rates affect *EE*, FE_{MOD} and FE_{MOF}. The effort and motivation variable (ii) affect value added for young personnel, and thus only *EE*. The variable for the value of older personnel (iii) also only affect the value added of increased labor supply (*EE*).

The values of the stochastic variables in the Monte Carlo scenarios (1-3) are shown in Table 7. The mean in scenario 1-3 is defined relative to the values of the inputs in scenario 0 (the standard

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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 stochastic variables are assumed to be independent.[31]

[INSERT TABLE 7 HERE]

First, we show the results for economic benefits for the Norwegian society when varying one random variable at the time. In scenarios 1, 2, and 3 we adjust only retention rates, motivation and efforts among young military employees, and the value of older military personnel, respectively (see the bolded numbers in Table 7). Figure 3 presents the results. Changing the retention rates negatively has small impact on the economic benefits for society.[32] 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 additive constant effect on the mean. In alternative 1, the sample space shows that the reform is potentially negative for Norwegian society. The standard deviation is similar in all alternatives in Scenario 2. 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). The standard deviation also grows in value with the number of older personnel.

[INSERT FIGURE 3 HERE]

Second, we study the results from the Monte Carlo simulation for all the variables simultaneously on Norwegian society. Figure 4 shows the results from this exercise. In scenario 0, there is no variation in outcomes and hence the results have zero standard deviation. In scenario 1, 2 and 3, the mean is lower than in scenario 0 in all alternatives. The variation is also much larger than when studying each of the stochastic variables. Alternative 1 is possibly negative in each of the scenarios, but with a positive mean in each scenario.

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

[31] Appendix C provides further details about the assumptions on the variables in the Monte Carlo simulation. Appendix D provides more results on the Monte Carlo simulations, while appendix E tests the reliability of the estimates.

[32] This holds only under the assumption that personnel contribute with social value equal to their wages. If higher retention means that personnel on average quits before the Armed Forces are able to fully exploit their competence and skills, the results will differ.

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 the Armed Forces. 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.

[INSERT FIGURE 4 HERE]

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 0.01 (32 million USD), 0.02 (76 million USD), and 0.03 (89 and 113 million USD) percent of GDP 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 the Armed Forces, 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.

The reform is also shown here to have significant positive financial effect on the 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. The net effect on the MOD's budget constitutes between 2.4 and 7.6 percent of the MOD's expenses on the modeled military workforce. The reform has a small negative effect on MOF's budget.

Our calculation methods include an estimate of the age structure of the Armed Forces 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 the Armed Forces 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 the Armed Forces. The Monte Carlo simulation shows that a reform is robust against low values on these variables.

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 will behave when facing a reformed 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 with more definite answers to what kind of country military organizations are for old men (and women).

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Declaration of interest statement

The Norwegian Ministry of Defense (MOD) funds our research program, and is (obviously) eager to understand the financial and economic effects of alternative increases in the special retirement age. MOD commented on the reports that this paper builds upon. The comments concerned understanding the underlying assumptions and details of the defense sector in Norway. To be clear, once assigned the task of investigating the effects, we have designed and executed the research independent of the MOD. We therefore emphasize that the results presented in this paper stem from unbiased and academically independent research.

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

In Norway, the government provides membership in the National Insurance Scheme for all its residents. The National Insurance Scheme 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 recently reformed to be based on 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 about to be implemented 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, the AFP was introduced in Norway, reducing the pension age in Norway from 67 years to 62 years over the following decade.[33] Prior to this reform, only quasi-voluntary or informal exit routes existed, i.e. unemployment, sickness leave and disability pensions (Vestad 2013). Initially, the AFP was a temporary benefit paid out from (early) retirement age up to the general retirement age. The 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.

More recent reforms have attempted to strengthen labor supply incentives instead of introducing disincentives. The reason behind the pension reform 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 GDP (mainland Norway) in 2050.[34] Thus, the reforms sought to provide a more sound financial stability in the pension system. At the same time, the reform 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 below is that we use the main characteristics in the 2010s reform 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 actuarially adjust the pension benefits by take-up age, meaning that early take-up leads to lower annual benefits, and vice versa. 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

[33] 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).
[34] https://www.regjeringen.no/no/tema/pensjon-trygd-og-sosiale-tjenester/pensjonsreform/sporsmal-og-svar/id86829/#Hvorfor_pensjonsreform.

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, i.e. the system is actuarially neutral.

As long as the life expectancy of younger cohorts is continuing to increase, younger 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 the National Insurance Scheme pension. 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 continuation of the pension reform of the public sector pension system was introduced. The main components of this part of the 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, the AFP was made into a life-long top-up benefit, similar to the AFP in the private sector.

The special retirement age pension system differs 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 pension age in the Armed Forces (for those with long enough military work experience) while it is 62 for many private sector and all public sector employees with normal retirement age. We have assumed in this study that the 85 year rule is removed in the future pension system for military personnel.

Although 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 the Armed Forces 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 of wage level up to 7.1 G and 23.8 percent up to 12 G. The average value of special retirement age pension allowance – the pension military personnel receives while being special retirees – 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).[35] 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: The justification of the MCF

The argument that there is a cost to society from taxation 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 critique of the Samuelson (1954) rule[36]. 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 Samuelson 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) show 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 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.[37]

Appendix C: Details about the assumptions on the variables in the Monte Carlo simulation

The retention rate variable 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 is 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

[35] 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[35] (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.

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

[37] 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).

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).

Appendix D: 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 1) the increase in labor supply among old people, 2) that special retirees is assumed to have a lower wage than non-retirees, and 3) that the increase in older personnel in the Norwegian Armed Forces increases the MOD's budget but only burdens the *EE* with the MCF. Figure 6 shows the change to *EE* from varying the effect on retention rates. As in the analysis above, the effect of lowered retention rates is small.

[INSERT FIGURE 5 HERE]

[INSERT FIGURE 6 HERE]

Appendix E: 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.

[INSERT FIGURE 7 HERE]

[INSERT FIGURE 8 HERE]

[INSERT TABLE 8 HERE]

Appendix F: 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.[38]

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.

[INSERT TABLE 9 HERE]

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

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Tables

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

Country	Statutory retirement age	Special retirement age in the Armed Forces
Norway	70	57-60
Denmark	70	63
Sweden	67	67
Germany	67	55-62
Netherlands	67	62
The UK	-	60
United States	-	39/~62

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

Category (i)	Alt. 0	Alt. 1	Alt. 2	Alt. 3	Alt. 4
1: Young employees – Armed Forces	12 000	11 680	11 254	11 147	10 880
2: Older employees – Armed Forces	0	319	745	853	1 120
3: Young employees – private sector	0	319	746	853	1 120
4: Older employees – private sector	0	43	98	118	156
5: Work able special retirees	1 119	760	287	0	0
6: Disabled special retirees	102	81	34	0	0
7: Disability benefits recipients – Armed Forces	0	17	56	92	156
8: Disability benefits recipients – private sector	0	9	20	24	32
9: Early retirees and retirees – Armed Forces	445	430	409	559	243
10: Early retirees and retirees – private sector	0	10	22	27	36
11: Disabled former special retirees – Armed Forces	78	75	72	70	0
Sum	**13 744**	**13 744**	**13 744**	**13 744**	**13 744**

Source: PEMOD 2.0.

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Table 3: Relevant parameters in equation (1) for group 1-11

Category (i)	Tax	Value	Pension	Social benefits	Leisure
1: Young employees – Armed Forces	✓	✓	✓		
2: Older employees – Armed Forces	✓	✓	✓		
3: Young employees – private sector	✓	✓	✓		
4: Older employees – private sector	✓	✓	✓		
5: Work able special retirees	✓	✓	✓		✓
6: Disabled special retirees	✓	✓	✓		✓
7: Disability benefits recipients – Armed Forces			✓	✓	✓
8: Disability benefits recipients – private sector			✓	✓	✓
9: Early retirees and retirees – Armed Forces	✓	✓	✓		✓
10: Early retirees and retirees – private sector	✓	✓	✓		✓
11: Disabled former special retirees – Armed Forces			✓		✓

Source: PEMOD 2.0.

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

Type	Δ Alt. 1	Δ Alt. 2	Δ Alt. 3	Δ Alt. 4
Fiscal effect (FE) on the MOD's budget (million USD)	29	69	95	94
FE_{MOD} as share of military workforce wage payments	2.4 %	5.6 %	7.7 %	7.6 %

Source: PEMOD 2.0.

Table 5: Change in the MOF budget, alternative 1 – 4 relative to alternative 0, million USD

Type	Δ Alt. 1	Δ Alt. 2	Δ Alt. 3	Δ Alt. 4
Fiscal effect on the MOF's budget (million USD)	-2	-5	-13	-4
FE_{MOF} as share of military workforce wage payments	-0.2 %	-0.4 %	-1.1 %	-0.3 %

Source: PEMOD 2.0.

Table 6: Economic benefits and costs, alternative 1 – 4 relative to alternative 0, million USD

Type	Δ Alt. 1	Δ Alt. 2	Δ Alt. 3	Δ Alt. 4
Economic effects for the Norwegian society (million USD)	32	76	89	113
EE as share of military workforce wage payments	2.6 %	6.1 %	7.2 %	9.1 %
EE as share of military spending (2018)	0.5 %	1.1 %	1.3 %	1.7 %
EE as share of GDP (2018), mainland Norway, market values	0.01 %	0.02 %	0.03 %	0.03 %

Sources: PEMOD 2.0., military spending (the MOD), GDP (Statistics Norway).

Table 7: 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 %**

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 %

Table 9: 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

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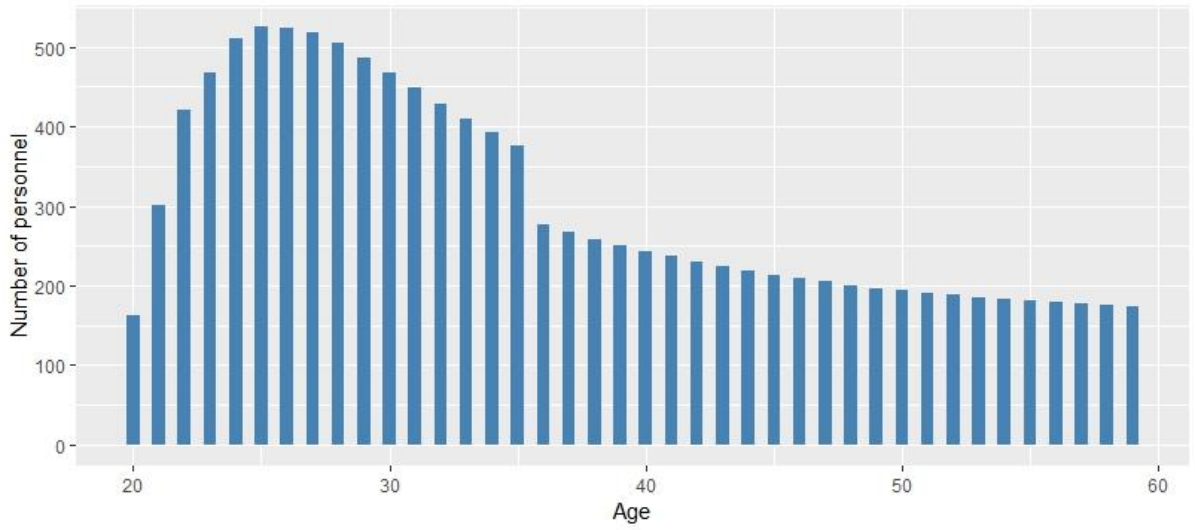
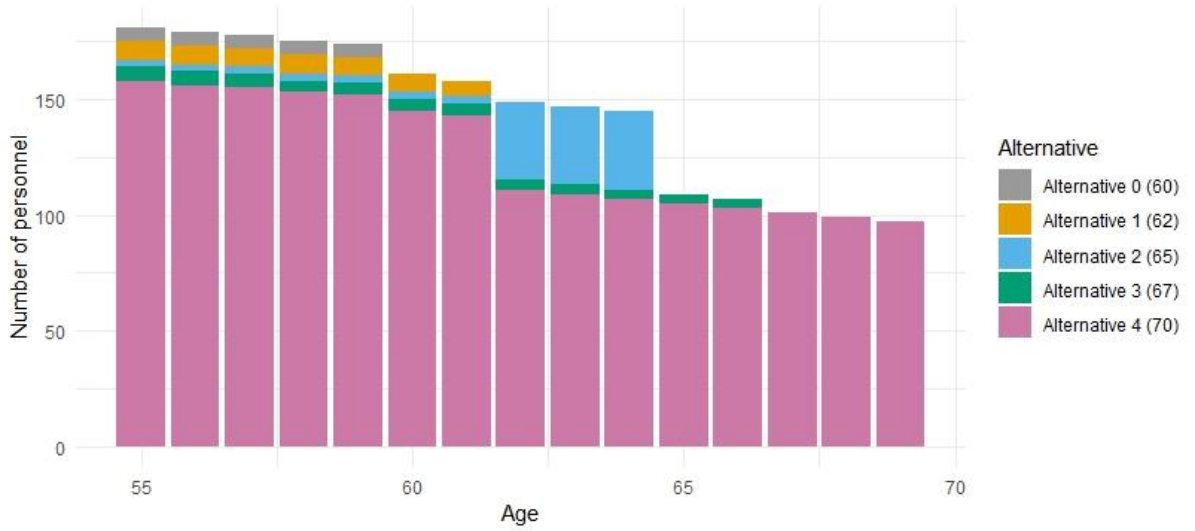
Figures

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



Source: Modified version of (Gisnås, Åmot, and Reitan 2016).

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



Source: Modified version of Gisnås, Åmot, and Reitan (2016).

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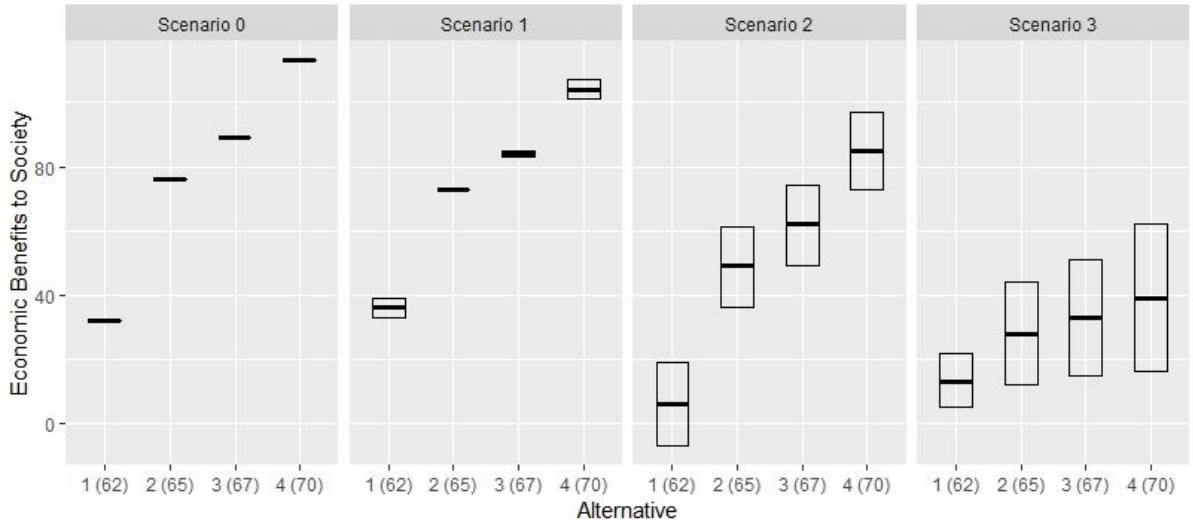
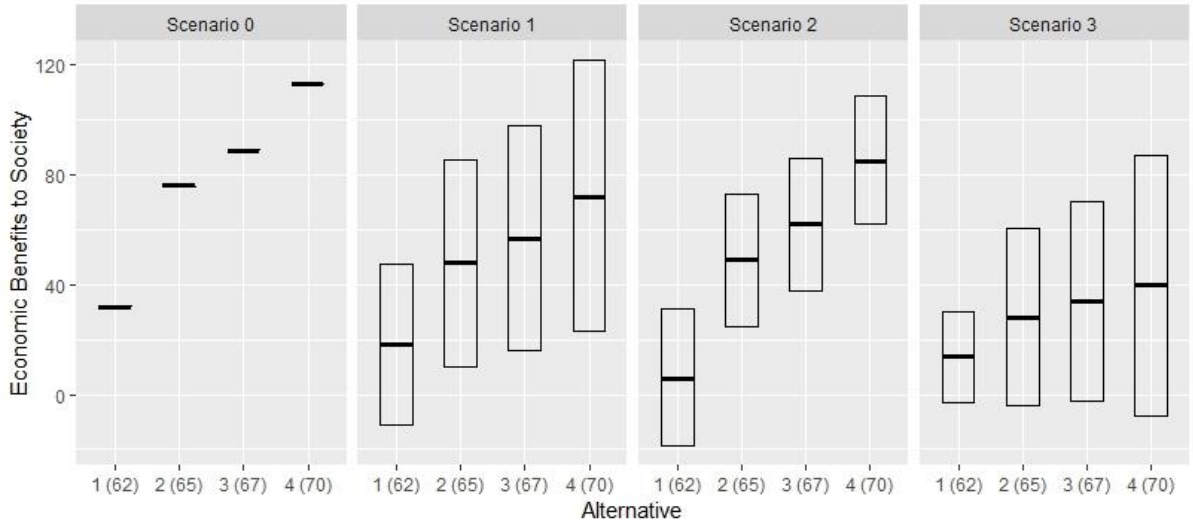
Figure 3: Mean and 2*standard deviation for economic benefits for society, four scenarios (scenario 0 – 4), economic benefits to society in million USD (y-axis), adjusting retention rates (Scenario 1), adjusting the motivation and efforts (Scenario 2), adjusting the value of older military personnel (Scenario 3).



Source: PEMOD 2.0.

Figure 4: Mean and 2*standard deviation for economic benefits for society, four scenarios (scenario 0-3), million USD



Source: PEMOD 2.0.

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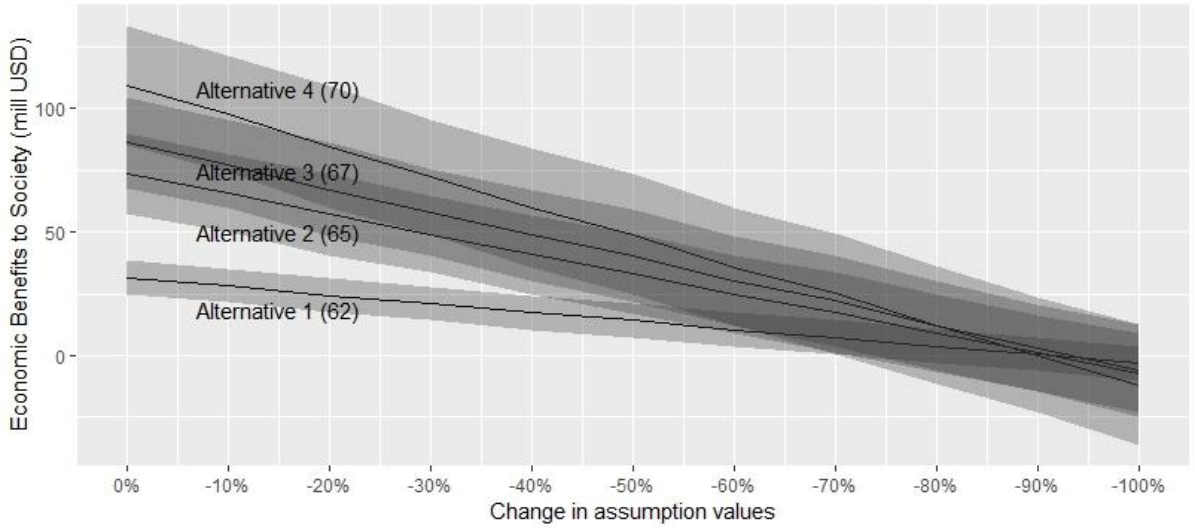
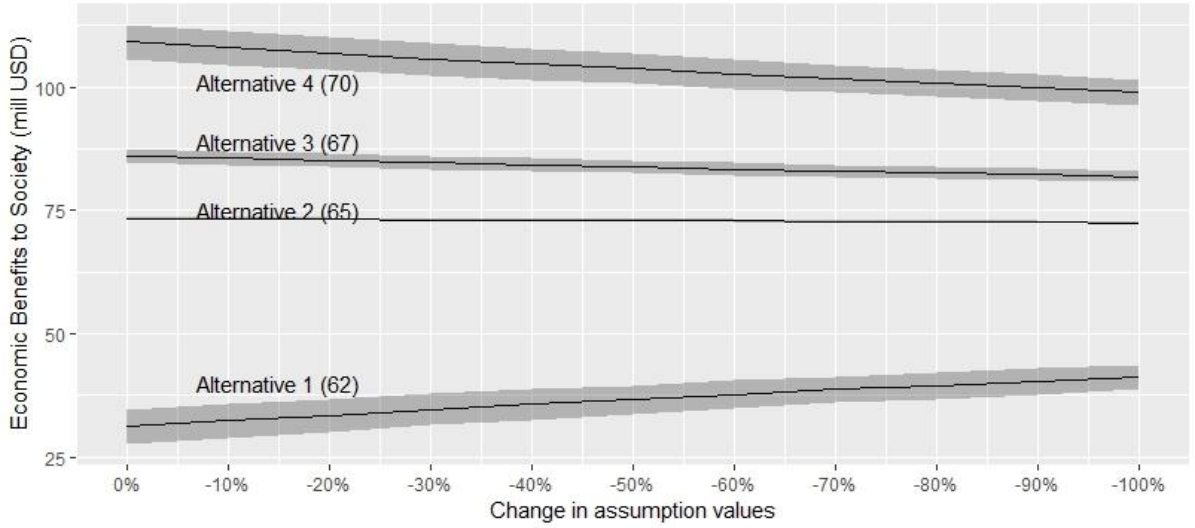
Figure 5: Monte Carlo simulation results for economic net benefits for society, *EE*, in million USD (y-axis), only the value of older personnel in NAF is modeled as random, change to this value (x-axis).



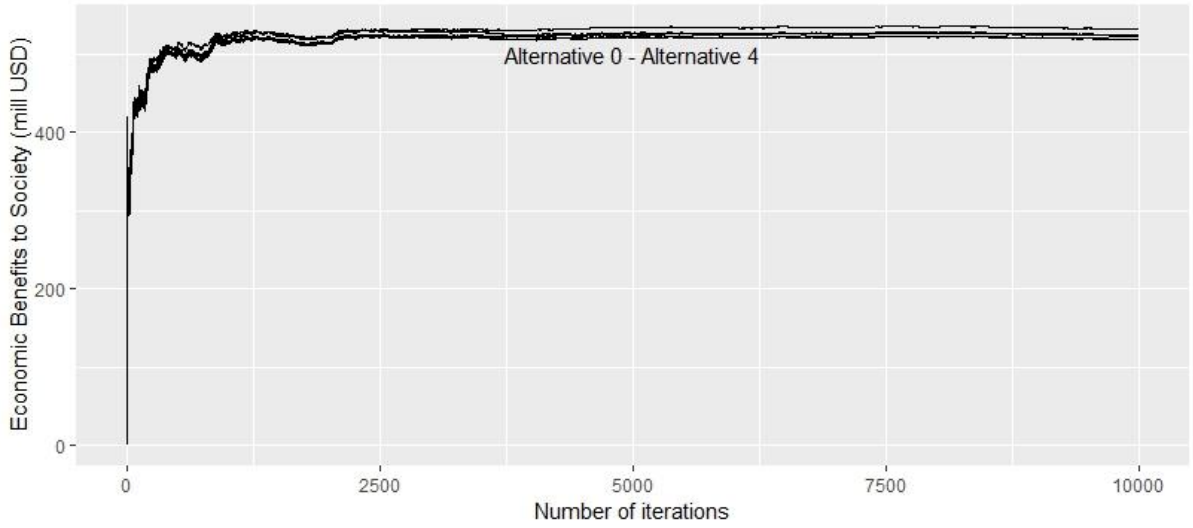
Source: PEMOD 2.0.

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)



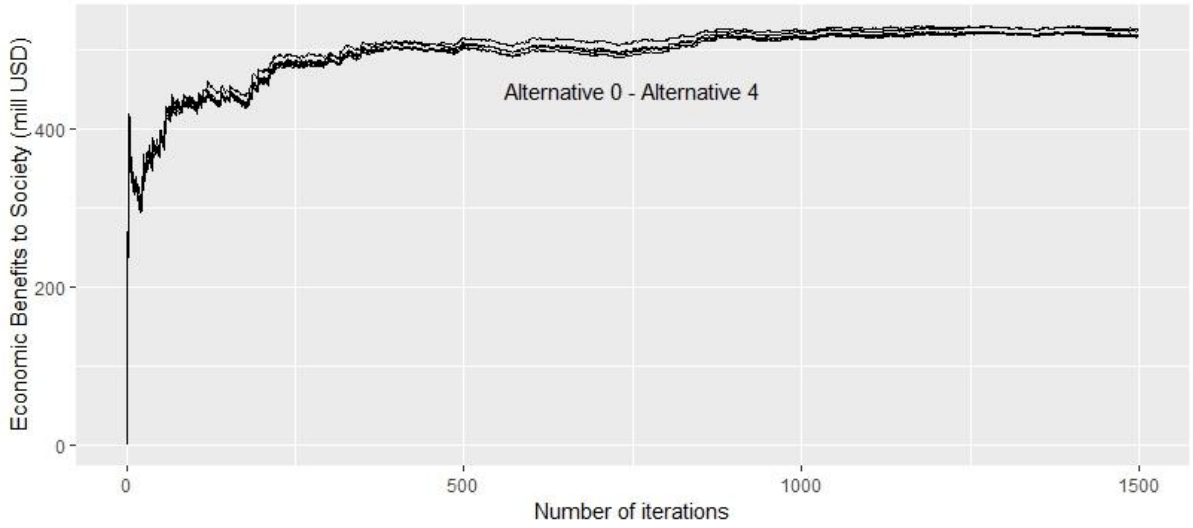
Source: PEMOD 2.0.

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



Source: PEMOD 2.0.

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



Source: PEMOD 2.0.

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