The Military Compensation and Retirement Modernization Commission's Blended Retirement Plan: Implications for Marine Corps Force Management Objectives

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Photography Credit: Gen James F. Amos, the 35th Commandant of the Marine Corps, passes the colors to Gen Joseph F. Dunford, Jr., during the change of command and subsequent retirement ceremony at Marine Corps Barracks Washington, DC, on October 17, 2014. Photo by Cpl Clayton J. Filipowicz (http://www.marines.mil/Photos.aspx?igphoto=2000948632).

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Abstract

This report examines the impact of the new military blended retirement system (BRS) on various U.S. Marine Corps force management objectives (FMOs). We estimated the effect of the retirement system changes on active component (AC) and reserve component (RC) force profiles and personnel costs and the financial impact on individual AC Marines. Our results depend on assumptions about personal discount, BRS opt-in, Thrift Savings Plan contribution, and return-on-investment rates. Our baseline estimates of the effects on FMOs use the assumptions in the Military Compensation and Retirement Modernization Commission (MCRMC) final report. We tested the sensitivity of our estimates to changes in the MCRMC assumptions and found that enlisted force profiles change very little, while enlisted personnel cost-saving estimates are more varied. Our long-run annual AC enlisted personnel cost-saving estimates range from $87 million to $225 million. Estimates for AC officer FMOs are more sensitive to changes in the assumptions. AC officer personnel cost savings range from $10 million to $54 million. RC enlisted and officer personnel cost savings are in the respective ranges of $0.2 million to $5 million and -$0.3 million to $1.5 million.

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Executive Summary

In 2015, the Military Compensation and Retirement Modernization Commission (MCRMC) recommended replacing the current system with a blended retirement system (BRS). A version of the BRS was passed into law in the Fiscal Year 2016 National Defense Authorization Act. The BRS will take effect on January 1, 2018.

The BRS reduces the current defined retirement benefit (DB) paid to servicemembers when they reach retirement eligibility at 20 years of service (YOS). The reduced DB amount is replaced with a portable Thrift Savings Plan (TSP), to which members may contribute throughout their careers. TSP contributions and the investment earnings that accrue become income to servicemembers later in life. In addition, a continuation bonus (also called continuation pay) will be paid to servicemembers at YOS 12 in exchange for four more years of service.

Because the BRS changes the timing and level of current and future military pay, it is expected to have an effect on servicemember retention behavior. This, in turn, may affect critical force management objectives (FMOs), such as YOS force profiles. The BRS also is expected to change service personnel costs and will have financial effects on the individual Marines and retirees.

The MCRMC estimated the effect of the BRS on force profiles, service personnel costs, and the financial status of Marines and retirees. It assumed specific values for servicemember personal discount rates (PDRs), opt-in rates, TSP contribution rates, and beliefs about the future rate of return on investment (ROI). The MCRMC also made assumptions about the timing and level of BRS continuation pay. However, we do not know how the estimated effects of the BRS on FMOs change when the underlying assumptions change. Given the uncertainty about these assumptions and the importance of achieving the FMOs, sensitivity analysis is necessary.

To address this analytic gap, the Deputy Commandant of the Marine Corps, Manpower and Reserve Affairs (DC, M&RA) asked CNA to identify and analyze the implications of the BRS for the Marine Corps. Specifically, DC, M&RA asked us to estimate the effect of the BRS on various FMOs, particularly as we change the underlying assumptions. The FMOs of interest follow:

- Active component (AC) and reserve component (RC) YOS profiles in future years, which may change as a result of changes in retention rates under the BRS

- AC and RC personnel costs
- Short- and long-term financial effects on AC Marines and retirees

To estimate the effect of the BRS on AC Marine Corps FMOs, we built a three-part model. Part 1 estimates the difference in the value of the two retirement systems to Marines at each YOS. Part 2 estimates how these differences may change retention rates. This allows us to estimate how the BRS may change the Marine Corps force profile. Part 3 of the model calculates changes in Marine Corps personnel costs caused by the BRS. We built a separate RC model in which we employ a similar estimation strategy, but adapted for differences in RC and AC careers.

Using the MCRMC assumptions, we estimate a baseline Marine Corps force profile and personnel costs under the BRS. We then run what-if scenarios to test the sensitivity of our results to changes in the assumptions. We conclude the following for the AC:

- Aggregate enlisted force profiles do not change much when the underlying assumptions are changed. This is because the effect of the BRS on reenlistment rates is small no matter how we change the underlying assumptions.
- Enlisted personnel cost savings are more sensitive to changes in the assumptions than the force profiles. We estimate long-term baseline enlisted personnel cost savings of about $122 million a year, but our estimates range from $87 million to $225 million, depending on assumptions about TSP contribution rates and opt-in rates.
- Aggregate officer force profiles are somewhat more sensitive than enlisted force profiles to changes in underlying assumptions. This is because, in general, officers can request to leave active service at any time after they complete their minimum service requirement, so there is more opportunity for them to change their stay/leave choices. Still, the changes to officer force profiles are relatively small even over a sizable range of assumption changes.
- On a percentage basis, officer personnel cost savings vary more than those for the enlisted force when assumptions are changed. Our long-term annual baseline officer cost-saving estimate is $21 million, but our estimates range from $10 million to $54 million, depending on assumptions about TSP contribution rates and opt-in rates.
- Although mitigating strategies do not appear necessary for the aggregate force profiles, they may be necessary for certain military occupational specialties (MOSs). In particular, if Marines in certain MOSs have lower PDRs and lower retention rates than the force averages, the BRS may affect the MOS-specific force profile enough to require mitigating strategies.

We also estimated the effect of the BRS on the short- and long-term finances of individual AC Marines. Here, we analyze how the BRS is expected to affect annual take-home pay (associated with military service) while in the AC and during retirement. We calculate the effects for four representative Marines: an E-5 who leaves after the first term, an E-7 who retires at YOS 20, an O-3 who leaves after completing YOS 4, and an O-5 who leaves at YOS 20. We estimate BRS effects using the MCRMC (i.e., baseline) assumptions and then test the sensitivity of our estimates to changes in the assumptions. Our findings follow:

- Marines who separate before YOS 20 are better off under the BRS than under the current system, even if they do not choose to contribute to the TSP because they still receive the 1-percent automatic Department of Defense (DOD) contribution, which becomes income after age 60.
- Assuming that Marines contribute the same amount to the TSP under both retirement systems, take-home pay while in the AC is the same under both systems. Those who complete a 20-year career and contribute to the TSP generally will have lower take-home pay (from military service) from retirement to age 60, and higher take-home pay after age 60—when TSP withdrawals begin. These Marines may be able to adjust their borrowing and saving to shift income to the immediate post-retirement period, making them as well-off under the BRS as they are under the current retirement system.
- The results are sensitive to the underlying assumptions. In particular, lowering the assumed TSP contribution rates and ROI can make careerists worse off under the BRS than under the current retirement system.

We built a separate model for analyzing the BRS effects on the RC using similar techniques as we used in our AC analysis but adapted for the specifics of the RC personnel system. In general, we find minimal BRS effects on RC enlisted and officer force profiles, and correspondingly modest personnel cost savings under the BRS. Specifically, our estimates show the following:

- RC enlisted personnel long-term annual cost savings under the BRS using baseline assumptions are about $1.5 million in the long term. When we vary the underlying assumptions, the high and low estimates range from about $0.2 million to $5.3 million.
- RC officer long-term annual cost savings under the BRS using baseline assumptions are about $0.4 million, with a range of about -$0.3 million (i.e., an increase in costs of $300,000) to $1.5 million as the underlying assumptions are changed. Some of these savings result from a smaller force profile, so mitigating strategies to maintain endstrength may further reduce these estimated personnel cost savings.

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Glossary

AC	Active Component
BAH	Basic Allowance for Housing
BAS	Basic Allowance for Subsistence
BP	Base Pay
BRS	Blended Retirement System
COLA	Cost-of-Living Adjustment
CP	Continuation Pay
CPI	Consumer Price Index
DB	Defined Benefit
DC	Defined Contribution
DC, M&RA	Deputy Commandant, Manpower and Reserve Affairs
DHRA OACT	Defense Human Resources Activity, Office of the Actuary
DOD	Department of Defense
DP	Drill Pay
EAOS	End of Active Obligated Service
FMO	Force Management Objective
FV	Future Value
FY	Fiscal Year
HYT	High-Year Tenure
IMA	Individual Mobilization Augmentee
IRR	Individual Ready Reserve
MCRMC	Military Compensation and Retirement Modernization Commission
MCTFS	Marine Corps Total Force System
mo.	Month
MOS	Military Occupational Specialty
MRTF	Military Retirement Trust Fund
MSR	Minimum Service Requirement

NDAA	National Defense Authorization Act
NPS	Non-Prior-Service
occfield	Occupational Field
PDR	Personal Discount Rate
PDV	Present Discounted Value
RC	Reserve Component
RCCPDS	Reserve Components Common Personnel Data System
REDUX	Reduced Retirement
RMC	Regular Military Compensation
ROI	Return on Investment
SelRes	Selected Reserve
SMCR	Selected Marine Corps Reserve
TFDW	Total Force Data Warehouse
TIG	Time in Grade
TSP	Thrift Savings Plan
YOS	Years of Service
Zone A	0 to 5 YOS
Zone B	6 to 9 YOS
Zone C	10 to 13 YOS
Zone D	14 to 19 YOS
Zone E	20 to 29 YOS

Introduction

The current military retirement system—with minor revisions over the years—dates back to 1947, when Congress implemented a common 20-year pension plan for all officers and enlisted personnel. This pension plan is a cliff-vesting defined benefit (DB) plan in which servicemembers become fully vested only after 20 years of service (YOS), with no partial vesting for less than 20 YOS. In retirement, the DB amount depends only on the servicemember's time in service and paygrade at retirement. Over the years, critics have charged that the system is (1) unfair to the vast majority of entrants, who do not serve long enough to receive any benefits, (2) inflexible, hampering force management, and (3) inefficient, making it costly and unfair to taxpayers.

The FY13 National Defense Authorization Act (NDAA) established the Military Compensation and Retirement Modernization Commission (MCRMC) to develop and recommend reforms to armed forces pay and benefits. The MCRMC makes 15 recommendations in its final report [1], including that the Department of Defense (DOD) adopt a blended retirement system (BRS) that would add defined-contribution (DC) and continuation pay (CP) elements to a reduced, traditional DB cliff-vesting retirement plan. Congress passed into law a variant of the MCRMC's BRS in the FY16 NDAA. Servicemembers with 12 YOS or more as of January 1, 2018, will remain on the current retirement system; servicemembers with less than 12 YOS will have a choice between the current system and the BRS. New entrants will be subject to the BRS.[1]

The MCRMC report contains estimates of the effects of the BRS on DOD-level armed services personnel costs and force structure. However, there is limited analysis of the effect of changing underlying assumptions about servicemember behavior and economic conditions on force outcomes. The Marine Corps' Deputy Commandant, Manpower and Reserve Affairs (DC, M&RA) asked CNA to analyze the BRS's effect on certain critical Marine Corps force management objectives (FMOs), particularly as underlying assumptions are changed.

[1] Appendix A describes the military retirement benefit and presents a brief history of revisions to it.

Background

In response to DC, M&RA's request, we conducted a preliminary analysis of the potential impacts of the BRS on Marine Corps FMOs. We identified key FMOs that could be affected by the BRS, and we developed an analytical framework for a more extensive follow-on analysis of these effects.

The primary conclusion was that the MCRMC's specific assumptions used in its DOD-level analysis of the BRS needed to be examined more closely for their impacts on Marine Corps FMOs. In particular, we recommended a more detailed examination of assumptions about personal discount rates (PDRs), opt-in rates, Thrift Savings Plan (TSP) contribution rates, servicemember beliefs about return on investment on TSP accounts, and the timing and amount of CP. Our preliminary analysis can be found in the CNA report, *The Military Compensation and Retirement Modernization Commission's Blended Retirement Plan: A First Look at Marine Corps Implications* [2].

BRS features

The key features of the BRS recommended by the MCRMC are summarized in the first CNA study [2]. Since its publication in 2015, Congress made several changes to the MCRMC's recommended BRS before passing the new system into law in FY16. Here, we summarize the FY16 NDAA BRS features:

- The services compute the active component (AC) servicemember retirement annuity using a 2-percent multiplier times YOS times the retired pay base.[2] Under the current system, the multiplier is 2.5 percent times YOS times retired pay base. This represents a 20-percent reduction in the retirement annuity. The same calculation applies to reserve component (RC) servicemembers, except that DOD will use an "effective YOS," which is computed by dividing the number of reserve points, based on days in training or days mobilized, by 360.

- At retirement, AC servicemembers can choose (1) monthly retirement payments, (2) a lump sum of 50 percent of the present discounted value (PDV) of the stream of defined benefit payments plus 50 percent of monthly retirement payments until full Social Security eligibility (at which point the full monthly pension amount would be paid), or (3) a lump sum of 25 percent of

[2] For most servicemembers, the retired pay base is the average of the three highest years of annual base pay (High-3)—typically their final three YOS. The retired pay base for those who entered service before September 8, 1980, is based on their single highest year of annual base pay.

the PDV of the stream of defined benefit payments plus 75 percent of monthly retirement payments until full Social Security eligibility (at which point the full monthly pension amount would be paid). Upon eligibility to begin receiving retirement payments (which is at age 60 unless they have qualifying creditable service toward a reduced age retirement), RC servicemembers can choose (1) monthly retirement payments or (2) a lump sum and reduced payments until full Social Security eligibility. RC servicemembers who choose the lump sum option receive full (not reduced) retirement payments when they become eligible for full Social Security.[3]

- Servicemembers and the services contribute to a servicemember's retirement savings account, which would reside entirely in DOD's Thrift Savings Plan.[4] The services contribute an amount equal to 1 percent of a servicemember's base pay (BP) to his or her TSP. This contribution is made regardless of whether a member actively participates in the TSP. Consequently, every servicemember will have a TSP. Servicemembers automatically are enrolled in a TSP at an amount equal to 3 percent of their BP, but they can terminate their participation (and still receive the 1-percent service contribution). The services begin matching servicemember TSP contributions up to a maximum of 5 percent of monthly BP once the member starts his or her third YOS. Servicemembers are fully vested in their TSPs at the start of their third YOS.

- The services provide CP equal to a minimum of 2.5 times a servicemember's monthly BP for all AC servicemembers who reach YOS 12 and are willing and able to incur an additional 4-year obligation. The CP minimum for reserve servicemembers is 0.5 times a servicemember's monthly BP.

- All current servicemembers will be grandfathered into the current retirement system but can choose to opt into the BRS if they have less than 12 YOS as of December 31, 2017. The opt-in period is from January 1, 2018, to December 31, 2018. Those who enter service on or after January 1, 2018, are subject to the BRS and cannot participate in the current retirement system.

- All servicemembers receive financial literacy training provided by the services to help them make good choices about whether to opt into the new system, how to participate in their TSPs, how much to contribute to their TSPs, and how to manage their TSPs.

[3] We do not analyze the lump-sum features of the BRS. Effectively, our analysis assumes that all retirees choose the monthly retirement payments.

[4] A 401(k) plan is an example of a DC plan provided by employers in the private sector. The commission's DC is similar in concept to a 401(k), though with some rules that differ. For details, see the federal government employee website: https://www.tsp.gov/index.shtml.

MCRMC estimates of the effect of the BRS on force profiles and costs

To analyze the effect of the BRS on DOD force profiles and costs, the MCRMC made certain critical assumptions about servicemember behavior in response to the BRS. Table 1 shows the MCRMC's assumptions.

Table 1. MCRMC assumptions about servicemember behavior and BRS CP[a]

Assumptions	Description
PDRs	• Enlisted PDR = 12.7 percent • Officer PDR = 6.4 percent
Opt-in rate	Opt-in rates in the first year: • 95+ percent of eligible first-term servicemembers • 75+ percent of eligible second-term servicemembers
TSP contributions	Average DOD contribution of 4 percent of BP (automatic contribution of 1 percent of BP plus a matching contribution of 3 percent of BP)
Return on investment (ROI)	TSP investments earn 4.95 percent real annual returns[b]
Continuation pay (CP)[a]	• Enlisted: 2.5 months of BP at YOS 12 • Officer: 2.5 months of BP plus additional amount that services determine (additional amount assumed to be zero in this report)

Source: MCRMC report.

a. The CP used in the MCRMC report was higher than the CP assumption used in this report. Since the MCRMC report was issued, the FY16 NDAA set the minimum CP amounts listed here.

b. The MCRMC report assumes 7.3 percent nominal annual returns. Our calculations are in real terms.

Using these assumptions, the MCRMC estimated that DOD-wide force profiles would be held roughly constant and that the DOD would save about $1.8 billion a year in personnel costs when the BRS was fully phased in. Based in part on the MCRMC analysis, a slightly modified version of the BRS recommended by the MCRMC was passed into law in the FY16 NDAA.

DOD-proposed BRS modifications

DOD has proposed the following modifications to the FY16 NDAA BRS:

- Service flexibility to pay CP at not less than 8 YOS and not more than 12 YOS, with a service obligation of not less than 3 years.
- Service flexibility to pay an amount of CP that is between 0 and 13 months of basic monthly pay for AC servicemembers and between 0 and 6 months of basic monthly pay for RC servicemembers.
- Increase in service TSP matching to 5 percent, for a total service contribution of 6 percent.
- Service TSP matching to start at the beginning of the fifth YOS.[5]

Tasking and approach

We address three main tasks in this report:

1. We analyze the FY16 NDAA BRS to help the Marine Corps to better understand how the BRS might change future AC and RC Marine Corps force profiles and personnel costs. We also analyze the short- and long-term financial effects on individual AC Marines compared with the current retirement system.[6] We use the MCRMC values for the key underlying assumptions to estimate the "baseline" effect of the BRS on Marine Corps FMOs (see Table 1).
2. We test alternative values for assumptions about Marine behavior against those used by the MCRMC and estimate the BRS effects on Marine Corps FMOs.
3. We provide analysis of the effect of DOD proposed modifications to the BRS on FMOs. We also examine some mitigating strategies for addressing negative BRS effects.

[5] DOD has also proposed service TSP matching to extend from YOS 26 to the servicemember's retirement. DOD also had concerns about the details of the implementation of the lump-sum provision in the BRS. In this report, we do not address the TSP matching extension beyond YOS 26, nor do we do any lump-sum implementation analysis.

[6] To redirect the study to other analytical priorities, the sponsor requested that we analyze the short- and long-term financial effects on AC Marines only.

To address tasks 1 and 2, we built on an existing CNA model to estimate how changes in the retirement system may change two of the Marine Corps FMOs for the AC: future force profiles and personnel costs. The three-part model comprises a compensation and retention component, an inventory aging component, and a personnel cost component. Using the MCRMC assumptions in the model, we estimate the FMO outcomes of interest under the current retirement system and under the BRS. We then conduct what-if scenarios by changing the assumptions from the MCRMC values in the model to estimate how the FMO outcomes change.

Our model is scaled for the entire AC Marine Corps inventory. It is not detailed enough to examine the third FMO of interest—the short- and long-run financial effects of the BRS on individual AC Marines. To address this task, we calculate current income and wealth accumulation over time under the current retirement system and under the BRS for representative individual Marines. Specifically, we calculate current income and wealth accumulation for a Marine in paygrade E-5 who leaves after the first term and for a Marine in paygrade E-7 with YOS 20. Similarly, we calculate the financial effects for an officer in paygrade O-3 at YOS 4 and one in paygrade O-5 at YOS 20.

Both the current retirement system and the BRS treat the AC and the RC differently. Our AC model cannot be used for RC analysis directly. We built a separate model to analyze the effect of the BRS on the RC FMOs of interest.[7] We describe our methodology for analyzing the effect of the BRS on these same FMOs for the RC and present our RC model results.

To address task 3, we consider the DOD-proposed changes to the timing and level of CP in the BRS. The most effective and efficient level and timing of CP is that which makes the force profiles about the same under the current retirement system and the BRS for the least cost. This may vary by military occupational specialty (MOS). Moreover, the average PDR for Marines in certain MOSs may be greater or less than the force average. The responsiveness to the BRS changes as the PDR assumption changes. Thus, to maximize the efficiency and effectiveness of the CP, the timing and level of CP may have to vary by MOS.

Report outline

In the next section, we refine the AC methodology that we developed in the first-look report (see [2]) and describe the alternative assumptions that we use to estimate the

[7] One connection between our AC and RC models is that our RC model takes the portion of the losses from the AC model that is expected to affiliate with the RC as input.

effect of the BRS on the FMOs. In the results section, we present the estimated effects of the BRS on the FMOs for the AC enlisted and officer inventories under the MCRMC assumptions as well as several alternative assumptions; we also discuss some mitigating strategies when BRS effects are negative. We then present our methodology and results for determining the financial impact of the BRS on individual Marines and retirees. The subsequent section describes the methodology for estimating the effect of the BRS on RC FMOs and presents results from our RC model. The last section contains a summary of results and conclusions.

AC Methodology

The promise of retirement benefits amounts to a deferral of some current income for expected future income. The compensation system sets the amount of current income and expected future income (i.e., retirement benefits) for each employee, and the combined current and expected future income defines lifetime earnings. If one compensation system generates higher lifetime earnings than another system, employees may retain at a higher rate under the first compensation system than under the second, all else equal.

The Marine Corps is no exception. If a change to the military compensation system, such as the BRS, results in lower lifetime military earnings than those generated under the current retirement system, reenlistment rates may decrease.[8] The degree to which Marines respond to the retirement system changes will determine the ability of the Marine Corps to maintain current force profiles. Appendix B contains a brief review of the theory of how expected lifetime military earnings may be valued. A more thorough review of these concepts is found in [2].[9]

The BRS also will change Marine Corps personnel costs. In particular, to cover future retirement benefit payments, the Marine Corps must contribute a specific amount to the military retirement trust fund (MRTF) each year for each Marine. The Marine Corps contribution to the MRTF is lower under the BRS than under the current retirement system, so the BRS is expected to generate personnel cost savings to the

[8] For officers, retirement reform may affect continuation rates. To make the description of our model (which follows) apply to both enlisted personnel and officers, we use the term *reenlistment* to describe enlisted servicemembers who sign new contracts when their current contracts are complete and for officers who make year-to-year decisions to stay in the AC after their initial service obligations are complete. Obviously, officers do not actually reenlist; they choose to continue their AC service as long as the service continues to promote them.

[9] Appendix B and [2] discuss the theoretical effects of retirement reform on the present value of expected lifetime military earnings (including how future pay may be discounted), opt-in decisions for eligible servicemembers, and the sensitivity of reenlistment rates to changes in lifetime military earnings (i.e., the wage elasticities of reenlistment). These effects provide the foundations for the mechanisms by which reform may influence servicemembers' stay/leave and opt-in decisions.

Marine Corps. However, the savings from the lower MRTF contributions will be offset by service contributions to TSP accounts and by the CP required under the BRS.[10]

The CNA simulation model

We developed a reenlistment and cost simulation model to estimate the effects of the BRS on Marine Corps AC force profiles and personnel costs. The goal of the model is to be able to quickly run what-if scenarios when we change the values of key underlying assumptions about Marine behavior and beliefs under the BRS—namely, about PDRs, TSP contribution rates, the ROI on TSP accounts, the opt-in rate, and the level and timing of CP.

Specifically, the model estimates the effect of the BRS on reenlistment rates. The adjusted reenlistment rates, in turn, are used to estimate changes in the force profile in the short and long term. Using the new force profile, the model calculates personnel cost savings from the BRS by computing changes in the cost of funding the MRTF, the cost of the service TSP contributions, and the CP in the short and long terms. The model consists of three components:

1. **Compensation and reenlistment component.** In this component, we calculate the change in the present discounted value of lifetime military earnings under the current retirement system and under the BRS for Marines at every YOS. We then estimate how the change in the PDV of lifetime military earnings changes reenlistment rates across the AC force profile.

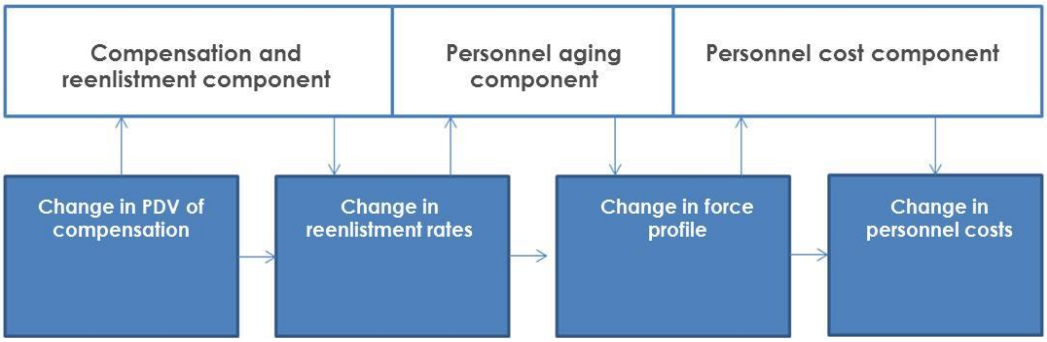
2. **Personnel aging component.** In this component, we use the estimated changes in reenlistment rates from the first component to forecast short- and long-run changes in the force profile for each YOS, from 0 to 30.

3. **Personnel cost component.** In this component, we calculate the savings from the smaller MRTF contributions under the BRS. We then adjust these savings by the service contributions to TSP accounts and the CP required under the BRS. We compute these amounts for every Marine in the personnel inventory in the short and long term.

Figure 1 shows how each model component is connected.

[10] The BRS also may change Regular Military Compensation (RMC) costs by changing the force profile even after the CP is implemented (e.g., by making the force more junior (typically less costly) or more senior (typically more costly)). We do not compute this potential cost change. Also, we do not compute changes in recruiting costs as the numbers of required accessions change.

Figure 1. Flow diagram of simulation model



We discuss each of these modeling components in more detail in the following subsections.

Compensation and reenlistment component

In this model component, we calculate the PDV of lifetime military earnings under both the current retirement system and the BRS. The PDV of lifetime military earnings is the PDV of the sum of career wages and the retirement benefit. Except for the CP, the sum of career wages is the same under the two plans, but the retirement benefit is about 20 percent lower under the BRS than under the current compensation system. Specifically, in the AC, the retirement benefit is calculated as the product of a multiplier, the servicemember's YOS, and the average of the servicemember's highest 3 years of earnings. The multipliers for the current retirement system benefit and the BRS retirement benefit are 2.5 percent and 2.0 percent, respectively.

The PDV of the sum of career wages and the retirement benefit completes the calculation of the PDV of lifetime military earnings under the current retirement plan. To complete the calculation under the BRS, we add the PDV of TSP contributions and the CP at YOS 12. Finally, we calculate the percentage change in the PDV of lifetime military earnings under the two plans.

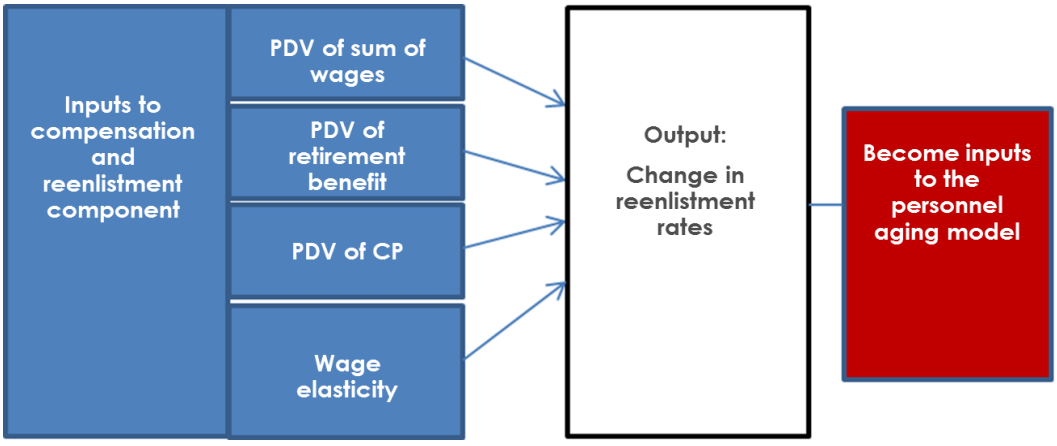
Some servicemembers will have a big behavioral (i.e., reenlistment) response to the percentage change in the PDV of lifetime military earnings. These are servicemembers for whom changes in compensation factor heavily into reenlistment decisions. Other servicemembers will have little to no behavioral response to changes in the PDV of lifetime military earnings. Their decisions to reenlist are not swayed much by compensation changes. Some in this group have no intention of becoming careerists no matter what compensation level is offered. Others have every intention

of becoming careerists, and compensation plays only a partial and likely secondary role in those decisions. Thus, when lifetime military earnings change, it may have a large effect on the reenlistment decisions of the first group of servicemembers (i.e., their responses are "elastic") and a small effect on the reenlistment decisions of the second group (i.e., their responses are "inelastic"). In this analysis, we call the responsiveness of reenlistment to changes to the PDV of lifetime military earnings the "wage elasticity of reenlistment."

To account for the overall responsiveness of Marine reenlistment rates to a change in lifetime military earnings, we multiply the percentage change in the PDV of lifetime military earnings by the wage elasticity of reenlistment at each YOS. The resulting product—the percentage change in the PDV of lifetime military earnings and the wage elasticity of reenlistment—is the factor by which we adjust historical reenlistment rates to project future force profiles under the BRS.[11]

In Figure 2, we illustrate the inputs and outputs of this model component. This component's outputs become inputs to the personnel aging component (the second component of CNA's simulation model). We present these calculations in more detail in Appendix C.

Figure 2. Inputs and outputs of compensation and reenlistment component

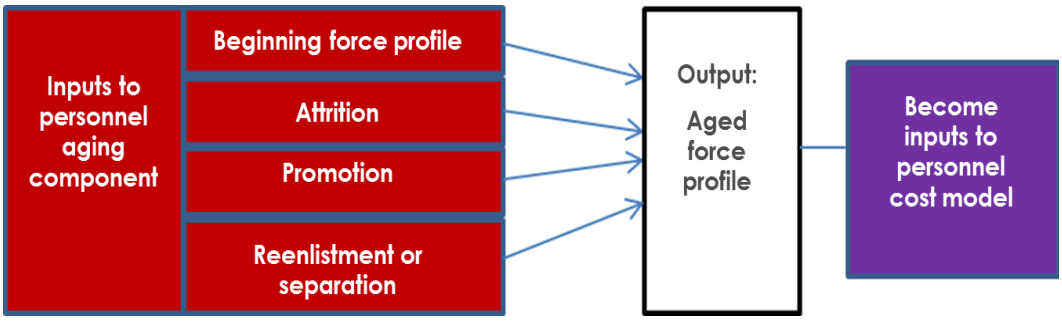


[11] Historical reenlistment rates were realized under the current retirement system. Using them to project future force profiles would ignore potential changes in stay/leave behavior due to the BRS.

Personnel aging component

The second component of CNA's model simulates the aging of the force profile. Our objective is to generate future force profiles under the BRS and to use those force profiles as an input to the personnel cost model (the third component). Starting from a recent actual Marine Corps force profile, this component simulates accession, attrition, promotion, reenlistment, separation, and retirement. (See Figure 3)

Figure 3. Inputs and outputs of personnel aging component



Simulating the future force profile under the current retirement system

We first forecast the force profile under the current retirement system. We use beginning FY16 Marine Corps personnel inventory by YOS to begin the aging simulation.[12] We age the FY16 inventory at each YOS by the average of the FY11-FY15 attrition, reenlistment, separation, and retirement rates for each YOS. For example, a portion of the YOS 0 cohort at the beginning of FY16 (i.e., those who had less than 12 months of service on October 1, 2015) will remain in the service and gain one YOS in each year of the simulation. Over the first term, a portion of this cohort will attrite, while the remainder will reach the end of their first contracts. At that point, a portion will either reenlist or separate. The model also produces high-year tenure (HYT) separations and retirements each year, which also are based on historical rates.

In each simulated year, vacancies are created by the portion of Marines who leave at each paygrade and YOS. These vacancies create promotion opportunities. In the model, vacancies at one paygrade are filled by Marines in the next lowest paygrade.

[12] For officers, we use the average of the FY12-FY16 inventories.

The model promotes from across the YOS distribution in a paygrade according to historical rates.[13]

To ensure that our aged inventories and paygrade profiles reflect Marine Corps endstrength requirements, we fix total endstrength in every year of the simulation to the level observed at the beginning of FY16. Similarly, we fix the number of Marines in each paygrade to the level observed at the beginning of FY16. This means that the force may get more junior or more senior as the simulation progresses, but only across the YOS distribution within each paygrade.

We age the FY16 inventory profile for 30 years. This achieves a long-term force profile that reflects the stay/leave behavior under the current retirement system. Aging the current profile for 30 years eliminates one-time FY16 force profile features that have nothing to do with responses to the compensation system. For example, the FY16 enlisted force profile reflects the unusually small accession cohorts from FY13 to FY15, whose surviving members are counted in YOS 1-3 inventory at the beginning of FY16.

Similarly, aging the FY16 force profile for 30 years also rids the future profile of one-time features of the FY11-FY15 reenlistment rates that may have nothing to do with Marine behavior toward compensation. For example, the Marine Corps may have undertaken force-shaping efforts that changed reenlistment rates absent any compensation system changes.

Simulating the future force profile under the BRS

We then simulate the force profile under the BRS. Here, we start with the 30-year inventory that is generated by aging the force under the current retirement system as described above. We age that force profile for another 30 years by the average of FY11-FY15 reenlistment rates *adjusted for the estimated response to the BRS*, where the adjustment factors were calculated as described in the first model component. By the 30th year of the simulation of the force profile under the BRS, every Marine in every YOS is subject to the BRS.

The opt-in choice and reenlistment behavior under the BRS

Under the law, servicemembers who have 12 YOS or more as of January 1, 2018, stay on the current retirement system. Servicemembers with less than 12 YOS as of

[13] This is in contrast to promoting Marines in a paygrade by seniority (i.e., by highest YOS). Historical data show that some Marines with a lower YOS promote to the next paygrade faster than other Marines with a higher YOS.

January 1, 2018, can choose the current retirement system or the BRS (i.e., they may opt into the new system). Servicemembers who access on or after January 1, 2018, are subject to the BRS.

The MCRMC predicted that more than 95 percent of first-term servicemembers and more than 75 percent of second-term servicemembers who are eligible to opt in will do so. For the Marine Corps, we believe that it is unlikely that very many of those who opt in will change their reenlistment plans as a result. We predict that the majority of those who opt in will be Marines who do not plan to stay and merely wish to receive the DOD TSP contributions under the BRS rather than no retirement benefit at all under the current system. In our model, therefore, we assume that the reenlistment behavior of Marines who opt in will not change.[14] Appendix B contains a more detailed discussion of the opt-in decision.

Short- and long-term future force profiles under the BRS

In the first year of the simulation, only accessions (i.e., Marines at YOS 0) are subject to the BRS and therefore may demonstrate different reenlistment behavior from what we observed under the current retirement system. (We assume that opt in-eligible Marines do not change their reenlistment behavior as described earlier.) In the second year of the simulation, only Marines at YOS 0 and 1 are subject to the BRS and therefore may demonstrate different reenlistment behavior, and so on. By aging the force for 30 years, we can observe the entire phase-in of the BRS until every Marine in every YOS is subject to the BRS and displays the adjusted reenlistment behavior.

Effectively, the beginning FY16 inventory is aged for 60 years. For the first 30 years, we assume that the force behaves as it would under the current retirement system (i.e., we age the force by the *unadjusted* average FY11-FY15 reenlistment rates). For the subsequent 30 years, we assume that the stay/leave behavior of each new cohort is affected by the BRS (i.e., we age each new accession cohort by the *adjusted* average FY11-FY15 reenlistment rates). The future force profiles generated under the current retirement system and the BRS become inputs for the cost component of the model.

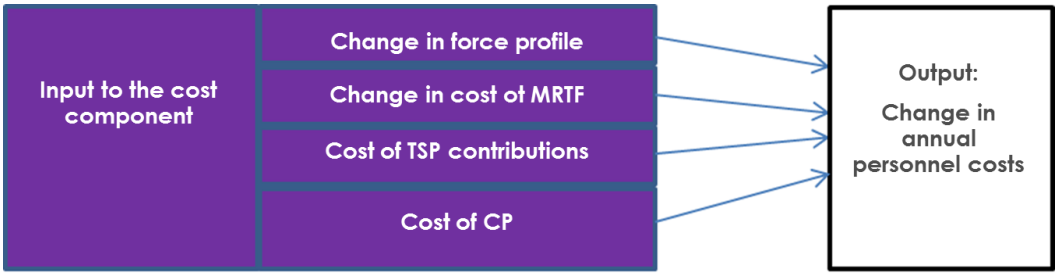
[14] It is possible that a small number of opt in-eligible Marines who are unsure of their reenlistment plans may decide that the new system is more valuable and reenlist (i.e., the BRS provides the necessary nudge to reenlist). A few others may find that the accumulated TSP funds (that they may withdraw only at separation, albeit with a 10-percent tax penalty) are an incentive to leave rather than stay. In either case, we have no data on how opt-in-eligible Marines who are undecided about reenlistment might act. Therefore, we assume that the reenlistment rates of Marines who are eligible to opt in are unaffected by having a choice of retirement system.

Personnel cost component

The third component of CNA's simulation model is a personnel cost component. The three mechanisms through which retirement reform affects personnel costs are listed here and are illustrated in Figure 4:

1. Reducing the DB reduces personnel costs by lowering Marine Corps annual accruals to the MRTF.
2. DOD contributions to servicemembers' TSP accounts will offset savings due to mechanism 1.
3. Payments of the YOS 12 CP will offset savings due to mechanism 1.

Figure 4. Inputs and outputs of cost model



Because the DB portion of the retirement system is reduced under the BRS, the Marine Corps can reduce its annual contributions to the DOD MRTF. Under the current retirement system, the Marine Corps estimates that it must contribute 31.4 percent of its AC servicemembers' BP each year to the MRTF.[15] Under the BRS, the retirement pension will be reduced by 20 percent. When all AC Marines are subject to the BRS, the new accrual rate will be 0.8 * 0.314 * BP = 0.251 * BP.

The Marine Corps must contribute 1 percent of BP for each Marine in the BRS. In addition, as Marines in the BRS contribute to their TSP accounts, the Marine Corps must match those contributions dollar-for-dollar up to 3 percent of BP and 50 cents on the dollar for contributions in excess of 3 percent but no more than 5 percent of

[15] This figure was provided by the Defense Human Resources Activity, Office of the Actuary (DHRA OACT).

BP. Marine Corps contributions to TSP accounts offset savings from the reduced MRTF contributions.

Finally, under the BRS, the Marine Corps must pay CP at YOS 12 to Marines who agree to serve four more years. For our baseline, we assume that all servicemembers would receive CP of 2.5 months of BP on completing 12 YOS and agreeing to four more years of service.[16]

Phase-in of personnel cost savings for new cohorts

In the long run, when all servicemembers are subject to the BRS, total potential savings are equal to the reduction in costs across the entire AC inventory due to lower annual MRTF payments less the increase in costs of Marine Corps TSP contributions and the YOS 12 CP. However, not all of these savings will come in the early years of BRS implementation. Marines with YOS 12 or more as of January 1, 2018, will stay on the current retirement system, so personnel costs for those servicemembers will remain the same regardless of BRS introduction. BRS savings will come year by year as eligible Marines opt in to the BRS and new servicemembers are subject to it.

Ignoring opt-ins for the moment, in the first year that the BRS is in effect, only those accessed on or after January 1, 2018, are subject to the new plan. In the first year of implementation, the Marine Corps will realize the MRTF cost savings only for these accessions. Moreover, the savings from this one cohort will be reduced by the 1 percent of BP contribution that DOD will make to the TSP accounts of these accessions.

Notionally, if there are 28,000 enlisted Marine accessions annually, and their average annual BP is $20,000, then MRTF costs for those Marines under the current retirement system are $20,000 * 28,000 * 0.314 = $175.8 million. Under the BRS, if there is no change in the number of accessions, MRTF costs would be $20,000 * 28,000 * (0.251 + 0.01) = $146.2 million. Thus, the BRS offers potential MRTF savings, less the smallest TSP contribution that the Marine Corps may make for these accessions, of roughly $30 million in the first year. More generally, total potential savings in the first year is 5.3 percent of annual BP for accessions.

In the second year, there will be two cohorts subject to the BRS— at YOS 0 and YOS 1. Potential MRTF savings are the difference in personnel costs for these two cohorts

[16] In the DOD's proposed changes to the FY16 NDAA BRS, the Marine Corps would have the flexibility to determine the YOS at which it would offer CP within a range of YOS (specifically, between YOS 8 and YOS 12). The added flexibility could improve the efficiency of the CP if the pay's retention effect is maximized at a YOS other than 12.

under the two retirement systems. If 23,000 from the first cohort stay for a second year, and their BP increases to $22,000, then potential MRTF savings for these Marines will be $22K * 23,000 * (0.063 – 0.01) = $27 million. Assuming that the newest (YOS 0) cohort is the same size as the previous year (28,000), the potential savings is $30 million. The combined savings for the two cohorts is $57 million.

In the third year after the BRS implementation, there are three cohorts subject to the BRS, and the potential MRTF savings for each cohort are calculated as just described. In addition, the amount of TSP contributions will increase from 1 percent of BP to 1 percent plus the Marine Corps match to Marine contributions for the first cohort as they enter their third year of service. In the fourth year after implementation, there will be four cohorts subject to the BRS, two of which will receive Marine Corps matching contributions. Then, when the first cohort reaches YOS 12, those who agree to continue for four more years will receive the CP, which is a one-year reduction in savings for that cohort. This goes on for 30 years, at which point all YOS cohorts will be subject to the BRS.

Cost savings from Marines who opt in

Marines with less than 12 YOS on January 1, 2018, must choose between remaining in the current retirement system and opting into the BRS. We have described why we assume that the opt-in choice will not affect force profiles. However, the percentage of eligible Marines who opt in will affect personnel costs. For those who opt in, savings are realized as described earlier—by the net effect of the reduction in the amount that the Marine Corps must set aside for the MRTF and the costs associated with TSP contributions and CP. The reduced MRTF amounts for these Marines will be realized as soon as the BRS is implemented, as will the costs associated with TSP contributions for Marines who opt in. The cost of CP for these Marines will begin to be incurred when the most senior of those who opt in reach YOS 12. This could be as early as sometime in the first year of BRS implementation.

The Marine Corps will realize personnel cost savings (as we define them) from Marines who opted into the BRS for as long as they are in the AC. For Marines who had less than one year of service when they opted into the BRS and who become careerists, the Marine Corps could realize cost savings for them for nearly 30 years.

Underlying model assumptions

Estimates of future force profiles and cost savings rely critically on certain underlying assumptions in the calculation of the PDV of lifetime military earnings under both retirement systems. The timing of personnel cost savings also is affected by assumptions about opt-in rates. Table 1 summarized the key assumptions used by

the MCRMC to estimate the effects on future force profiles and personnel cost savings.

We begin our analysis by using the MCRMC assumptions to estimate Marine Corps future force profiles under the current retirement system and under the BRS. We also use the MCRMC assumptions to estimate Marine Corps personnel cost savings as the BRS is phased in.

Alternative assumptions

The estimates of Marine Corps future force profiles and personnel cost savings may vary if we change the MCRMC assumptions. We propose alternative assumptions, and we estimate how future force profiles and personnel cost savings change as each alternative assumption is used in the model.

PDRs that decrease with age

The MCRMC assumed that enlisted servicemembers and officers have a constant PDR of 12.7 and 6.4 percent, respectively, across all YOS. However, there is substantial statistical evidence that PDRs are negatively correlated with age. Thus, assuming the same PDR for all ages (YOS) could underestimate the PDRs of younger servicemembers and, more critically, could overestimate the PDRs of older servicemembers, many of whom are military careerists.

The higher the PDR, the lower is today's value of a dollar that is expected to be paid in the future. Also, for a given PDR, the longer the time to a future payment, the lower is the value of the payment today. The BRS can change the timing and level of total lifetime military earnings compared with the current retirement system. Therefore, the value of the BRS relative to the current retirement system can vary over time and across PDR values. Estimates of the effects of retirement reform on reenlistment that assume a fixed PDR across YOS may overstate the effects for young servicemembers and understate them for careerists.[17]

In our first alternative BRS scenario, we assume that younger and older servicemembers have different PDRs. Specifically, we assume that PDRs decrease monotonically with YOS (i.e., the PDR never increases from the highest PDR at YOS 0). Figure 5 and Figure 6 illustrate the YOS-varying PDRs that we use for enlisted Marines and officers, respectively.

[17] See [3], [4], [5], [6], and [7] for background on estimating PDRs.

Figure 5. Enlisted PDRs that vary by YOS (proxy for age)

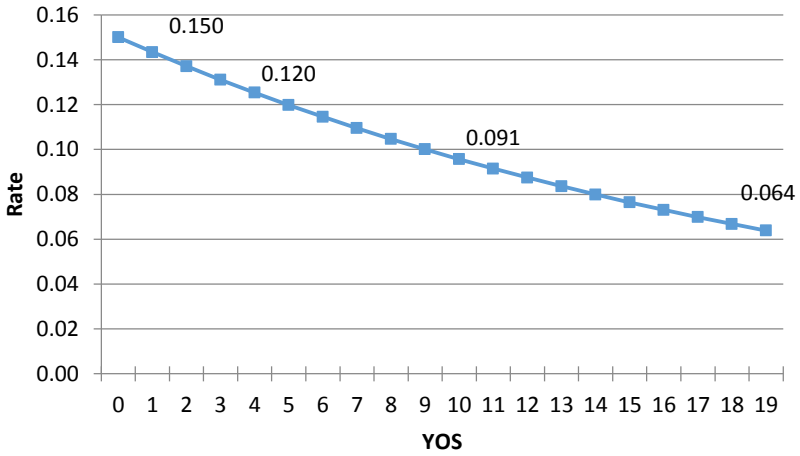
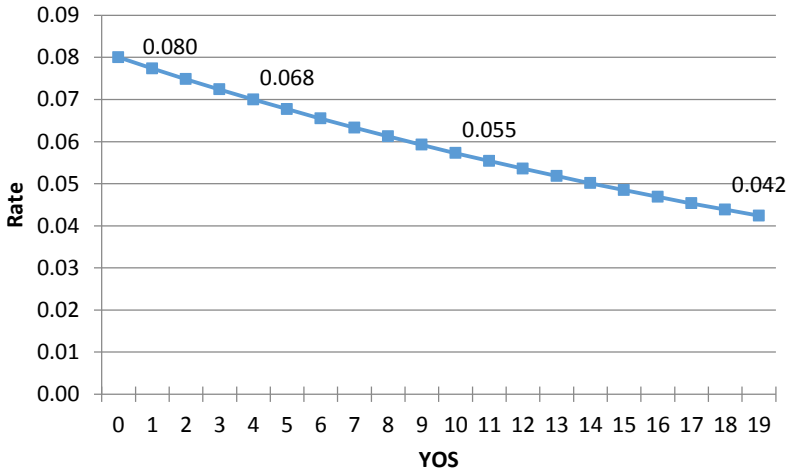


Figure 6. Officer PDRs that vary by YOS (proxy for age)



The PDRs shown in Figure 5 and Figure 6 are not derived directly from data, but they are informed by previous research on PDRs.[18] The weighted average of the enlisted PDRs in Figure 5 is 12.7 percent; the weighted average of the officer PDRs in Figure 6 is 6.4 percent.

[18] See, for example, references [3] and [5], which report a negative estimated relationship between age and PDR, other factors held constant.

Higher and lower average PDRs

Despite a growing literature on PDR estimates, we do not have clear consensus on the average PDR that should be used to estimate future force profiles. To understand how the assumption about the average PDR may change future force profiles, we run two scenarios each for enlisted personnel and officers. First, to understand the effects of a lower bound PDR, we assume that the average PDR is much lower than the MCRMC assumption. We use 1 percent instead of 12.7 percent in the enlisted analysis and 1 percent instead of 6.4 percent in the officer analysis. Second, to understand the effects of an upper bound PDR, we assume that the average PDR is much higher than the MCRMC assumption. We use 18 percent instead of 12.7 percent in the enlisted analysis and 12 percent instead of 6.4 percent in the officer analysis.

Lower opt-in rates for eligible Marines

The MCRMC assumed that, as of January 1, 2018, approximately 95 percent of eligible Marines in YOS 0-5 and 75 percent of eligible Marines in YOS 6-11 will opt into the BRS. In the alternative scenario, we assume that the opt-in rate is 50 percent for eligible Marines with YOS 0-5 and 40 percent for Marines with YOS 6-11.

We examine this scenario for two reasons. First, the opt-in rate assumption could substantially affect personnel cost savings in the short run. Because the BRS is less costly per servicemember than the current retirement system, the higher the opt-in rates, the higher the personnel cost savings. Second, although economic theory supports the high opt-in rates that the MCRMC assumed, Marines may not behave as theory suggests. The respondents in one survey showed that more junior eligible Marines may opt in at a 50-percent rate, while more senior eligible Marines may opt in at a 40-percent rate [8]. Although the results of the survey may have suffered from response bias, we nevertheless use them to determine how sensitive estimates of personnel cost savings are to a change in the opt-in assumptions.

Higher and lower TSP contribution rates

The MCRMC assumed a uniform contribution by servicemembers to their TSP accounts of 3 percent of BP. However, the likely outcome of this is more complex. For servicemembers to receive Marine Corps matching contributions, they must contribute to TSP accounts from their own pockets. Furthermore, as long as they are servicemembers, they are not allowed to withdraw the funds except for specific economic emergencies. Even then, servicemembers may be subject to a sizable penalty for early withdrawal of TSP funds.

To estimate the smallest and largest effect that the TSP contribution rate assumption could have on future force profiles and personnel cost savings, we run two scenarios each for enlisted personnel and officers. In the first, we assume that Marines make

no contributions to their TSP accounts. In the second, we assume that Marines make the maximum contribution to their TSP accounts—5 percent of BP.

In the first scenario, the Marine Corps will not have to make any matching TSP contributions (although it still will have to make the nonmatching contribution of 1 percent of BP). In the second scenario, the Marine Corps will have to make the maximum matching contribution for every Marine. The combined Marine Corps nonmatching and matching TSP contributions are 5 percent of BP.

Lower ROI

The MCRMC assumed that TSP account balances would grow at a real rate of 4.95 percent. This assumption is based on results from a survey of TSP account holders who reported the past ROI achieved by their TSP accounts. By using 4.95 percent in our model, we implicitly assume that servicemembers believe that the real ROI achieved in the past also will be achieved in the future.

If servicemembers do not believe that past ROI is a good indicator of future ROI, then other ROI assumptions should be considered. In particular, we run one scenario each for enlisted personnel and officers in which we assume that Marines are more pessimistic about future ROI. Specifically, we assume that TSP account balances will grow at a real ROI of 3.15 percent.[19]

Some DOD-proposed BRS changes

Preliminary analysis on changing the timing and level of the CP

The BRS requires the Marine Corps to pay a CP at YOS 12 for Marines who agree to serve another four years. DOD and the services have expressed concern about the rigidity of the timing of this CP. DOD has proposed allowing the services more flexibility in when they may offer the CP and how much they may offer. Specifically, DOD has proposed allowing the CP to be offered between YOS 8 and YOS 12, and at amounts between zero and 16 months of BP at the discretion of the services.

YOS continuation patterns among servicemembers can vary by occupational specialty, including in the Marine Corps. For some occupational specialties, continuation around YOS 12 and after may already be sufficiently high to maintain the required YOS profile to meet the service requirements for the occupation, even

[19] In some of the analysis conducted for the MCRMC, the inflation rate was assumed to be 2.35 percent. An assumption of 3.15 percent real ROI is approximately consistent with a nominal ROI assumption of 5.5 percent when inflation is assumed to be 2.35 percent. Also, it is not uncommon to see an assumption of 5.5 percent nominal ROI on government investments.

under the BRS. Thus, a CP at YOS 12 is likely both ineffective (i.e., it does not address an actual continuation problem) and inefficient (i.e., scarce service financial resources would be spent for no reason, while other service needs that require more financial resources may go unmet). By contrast, another occupational specialty may require an earlier and a larger CP than 2.5 months of BP at YOS 12 to achieve a force profile that meets requirements under the BRS. More generally, the Marine Corps may need to offer a CP at different YOS and/or of different amounts to maximize the efficiency and effectiveness of the pay for different MOSs.

MOSs that typically face retention challenges that require CPs are often those in which Marines have plentiful and lucrative civilian sector opportunities. This is particularly true for highly technical MOSs—which usually require high cognitive abilities—because the required skills and abilities for these MOSs are nearly always in demand in the civilian sector.

In the PDR literature, researchers have found a negative correlation between education level and PDR: the higher the education level achieved, the lower the estimated PDR [9]. Education level may, in turn, be correlated with cognitive ability. Therefore, it may be that servicemembers in highly technical MOSs—that is, those who have higher-than-average cognitive ability—may have lower PDRs than the force average. We consider how the timing and level of CP may have to vary to address a force profile that changes under the BRS, whether that be the entire force profile or the profile of a specific MOS.

DOD contributions to the TSP accounts will be vested at YOS 5 rather than at YOS 3

Under the BRS, servicemembers vest in the military retirement system (and DOD begins contributing matching TSP contributions) beginning in YOS 3. DOD has proposed delaying the vesting period to YOS 5. We run this scenario to examine the effects on force profiles and personnel cost savings using the MCRMC assumptions.

DOD matches TSP contributions dollar for dollar up to 5 percent of BP

Under the BRS, DOD matches servicemember contributions to their TSP accounts dollar for dollar up to 3 percent of BP and fifty cents on the dollar from 3 to 5 percent of BP. DOD has proposed increasing the DOD matching contribution to be dollar for dollar on all servicemember contributions up to 5 percent of BP. We run this scenario to examine the effects on force profiles and personnel cost savings using the MCRMC assumptions.

Summary of scenarios

Table 2 shows the summary of the scenarios. For each scenario, we compare the future force profiles and personnel savings costs with those estimated using the MCRMC (baseline) assumptions.

Table 2. Baseline and alternative assumption scenarios

Baseline	BRS alternative assumption scenarios	DOD-proposed scenarios
BRS with MCRMC assumptions (see Table 1)	Vary PDR across YOS (see Figure 5 and Figure 6)	CP can be paid from YOS 8 to YOS 12 and in different amounts
	PDR = 1 percent for all Marines (enlisted and officers)	Servicemembers vest (DOD begins TSP matching) at YOS 5 instead of YOS 3
	PDR = 18 percent for all enlisted Marines	DOD matches all TSP contributions dollar for dollar up to 5 percent of BP plus the automatic 1 percent of BP unmatched contribution
	PDR = 9 percent for all officers	
	PDR = 12 percent for all officers	
	Opt-in rates are 50 percent for Marines in YOS 0-5 and 40 percent for Marines in YOS 6-11 (affects personnel cost savings only)	
	No matching TSP contributions (Marines contribute nothing to their TSPs)	
	5 percent matching TSP contributions (Marines contribute 5 percent of BP to their TSPs)	
	Real ROI = 3.15 percent	

Data

We use Marine Corps personnel data in our simulation model to estimate the effects of the BRS on force profiles and personnel cost savings. We use the beginning FY16 inventory data by YOS from the Marine Corps Total Force Data Warehouse (TFDW) to begin our simulation of future enlisted force profiles. We use average FY11-15 reenlistment rates, attrition rates, promotion rates, and separation rates by YOS, all of which are derived from TFDW data.

To smooth some unusual patterns in the officer YOS profiles, we use an average of the FY11-FY16 inventory data by YOS from the TFDW to begin our simulation of

future officer force profiles. We use average FY11-FY15 continuation rates, promotion rates, and separation rates by YOS, which are derived from TFDW data.[20]

To calculate the RC enlisted and officer affiliation rates, force profiles, and continuation rates, we use individual servicemember records from monthly snapshots of the Marine Corps Total Force System (MCTFS) for October 2001 through September 2011 as well as annual RC inventory profile information from 2005 to 2015.

[20] The promotion rates used in our simulation model are neither the statutory rates nor the actual rates reported for recent promotion boards. Instead, we use recent historical data to show the percentage of officers in a particular paygrade in one YOS cell who increase their paygrade by the next YOS. For example, the historical data show that a substantial percentage of officers in paygrade O-3 at YOS 9 will promote to paygrade O-4 by YOS 10, while a small percentage of officers (if any) in paygrade O-3 at YOS 8 will promote to paygrade O-4 by YOS 9, and so on.

Results for AC Force Profiles and Personnel Cost Savings

This section presents our estimates of the effect of the BRS on the force profile and personnel costs for Marine Corps AC enlisted personnel and officers. As discussed, the estimated effects depend on many underlying assumptions. We set a "current" long-term force profile (calculated assuming that the current retirement system remains in place for the next 30 years) and a "baseline" long-term BRS force profile (calculated when the BRS is fully phased in), which assumes that the values of the key underlying assumptions are those used by the MCRMC.[21] Differences in the two force profiles are attributable to differences in the retirement systems.

We then change the value of one underlying assumption at a time and reestimate the long-term BRS force profile. These alternative BRS force profiles are compared with the BRS baseline to understand the impact of changing that particular underlying assumption. Likewise, we compute differences in the personnel costs under the current retirement system, the BRS baseline (i.e., using MCRMC assumptions), and the BRS using alternative assumptions.

AC enlisted force

BRS impact on force profiles

The columns labeled "current" and "baseline" in the table at the top of Figure 7 show the aged force profiles under the current retirement system and the baseline BRS, summarized by YOS Zones A through E.[22] The baseline BRS profile (labeled "baseline"

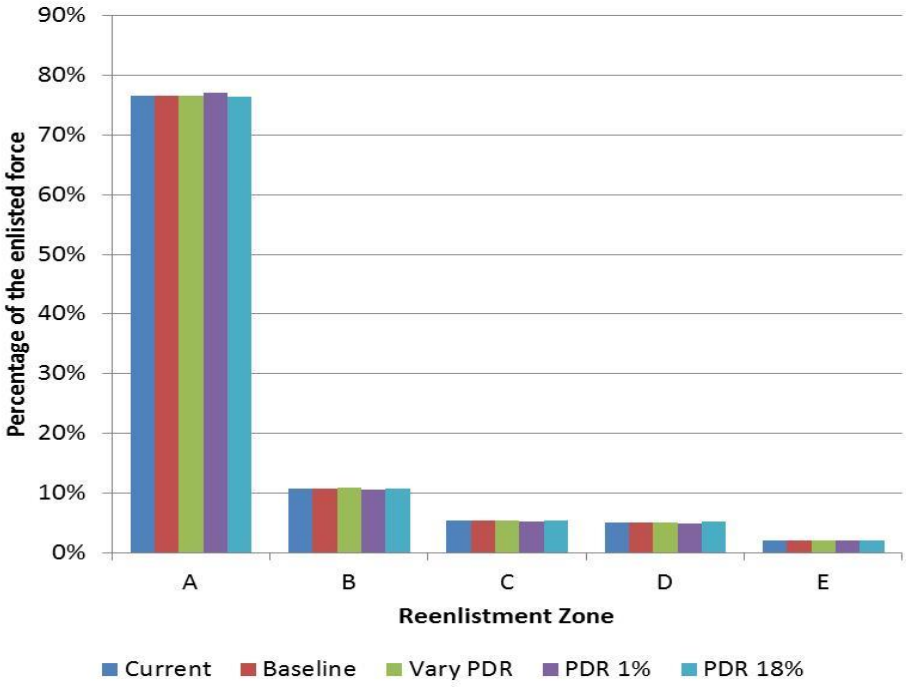
[21] See Table 1 for the MCRMC assumptions about PDRs, TSP contribution rates, ROI, opt-in rates, and CP.

[22] YOS zones follow: Zone A, 0-5 YOS; Zone B, 6-9; Zone C, 10-13; Zone D, 14-19; Zone E, 20-29.

in the figures in this section) is nearly identical to the force profile generated under the current retirement system (labeled "current" in the figures in this section).[23]

Figure 7. AC enlisted force profiles: testing different PDR assumptions

Zone	Current	Baseline	Vary PDR	PDR 1%	PDR 18%
A	76.61%	76.51%	76.54%	77.10%	76.39%
B	10.82%	10.83%	10.90%	10.64%	10.82%
C	5.37%	5.40%	5.37%	5.20%	5.46%
D	5.12%	5.16%	5.10%	4.99%	5.23%
E	2.09%	2.10%	2.09%	2.08%	2.10%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**



Source: CNA simulation model results.

[23] Using the MCRMC (baseline) assumptions, there are modest positive adjustments to reenlistment rates due to the BRS for YOS cells 0-19 and 27-29, and modest negative adjustments in YOS cells 20-26, but they are not large enough to change the long-term force profile as described by the zones. These adjustments are described in this subsection.

Enlisted force profiles with different PDR assumptions

The PDR of individual Marines affects how they value the BRS relative to the current retirement system. Each different PDR assumption may affect reenlistment rates, and therefore the BRS force profile, differently. We compare the BRS force profile generated under the following three alternative PDR assumptions, holding constant all other MCRMC assumption values:

- PDR varies by YOS (see Figure 5)
- PDR = 1 percent for all enlisted Marines
- PDR = 18 percent for all enlisted Marines

Each of the resulting force profiles is compared with the baseline BRS force profile (which assumes a 12.7-percent PDR for all enlisted Marines). Figure 7 shows the profile comparisons by the percentage of Marines in each of the five reenlistment zones. It shows that the various PDR assumptions do not appear to change the long-term BRS force profile as summarized by the zones.[24]

This seems somewhat counterintuitive. The difference in the PDV of lifetime military earnings under the current retirement system and the BRS should change as the PDR assumption changes. In particular, higher PDRs mean that Marines place a relatively low value on retirement benefit payments (i.e., income expected to be paid in the future) vice income today, while the opposite is true for lower PDRs. Thus, we expect that the current retirement system is relatively less attractive for Marines with a high PDR because the DB under the current retirement system is 20 percent higher than the DB under the BRS.

Likewise, all else equal, Marines with a low PDR will find military service relatively less attractive under the BRS than under the current retirement system. This difference in preference for retirement systems for the low and high PDR Marines will be especially pronounced in the early YOSs, when the DB retirement payments are far off in the future. However, if the different assumptions about PDRs result in only small changes to the PDV of lifetime military earnings, and therefore in reenlistment rates, the force profiles will not change much. In fact, this appears to be the case. Table 3 shows the reenlistment rate adjustment factors at each YOS that we

[24] In addition, in years 5 and 15 after BRS implementation, we find virtually no difference in the current retirement system force profile, the baseline BRS profile, or the profiles produced under different PDR assumptions.

estimate for the BRS baseline and the different PDR scenarios. These adjustment factors are applied to the actual average FY11-FY15 reenlistment rates.[25]

A red (negative) entry in Table 3 means that, for that YOS, the BRS generates a lower estimated PDV of lifetime military earnings than for the current retirement system. Therefore, the adjustment to the reenlistment rate for that YOS is negative under the BRS. A black entry (positive) in Table 3 means that the BRS has a higher estimated PDV of lifetime military earnings than for the current retirement system in that YOS. Therefore, reenlistment rates in that YOS are expected to increase under the BRS compared with the current retirement system.

Table 3. Reenlistment rate adjustment factors under various PDR assumptions

YOS	Baseline PDR = 12.7%	PDR varies by YOS	PDR= 1%	PDR= 18%
0	0.0081	0.0387	-0.0900	0.0090
1	0.0100	0.0396	-0.0926	0.0121
2	0.0130	0.0417	-0.0994	0.0170
3	0.0151	0.0383	-0.0985	0.0217
4	0.0187	0.0357	-0.1018	0.0292
5	0.0230	0.0313	-0.1055	0.0392
6	0.0189	0.0166	-0.0730	0.0350
7	0.0231	0.0110	-0.0759	0.0464
8	0.0282	0.0041	-0.0790	0.0611
9	0.0341	-0.0039	-0.0824	0.0793
10	0.0205	-0.0063	-0.0431	0.0507
11	0.0244	-0.0108	-0.0452	0.0633
12	0.0286	-0.0152	-0.0474	0.0773
13	0.0030	-0.0337	-0.0534	0.0301
14	0.0007	-0.0076	-0.0113	0.0069
15	0.0008	-0.0082	-0.0119	0.0077
16	0.0008	-0.0088	-0.0127	0.0084
17	0.0009	-0.0092	-0.0135	0.0090
18	0.0010	-0.0095	-0.0145	0.0094
19	0.0007	-0.0080	-0.0142	0.0063
20	-0.0005	-0.0011	-0.0020	-0.0005
21	-0.0005	-0.0011	-0.0020	-0.0004
22	-0.0004	-0.0012	-0.0022	-0.0002
23	-0.0004	-0.0013	-0.0023	0.0000

[25] The reenlistment rate adjustment factors presented in Table 3 are the product of (1) the percentage difference in the PDV of lifetime military earnings under the current retirement system and the BRS scenario of interest and (2) the wage elasticity for each YOS. Appendix C contains more detail on these calculations.

YOS	Baseline PDR = 12.7%	PDR varies by YOS	PDR= 1%	PDR= 18%
24	-0.0003	-0.0014	-0.0024	0.0002
25	-0.0001	-0.0014	-0.0024	0.0004
26	0.0000	-0.0014	-0.0025	0.0007
27	0.0001	-0.0015	-0.0025	0.0011
28	0.0003	-0.0015	-0.0026	0.0015
29	0.0007	-0.0017	-0.0028	0.0029

Source: CNA simulation model results

Table 3 shows that, under the baseline assumptions (includes a PDR of 12.7 percent for every Marine), the BRS is more attractive than the current system at every YOS from YOS 0-19 and from YOS 27-29. That is, the adjustments for the reenlistment rates estimated under the baseline BRS are positive (but small) for YOS 0-19 and YOS 27-29. By contrast, under the baseline assumptions, we estimate that the current retirement system is more attractive than the BRS from YOS 20-26; we estimate small negative adjustments to reenlistment rates under the BRS from YOS 21-26.

When we change the PDR assumption, the direction of the adjustment factors is as we would expect. For example, when we assume a very low PDR (e.g., 1 percent), the BRS is less attractive than the current retirement system at every YOS, all else equal, and the adjustment to the reenlistment rate at every YOS is negative. For a very high PDR (e.g., 18 percent), the BRS is more attractive than the current retirement system at YOS 0-19 and YOS 24-29, all else equal.[26] And, as we expected, assuming an average PDR for all Marines understates the negative reaction to the BRS among older Marines compared with a YOS-varying PDR. That is, Table 3 shows that the scenario that varies PDR by YOS produces a negative adjustment factor for reenlistment rates beginning at YOS 9 compared with YOS 20 under the baseline.

However, none of the effects on reenlistment rates is large. Moreover, recall that, as we age the profile, we fix endstrength as well as the number of Marines in each paygrade. Thus, in our model, the force profile can only change *across YOS within a paygrade*. As a result, we find minimal changes to the force profile due to the BRS, regardless of what we assume about the PDR.

[26] Assuming a PDR of 18 percent vice 12.7 percent results in estimated adjustment factors in same direction (positive or negative) at every YOS except YOS 24-26. However, the size of the adjustment factor is larger under the 18-percent assumption.

Enlisted force profiles with different assumptions about TSP contribution rates

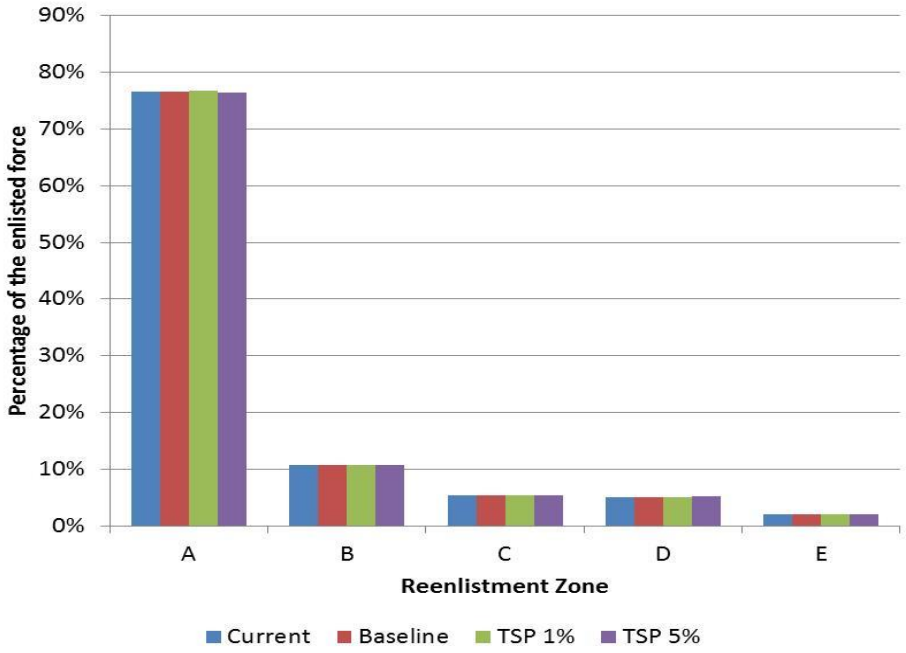
Like differences in PDR, differences in the DOD contribution rate to individual TSP accounts may affect how Marines value the BRS relative to the current retirement system. This, in turn may, affect their reenlistment rates, which then may affect force profiles. We compute BRS force profiles with two different assumptions about these DOD TSP contribution rates, holding all other baseline assumptions constant. We assume DOD TSP contribution rates of 1 percent and 5 percent.

We compare these two scenarios with the force profile generated under the current retirement system and the BRS baseline (which assumes a DOD TSP contribution rate of 4 percent).[27] In Figure 8, we display the force profile comparisons for different assumptions about DOD TSP contributions by the percentage of Marines in each of the five reenlistment zones.

[27] Recall that DOD automatically contributes 1 percent of BP to every TSP account regardless of the level of servicemember contributions. In addition, DOD will match servicemember contributions dollar for dollar on up to 3 percent of BP, and fifty cents on the dollar for contributions of more than 3 percent but not more than 5 percent of BP. Thus, a DOD TSP contribution rate of 4 percent occurs when servicemembers contribute 3 percent of BP.

Figure 8. AC enlisted force profiles: testing different DOD TSP contribution rate assumptions

Zone	Current	Baseline	TSP 1%	TSP 5%
A	76.61%	76.51%	76.69%	76.46%
B	10.82%	10.83%	10.81%	10.84%
C	5.37%	5.40%	5.34%	5.42%
D	5.12%	5.16%	5.08%	5.19%
E	2.09%	2.10%	2.08%	2.10%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**



Source: CNA simulation model results.

As we found with changing the PDR assumptions, there are few changes in the long-term force profiles when we change the assumptions about DOD TSP contribution rates.[28] The adjustment factors to reenlistment rates under each scenario are so small that the force profiles effectively remain the same. Still, we can examine the reenlistment rate adjustment factors in more detail to see if they conform to our

[28] In years 5 and 15 after BRS implementation, we find that the difference between the current retirement system force profile and the profiles produced under different BRS scenarios is even smaller than those shown in Figure 8.

expectations (i.e., whether the sign of the change (+ or −) is as we expected). Table 4 shows the reenlistment rate adjustment factors for that we estimate for the BRS baseline and for the different DOD TSP contribution rate scenarios.

Table 4. Reenlistment rate adjustment factors under various DOD TSP contribution rate assumptions

YOS	Baseline TSP = 4%	TSP = 1%	TSP = 5%
0	0.0081	-0.0031	0.0119
1	0.0100	-0.0038	0.0146
2	0.0130	-0.0050	0.0189
3	0.0151	-0.0058	0.0221
4	0.0187	-0.0072	0.0273
5	0.0230	-0.0088	0.0336
6	0.0189	-0.0073	0.0276
7	0.0231	-0.0089	0.0338
8	0.0282	-0.0108	0.0412
9	0.0341	-0.0131	0.0499
10	0.0205	-0.0079	0.0300
11	0.0244	-0.0094	0.0356
12	0.0286	-0.0110	0.0418
13	0.0030	-0.0428	0.0182
14	0.0007	-0.0097	0.0041
15	0.0008	-0.0109	0.0046
16	0.0008	-0.0120	0.0051
17	0.0009	-0.0129	0.0055
18	0.0010	-0.0137	0.0058
19	0.0007	-0.0104	0.0044
20	-0.0005	-0.0022	0.0000
21	-0.0005	-0.0022	0.0001
22	-0.0004	-0.0023	0.0002
23	-0.0004	-0.0023	0.0003
24	-0.0003	-0.0023	0.0004
25	-0.0001	-0.0023	0.0006
26	0.0000	-0.0023	0.0007
27	0.0001	-0.0023	0.0009
28	0.0003	-0.0023	0.0011
29	0.0007	-0.0028	0.0019

Source: CNA simulation model results.

Again, the direction of the changes to reenlistment rates is as we would expect given the changes in the DOD TSP contribution rate assumptions. For the lowest allowable contribution rate (i.e., automatic 1 percent of BP but no matching contributions), the

BRS is less attractive than the current retirement system at every YOS, all else equal. This is because, assuming a 12.7-percent PDR and an ROI of 4.95 percent, the PDV of the amount that Marines accumulate in their TSP accounts by the time they retire cannot make up for the 20-percent reduction in the DB.

By contrast, for the highest DOD TSP contribution rate allowed (5 percent), the BRS is more attractive than the current retirement system at every YOS, all else equal. Note that this result shows reenlistment rate adjustments of the same sign for YOS 0 through 19 and YOS 27 through 29 as those estimated for the BRS baseline—when it is assumed that the total DOD TSP contribution rate is 4 percent. However, the adjustments to reenlistment rates estimated when we assume a 5-percent contribution rate are larger than those estimated for the BRS baseline.

As we found with altering the PDR assumptions, the effects of changing assumptions about DOD TSP contribution rates on reenlistment rates are small. This, along with fixing endstrength and size of the inventory in each paygrade during the inventory aging process, results in minimal changes to the force profile.

Enlisted force profiles with different ROI assumptions

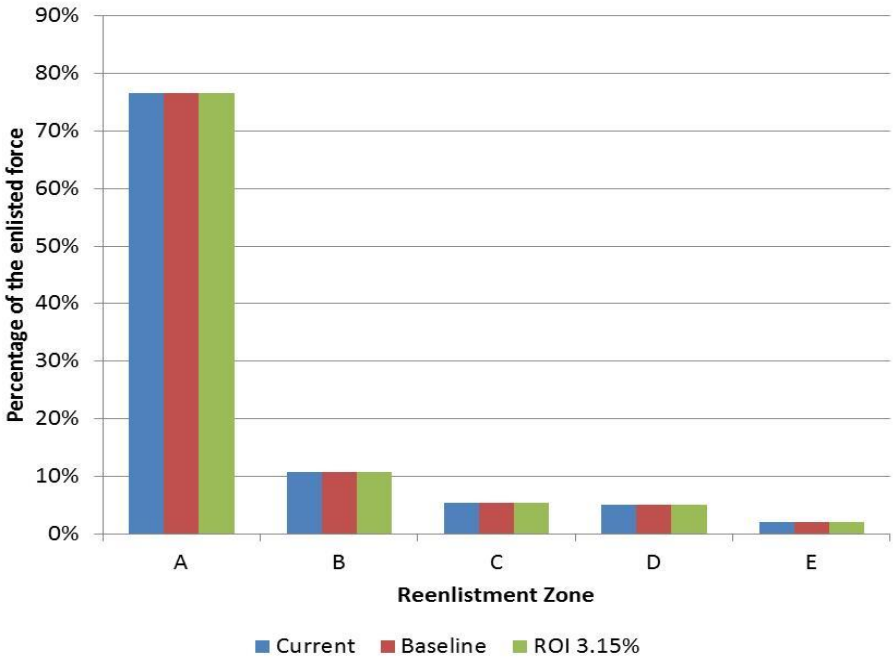
The assumed ROI for individual TSP accounts also affects how individual Marines value the BRS relative to the current retirement system. In particular, all else equal, lower ROIs decrease the value of TSP accounts and make the BRS relatively less attractive than the current retirement system. The MCRMC assumed a real ROI of 4.95 percent. We estimate the effect on reenlistment rates (and, ultimately, on the force profile) when the real ROI is 3.15 percent. Figure 9 shows the force profiles by zone for the current retirement system, the BRS baseline (which includes a 4.95-percent ROI), and an ROI of 3.15 percent.

As with the other scenarios, there is little change in the long-term force profile generated by the BRS assuming a 3.15-percent real ROI vice a 4.95-percent ROI (i.e., the baseline). And, both of the BRS profiles are virtually the same as the profile generated by the current retirement system.[29]

[29] In years 5 and 15 after BRS implementation, we find that the difference between the current retirement system force profile and the BRS profiles produced under different ROI assumptions is about the same as that shown in Figure 9.

Figure 9. AC enlisted force profiles: testing a lower ROI assumption

Zone	Current	Baseline	ROI 3.15%
A	76.61%	76.51%	76.55%
B	10.82%	10.83%	10.83%
C	5.37%	5.40%	5.39%
D	5.12%	5.16%	5.15%
E	2.09%	2.10%	2.09%
Total	**100.00%**	**100.00%**	**100.00%**



Source: CNA simulation model results.

As we did in the previous scenarios, we determine whether the estimated reenlistment rate adjustments by YOS are as we would expect. In this case, we expect that a lower ROI should make the BRS relatively less attractive. Note that the degree to which the BRS is made less attractive by a lower ROI assumption—specifically, whether the reenlistment rate adjustment changes in sign compared with the baseline BRS—depends on the Marine's age (YOS). Table 5 displays the estimated changes to reenlistment rates for the two BRS scenarios.

Table 5 shows that the sign of the reenlistment rates adjustments estimated for the BRS assuming a 3.15-percent ROI is positive for YOS 0-12. This is in contrast to the baseline BRS, where the sign of the adjustment to the reenlistment rate is positive for

YOS 0-19 and YOS 27-29. Moreover, the YOS 0-12 adjustments under the BRS with a 3.15-percent ROI are smaller than those for the baseline BRS. However, as we observed with the other scenarios, the effects are not large enough to materially change the force profile.

Table 5. Reenlistment rate adjustment factors under a lower ROI assumption

YOS	Baseline ROI = 4.95%	ROI = 3.15%
0	0.0081	0.0060
1	0.0100	0.0074
2	0.0130	0.0096
3	0.0151	0.0112
4	0.0187	0.0138
5	0.0230	0.0170
6	0.0189	0.0140
7	0.0231	0.0171
8	0.0282	0.0209
9	0.0341	0.0252
10	0.0205	0.0152
11	0.0244	0.0180
12	0.0286	0.0211
13	0.0030	-0.0056
14	0.0007	-0.0013
15	0.0008	-0.0014
16	0.0008	-0.0016
17	0.0009	-0.0017
18	0.0010	-0.0018
19	0.0007	-0.0014
20	-0.0005	-0.0011
21	-0.0005	-0.0010
22	-0.0004	-0.0010
23	-0.0004	-0.0010
24	-0.0003	-0.0009
25	-0.0001	-0.0008
26	0.0000	-0.0007
27	0.0001	-0.0006
28	0.0003	-0.0005
29	0.0007	-0.0004

Source: CNA simulation model results.

BRS impact on enlisted personnel cost savings

Under the current retirement system, the Marine Corps must set aside about 31.4 percent of BP for each AC Marine annually to pay for future DBs (the Marine Corps set-aside goes to the MRTF). This set-aside amount will be reduced to approximately 25.1 percent of BP for each Marine who is enrolled in the BRS, resulting in a cost savings to the Marine Corps under the BRS.[30] This cost savings from lower set-aside amounts under the BRS will be partially offset by the TSP contributions made by DOD each year and by the CP (in our scenarios, CP is assumed to be 2.5 times monthly BP for all Marines who reach YOS 12 and choose to continue in the AC).

To estimate personnel cost savings under the BRS, we first calculate the total MRTF set-aside associated with the long-term force profile generated under the current retirement system. We then set up the calculation of the costs under the BRS. We use the long-term force profile under the current retirement system as the beginning profile for our BRS analysis. The beginning BRS profile is aged for 30 years, this time using the reenlistment rates adjusted for the estimated response to the BRS. We calculate the MRTF set-aside associated with the baseline BRS force profile, as well as the DOD TSP contribution amounts and the CP, in each year of the 30-year aging process. Finally, we make these three calculations in each year for each BRS scenario.

Two critical drivers of cost savings under the BRS are the assumptions about DOD contribution rates to TSP accounts and opt-in rates for eligible Marines.[31] We present cost saving results for the various scenarios regarding these assumptions.

Impact of different DOD TSP contribution rates on personnel cost savings

Figure 10 shows how different assumptions about the TSP contributions made by DOD under the BRS affect personnel cost savings for AC enlisted Marines. It gives these annual cost savings relative to the current retirement system for all 30 years after the BRS is implemented using baseline assumptions with the following caveats:

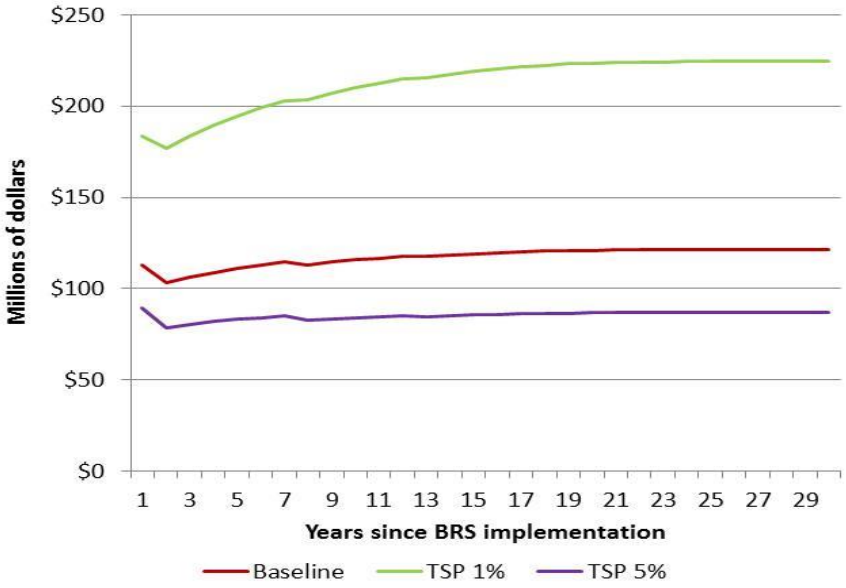
- Baseline assumptions, where DOD contributes 4 percent of BP to individual TSP accounts

[30] For a servicemember retiring at YOS 20, the DB payment under the BRS will be 40 percent of the high three years of BP instead of the 50 percent of high three years of BP in the current retirement system. Since this is a 20-percent reduction in DB under the BRS, we assume that the accrual amount also will be reduced by 20 percent, from the current accrual of 31.4 percent to an accrual of 25.1 percent under the BRS.

[31] In the case of the alternative opt-in assumption scenario, there is no effect on reenlistment rates compared with the BRS baseline.

- Baseline assumptions, except DOD contributes 1 percent of BP to individual TSP accounts
- Baseline assumptions, except DOD contributes 5 percent of BP to individual TSP accounts.

Figure 10. Estimated annual AC enlisted personnel cost savings for different TSP contribution rates under the BRS, in millions of FY15 dollars



Source: CNA simulation model results.

Note: Assumes an AC enlisted endstrength of 163,000.

In Figure 10, we see that, under the baseline BRS, cost savings in the first year of implementation are about $113 million. This includes the MRTF set-aside savings for the accessions and the Marines who opt in to the BRS less the unmatched contribution to TSP accounts of 1 percent of BP. Cost savings decrease to about $103 million in the second year of implementation. Although there are now two cohorts of Marines who are subject to the BRS (YOS 0 and YOS 1) as well as the Marines who opted in, all of whom require a lower MRTF set-aside, the Marine Corps must provide

CP at YOS 12 for the opt-in Marines who are eligible for the pay.[32] Thereafter, savings grow as each new accession cohort is subject to the BRS. Personnel cost savings increase to $122 million in year 30 when all Marines are subject to the BRS.

Figure 10 also shows the pattern of cost savings over the 30-year BRS phase-in when we assume that DOD contributes 5 percent to the TSP accounts of all Marines subject to the BRS (i.e., an increase in the DOD TSP contribution rate from 4 percent in the BRS baseline to 5 percent). This scenario generates about $24 million to $35 million less in savings each year compared with the savings generated by the BRS baseline (an almost 30-percent reduction in savings in the long term), but the pattern is the same across years.[33]

Likewise, the cost savings when DOD contributes only 1 percent to TSP accounts has roughly the same pattern across the years as the BRS baseline. However, under this scenario, the cost savings are greater. We estimate that the savings will be about $184 million in the first year of the BRS and will reach $225 million in year 30 when all Marines are subject to the BRS.

Table 6 shows the breakout of the estimated enlisted personnel cost savings by the reduced set aside amount and the costs of the DOD TSP contributions and the CP.

Table 6. Long run enlisted personnel cost savings for various DOD TSP contribution rates, in millions of FY 15 dollars

Savings or cost category	Baseline (TSP = 4%)	TSP = 1%	TSP = 5%
Savings from reduced set-aside	289.3	288.9	289.4
TSP costs	149.4	46.0	184.0
CP costs	18.2	18.0	18.3
Total net savings	121.6	224.9	87.1

Source: CNA calculations

Impact of different opt-in rates on enlisted personnel cost savings

Figure 11 shows how a different assumption about opt-in rates for eligible Marines affects personnel cost savings over time. Our BRS baseline assumes that about 95 percent of first-term Marines and 75 percent of second-term Marines will opt in to

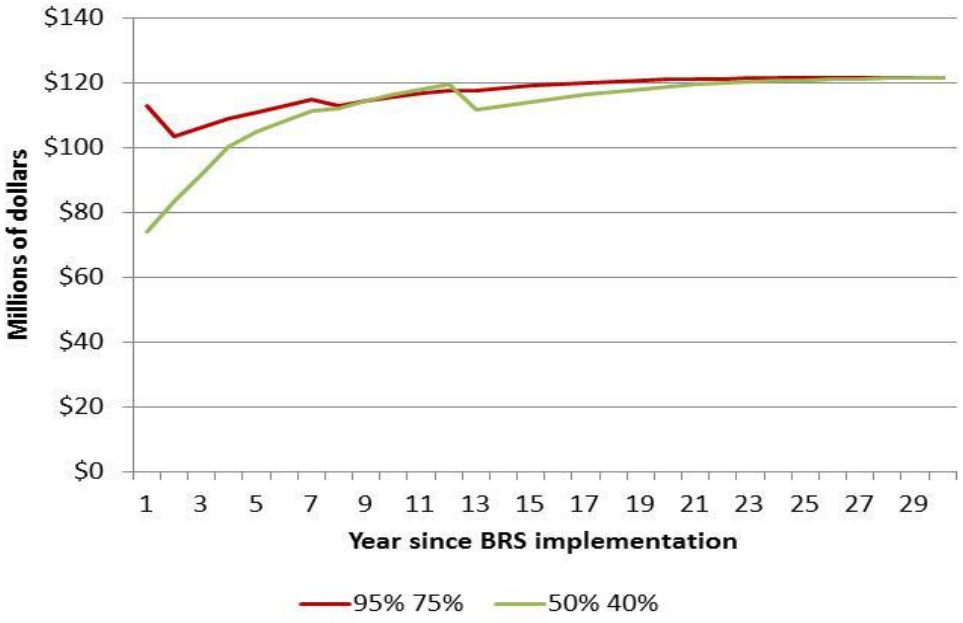
[32] Specifically, the cost savings decrease in the second year of the BRS because, in the first year, 75 percent of Marines with YOS 11 are assumed to opt in to the BRS. In the second year of the BRS, these Marines (who are now at YOS 12) are eligible for the CP.

[33] Under this scenario, first-year savings are slightly higher than the long-term savings. This is because the YOS 12 CP is paid to only the first opt-in-eligible cohort (only 75 percent of whom we assume opt in), whereas the YOS 12 CP is paid to the entire YOS 12 cohort in the long run.

the BRS (referred to as "95% 75%" in the figure legend).[34] In the alternative scenario, we assume that the opt-in rate is 50 percent for first-term Marines and 40 percent for second-term Marines (referred to as "50% 40%" in the figure legend).

The cost savings in the first year of the BRS under the 50% 40% scenario are only $74 million compared with $113 million for the BRS baseline (95% 75%). The cost savings under the 50% 40% scenario gradually approach the cost savings under the baseline until year 11 of the BRS implementation, when the cost savings are roughly $119 million for both the baseline and the 50% 40% scenario.[35]

Figure 11. Estimated annual AC enlisted personnel cost savings with different opt-in rates under the BRS in millions of FY15 dollars



Source: CNA simulation model results.

Note: Assumes an AC enlisted endstrength of 163,000.

[34] As a reminder, this is a simplification. The MCRMC allowed the opt-in rates to vary by YOS. According to a graph presented in the MCRMC final report, it appears as though the Zone A YOS cohorts eligible to opt in would do so at about a 95-percent rate, on average, and the Zone B YOS cohorts eligible to opt in would do so at a 75-percent rate, on average.

[35] In year 11 of the BRS, the extra cost of the CP under the baseline compared with that under the 50% 40% scenario is about the same as the additional savings realized under the baseline for Marines with YOS 13 and greater.

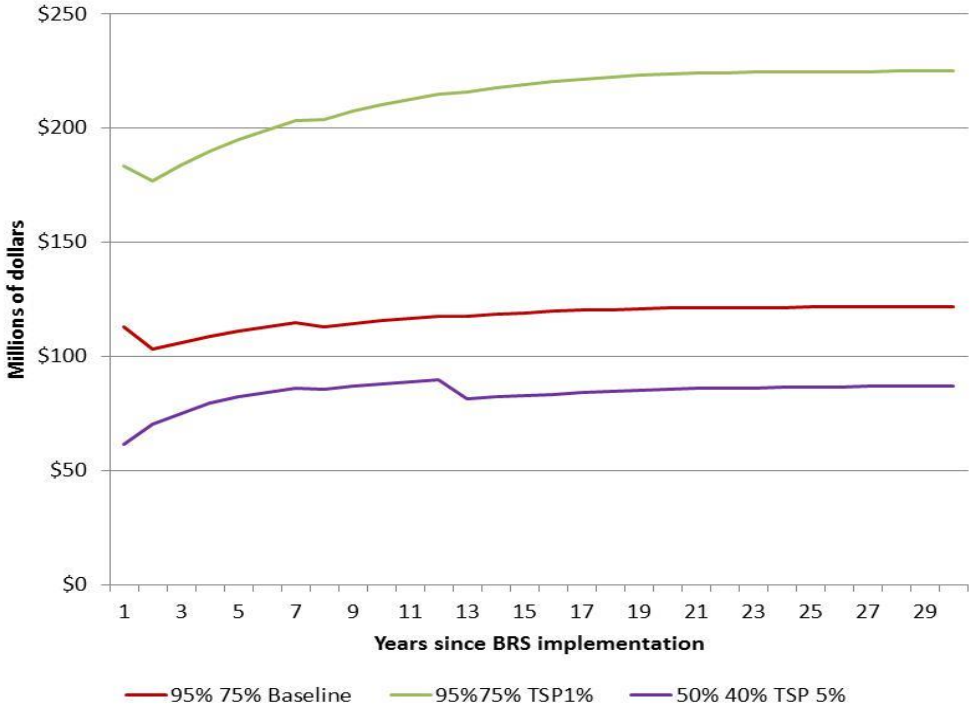
In year 12 of the implementation, the cost savings under the 50% 40% scenario decrease from $119 million to $112 million. This is because *all* Marines at YOS 12 in year 12 of the implementation are given CP (these are Marines who have been subject to the BRS since accession). By contrast, only 50 percent of Marines at YOS 12 in year 11 of the implementation are given CP (these are Marines in the last cohort eligible to opt in, and they chose to do so). Cost savings under the 50% 40% scenario gradually approach $122 million in year 30 of the implementation, when all servicemembers are under the BRS.

Highest and lowest personnel cost savings scenarios

As shown in the foregoing figures, the annual cost savings achieved under the BRS depends on opt-in rates by eligible Marines and the DOD contribution rates to individual Marine TSP accounts. In Figure 12, we change both to show the highest and lowest personnel cost-savings scenarios. Specifically, Figure 12 gives the annual cost savings under the BRS for the following scenarios:

- Baseline BRS assumptions: DOD contributes 4 percent and opt-in rates are 95 percent for first-term Marines and 75 percent for second-termers
- Lowest annual cost savings: DOD contributes 5 percent and BRS opt-in rates are 50 percent for first-term Marines and 40 percent for second-termers
- Highest annual cost savings: DOD contributes 1 percent and BRS opt-in rates are 95 percent for first-term Marines and 75 percent for second-termers

Figure 12. High and low estimated AC enlisted personnel cost savings under the BRS in millions of FY15 dollars



Source: CNA simulation model results.
Note: Assumes an AC enlisted endstrength of 163,000.

Figure 12 shows that, in year 30 of the BRS, the highest annual cost savings are $225 million, or about 75 percent more than those for the BRS baseline ($122 million). By contrast, the lowest annual cost savings are $87 million in year 30 of the BRS. This is an almost 30-percent reduction in savings compared with the baseline.

AC officers

We present our results for AC officers in the same way that we did for enlisted personnel. We discuss the impact of the BRS on officer force profiles under the baseline and alternative assumptions and then present our cost savings results.

BRS impact on YOS profiles

The BRS impact on the force profile is larger for officers than enlisted. *Enlisted* personnel sign initial, multiyear contracts and reenlist by signing new, multiyear contracts when their current contracts are completed, so only a fraction of enlisted personnel at any given YOS is eligible to reenlist. Indeed, in many YOS cells, few personnel are eligible. When we adjust historical reenlistment rates to account for the response to the BRS, the overall one-year continuation rate in many YOS cells—which reflects the continuation rate of enlisted personnel who are and are not eligible to reenlist—may be minimally affected. *Officers,* in contrast, may continue to serve or may request to leave the AC at any time after their AC minimum service requirement (MSR) is complete as long as they continue to be promoted. For many officers, the AC MSR is four years after commissioning.[36] Thus, the BRS may affect the stay/leave behavior of the majority of officers at every YOS greater than YOS 4.

We compare officer force profiles under the current retirement system, the baseline BRS, and the BRS with alternative assumptions. We display the 30-year force profiles after most of the profile changes have been realized.

Officer force profiles with different PDR assumptions

As with AC enlisted personnel, the PDR of individual officers affects how they value the BRS relative to the current retirement system and, therefore, will affect their continuation rates. A change in continuation rates may change the force profile. We compare the BRS force profile under four alternative assumptions about the PDRs of individual Marine officers, holding constant all other MCRMC assumption values:

1. PDR varies by YOS (see Figure 6)
2. PDR = 1 percent for all officers
3. PDR = 9 percent for all officers
4. PDR = 12 percent for all officers

Figure 13 summarizes the force profiles by the percentage of officers in each of five YOS intervals. The table at the top of Figure 13 show the long-term force profile under the current retirement system and the baseline BRS. The baseline BRS force profile becomes more junior in the long run, suggesting that continuation rates are slightly lower under the baseline BRS than under the current retirement system for

[36] Several officer specialties have longer initial MSRs, specifically aviators. Also, officers may incur an additional service obligation if they undertake a service-funded graduate education program or accept an assignment that requires follow-on service. To make the analysis tractable within the study resources, we make the simplifying assumption that all officers meet their initial MSR on completing YOS 4.

AC officers. For example, under the current retirement system, we estimate that just under 46 percent of the officer corps is made up of officers in the 0-5 YOS interval in the steady state. Under the baseline BRS, we estimate that these junior officers make up just under 49 percent of the officer corps in the steady state.[37]

There appears to be a modest negative impact of varying the PDRs by YOS on the officer force profile compared to the baseline BRS (in Figure 13, compare the "Vary PDR" and the "Baseline" columns). In this scenario, even though we assume that younger officers have higher PDRs and older officers have lower PDRs compared with the baseline (where all officers are assumed to have a PDR of 6.4 percent), the modest force profile changes suggest only modest adjustments to continuation rates.

By contrast, when we assume a PDR of 1 percent for all officers, the BRS becomes relatively less attractive than the current system. This implies that the continuation rates decrease. The force becomes noticeably more junior, as Figure 13 shows. The percentage of the force in the last four YOS ranges under the BRS decreases compared with that under the current system, leading to a greater number of accessions under the BRS, as indicated by the percentage increase in the 0-5 YOS interval.[38]

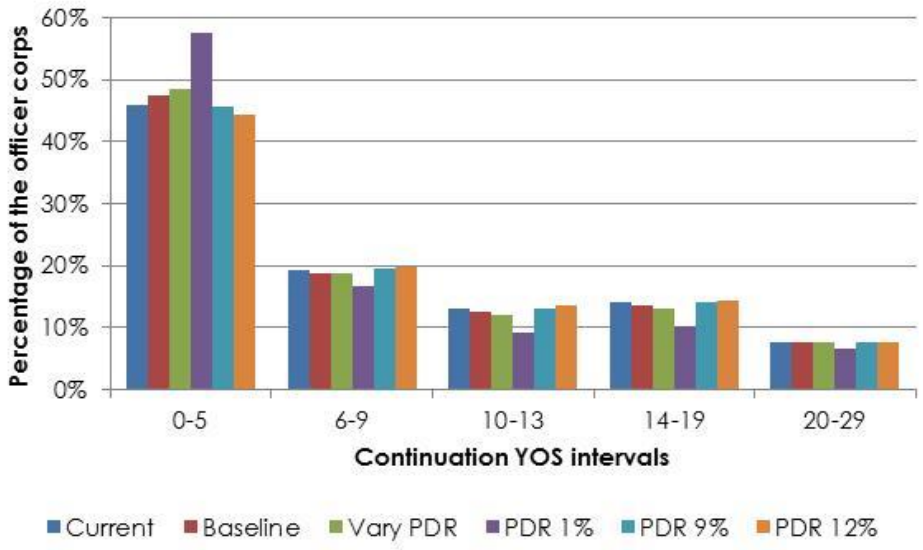
When we increase the PDR assumption for all officers, the force profile changes little compared with the one generated by the current retirement system, although it is slightly more senior than the baseline BRS force profile. When we assume a PDR of 9 percent, officers in a greater range of YOS cells should prefer the BRS to the current retirement system, and this should change continuation behavior. But, as Figure 13 shows, any changes in continuation behavior produce relatively modest changes to the force profile. The effect on the force profile is also small when we assume a 12-percent PDR for all officers.

[37] To Marine Corps manpower subject matter experts (SMEs), the estimated change in force profile under the baseline BRS appears to be small enough to be addressed by currently available force management policies and procedures.

[38] In addition, the effect of a very low PDR is greater for the officer force profile than it is for the enlisted force profile (see Figure 7).

Figure 13. AC officer force profiles: testing different PDR assumptions

YOS	Current	Baseline	Vary PDR	PDR 1%	PDR 9%	PDR 12%
0-5	45.97%	47.49%	48.35%	57.47%	45.60%	44.44%
6-9	19.35%	18.78%	18.83%	16.58%	19.48%	19.78%
10-13	12.94%	12.48%	12.13%	9.24%	13.18%	13.67%
14-19	14.08%	13.66%	13.17%	10.13%	14.12%	14.45%
20-29	7.67%	7.60%	7.51%	6.59%	7.63%	7.66%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**



Source: CNA simulation model results.

As we did in our enlisted analysis, we examine officer continuation rate adjustment factors for each PDR assumption scenario to understand the force profile changes. In Table 7, we display the adjustments to continuation rates in each YOS under each scenario. A red (negative) entry in Table 7 means that, for that YOS, the BRS generates a lower estimated PDV of lifetime military earnings than for the current retirement system, and the adjustment to the continuation rate for that YOS is negative under the BRS. After YOS 4, a black (positive) entry in Table 7 means that, for that YOS, the BRS has a higher estimated PDV of future military earnings than for the current retirement system; we estimate that the continuation rate in that YOS increases under the BRS compared with the current retirement system. (Recall that we assume that all officers are serving their MSR in the first four years. We do not allow changes to those continuation rates under any version of the BRS.)

Table 7. Continuation rate adjustment factors under various PDR assumptions

YOS	Baseline PDR = 6.4%	PDR varies by YOS	PDR = 1%	PDR = 9%	PDR = 12%
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	-0.0163	-0.0157	-0.1012	0.0053	0.0207
5	-0.0182	-0.0226	-0.1048	0.0061	0.0253
6	-0.0136	-0.0201	-0.0725	0.0048	0.0205
7	-0.0151	-0.0255	-0.0753	0.0055	0.0247
8	-0.0167	-0.0312	-0.0782	0.0063	0.0296
9	-0.0185	-0.0371	-0.0814	0.0072	0.0352
10	-0.0016	-0.0035	-0.0068	0.0007	0.0033
11	-0.0018	-0.0040	-0.0071	0.0008	0.0039
12	-0.0020	-0.0045	-0.0075	0.0008	0.0045
13	-0.0041	-0.0065	-0.0085	-0.0021	0.0004
14	-0.0034	-0.0053	-0.0067	-0.0017	0.0003
15	-0.0037	-0.0056	-0.0071	-0.0019	0.0003
16	-0.0040	-0.0060	-0.0075	-0.0021	0.0004
17	-0.0043	-0.0063	-0.0079	-0.0022	0.0004
18	-0.0046	-0.0066	-0.0085	-0.0024	0.0004
19	-0.0041	-0.0060	-0.0083	-0.0020	0.0003
20	-0.0032	-0.0034	-0.0036	-0.0029	-0.0027
21	-0.0032	-0.0034	-0.0036	-0.0029	-0.0027
22	-0.0032	-0.0034	-0.0036	-0.0030	-0.0027
23	-0.0032	-0.0034	-0.0036	-0.0030	-0.0027
24	-0.0033	-0.0034	-0.0036	-0.0030	-0.0028
25	-0.0033	-0.0034	-0.0036	-0.0031	-0.0028
26	-0.0033	-0.0034	-0.0037	-0.0031	-0.0029
27	-0.0034	-0.0035	-0.0037	-0.0032	-0.0030
28	-0.0034	-0.0035	-0.0037	-0.0032	-0.0030
29	-0.0034	-0.0035	-0.0037	-0.0032	-0.0031

Source: CNA model simulation results.

Table 7 shows that the baseline BRS (which assumes a PDR of 6.4 percent for all officers) is always less attractive than the current retirement system, and the estimated changes to continuation rates under the baseline BRS are negative for all YOS cells. Note, however, that the changes to continuation rates under the baseline BRS are relatively small and, therefore, only modestly affect the force profiles.

The estimated effect of the BRS on continuation rates when we assume that the PDR varies across YOS is about the same as when we assume a constant PDR of 6.4 percent: the current retirement system still is preferred at every YOS, so the adjustments to continuation rates are negative at every YOS. In this scenario, the PDR is higher than 6.4 percent for officers early in their careers; therefore, we would expect that, if the BRS effect on continuation is negative in the early YOS cells, it would have a smaller (i.e., less) negative effect on continuation under the baseline BRS. In our results, however, the continuation rate adjustments for junior officers in this scenario appear to be slightly more negative than those under the baseline BRS. The differences, however, are very small.

By contrast, the continuation rate adjustments for more senior officers under the varying PDR scenario are negative, and they are more negative than those under the baseline BRS. Given that more senior officers in this scenario have lower PDRs than senior officers under the baseline BRS, these continuation rate adjustment factors are what we would expect.

When we assume that the PDR is 1 percent for all officers, the direction of the impact on continuation rates is the same as under the baseline BRS at every YOS. However, the size of the impact is larger in YOS 0 through 19. This is consistent with the idea that officers with very low PDRs have a greater preference for income far in the future (i.e., high DB payments) compared with officers with high PDRs. Therefore, they have a greater preference for the current retirement system than officers with high PDRs, especially in the early years of service.

When we increase the PDR assumption above the baseline PDR of 6.4 percent, the direction of the changes to officer continuation rates is as expected—namely, that the BRS becomes increasingly more attractive when compared with the current retirement system. For example, if the PDR is 9 percent rather than 6.4 percent, the adjustments to the continuation rates are positive, albeit small, through 12 YOS. When the PDR is 12 percent, the BRS becomes more attractive than the current retirement system at every YOS from 0 through 19), all else equal.

Officer force profiles with different assumptions about TSP contribution rates

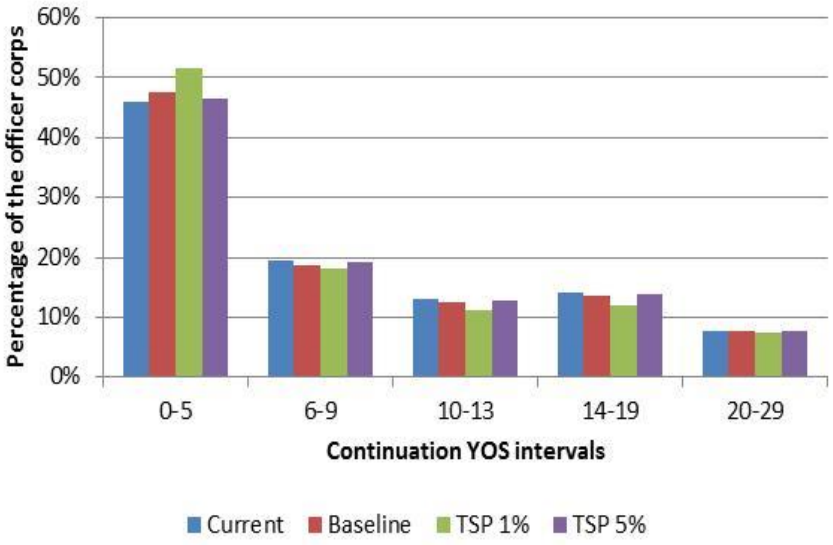
Changes in the rate at which DOD contributes to individual TSP accounts also will affect how officers value the BRS relative to the current retirement system and will potentially change their continuation behavior. We compare force profiles under the BRS for two different assumptions about DOD TSP contribution rates:

- DOD TSP contribution rate of 1 percent
- DOD TSP contribution rate of 5 percent

In Figure 14, we compare the force profiles generated under these two scenarios with the force profile generated under the current retirement system and under the BRS baseline (4-percent DOD TSP contribution rate).

Figure 14. AC officer force profiles: testing different DOD TSP contribution rate assumptions

YOS	Current	Baseline	TSP 1%	TSP 5%
0-5	45.97%	47.49%	51.57%	46.51%
6-9	19.35%	18.78%	18.09%	19.16%
10-13	12.94%	12.48%	11.06%	12.82%
14-19	14.08%	13.66%	11.99%	13.89%
20-29	7.67%	7.60%	7.31%	7.62%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**



Source: CNA simulation model results.

A smaller DOD TSP contribution rate makes the BRS relatively less attractive, and this has a negative effect on continuation rates. We would expect that the force would become more junior. The column labeled "TSP = 1%" in Figure 14 shows the 30-year BRS force profile under the assumption that DOD makes only the minimum TSP contribution (i.e., only the 1-percent unmatched contribution) to officer TSP accounts. The percentage of officers in the YOS 0-5 interval is approximately 5.5 percentage points higher than that for the current retirement system. There is a corresponding decrease in the percentage of officers in the other four YOS intervals compared with the profile under the current retirement system. Note, however, that this scenario represents the extreme lower bound for TSP contribution rates.

If the DOD TSP contribution rate is the maximum 5 percent, the force profile is more junior than the profile under the current retirement system but is more senior than the profile under the baseline BRS. This suggests that continuation rates decrease in comparison to the current retirement system, but the decrease is less than that for the BRS baseline.

Table 8 shows the estimated adjustments to current retirement system continuation rates for the BRS scenarios in which we change the TSP contribution rate assumptions. These adjustment rates provide the supporting detail for the force profile changes. The adjustments to continuation rates when we assume a 1-percent DOD TSP contribution are negative at every YOS, but the sizes of the adjustments are noticeably larger than those for the baseline BRS. The adjustments to continuation rates when we assume a DOD TSP contribution rate assumption of 5 percent also are negative at every YOS, but they are smaller in magnitude than those for the baseline BRS.

Table 8. Continuation rate adjustment factors under various DOD TSP contribution rate assumptions

YOS	Baseline (TSP = 4%)	TSP = 1%	TSP = 5%
0	0.0000	0.000000	0.000000
1	0.0000	0.000000	0.000000
2	0.0000	0.000000	0.000000
3	0.0000	0.000000	0.000000
4	-0.0163	-0.0487	-0.0056
5	-0.0182	-0.0543	-0.0062
6	-0.0136	-0.0404	-0.0046
7	-0.0151	-0.0449	-0.0051
8	-0.0167	-0.0498	-0.0057
9	-0.0185	-0.0551	-0.0063
10	-0.0016	-0.0049	-0.0006
11	-0.0018	-0.0054	-0.0006

YOS	Baseline (TSP = 4%)	TSP = 1%	TSP = 5%
12	-0.0020	-0.0060	-0.0007
13	-0.0041	-0.0085	-0.0027
14	-0.0034	-0.0070	-0.0022
15	-0.0037	-0.0076	-0.0024
16	-0.0040	-0.0082	-0.0026
17	-0.0043	-0.0089	-0.0028
18	-0.0046	-0.0095	-0.0030
19	-0.0041	-0.0085	-0.0027
20	-0.0032	-0.0033	-0.0031
21	-0.0032	-0.0033	-0.0031
22	-0.0032	-0.0033	-0.0031
23	-0.0032	-0.0034	-0.0032
24	-0.0033	-0.0034	-0.0032
25	-0.0033	-0.0034	-0.0032
26	-0.0033	-0.0034	-0.0032
27	-0.0034	-0.0035	-0.0034
28	-0.0034	-0.0035	-0.0034
29	-0.0034	-0.0035	-0.0034

Source: CNA simulation model results.

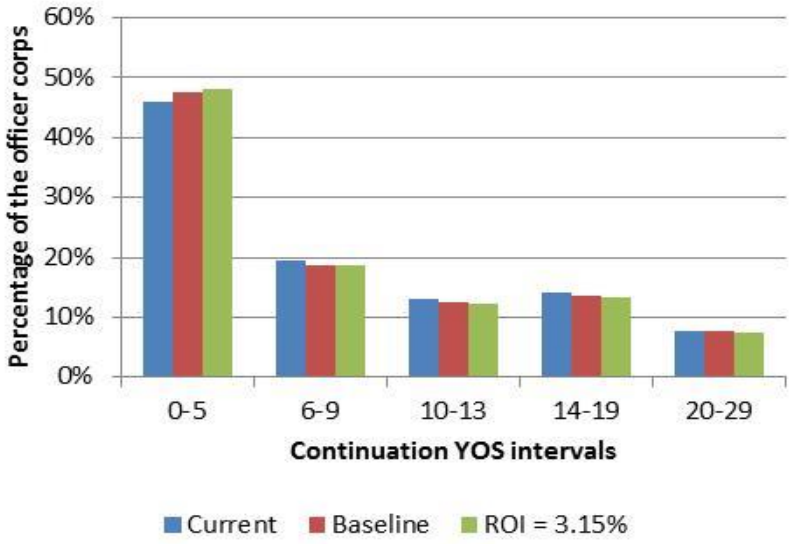
Officer force profiles with different ROI assumptions

All else equal, lower ROIs decrease the value of TSP accounts and make the BRS relatively less attractive than the current retirement system, and the force could become more junior. Our baseline BRS assumes a real ROI of 4.95 percent. We also estimate the effect on the force profile when the real ROI is 3.15 percent. Figure 15 shows the resulting long-term force profiles. We see that the BRS force profile becomes even more junior (although modestly so) when we assume an ROI of 3.15 rather than 4.95.[39]

[39] In years 5 and 15 after BRS implementation, we find that the difference between the current retirement system force profile and the BRS profiles produced under different ROI assumptions is even smaller than that shown in Figure 15.

Figure 15. AC officer force profiles: testing a lower ROI assumption

YOS	Current	Baseline	ROI = 3.15%
0-5	45.97%	47.49%	48.07%
6-9	19.35%	18.78%	18.65%
10-13	12.94%	12.48%	12.29%
14-19	14.08%	13.66%	13.43%
20-29	7.67%	7.60%	7.56%
Total	**100.00%**	**100.00%**	**100.00%**



Source: CNA simulation model results.

As we did in the previous scenarios, we determine whether the estimated continuation rate adjustment factors conform to our expectations about officer behavior in response to assumption changes. In this case, the lower the ROI, the less attractive the BRS should be relative to the current retirement system. The degree to which the BRS is less attractive depends on age (YOS). Table 9 displays the estimated continuation rate adjustment factors for the two BRS scenarios.

Table 9 confirms that the sign of the adjustments to the continuation rates for the BRS under both a 3.15-percent ROI assumption and a 4.95-percent ROI assumption are negative for all YOS cells after YOS 4. However, the negative adjustments to the continuation rates are greater for an ROI of 3.15 percent than for an ROI of 4.95 percent.

Table 9. Continuation rate adjustment factors under a lower ROI assumption

YOS	Baseline (ROI = 4.95%)	ROI = 3.15%
0	0.0000	0.0000
1	0.0000	0.0000
2	0.0000	0.0000
3	0.0000	0.0000
4	-0.0163	-0.0225
5	-0.0182	-0.0251
6	-0.0136	-0.0187
7	-0.0151	-0.0208
8	-0.0167	-0.0230
9	-0.0185	-0.0255
10	-0.0016	-0.0023
11	-0.0018	-0.0025
12	-0.0020	-0.0028
13	-0.0041	-0.0050
14	-0.0034	-0.0041
15	-0.0037	-0.0044
16	-0.0040	-0.0048
17	-0.0043	-0.0052
18	-0.0046	-0.0056
19	-0.0041	-0.0050
20	-0.0032	-0.0032
21	-0.0032	-0.0032
22	-0.0032	-0.0032
23	-0.0032	-0.0033
24	-0.0033	-0.0033
25	-0.0033	-0.0033
26	-0.0033	-0.0033
27	-0.0034	-0.0034
28	-0.0034	-0.0035
29	-0.0034	-0.0035

Source: CNA simulation model results.

BRS impact on officer personnel costs

As described earlier, the Marine Corps will realize personnel cost savings under the BRS due to the reduced set-aside for the MRTF. These MRTF set-aside savings are offset by the DOD TSP contributions and the CP at YOS 12. We present the estimated

officer personnel cost savings under the baseline BRS compared with the current retirement system for the first 30 years after BRS implementation. We also show changes to the cost savings under the various DOD TSP contribution rate and eligible officer opt-in rate scenarios.

Impact of different DOD TSP contributions on personnel cost savings

Figure 16 shows how different assumptions about the DOD contributions to TSP accounts affect officer personnel cost savings under the BRS. Figure 16 shows these annual cost savings relative to the current retirement system for every year until the BRS is fully phased in (i.e., 30 years after implementation), using baseline assumptions with the following caveats:

- Baseline assumptions, where DOD contributes 4 percent of BP to individual TSP accounts
- Baseline assumptions, except DOD contributes 1 percent of BP to individual TSP accounts
- Baseline assumptions, except DOD contributes 5 percent of BP to individual TSP accounts

Figure 16 shows that, when the baseline assumptions are used, savings due to the BRS in the first year of implementation are about $18 million and about $12 million in the second year after implementation. Savings increase steadily thereafter to $21 million in year 30.[40]

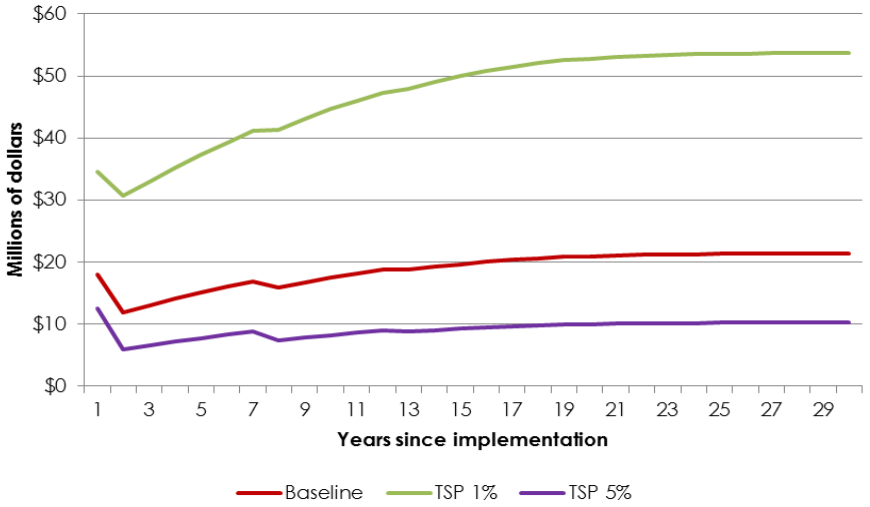
The pattern of cost savings under the BRS if DOD contributes 5 percent to TSP accounts also is shown in Figure 16. These cost savings have the same pattern over time as the cost savings under the BRS baseline, although the level is lower. The cost savings under the 5-percent scenario are only $13 million in the first year vice $18 million for the baseline BRS; in the 30th year, the savings under this scenario are about $18 million vice $29 million for the baseline BRS.

The cost savings under the BRS when the DOD TSP contribution rate is 1 percent have a somewhat similar pattern over time as the baseline BRS cost savings. However, because the contribution rate is so low in this scenario, the savings are substantially greater than under the baseline BRS. In the first year, savings under this scenario are

[40] In our model, we count the entire amount of CP paid to the first eligible cohort (i.e., officers with between 11 and 12 YOS who opt in) in year 2 of the implementation—that is, only after the entire cohort has achieved YOS 12. Therefore, the cost savings decrease in the second year of the BRS. The model misses the fact that some officers in the first eligible cohort will achieve YOS 12 well before the beginning of year 2 of the implementation.

$35 million vice $18 million for the baseline BRS. In the long term, this scenario produces savings of about $52.5 million annually vice $21 million under the baseline BRS.

Figure 16. Estimated annual AC officer personnel cost savings for different TSP contribution rates under the BRS, in millions of FY15 dollars



Source: CNA simulation model results.

Note: Assumes an AC officer endstrength of 18,100.

Table 10 shows the shows the breakout of the estimated officer personnel cost savings by the reduced set aside amount and the costs of the DOD TSP contributions and the CP.

Table 10. Long run officer personnel cost savings for various DOD TSP contribution rates, in millions of FY15 dollars

Savings or cost category	Baseline (TSP = 4%)	TSP = 1%	TSP = 5%
Savings from reduced set-aside	76.0	74.1	76.4
TSP costs	44.9	11.8	56.3
CP costs	9.9	9.9	9.9
Total net savings	21.2	52.5	10.2

Source: CNA calculations

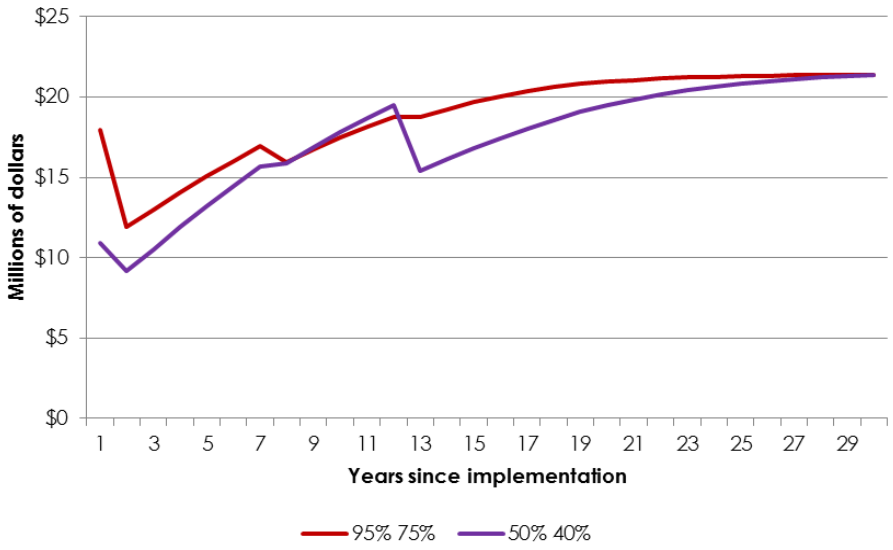
Impact of different opt-in rates on officer personnel cost savings

In the baseline BRS, 95 percent of the most junior of the eligible officers (those in YOS cells 0-5) and 75 percent of the most senior of the eligible officers (those in YOS

6-11) are assumed to opt in to the BRS. The alternative assumption is that the opt-in rates are 50 percent and 40 percent, respectively. All else equal, BRS cost savings will be lower in the early years of implementation because the reduced MRTF set-aside applies to fewer officers. Figure 17 displays the cost savings over the first 30 years under the baseline BRS (denoted "95% 75%" in the figure) and under the alternative opt-in scenario (denoted "50% 40%" in the figure).

Figure 17 shows that cost savings under the BRS baseline are $18 million in the first year of implementation. First-year savings under the alternative opt-in scenario are $11 million because fewer eligible officers opt in to the BRS. After accounting for the larger change in the percentage of officers eligible for CP in the 12th year of implementation, the cost savings under the "50% 40%" scenario gradually approach $21 million in year 30, when all servicemembers are under the BRS.

Figure 17. Estimated annual AC officer personnel cost savings with different opt-in rates under the BRS, in millions of FY15 dollars



Source: CNA simulation model results.
Note: Assumes an AC officer endstrength of 18,100.

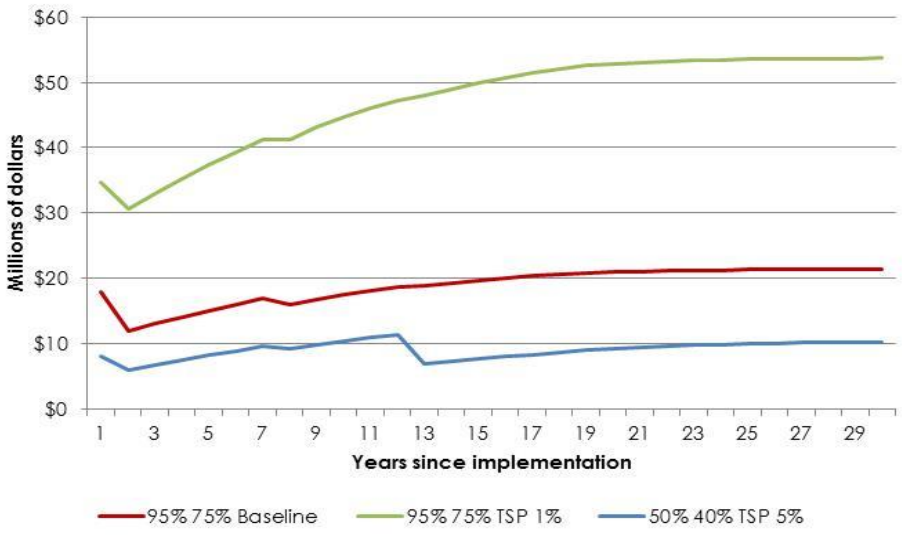
Highest and lowest personnel cost savings scenarios

The annual cost savings achieved under the BRS will depend on the BRS opt-in rates by current Marines who are eligible to opt in to the BRS and the percentage of BP contributions made by DOD to individual Marine TSP accounts. In Figure 18, we show the highest annual cost savings case, the lowest annual cost savings case, and the

baseline annual cost savings for AC officers under BRS. Specifically, Figure 18 gives annual cost savings for AC officers using:

- Baseline BRS assumptions, where DOD TSP contributions are 4 percent and BRS opt-in rates are 95 percent for more junior eligible officers and 75 percent for more senior eligible officers
- Lowest annual cost savings case, where DOD TSP contributions are 5 percent and BRS opt-in rates are 50 percent for more junior eligible officers and 40 percent for more senior eligible officers
- Highest annual cost savings case, where DOD TSP contributions are 1 percent, and BRS opt-in rates are 95 percent for more junior eligible officers and 75 percent for more senior eligible officers

Figure 18. High and low estimated AC officer personnel cost savings under the BRS in millions of FY15 dollars



Source: CNA simulation model results.
Note: Assumes an AC officer endstrength of 18,100.

Figure 18 shows that long-term annual cost savings under the baseline BRS are $21 million. This assumes that the DOD TSP contribution rate is 4 percent and the opt-in rates for eligible officers are high (95% 75%). Figure 18 also shows that the highest long-term annual cost savings under the BRS is $54 million. This is achieved only by assuming the lowest possible DOD TSP contribution rate (1 percent of BP) and high opt-in rates for eligible officers. The lowest annual cost savings are $10 million in

year 30, and this occurs by assuming the highest possible DOD TSP contribution rate (5 percent of BP) and low opt-in rates for eligible officers.

DOD-proposed BRS changes

We analyze three changes to the BRS proposed by DOD. The first allows for more flexibility in the timing and level of the CP. The second lengthens the time to vest in the BRS. The third increases the maximum DOD TSP matching contribution.

Continuation pay changes

The FY16 NDAA requires the services to pay a minimum CP equal to 2.5 times the servicemember's monthly BP to all servicemembers who reach YOS 12 and agree to serve for four more years. Services have the authority to increase the CP amount to up to 13 times monthly BP.

The CP can be viewed as a way to offset estimated reenlistment rate decreases due to the BRS. The CP's effectiveness in mitigating negative BRS effects depends in part on the PDR. For example, we found in our enlisted force profile analysis that, using the baseline assumptions (including that all enlisted Marines have a PDR of 12.7 percent and the minimum CP is paid at YOS 12), the BRS effect on reenlistment rates is positive up to YOS 19 (and also from YOS 27 through YOS 29). However, when we assume that the PDR varies across YOS, the BRS effect on reenlistment rates is positive only until YOS 8, at which point the BRS effect becomes negative (refer to Table 3).

For the enlisted force, we reran the BRS scenario in which we assume that the PDR varies across YOS, but we moved the payment of CP to YOS 8. We found that the reenlistment rate adjustment factors still became negative at YOS 8. Moreover, the size of the adjustment to the reenlistment rates was about the same as when the CP was paid at YOS 12.

To test an extreme example, we increased the amount of CP paid at YOS 8 to 13 times the servicemembers' monthly BP. Our model results show that the reenlistment rate adjustment still became negative at YOS 8, but the positive adjustments at every YOS from 0 to 8 were about 2.5 times greater than those for a CP of 2.5 times monthly BP.

As we show in Table 7, for the officer corps, the BRS effect on continuation rates was negative at every YOS under the baseline assumptions (assumes that the PDR is 6.4 percent for all officers and that the minimum CP is paid at YOS 12). We also found negative continuation rate adjustments at every YOS for the BRS scenario in which

we assume that the PDR varies across YOS. We reran both scenarios but moved the payment of the CP to YOS 8 (the earliest allowed under the DOD proposal). We found almost no effect on either the baseline BRS adjustments or the adjustments associated with the YOS-varying PDR.

Again, to test an extreme example, we increased the amount of CP paid at YOS 8 to 13 times the servicemembers' monthly BP. With the much larger CP payment at YOS 8, the effect on reenlistment rates under the BRS baseline changed from negative to positive for YOS 4 to YOS 8. Likewise, with a much larger CP paid at YOS 8, the adjustments to reenlistment rates under the scenario where the PDR varies changed from negative to positive for YOS 4 to YOS 8.[41]

Changing the timing and level of the CP likely is not necessary for the entire enlisted and officer forces. Our estimated effects of the BRS on aggregate force profiles are minimal under most PDR assumptions. Nevertheless, the Marine Corps may find it useful to target certain MOSs with a more flexible CP. The targeted MOSs would be those in which reenlistment rates are too low to meet requirements and in which we expect that servicemembers may have lower-than-average PDRs. We discuss this in more detail in the upcoming subsection on mitigating strategies.

Vesting at YOS 5 instead of YOS 3

DOD has proposed delaying servicemember vesting in the military retirement system from YOS 3 to YOS 5. This means that DOD would not begin to match servicemember contributions to their TSP accounts until YOS 5. (The DOD unmatched contribution of 1 percent of BP would continue to be paid under this proposal.)

We find that a vesting period two years longer increases long-run enlisted personnel savings by about 40 percent (i.e., $171 million vice $122 million). We also find that the longer vesting period increases long-run officer personnel savings by about 33 percent (i.e., $28 million vice $21 million).

Maximum DOD TSP contributions of 6 percent of BP

Under the FY16 NDAA, DOD is required to make an unmatched TSP contribution equal to 1 percent of BP for every servicemember. In addition, DOD must match

[41] We also tested a CP payment of 13 times monthly BP paid at YOS 10. All of the continuation rate adjustments became positive for YOS 4 through 10 under both the baseline BRS and the PDR-varying BRS scenarios. Likewise, we tested a CP payment of 13 times monthly BP paid at YOS 12. For both BRS scenarios, the continuation rate adjustments became positive for YOS 4 through YOS 12.

servicemember contributions dollar for dollar up to 3 percent of BP and fifty cents on the dollar for servicemember contributions greater than 3 percent but no more than 5 percent of BP. DOD has proposed increasing its matching contribution to *all* servicemember contributions dollar for dollar up to 5 percent of BP. Thus, under the DOD proposal, the maximum contribution that DOD could make to servicemember TSP accounts increases from 5 to 6 percent.

We find that, for enlisted personnel, the increase in the DOD matching reduces enlisted personnel cost savings in the long term by about 40 percent compared with the BRS scenario with 5-percent maximum DOD contributions (long-term enlisted personnel cost savings are about $87 million under the 5-percent scenario and $52.5 million under the 6-percent scenario).

For officers, the increase in DOD matching reduces officer personnel cost savings in the long term by more than 100 percent compared with the BRS scenario with 5-percent maximum DOD contributions. That is, long-term officer personnel cost savings are about $10 million under the 5-percent matching contribution rate scenario and -$1 million under the 6 percent DOD matching contribution rate scenario.

Mitigating strategies for specific MOSs

In general, we do not find large changes in the enlisted or officer force profiles under most of the various BRS scenarios; exceptions are those scenarios in which we set the underlying assumptions to extreme values. For both enlisted and officer force profiles, the largest changes are associated with a very low PDR assumption—specifically, that all Marines have a PDR of 1 percent. The low PDR assumption has a negative effect on reenlistment/continuation rates at every YOS, and this produces a more junior profile.

Much of the past research on PDRs suggests that 1 percent is lower than even the most conservative (i.e., low) PDR estimates. We use it simply to demonstrate the bounds of the reenlistment rate adjustments that might occur under the BRS. However, the results from the 1-percent PDR assumption scenario can also serve another purpose. If there are MOSs in which reenlistment (continuation) rates are already insufficient to meet requirements, any negative adjustment to those rates is likely to be problematic, even if the adjustment is small. Furthermore, if Marines in those MOSs tend to have low PDRs, the likelihood of a negative reenlistment (continuation) response to the BRS increases at every YOS.

We asked the sponsor to suggest some enlisted and officer MOSs for which maintaining adequate reenlistment (or continuation) rates to meet requirements is a challenge. These MOSs may be particularly affected by negative BRS effects. For each

of the MOSs suggested, we examined the size of the inventory in each YOS because our model requires a sufficiently large inventory to perform the BRS analysis. We chose enlisted MOS 06XX (Communications) and officer MOS 0402 (Logistics).

Results for a sample enlisted MOS

Just as we did in our analysis of the DOD-proposed BRS changes, we examine how the reenlistment adjustment factors change as we vary the timing and size of the CP, this time using the 1-percent PDR scenario as our base case. The data in Table 11 show the results.

Table 11. Results for MOS 06XX

YOS	Baseline PDR = 12.7%, CP is 2.5 mo. of BP paid at YOS 12	PDR = 1%, CP is 2.5 mo. of BP paid at YOS 12	PDR = 1%, CP is 13 mo. of BP paid at YOS 12	PDR = 1%, CP is 13 mo. of BP paid at YOS 10	PDR = 1%, CP is 13 mo. of BP paid at YOS 8
0	0.0081	-0.0900	-0.0664	-0.0684	-0.0703
1	0.0100	-0.0926	-0.0683	-0.0704	-0.0723
2	0.0130	-0.0994	-0.0733	-0.0755	-0.0777
3	0.0151	-0.0985	-0.0726	-0.0748	-0.0769
4	0.0187	-0.1018	-0.0751	-0.0774	-0.0796
5	0.0230	-0.1055	-0.0778	-0.0802	-0.0824
6	0.0189	-0.0730	-0.0539	-0.0555	-0.0571
7	0.0231	-0.0759	-0.0560	-0.0577	-0.0593
8	0.0282	-0.0790	-0.0583	-0.0601	-0.0617
9	0.0341	-0.0824	-0.0608	-0.0626	-0.0881
10	0.0205	-0.0431	-0.0318	-0.0328	-0.0461
11	0.0244	-0.0452	-0.0333	-0.0483	-0.0483
12	0.0286	-0.0474	-0.0350	-0.0507	-0.0507
13	0.0030	-0.0534	-0.0534	-0.0534	-0.0534
14	0.0007	-0.0113	-0.0113	-0.0113	-0.0113
15	0.0008	-0.0119	-0.0119	-0.0119	-0.0119
16	0.0008	-0.0127	-0.0127	-0.0127	-0.0127
17	0.0009	-0.0135	-0.0135	-0.0135	-0.0135
18	0.0010	-0.0145	-0.0145	-0.0145	-0.0145
19	0.0007	-0.0142	-0.0142	-0.0142	-0.0142
20	-0.0005	-0.0020	-0.0020	-0.0020	-0.0020
21	-0.0005	-0.0020	-0.0020	-0.0020	-0.0020
22	-0.0004	-0.0022	-0.0022	-0.0022	-0.0022
23	-0.0004	-0.0023	-0.0023	-0.0023	-0.0023
24	-0.0003	-0.0024	-0.0024	-0.0024	-0.0024
25	-0.0001	-0.0024	-0.0024	-0.0024	-0.0024
26	0.0000	-0.0025	-0.0025	-0.0025	-0.0025
27	0.0001	-0.0025	-0.0025	-0.0025	-0.0025
28	0.0003	-0.0026	-0.0026	-0.0026	-0.0026
29	0.0007	-0.0028	-0.0028	-0.0028	-0.0028

Source: CNA simulation model results.

For context, we report the baseline BRS reenlistment rate adjustment factors in the left-hand column of Table 11. In the column immediately to the right of the baseline BRS column, we report the results holding all of the baseline assumptions constant except PDR, which we decrease to 1 percent. The adjustment factors increase in size and are negative. To attempt to offset the negative adjustments, particularly in the early YOS cells, we increase the size of the CP to 13 times monthly BP, but we keep the time of the payment at 12 YOS. The center column shows that all of the adjustment factors remain negative, but they have a smaller negative effect through 12 YOS. We then examine the effect of retiming the CP payment—first to 10 YOS and then to 8 YOS—and we assume that the maximum CP amount is paid (i.e., 13 months of BP). The last two columns report those results. At 10 YOS and at 8 YOS, the adjustment factors remain negative and are slightly larger than when the CP is paid at 12 YOS.

Table 11 shows that, when a low PDR is assumed, increasing the CP amount offsets some of the negative BRS effect, but paying the CP earlier than 12 YOS does not. In fact, paying the CP earlier actually increases the negative adjustment factors compared with paying the CP at 12 YOS, albeit very slightly. This may seem counterintuitive, but suppose a Marine is making his or her first reenlistment decision at YOS 4. When we assume that the CP is paid earlier in the career (e.g., at 8 YOS), the period over which the CP amount is discounted is shorter. All else equal, the closer the CP is paid to the reenlistment decision, the more valuable to the Marine. However, all else is not equal when the CP is paid earlier: Monthly BP at 8 YOS is less than monthly BP at 10 YOS, which in turn is less than monthly BP at 12 YOS. The PDV of the CP can increase or decrease depending on the assumed PDR, the decrease in the length of the discounting period, and the decrease in the CP amount due to paying it earlier in the career. Our results show that, for very low PDRs, the decrease in the CP amount has a greater (negative) effect on the PDV of the CP than the (positive) effect of the reduction in the length of the discounting period.

We then computed a CP of 13 times monthly basic pay at 8 YOS, 10 YOS, and 12 YOS and found the PDR for which paying the CP earlier results in about the same YOS adjustment factors. For MOS 06XX, the "break-even" PDR is about 5 percent. That is, we estimate that Marines in MOS 06XX with PDRs of about 5 percent would be roughly indifferent between the (smaller) CP paid at 8 YOS vice the (greater) CP paid at 12 YOS. For those with PDRs less than 5 percent, we estimate that paying the CP earlier has a slightly greater negative effect on reenlistment than paying the CP later. For those with PDRs greater than 5 percent, we estimate that paying the CP earlier has a greater positive effect on reenlistment than paying the CP later.

Results for an officer example

We use the same method to analyze the BRS effects on MOS 0402 as we did for MOS 06XX. Because MOS 0402 is an officer specialty, however, our baseline BRS estimate

uses a PDR of 6.4 percent. For reference, we report the baseline adjustment factors for MOS 0402 in the far left-hand column of Table 12.

Table 12. Results for MOS 0402

YOS	Baseline PDR = 6.4%, CP is 2.5 mo. of BP paid at YOS 12	PDR = 1%, CP is 2.5 mo. of BP paid at YOS 12	PDR = 1%, CP is 13 mo. of BP paid at YOS 12	PDR = 1%, CP is 13 mo. of BP paid at YOS 10	PDR = 1%, CP is 13 mo. of BP paid at YOS 8
0	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000
4	-0.0163	-0.1012	-0.0673	-0.0697	-0.0730
5	-0.0182	-0.1048	-0.0697	-0.0722	-0.0756
6	-0.0136	-0.0725	-0.0482	-0.0500	-0.0523
7	-0.0151	-0.0753	-0.0500	-0.0519	-0.0543
8	-0.0167	-0.0782	-0.0520	-0.0539	-0.0564
9	-0.0185	-0.0814	-0.0541	-0.0561	-0.0879
10	-0.0016	-0.0068	-0.0045	-0.0047	-0.0073
11	-0.0018	-0.0071	-0.0047	-0.0077	-0.0077
12	-0.0020	-0.0075	-0.0050	-0.0081	-0.0081
13	-0.0041	-0.0085	-0.0085	-0.0085	-0.0085
14	-0.0034	-0.0067	-0.0067	-0.0067	-0.0067
15	-0.0037	-0.0071	-0.0071	-0.0071	-0.0071
16	-0.0040	-0.0075	-0.0075	-0.0075	-0.0075
17	-0.0043	-0.0079	-0.0079	-0.0079	-0.0079
18	-0.0046	-0.0085	-0.0085	-0.0085	-0.0085
19	-0.0041	-0.0083	-0.0083	-0.0083	-0.0083
20	-0.0007	-0.0019	-0.0019	-0.0019	-0.0019
21	-0.0007	-0.0019	-0.0019	-0.0019	-0.0019
22	-0.0008	-0.0020	-0.0020	-0.0020	-0.0020
23	-0.0008	-0.0021	-0.0021	-0.0021	-0.0021
24	-0.0009	-0.0022	-0.0022	-0.0022	-0.0022
25	-0.0009	-0.0023	-0.0023	-0.0023	-0.0023
26	-0.0009	-0.0023	-0.0023	-0.0023	-0.0023
27	-0.0009	-0.0024	-0.0024	-0.0024	-0.0024
28	-0.0009	-0.0024	-0.0024	-0.0024	-0.0024
29	-0.0008	-0.0024	-0.0024	-0.0024	-0.0024

Source: CNA simulation model results.

The baseline continuation rate adjustments are negative for all YOS, but they are quite modest. When the PDR is reduced to 1 percent, we estimate that the size of the negative adjustments increases substantially. Moving to the right across the columns in Table 12, we show the effect of paying the CP in earlier YOS. As we found with MOS 06XX, increasing the size of the CP at YOS 12 helps offset the negative continuation rate adjustments in the early YOSs, but, at a very low PDR, paying the CP earlier does not increase the offset. In fact, the negative adjustment factors grow

slightly as the CP is paid earlier. We calculate the break-even PDR to be about 5 percent.

Our results suggests that, for certain MOSs that already have barely sufficient reenlistment rates, the Marine Corps may have to consider strategies to improve reenlistment before YOS 8 as the BRS is implemented, particularly if there is concern that those Marines may have lower than average PDRs. Although our estimates indicate that force profile changes will be small under the BRS, manpower planners and analysts should carefully track reenlistment and continuation rates throughout BRS implementation and be particularly attentive to changes that current force management tools cannot mitigate.

Short- and Long-Term Financial Status of Individual Marines and Retirees

Another Marine Corps FMO of interest is the financial impact of the BRS on typical individual Marines, which we consider in this section. Beginning in the accession year and continuing through retirement, we estimate the annual take-home income (i.e., income after taxes) available to each Marine under the BRS and compare it with take-home income available under the current retirement system. Take-home income provides a measure of how much consumption (of goods and services) a Marine can afford—an important determinant of a Marine's quality of life.

We consider the following four typical Marine career paths:

1. An enlisted Marine who completes one term and separates voluntarily as an E-5 after 4 years
2. An enlisted Marine who completes 20 YOS and retires as an E-7
3. A Marine officer who separates after 4 years as an O-3
4. A Marine officer who completes 20 YOS and retires as an O-5

Assumptions

In general, our assumptions follow those of the MCRMC. We assume that Marines make the same, voluntary individual contributions to the TSP under both the current retirement system and the BRS. Under the BRS, however, their individual contributions are matched dollar for dollar by DOD after YOS 2.[42] DOD also

[42] Because the MCRMC assumption for the TSP contribution rate by servicemembers is 3 percent of BP, the service contribution match is dollar for dollar. The service match on contributions in excess of 3 percent but no more than 5 percent of BP is fifty cents on the dollar.

contributes 1 percent of BP annually to the Marines' TSP accounts under the BRS. We assume that members do not make withdrawals from the TSP before age 59½ because such withdrawals would incur a 10-percent penalty.

We assume that DOD also pays CP to members who reach YOS 12. The CP is equivalent to 2.5 months of BP for enlisted members and officers.

We assume that Marines follow standard promotion paths. Also, for calculating the basic allowance for housing (BAH) and federal income tax liability, we assume that Marines are single through YOS 4 and have dependents thereafter.

We assume that pay and allowances keep pace with inflation, so that future pays will have the same purchasing power as the 2016 pay scale.

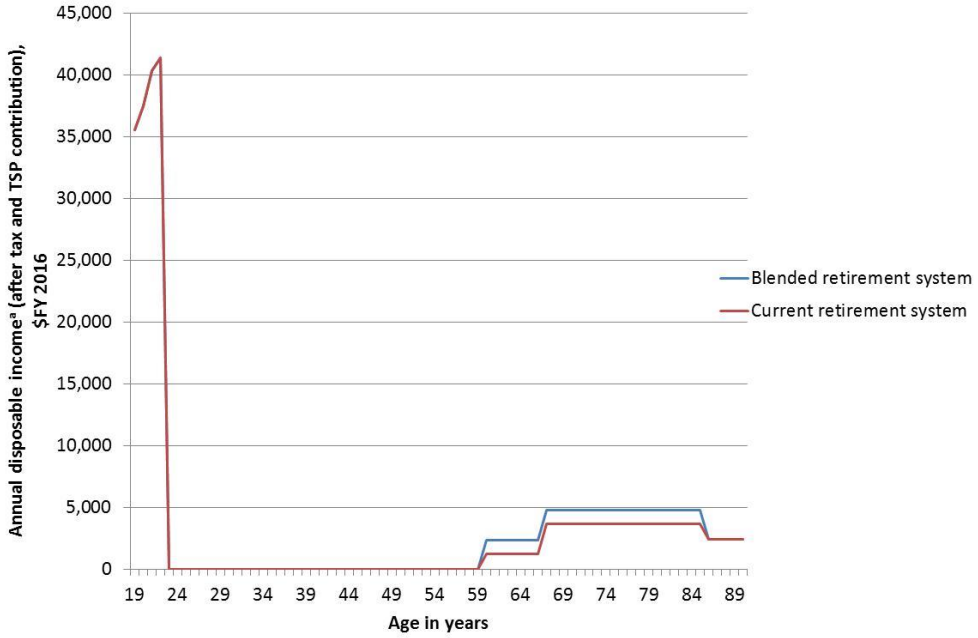
We assume that the 2016 federal income tax rates and thresholds will remain constant (in real terms) over time. We exclude state income tax (there is considerable variation in income tax rates across states) and do not consider any second-career income Marines may earn after separation. We include Social Security benefits because they represent part of the lifetime earnings associated with military service.

One-term enlisted Marine

As Figure 19 shows, a Marine who completes one term in the AC and separates will have the same take-home pay while in the service under the BRS as under the current retirement system.[43] This follows from our assumption that the Marine makes the same individual TSP contributions under each system, which we assumed to be 3 percent of BP. We assume that the Marine separates in paygrade E-5. On separation at the end of the first term, the Marine would accumulate over $5,600 in TSP savings under the BRS, but about $3,000 under the current retirement system. We assume that the Marine does not make TSP withdrawals until age 60 (such withdrawals are allowed, but they incur a 10-percent penalty). The TSP account grows at a compounded real rate of 4.95 percent per year. Because the Marine makes no TSP withdrawals and has no military pension, take-home income attributable to military service is zero between ages 23 and 60 under both retirement plans. Typically, the Marine would be engaged in civilian employment during this time.

[43] Take-home (disposable) income includes BP, BAH, and basic allowance for subsistence (BAS), net of TSP contributions by the individual and applicable federal, Social Security, and Medicare taxes.

Figure 19. Annual take-home income for a typical one-term enlisted AC Marine



Source: CNA calculations.

[a.] Disposable income is calculated as income (pay, allowances, retirement benefits, TSP distributions) less federal, Social Security, and Medicare taxes and pre-tax contributions to TSP. We assume that, under BRS, DOD contributes 1 percent of BP per year automatically, plus 3 percent per year to the TSP to match individual TSP contributions of 3 percent per year. The TSP balance is assumed to grow at a 4.95-percent real annual rate. The current retirement system scenario assumes individual TSP contributions of 3 percent of BP per year. We assume that TSP is fully withdrawn in equal annual amounts for 26 years beginning at age 60. Social Security benefits are calculated according to current benefit formulas and are assumed to start at age 67.

At age 60 (the first year in which TSP withdrawals are not penalized), we assume that the Marine begins to make equal annual TSP withdrawals over 26 years (until age 85) in an amount that will fully deplete the TSP account. We have chosen this time period and withdrawal amount purely for illustrative purposes and acknowledge that the best pattern of TSP withdrawals will depend on individual preferences and situations.

In addition to the TSP withdrawals, beginning at age 67, we assume that the Marine receives Social Security retirement benefits. We calculated the benefit amount based only on earnings in the AC (assuming no other earnings during his or her working life). In practice, the Social Security benefit we show in Figure 19 will be a lower bound. Any wages the Marine earns as a civilian will increase the Social Security benefit. As seen in the figure, the one-term Marine will enjoy larger take-home

income under the BRS between ages 60 and 85 (approximately $1,100 per year, in constant 2016 dollars). This is attributable to the TSP withdrawals. On exhausting the TSP after age 85, the Marine will have only Social Security benefits, which are the same under both retirement systems.

To summarize, a one-term Marine who makes the default 3-percent contribution to the TSP will have the same take-home income during the first term under both retirement systems. Take-home pay will be higher in older age under the BRS than under the current retirement system (due to DOD's TSP contributions). Thus, a one-term enlisted Marine would be unambiguously better off over his or her lifetime under the BRS.

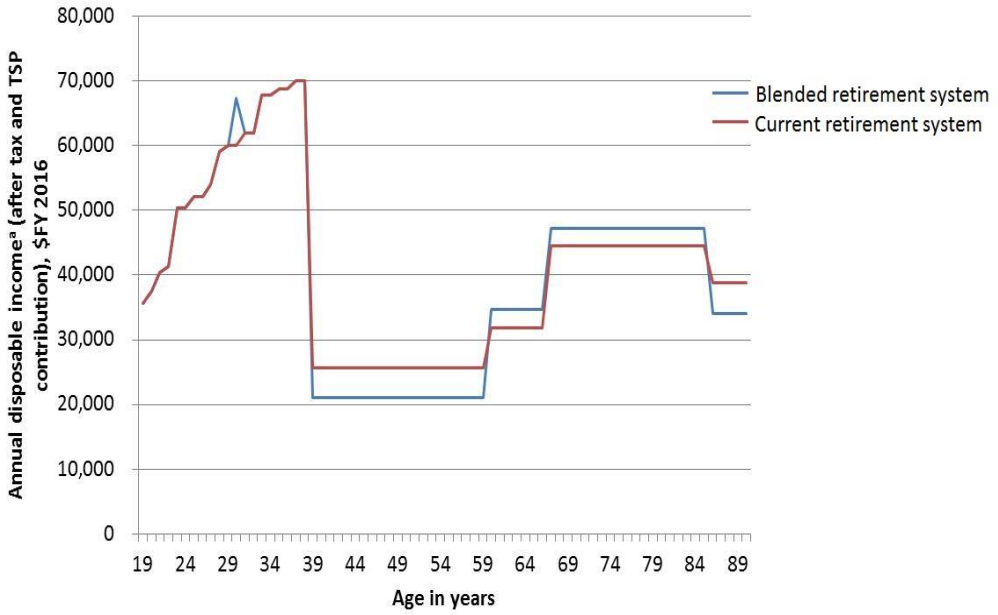
Enlisted Marine who retires as E-7 after 20 YOS

In Figure 20, we show the lifetime path of take-home pay (attributable to AC service) for a typical enlisted Marine who retires as an E-7 after 20 years of service. We assume that the Marine makes an individual TSP contribution of 3 percent of BP under each retirement system. In each year during AC service, the Marine has the same take-home pay under BRS as under the current retirement system. One exception is YOS 12, during which the Marine receives CP equivalent to 2.5 months' BP.

During the "second career" period following retirement, the Marine receives military retirement pay under both systems. The take-home amount is about 20 percent lower under the BRS than under the current retirement system, reflecting the lower multiplier in the retirement pay formula under BRS.

Between ages 60 and 85, we assume that the Marine under BRS makes annual TSP withdrawals. The TSP balance at age 60 allows the Marine to withdraw over $15,260 (in constant 2016 dollars) annually for 26 years. During this period, these withdrawals (or TSP distributions) contribute to higher take-home pay than under the current retirement system. The TSP withdrawals more than offset the approximate $5,000 per year difference in retirement pay. From age 67 on, the Marine also receives Social Security benefits amounting to $13,000 per year (a lower bound, based only on military earnings during the Marine's 20-year career). After age 85, we assume that the TSP has been exhausted and take-home pay comes purely from military retirement and Social Security. After the TSP is exhausted at age 85, pay under the BRS is lower than under the current retirement system (reflecting the lower military retirement benefit under BRS).

Figure 20. Annual take-home income for an enlisted Marine who retires as E-7 after 20 years



Source: CNA calculations.

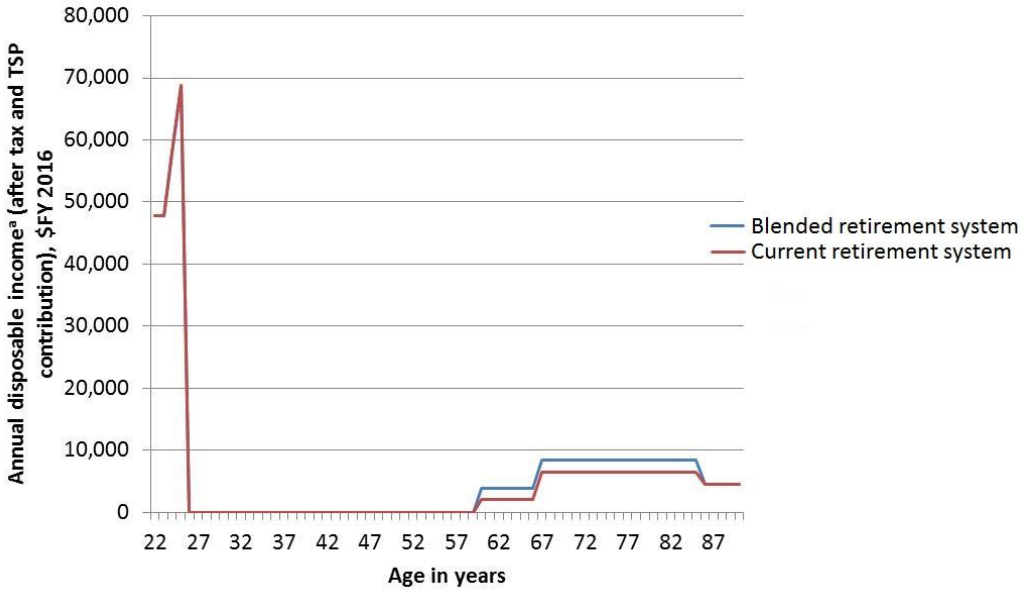
[a.] Disposable income calculated as income (pay, allowances, retirement benefits, TSP distributions) less federal, Social Security, and Medicare taxes and pre-tax contributions to TSP. We assume that, under BRS, DOD contributes 1 percent of BP per year automatically, plus 3 percent per year to the TSP to match individual TSP contributions of 3 percent per year. The TSP balance is assumed to grow at a 4.95-percent real annual rate. The current retirement system scenario assumes only individual TSP contributions, at 3 percent of BP. We assume that TSP is fully withdrawn in equal annual amounts for 26 years beginning at age 60. Social Security benefits are calculated according to current benefit formulas and are assumed to start at age 67.

Marine officer who separates after 4 YOS

In Figure 21, we illustrate the case of a Marine officer who separates after a minimum initial service obligation of 4 years. This case is similar to a one-term enlisted Marine, though the amounts earned over the lifetime are higher (reflecting the higher pay and allowances of officers). During the period of AC service, take-home income for the Marine officer is the same under BRS and the current retirement system because we assume 3-percent individual TSP contributions in each case.

No income is derived from military service following separation during the Marine's second career because the period of service was not long enough to qualify for a military pension. In older age, take-home income is higher under the BRS because the Marine receives larger TSP distributions (resulting from the DOD contributions under the BRS). The Marine's military service also contributes to the Social Security benefit, which begins at age 67 and is the same in each retirement system.

Figure 21. Annual take-home income for a Marine officer who serves for four years



Source: CNA calculations.

[a.] Disposable income calculated as income (pay, allowances, retirement benefits, TSP distributions) less federal, Social Security, and Medicare taxes and pre-tax contributions to TSP. We assume that, under BRS, DOD contributes 1 percent of BP per year automatically, plus 3 percent per year to the TSP to match individual TSP contributions of 3 percent per year. The TSP balance is assumed to grow at a 4.95-percent real annual rate. The current retirement system scenario assumes only individual TSP contributions of 3 percent of BP per year. We assume that TSP is fully withdrawn in equal annual amounts for 26 years beginning at age 60. Social Security benefits are calculated according to current benefit formulas and are assumed to start at age 67.

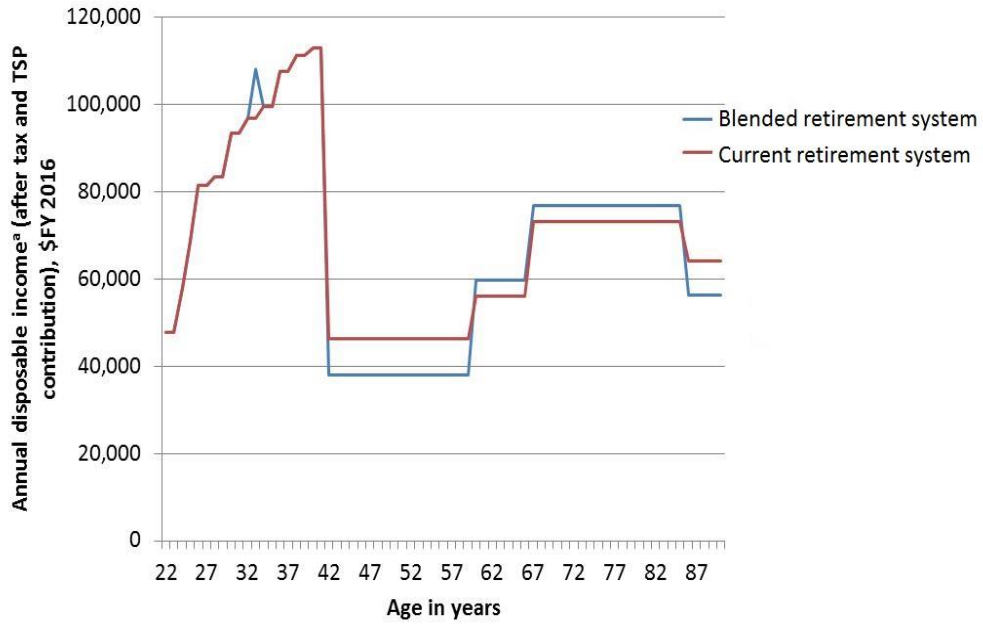
Marine officer who retires as O-5 after 20 YOS

Finally, we consider a Marine officer who serves for 20 years and retires as an O-5, depicted in Figure 22. We see that, during the 20 years of service, take-home pay is identical under the two retirement systems (with the exception of YOS 12, during

which the CP is paid). This follows from our assumption that the officer makes the same 3-percent voluntary individual contribution to the TSP in each retirement system.

Following retirement (between ages 42 and 60), the Marine receives a military pension as the sole source of take-home pay attributable to military service (i.e., excluding any civilian earnings). After taxes, the officer's take-home military pension is over $46,400 per year (in constant 2016 dollars) under the current retirement system, but slightly less than $38,000 under the BRS. Penalty-free TSP distributions begin at age 60 and are approximately $14,000 higher per year under the BRS than under the current retirement system (because the latter does not benefit from DOD contributions). Between the ages of 60 and 85, these distributions more than offset the $8,400 difference in military retirement benefits.

Figure 22. Annual take-home income for a Marine officer who retires as O-5 after 20 years



Source: CNA calculations.

[a.] Disposable income calculated as income (pay, allowances, retirement benefits, TSP distributions) less federal, Social Security, and Medicare taxes and pre-tax contributions to TSP. We assume that, under BRS, DOD contributes 1 percent of BP per year automatically, plus 3 percent per year to the TSP to match individual TSP contributions of 3 percent per year. The TSP balance is assumed to grow at a 4.95-percent real annual rate. The current retirement system scenario assumes only individual TSP contributions of 3 percent per year. We assume that TSP is fully withdrawn in equal annual amounts for 26 years beginning at age 60. Social Security benefits are calculated according to current benefit formulas and are assumed to start at age 67.

The officer may choose to withdraw a lower TSP amount each year but for a longer time period. Also note that the TSP balance is subject to risk; the realized return may be greater or less than the assumed 4.95-percent real annual rate.

Cumulative lifetime take-home income

In Table 13 (for enlisted) and Table 14 (for officers) we show the total cumulative lifetime take-home income earned under the current and blended retirement systems for the four typical Marine career paths illustrated in Figure 19 through Figure 22. The tables reflect the same baseline assumptions we adopted for the calculations in the earlier figures.

Table 13. Cumulative take-home income for enlisted career paths, by source

	One-term enlisted Marine		E-7 retiree at 20 YOS	
	Current	**BRS**	**Current**	**BRS**
Income while in service:				
Basic pay, before tax	$94,463	$94,463	$777,970	$777,970
BAH (tax-free)	$58,416	$58,416	$389,040	$389,040
BAS (tax-free)	$17,678	$17,678	$88,390	$88,390
Continuation bonus, before tax	$0	$0	$0	$8,522
Minus:				
Indiv. TSP contributions (3 percent)	$2,834	$2,834	$23,339	$23,339
Social Security and Medicare taxes	$7,226	$7,226	$59,515	$59,515
Federal taxes	$5,716	$5,716	$42,459	$43,738
Take-home income during service	$154,780	$154,780	$1,130,086	$1,137,329
Income after service, through age 85:				
Defined benefit	$0	$0	$1,235,639	$988,512
TSP DOD contributions	$0	$2,535	$0	$29,875
TSP indiv. contributions	$2,834	$2,834	$23,339	$23,339
TSP real growth (4.95 percent annual)	$29,745	$55,580	$153,162	$343,551
Social Security benefits	$46,152	$46,152	$248,342	$248,342
Minus:				
Federal taxes	$0	$0	$51,157	$53,857
Take-home income post-service	$78,731	$107,101	$1,609,325	$1,579,762
Total take-home income	$233,511	$261,881	$2,739,411	$2,717,091

Source: CNA calculations. The totals are in constant 2016 dollars and are not discounted.

Table 14. Cumulative take-home income for officer career paths, by source

	Four-year officer		O-5 retiree at 20 YOS	
	Current	BRS	Current	BRS
Income while in service:				
Basic pay, before tax	$176,332	$176,332	$1,500,880	$1,500,880
BAH (tax-free)	$71,304	$71,304	$514,704	$514,704
BAS (tax-free)	$12,174	$12,174	$60,871	$60,871
Continuation bonus, before tax	$0	$0	$0	$16,865
Minus:				
Indiv. TSP contributions (3 percent)	$5,290	$5,290	$45,026	$45,026
Social Security and Medicare taxes	$13,489	$13,489	$114,817	$116,107
Federal taxes	$18,436	$18,436	$121,519	$125,735
Take-home income during service	$222,595	$222,595	$1,795,093	$1,806,451
Income after service, through age 85:				
Defined benefit	$0	$0	$2,194,394	$1,755,516
TSP DOD contributions	$0	$4,913	$0	$57,895
TSP indiv. contributions	$5,290	$5,290	$45,026	$45,026
TSP real growth (4.95 percent annual)	$47,119	$89,618	$250,044	$563,110
Social Security benefits	$86,151	$86,151	$373,922	$373,922
Minus:				
Federal taxes	$0	$0	$243,665	$233,477
Take-home income post-service	$138,560	$185,972	$2,619,722	$2,561,992
Total take-home income	$361,155	$408,567	$4,414,815	$4,368,442

Source: CNA calculations. The totals are in constant 2016 dollars and are not discounted.

For both the enlisted and officer cases, Marines who do not stay for 20 years receive more income overall under the BRS. With the baseline assumptions, those who retire after 20 years receive about 1 percent lower total lifetime take-home income under the BRS than under the current system. Under the BRS, retirees receive more take-home income while in service (because of the continuation pay at YOS 12) but lower income after service.

Note, however, that the BRS provides an option to achieve higher total take-home income than under the current system by increasing the individual TSP contribution and thereby receiving additional DOD matching contributions. For example, we estimate that an enlisted Marine who retires as an E-7 at 20 years would achieve the same undiscounted lifetime income under the BRS as under the current system by making TSP contributions of 4.1 percent instead of the default 3 percent. Similarly, a Marine officer could achieve the same lifetime income by contributing 4.2 percent.

Although it is informative to compare undiscounted lifetime take-home income, this comparison should not be taken as a stand-alone measure of whether an individual

Marine is better or worse off under the BRS. Additional important factors are the timing of income and the amounts (and interest rates at which) Marines can save and borrow over their lifetimes. These factors, which are likely to vary by individual, together define the Marine's lifetime consumption possibilities.

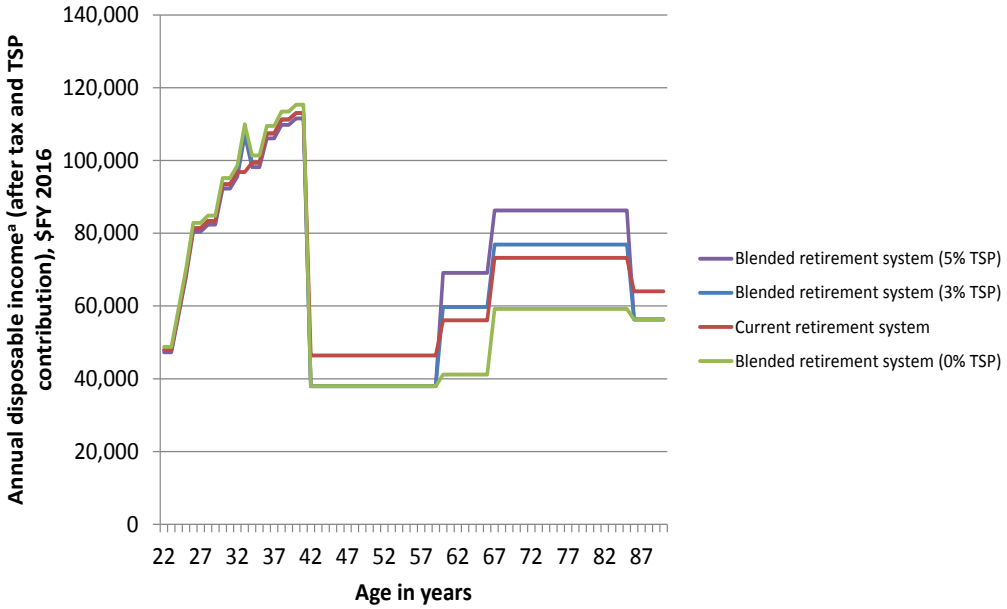
Sensitivity analysis

The earlier figures showed the path of disposable income, assuming that the member contributes 3 percent of BP annually to the TSP, and the TSP has an annual real growth rate of 4.95 percent. In this subsection, we evaluate the effects of alternative assumptions for these two factors.

Alternative TSP contributions

First we consider the effects of different TSP contribution rates, assuming a 4.95-percent ROI. We use the baseline case of the officer who retires as an O-5 after 20 years, depicted in Figure 22. Figure 23 shows that achieving the take-home income available under the current retirement plan requires making individual TSP contributions (and collecting the DOD matching contributions). As illustrated by the green line, the 1-percent DOD automatic contribution alone (assuming a 4.95-percent ROI) is insufficient to offset the lower pension income under the BRS.

Figure 23. Effect of TSP contributions on annual take-home income, officer who retires as an O-5 at YOS 20



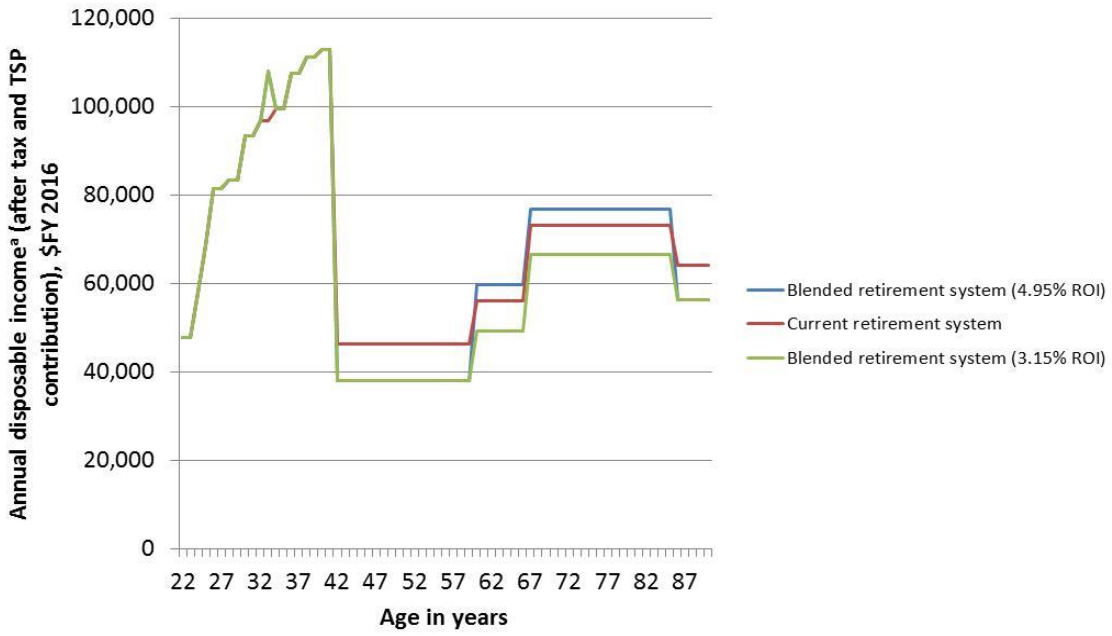
Source: CNA calculations.

[a.] Disposable income calculated as income (pay, allowances, retirement benefits, TSP distributions) less federal, Social Security, and Medicare taxes and pre-tax contributions to TSP. We assume that, under BRS, DOD contributes 1 percent of BP per year automatically and matches individual TSP contributions. The TSP balance is assumed to grow at a 4.95-percent real annual rate. The current retirement system scenario assumes only individual TSP contributions of 3 percent of BP per year. We assume that TSP is fully withdrawn in equal annual amounts for 26 years beginning at age 60. Social Security benefits are calculated according to current benefit formulas and are assumed to start at age 67.

Alternative TSP ROI assumptions

Another important assumption is the rate at which the TSP grows, assumed to be 4.95 percent per year by the MCRMC. At this growth rate, a large part of the TSP balance available at age 60 is a result of accumulated growth on the contributions. In Figure 24, we show the effect of reducing the assumed real ROI to 3.15 percent per year.

Figure 24. Effect of TSP ROI on annual take-home income, officer who retires as an O-5 at YOS 20



Source: CNA calculations.

[a.] Disposable income calculated as income (pay, allowances, retirement benefits, TSP distributions) less federal, Social Security, and Medicare taxes and pre-tax contributions to TSP. We assume that, under BRS, DOD contributes 1 percent of BP per year automatically and matches individual TSP contributions of 3 percent per year. The current retirement system scenario assumes only individual TSP contributions of 3 percent of BP per year. We assume that TSP is fully withdrawn in equal annual amounts for 26 years beginning at age 60. Social Security benefits are calculated according to current benefit formulas and are assumed to start at age 67.

Because of the number of years over which it compounds, the ROI has a significant effect on the TSP balance available at age 60. In Table 15, we present the officer's total TSP balance under the two different ROIs, decomposed by funding source. The available TSP balance is almost $140,000 lower due to the lower ROI.

Table 15. TSP available balance at age 60 under different ROI, by funding source

Funding source	ROI = 3.15	ROI = 4.95
Individual contributions[a]	$45,026	$45,026
DOD contributions	$57,895	$57,895
Real growth	$129,346	$267,228
Total	$232,267	$370,149

Source: CNA calculations. Values are constant 2016 dollars.

[a.] Assumes Marine officer retires after 20 years as an O-5, contributing 3 percent of BP every year to the TSP.

Borrowing and saving

We have shown the stream of disposable income each Marine receives through time as a measure of financial status. In practice, Marines (like other consumers) can borrow (or save less) in low-income years and save more in high-income years to achieve a more desirable lifetime spending pattern.[44] For example, a Marine might save the CP received in YOS 12 and spend it in small increments over YOS 13-20. Other examples might be decisions to save less by not contributing to the TSP during AC service or saving less of civilian earnings during a second career.

Allowing for unlimited borrowing and saving (subject only to the constraint that debts must be fully repaid), we can calculate whether Marines under the BRS can replicate the stream of take-home income provided under the current retirement system. The ability to replicate or exceed each year's take-home income under the current system indicates that the Marine is no worse off in a financial sense under the BRS.

Marines who separate before 20 years are better off under the new system because, if they opt to contribute nothing to the TSP, they still receive the 1-percent automatic DOD contribution. This choice will leave them with at least as much income in each year under the BRS as under the current system, with no borrowing or saving required.[45] Marines who separate after 20 years may or may not be better off under the BRS, depending on (1) how much they contributed to the TSP, (2) how much (if any) additional amount (above 2.5 months of BP) they received in YOS 12 CP, and (3) how the realized returns on the TSP compare with the interest rate at which we assume Marines can borrow and save.

[44] Saving and spending decisions of individual Marines depend on the interest rates they must pay to borrow, the interest rates they earn from savings, and their discount rates.

[45] They may opt to contribute more to the TSP but would, by definition, still be better off.

If Marines are unable to borrow against future income (or reduce other savings), the BRS implies a shift in consumption to later years. Whether the Marine is better off would depend on how he or she discounts take-home income in future years.

Risk

We have not explicitly addressed risk differences between the BRS and current retirement systems. The Social Security benefit and military retirement benefit are relatively low-risk future income streams. The TSP may not be, because its level depends on how it is invested and the actual returns it earns over time. We assumed a real growth rate of 4.95 percent for the TSP, but there is likely more risk associated with this expected return.

Summary

In sum, Marines who contribute to the TSP can expect the same take-home pay during their AC service but a higher payout from these contributions (and the DOD match) during old age. Marines who separate before 20 years are better off under the BRS than under the current system even if they choose not to contribute to the TSP because they still receive the 1-percent automatic DOD contribution, which becomes income (albeit a small amount) after age 60. Marines who complete a 20-year career and contribute to the TSP generally will have lower take-home pay from military service from retirement to age 60 and higher take-home pay after age 60 (when TSP withdrawals begin). These Marines may be able to adjust their borrowing and saving to shift income to the immediate post-retirement period, making them as well-off under the BRS as they were under the current retirement system. Whether their lifetime take-home income under the BRS is sufficient to replicate their income under the current system depends on the individual's TSP contributions, the CP, and the interest or discount rate assumptions.

The RC Methodology and Results

In this section, we describe the methodology that we use to estimate the effects of the BRS on RC force profiles and personnel cost savings, and we present our estimates of the BRS effect on these RC FMOs.

Background on BRS for the RC

The major policy changes under the BRS for the RC are conceptually similar to the AC changes.[46] In particular, the BRS affects RC lifetime earnings in the following ways:

- It reduces the DB portion of RC retirement by 20 percent.
- It introduces both automatic DOD unmatched and matching contributions to servicemembers. For the RC, drill pay (DP) is used in the matching calculation instead of BP.[47]
- It introduces a continuation bonus of 0.5 month of BP paid at YOS 12 in exchange for 4 more years of service. Based on the MCRMC assumptions about the annual workload (and earnings) of an RC Marine, this is approximately the same relative amount as the minimum CP paid to AC Marines (i.e., both the AC minimum CP of 2.5 months of BP at YOS 12 and the minimum RC CP of 0.5 months of BP at YOS 12 equal approximately 20 percent of annual BP).

There are several differences between the AC and RC retirement systems that can lead to different stay/leave decisions for AC and RC servicemembers. These differences occur even when the underlying assumptions about servicemembers' preferences (e.g., PDR) are held constant. The first major difference is that the annual

[46] There are some key differences between the lump sum choices for eligible AC members and those for RC members which are described in the law. We do not describe them here because we do not analyze the lump sum options for either the AC or the RC.

[47] The pay for a single drill in the RC (i.e., DP) is equal to 1/30th of the BP for AD servicemembers.

RC DB payments are smaller than those for the AC: the RC DB payments are calculated using days of service rather than YOS. Retirement-eligible Marines in the SMCR and IMA serve fewer days than retirement-eligible AC Marines.

The second major difference is the delayed start of DB payments for RC Marines. AC Marines retire and receive DB payments immediately. RC Marines typically do not receive DB payments until age 60, but many retire before that age. Thus, DB payments represent a larger portion of lifetime military earnings for an AC Marine than for an RC Marine, not only because the AC annual payments are larger but also because the expected amount of time that she/he will receive DB payments is longer.

The difference in timing of DB payments in the future leads to substantial differences in the PDV of the DB today. For example, consider the difference in the PDV of $100 in the future to a 20-year-old Marine today, assuming he or she has a 12.7-percent PDR. This Marine values $100 received at age 40—approximately the minimum age for receiving AC DB payments—at about $9 today. The same Marine values $100 received at age 60—approximately the minimum age for receiving RC DB payments—at $0.81 today. As such, we expect that BRS changes to the DB will affect RC Marine reenlistment behavior less than it will affect that of AC Marines.

In the next subsections, we discuss our RC modeling methodology and then describe our calculations of lifetime RC earnings under the current retirement system and the BRS. We then use the difference in these two calculations to estimate the changes in force profiles and personnel costs.

Methodology

In general, the BRS has parallel and proportionate features for the RC and the AC. Therefore, in our RC analysis, we use a similar method of adjusting historical reenlistment rates to reflect how Marines may respond to changes in expected lifetime military earnings under the BRS, just as we did in our AC analysis. We then use the adjusted RC reenlistment rates to simulate future RC force profiles, and we calculate RC personnel cost savings under the current and simulated BRS force profiles.

In addition, we must incorporate two sources of personnel for our RC force profile simulation: direct (or non-prior-service (NPS)) accessions and Marines who affiliate with the RC after separating from the AC. The BRS may affect affiliation rates of Marines separating from the AC. We adjust historical affiliation rates to reflect how Marines contemplating RC affiliation may respond to changes in expected RC lifetime military earnings under the BRS. We use the adjusted affiliation rates as part of our simulation of RC force profiles under the BRS.

The connection between our AC and RC models is straightforward. Our AC model produces steady-state force profiles under the BRS; in doing so, it also produces annual steady-state AC losses under the BRS. We use the steady-state AC losses from our AC force profile simulations to estimate RC affiliations. To complete the estimated inflows of Marines to the RC, we use reported data on NPS accessions.[48]

Calculating continuation rates

We do not have information on reenlistment eligibility in the RC, and we cannot observe the difference between RC servicemembers who attrite and those who leave at the end of an obligated service period. As a result, we compute annual continuation rates for enlisted RC members by calculating the share of members in the RC at the beginning of a year and the share still in the RC at the end of the year.[49] We compute a continuation rate for each YOS in the RC. We use MCTFS data to compute continuation rates using an average of starting inventories from FY06 to FY14.

Estimating changes in lifetime RC military earnings and wage elasticities

Here, we describe how we calculate current and future drill pay, the value of lifetime military earnings, and the responsiveness of RC Marines to changes in lifetime military earnings (i.e., the "wage" elasticity).

Calculating RC wage growth

Our data on RC members consists of annual snapshots of the RC inventory from FY06 to FY14. In each snapshot, we observe each member's military pay entry base date (PEBD) and paygrade. Based on overall YOS (i.e., the combined time in the AC and the RC that is reflected in their PEBD) and the paygrade at the time that we first observe the member in the RC, we assign the corresponding nominal BP value from the military pay table applicable in that year. We use the Consumer Price Index (CPI) to transform the nominal rates of BP into real BP (base year is 2004).

[48] We assume that the propensity of potential NPS recruits to access to the RC is unaffected by the BRS.

[49] We also exclude servicemembers who fail to accumulate at least 50 retirement points from the beginning to the end of a year from our count of those who "continue" in the RC. In our data, servicemembers who fail to accumulate the minimum retirement points account for about 2 percent of those who do not continue.

We need to know how the value of BP will change over time for each RC Marine for two essential calculations in our analysis: the stream of DP while in the RC and the stream of DBs expected to be paid in retirement, which is based on the average of the highest 3 years of BP earned by the retiring RC member. (Recall that the pay for a single drill in the RC (i.e., DP) is equal to 1/30th of the BP for AD servicemembers.)

Unfortunately, the available data do not allow us to follow each RC member over his or her entire RC career in order to observe how BP changes over time. Instead, we must estimate the BP growth rate for RC servicemembers. There are two ways to estimate BP growth for RC Marines with the limited data we have. The first is to estimate RC members' probability of promotion to the next paygrade for each year in the RC, which necessarily includes capturing promotion eligibility, minimum time in grade (TIG), and HYT. However, the RC is relatively small, especially for officers. As a result, we have concerns about the accuracy of such promotion estimates. Also, this is a computationally intensive approach that exceeds the study resources.

Instead, we use a second, simpler method. We organize the sample into separate annual cohorts defined by the amount of service that servicemembers have accrued when we first observe them in the RC. For example, we create a cohort of Marines who have 4 YOS when we first observe them in our RC data. Members of this cohort include those who entered the AC in FY02 and the RC in FY06, as well as those who entered the AC in FY10 and the RC in FY14. The cohort also includes NPS Marines who entered the RC in FY02 whom we first observe in FY06.

Although the servicemembers in our constructed cohort have the same amount of service at the time that we first observe them in the RC, they may have earned different paygrades by that time. For example, the paygrades of enlisted servicemembers in the 4-YOS cohort could span E-3 to E-5. Using the BP values that we assigned to RC members when we first observe them, we calculate the average real BP of the servicemembers in our constructed cohort.

We then calculate an average annual growth rate in real BP for each successive constructed cohort. This growth rate reflects changes in real BP due to the following:

- Promotion to a new paygrade
- Additional tenure
- Annual increases in real BP for a given paygrade and YOS (if any)

Appendix D provides additional detail on how we calculate RC wage growth rates. Note that we estimate RC enlisted and officer wage growth rates separately.

Estimating lifetime military earnings

We calculate the PDV of lifetime RC military earnings at every YOS, assuming that Marines stay in the RC for 30 YOS. The calculation of the PDV of this stream of

earnings will be different for Marines with greater or less than 20 YOS. Those with less than 20 YOS still have the draw of retirement eligibility. Those with 20 or more YOS are already eligible to retire, so their stay/leave behavior is affected by increases in the value of the retirement for each additional year that they stay in the RC but not by the draw of eligibility. Appendix D contains additional detail on the estimation of lifetime RC military earnings.

Estimating wage elasticities

Like their AC counterparts, RC members may have different responses to changes in expected lifetime military earnings. For some, changes in expected lifetime military earnings play an important role in their RC stay/leave decision. Others may exhibit little response to changes in military earnings. We capture the degree to which RC members' reenlistment behaviors are affected by changes in expected lifetime military earnings by the wage elasticity.[50] However, we did not find estimates of wage elasticities for the RC in previous research. Instead, we estimate RC wage elasticities (enlisted and officer) using MCTFS data.

To estimate wage elasticity, we use the PDV of lifetime RC military earnings under the current retirement system (see equations (22, (23, and (24 in appendix D) and the continuation rates described above. We use logistic regression to estimate the relationship between yearly continuation and the PDV of lifetime RC military earnings.[51]

Our analysis exploits the variation in accumulated retirement points across servicemembers with the same YOS, which are due to differences in AC service, deployments, etc. This variation drives differences in expected lifetime military earnings for servicemembers *with the same YOS*. Since accumulated retirement points also vary across YOS and therefore drive differences in expected lifetime earnings *across YOS*, we include a series of YOS indicator variables in the regression.

We estimate wage elasticities for enlisted RC personnel and for officers, respectively, of -2.26 and -1.47. These are similar in magnitude to the estimates of wage elasticities for AC personnel. Like their AC counterparts, RC enlisted personnel

[50] As we did in our AC analysis, we use the term *wage elasticity* to indicate the responsiveness of RC member stay/leave behavior to changes in expected lifetime military earnings.

[51] To be precise, we estimate the relationship between yearly *losses* and the PDV of lifetime RC military earnings.

appear to be more responsive to changes in lifetime military earnings than are RC officers.[52]

Adjusting RC continuation rates under the BRS

We calculate the percentage difference in the PDV of lifetime military earnings under the current retirement system and the BRS at each YOS (these calculations are done separately for enlisted personnel and officers). We multiply each percentage difference by the appropriate estimated wage elasticity. We adjust the actual continuation rates in the RC by the product of the percentage difference in PDVs and the wage elasticity.[53] We use the adjusted continuation rates to simulate a new RC force profile under the BRS.

Adjusting affiliation rates under the BRS

We must also adjust affiliation rates for the estimated response of separating AC Marines to affiliating with the RC under the BRS. We determine the number of Marines who choose to affiliate with the RC after leaving the AC by YOS. We call the set of YOS-specific RC affiliations the RC affiliation YOS-profile. We look at how the RC affiliation YOS-profile might change as a result of shifting from the current retirement system to the BRS. As we did for our AC analysis, we take the following steps to estimate the effect of the BRS on RC affiliation:

- We estimate a statistical model that explains the affiliation decision as a function of several factors, including a Marine's YOS at the time of his/her decision. Our model yields YOS-specific affiliation rates.
- We estimate the affiliation YOS-profile that we would expect under the current retirement system. We apply our YOS-specific affiliation rates to the YOS-profile for Marines leaving the AC (under the current retirement system).
- We adjust the profile calculated under the current retirement system to account for the BRS effect on RC compensation and the sensitivity of affiliation rates to compensation changes.

Appendix D describes our estimates of the BRS effects on RC affiliation rates.

[52] A wage elasticity of -2 means that annual losses decrease by 2 percent (not 2 percentage points) for every 1-percentage-point increase in expected lifetime earnings.

[53] Again, to be precise, we actually adjust loss rates.

Other RC model assumptions

To calculate a baseline BRS RC force profile, we use the MCRMC assumptions for PDRs, ROI, and minimum CP outlined in Table 1. Although Table 1 does not reflect it, the MCRMC also assumed that no eligible current RC members will opt in to the BRS. We follow this opt-in assumption, and we also assume that all eligible affiliations will opt in.[54] Other assumptions we use in our RC analysis include the following:

- Annual retirement point accumulation of 75 per year, which follows the MCRMC assumption in its RC analysis
- Age at entry into military service of 19 for enlisted and 22 for officers
- Life expectancy of 85 years, following MCRMC assumptions.

RC results

We estimate the RC enlisted and officer force profiles and compute costs under the current retirement system. We then estimate a baseline BRS force profile and compute costs for both enlisted personnel and officers. Finally, we estimate BRS force profiles and costs in which we vary the underlying assumptions. We estimate the same alternative scenarios that we analyzed for the AC except for the scenario in which PDR varies by YOS. The scenarios are:

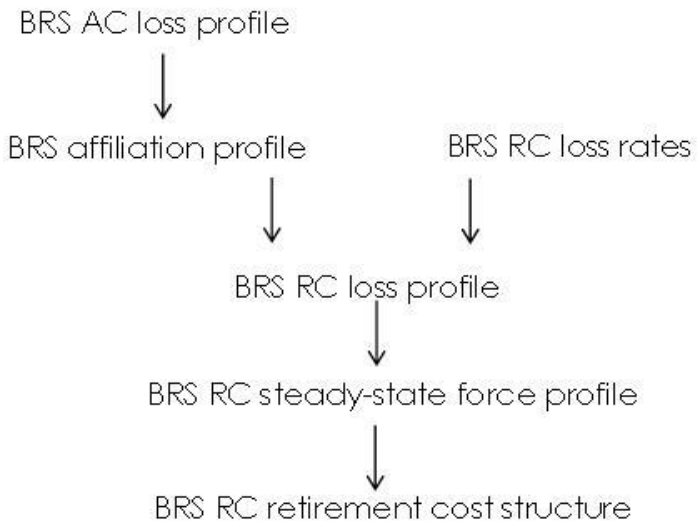
- Current retirement system steady state
- BRS baseline (MCRMC assumptions)
- Low PDR (1 percent for enlisted and officers)
- High PDR (18 percent for enlisted, 12 percent officer)
- No DOD matching TSP contributions (the servicemember makes no TSP contributions, so DOD makes the 1-percent unmatched contribution only)
- 5 percent DOD matching TSP contributions (servicemember contributes the maximum amount to TSP)
- Vesting at 5 YOS

[54] Recall that the baseline MCRMC opt-in assumption for the more junior eligible AC servicemembers is approximately 95 percent. Since these AC servicemembers will make up a significant portion of the RC affiliations for several years after the BRS is implemented, it is reasonable to assume that most if not all eligible affiliations will have already opted in to the BRS before their RC service begins.

- 6 percent total DOD TSP contributions (matching contributions are dollar for dollar on up to 5 percent of servicemember TSP contributions)
- Lower ROI (3.15 percent)

We use the losses from the AC model as inputs into our RC model for each scenario. Then we apply the corresponding adjusted affiliation rates to the AC losses to determine affiliations under each scenario and calculate RC force profiles and personnel cost savings for each scenario. The process is illustrated in Figure 25.

Figure 25. RC scenarios



These calculations form the answers to our primary questions about the impacts of the BRS implementation:

- How does the RC YOS profile of the RC change?
- How do the RC personnel costs change?

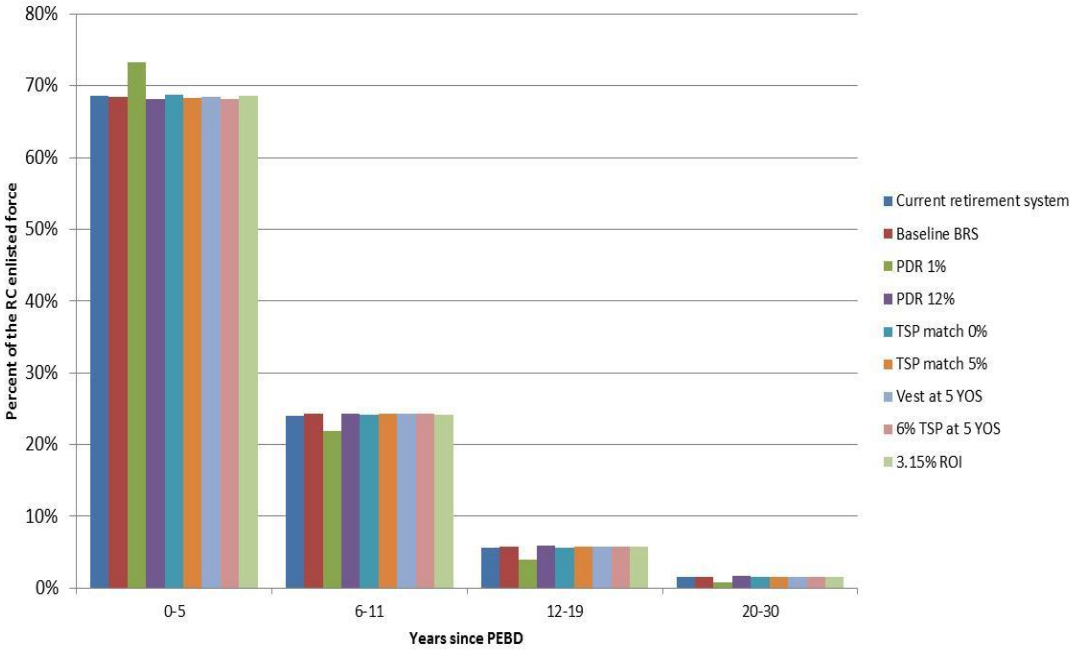
An important distinction is that we do not hold total endstrength or endstrength in each paygrade constant in our RC analysis as we do in our AC analysis. In our RC model, if a scenario produces lower RC affiliation and/or continuation rates, RC endstrength may decrease. Thus, we also report changes in RC endstrength to put into context our results on changes in RC force profiles and personnel cost savings.

As we show for both officers and enlisted personnel, the changes to force profiles are minimal under most scenarios. We do see some potential for changes in endstrength, although these occur mostly for officers. Compared with the cost changes calculated for the AC, the RC cost changes are minimal.

Enlisted results

Figure 26 shows the YOS force profile under each of the scenarios. (The changes in endstrength are reported in Table 16.) As Figure 26 illustrates, force profile changes are minimal in all but one scenario: a very low PDR. This occurs because, with a sufficiently low PDR, the PDV of the stream of DBs under the current retirement system is greater than the PDV of the streams of retirement system income under the BRS (i.e., the combination of lower DBs, TSP amounts, and the CP). As a result, continuation rates are negatively affected enough to produce a noticeably smaller, more junior force profile in the steady state.[55]

Figure 26. Enlisted RC steady-state force profiles



Source: CNA calculations

[55] However, if the low PDR scenario occurred in reality, we would expect some of the force profile changes to be mitigated. Marines with very low PDRs would likely invest the maximum amount allowed into TSP. This increase in TSP would serve to offset the lost value of DBs. Because we hold constant TSP contributions at 3 percent in this scenario, our results do not reflect this likely behavioral interaction.

The notable exception to stability in force profile and endstrength—the scenario with a very low value of PDR—suggests that the Marine Corps should pay close attention to RC TSP contribution rates and opt-in rates. Higher-than-anticipated TSP contribution rates combined with lower-than-anticipated opt-in rates could suggest that PDRs are lower than 12.7 percent, and mitigating strategies to maintain the force profile may be necessary.

Table 16. Enlisted RC steady-state endstrength under various scenarios

	Current system	Base-line	1% PDR	18% PDR	TSP = 1%	TSP = 5%	Vest at 5 YOS	TSP= 6%; vest at 5 YOS	3.15% ROI
Estimated number in RC	**32,749**	**32,901**	**30,211**	**32,993**	**32,711**	**32,966**	**32,895**	**33,017**	**32,812**

Source: CNA calculations.

We turn to calculating steady-state personnel cost savings under the various BRS scenarios. Recall that we define personnel cost savings as the savings from the reduced MRTF set-aside offset by DOD TSP contributions and CP. The BRS cost savings are calculated in relation to the RC steady-state personnel cost of the current retirement system. For the RC under the current retirement system, we use a MRTF set-aside rate of 23 percent of drill pay. Under the BRS, we use a MRTF set-aside rate of 18.4 percent of drill pay (80 percent of the 23 percent set-aside rate under the current system).

Table 17 shows that the current retirement system cost—which is entirely composed of MRTF set-aside amount—is $33.1 million. A 20-percent reduction in this set-aside amount ($6.6 million) represents the maximum obtainable savings absent changes in force profile or endstrength. Table 17 also shows that there are modest cost savings associated with most of the BRS scenarios. For example, we estimate that the steady-state BRS baseline will result in savings of about $1.4 million per year even with a very slight increase in endstrength.

The two highest cost-saving scenarios—1-percent PDR and no DOD TSP matching contributions—generate savings through different means. We estimate that endstrength decreases by about 8 percent with the lowest PDR (1 percent). The cost savings result from lower set-aside amounts for fewer servicemembers. In contrast, in the scenario where DOD makes no matching TSP contributions, endstrength is largely unaffected, so cost savings are driven simply by lower Marine Corps outlays.

The remaining scenarios have similar savings outcomes as the BRS baseline of $1 million to $3 million per year in the steady state. The exception is the largely negligible savings generated by the scenario in which DOD contributions to the TSP

are maximized. In this case, there is minimal change in the endstrength, but the DOD TSP contributions are roughly equal to the set-aside savings.

Table 17. Enlisted RC retirement costs (in millions of dollars) and steady-state endstrength

	Current system	Base-line	PDR = 1%	PDR = 18%	TSP = 1%	TSP = 5%	Vest at 5 YOS	TSP = 6%; vest at 5 YOS	3.15% ROI
MRTF set-aside	33.1	26.6	23.5	26.8	26.4	26.7	26.6	26.7	26.5
Set-aside savings[a]	---	6.5	9.6	6.3	6.7	6.4	6.5	6.4	6.6
TSP		4.7	4.0	4.7	1.4	5.8	3.2	4.4	4.7
CP		0.4	0.3	0.5	0.4	0.4	0.4	0.5	0.4
Total savings		1.4	5.3	1.2	4.8	0.2	2.9	1.5	1.5
Estimated number in RC	**32,749**	**32,901**	**30,211**	**32,993**	**32,711**	**32,966**	**32,895**	**33,017**	**32,812**

Source: CNA calculations.

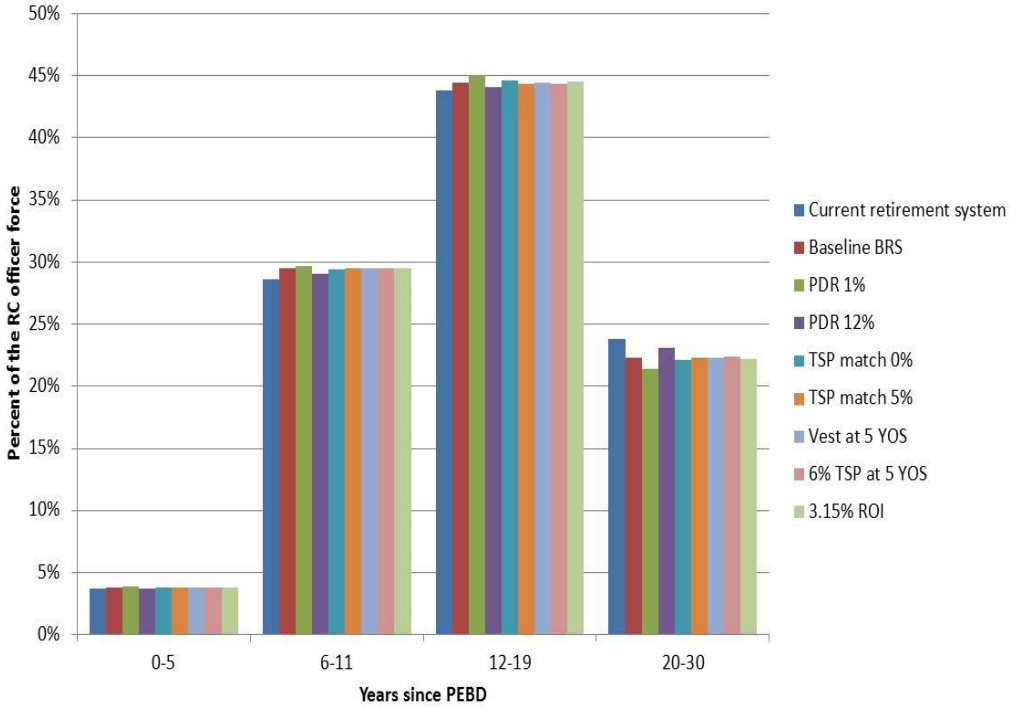
a. Set-aside saving is the difference between the MRTF set-aside under the BRS scenario and the current retirement system.

Officer results

The effects of the BRS on RC officer force profiles are proportionately larger than those for the RC enlisted force, although they are still modest. This occurs via two mechanisms. First, enlisted affiliation rates tend to increase under the BRS, whereas officer affiliation rates tend to decrease. Second, officer loss rates increase slightly, meaning that fewer of the officer affiliations remain in the RC. Projected cost savings are minimal, and would likely become slightly negative if the Marine Corps chose to maintain endstrength via an increase in NPS officer accessions or through increased affiliation incentives.

As Figure 27 shows, we estimate that all of the BRS scenarios (including the baseline) will lead to slightly more junior RC officer force profiles in the steady state compared with the current retirement system. As we found for enlisted personnel, the change in the officer force profiles is most pronounced for the very low PDR scenario. Officers with low PDRs value the future stream of DBs more than Marines with high PDRs do. When the future stream of DBs is reduced, this leads to lower RC continuation.

Figure 27. Officer RC steady-state force profiles



Source: CNA calculations.

Table 18 shows the steady-state officer endstrength by scenario. There is a decrease in BRS baseline endstrength of about 6 percent compared with the endstrength under the current retirement system. Except for the low and high PDR scenarios, most BRS scenarios yield about the same endstrength as the baseline BRS. Compared with the baseline BRS, endstrength decreases by 8 percent with a very low PDR assumption and increases by 5 percent with a high PDR assumption. Projected endstrength under every BRS scenario is less than that under the current retirement system.

Table 18. Officer RC steady-state endstrength under various scenarios

	Current system	Base-line	1% PDR	12% PDR	TSP match 0%	TSP match 5%	Vest at 5 YOS	6% TSP at 5 YOS	3.15% ROI
Esti-mated number in RC	**2,564**	**2,423**	**2,220**	**2,531**	**2,371**	**2,440**	**2,422**	**2,458**	**2,396**

Source: CNA calculations.

Table 19 displays the officer personnel cost savings under the various BRS scenarios. The set-aside savings under the BRS, which is driven by the reduced set-aside rate as well as the overall decrease in endstrength, is approximately $2 million a year in the steady state. Except when we assume a very low PDR or when DOD makes no TSP matching contributions, the DOD TSP matching contributions and the CP offset the majority, if not all, of the set-aside savings.

A worst case scenario is one in which DOD matches contributions dollar for dollar for 5 percent of BP (i.e., total DOD TSP contributions are 6 percent) and where vesting begins at 5 YOS. In this case, the BRS is both more expensive and decreases endstrength compared with the current retirement system.

Table 19. Officer RC retirement costs (in $millions) and steady-state endstrength

	Current system	Base-line	PDR = 1%	PDR =12%	TSP = 1%	TSP = 5%	Vest at 5 YOS	TSP = 6%; vest at 5 YOS	3.15% ROI
MRTF set-aside	8.1	6.1	5.6	6.4	6.0	6.1	6.1	6.2	6.0
Set-aside savings		2.0	2.5	1.7	2.1	2.0	2.0	1.9	2.1
TSP		1.3	1.2	1.3	0.3	1.6	1.3	1.9	1.3
CP		0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Total savings		0.4	1.1	0.0	1.5	0.0	0.4	-0.3	0.5
Estimated number in RC	**2,564**	**2,423**	**2,220**	**2,531**	**2,371**	**2,440**	**2,422**	**2,458**	**2,396**

Source: CNA calculations.

In summary, the officer RC force profile is slightly more sensitive to alternative BRS scenarios than is the enlisted RC force profile. The force profile becomes slightly more junior under all of the BRS scenarios than it was under the current retirement

plan. Furthermore, we typically see a decrease in endstrength of 100 to 200 officers. These decreases are due to both slightly lower affiliations and slightly lower continuation rates. Finally, personnel cost savings for RC officers are expected to be minimal under the BRS; the only BRS scenario where endstrength was essentially unchanged (the 12% PDR scenario) produced no cost savings.

Summary and Conclusions

We estimated the effect of the BRS on Marine Corps force profiles and personnel cost savings. Using the MCRMC assumptions, we estimate baseline enlisted and officer BRS force profiles and long-term annual personnel cost savings. We then ran what-if scenarios to test the sensitivity of our results to changes in the assumptions.

We also estimated the effect of the BRS on take-home pay for representative AC Marines, both when they are in AC service and in retirement. Again, we estimated baseline BRS effects using the MCRMC assumptions, and then we tested the sensitivity of our estimated effects to changes in the underlying assumptions.

AC summary

Based on our AC results, we conclude the following:

- Aggregate enlisted force profiles are not sensitive to changes in the underlying assumptions. Regardless of our assumptions, the BRS's effect on reenlistment rates is small; therefore, force profiles are largely unaffected.
- Enlisted personnel cost savings are more sensitive to changes in the assumptions than the force profiles. We estimate long-term baseline enlisted personnel cost savings of about $122 million a year, but our estimates range from $87 million to $225 million, depending on assumptions about TSP contribution rates and opt-in rates.
- Aggregate officer force profiles are more sensitive to changes in underlying assumptions than enlisted force profiles, but the changes to officer force profiles are relatively small even over a sizable range of assumptions.
- On a percentage basis, officer personnel cost savings vary more than those for the enlisted force when assumptions are changed. Our long-term annual baseline officer cost-saving estimate is $21 million, but our estimates range from $10 million to $54 million, depending on assumptions about TSP contribution rates and opt-in rates.

- Mitigating strategies do not appear necessary for the aggregate force profiles because they don't change much with changes in underlying assumptions. However, this aggregate result may not hold for certain MOSs. In particular, if Marines in certain MOSs have lower PDRs and lower reenlistment rates than the force averages, the BRS may affect the MOS-specific force profile enough to require mitigating strategies.

We also estimated the BRS's effect on the short- and long-term finances of individual representative AC Marines. We find the following:

- Marines who separate before YOS 20 are better off under the BRS than under the current system—even if they choose not to contribute to the TSP—because they still receive the 1-percent automatic DOD contribution, which becomes income after age 60.

- Assuming that Marines contribute the same amount to the TSP under both retirement systems, take-home pay while in AC service is the same under both systems. Those who complete a 20-year career and contribute to the TSP will have generally lower take-home pay from military service between retirement and age 60 and higher take-home pay after age 60, when TSP withdrawals begin. If these Marines are able to adjust their borrowing and saving to shift income to the immediate post-retirement period, they may be as well-off under the BRS as they were under the current retirement system.

- The results are sensitive to the underlying assumptions. In particular, lowering the assumptions about TSP contribution rates and ROI can make those who retire at YOS 20 worse off under the BRS than under the current retirement system.

RC summary

Although we built a separate model for analyzing the BRS effects on the RC, we use the same strategy of adjusting continuation rates to reflect the estimated response to changes in lifetime military earnings as we did in our AC model. A key difference is that we allow RC endstrength and the number of RC members in each paygrade to change under the BRS scenarios. Nevertheless, in general, we find minimal BRS effects on enlisted and officer force profiles, and correspondingly modest personnel cost savings under the BRS. Specifically, we find the following:

- RC enlisted personnel cost savings under the baseline BRS are about $1.5 million in the long term. The high and low estimates across the BRS scenarios range from $0.2 million to $5.3 million.

- RC officer personnel cost savings under the baseline BRS are about $0.4 million, with a range of -$0.3 million to $1.5 million. Some of these savings result from a smaller force profile under the particular BRS scenario, so mitigating strategies to maintain endstrength may further reduce these estimated personnel cost savings.

Implications

Our estimates indicate that force profile changes under the BRS should be small enough to address with current force management tools. However, Marine Corps manpower planners and analysts must carefully track reenlistment and continuation rates as the BRS is implemented. Should data indicate that reenlistment and continuation rates are changing more than current force management tools can address, the Marine Corps could pursue changing the level or timing of the BRS CP and/or adjusting or expanding other force management levers.

Appendix A: Description of the Military Retirement Benefit and a Brief History of Revisions

Because the military retirement system has been revised over the years, an AC member's potential retirement benefit is determined by when he or she entered the military. There are currently three possible systems, and soon to be a fourth, to which a retiree belongs.

Servicemembers who entered the AC *before 1980* and who remained active for 20 years of service (YOS) received an annuity that was equal to 2.5 percent of his or her *final year's* basic pay (BP) times the number of YOS at the time of retirement. So, a servicemember who stayed 20 years would receive an annuity of 50 percent of the final year's BP. For servicemembers who stay beyond 20 years, the annuity would increase by 2.5 percent of BP per year up to year 30. Thus, an AC member who retired at 30 YOS would receive an immediate annuity worth 75 percent of final-year BP.

After retirement, the amount of the retirement annuity would be indexed to the cost of living, meaning that annual Cost of Living Adjustments (COLAs) increased the annuity each year by the Consumer Price Index (CPI). Thus, the value of the annuity would remain the same in real terms throughout the retiree's lifetime.

This system changed in 1980 to a retirement plan known as High-3. For those who entered the AC between 1980 and 1986, the retirement would be similar to the one just described, except that the annuity would be based on the average of the highest 36 months of BP over a servicemember's career, most typically the last 3 years of AC service. Otherwise, the rules would be the same. The servicemember would receive an annuity equal to 2.5 percent of High-3 BP times the number of YOS, payable at retirement, and it would be increased annually by the CPI.

Because the vast majority of servicemembers leave before YOS 30, only a very small number of servicemembers currently remain on either of these plans.

In 1986, the military reformed its retirement system under the Retirement Reform Act of 1986. Servicemembers who entered the service between 1986 and 1999 fall under this system. Here, the servicemember who retired with 20 YOS would receive

an immediate annuity of 40 percent of the High-3 BP (vice 50 percent under the previous system). If he or she remained active beyond 20 years, the annuity would increase by 3.5 percent of High-3 BP for each additional year of AC service up to 30 YOS. As a result, an AC member who stayed 30 YOS would receive the same annuity as under the original High-3 system (i.e., 75 percent of High-3 BP). This reduces the pull of a 20-year retirement, but, for servicemembers who reach YOS 20, it provides an added incentive to extend their careers beyond 20 years.[56]

Also, under this system, annual COLAs for the annuity would not be as high as under the previous High-3 plan. Here, the COLA would be the CPI *minus 1 percentage point* until the retiree reached age 62. Then, at age 62, the retiree's annuity would receive a one-time increase to reflect the total change in cost of living from the year of retirement. After age 62, his or her annuity would resume rising each year at the CPI minus 1 percentage point for the remainder of the retiree's lifetime.

Under the National Defense Authorization Act (NDAA) of 1999, however, the Retirement Reform Act of 1986 was repealed, following complaints from servicemembers that the system was not fair and complaints by military leaders that it hurt retention. That said, in 1999, the Congressional Budget Office estimated the effects of the reduced retirement benefit on retention and found them to be small and not statistically significant [10]. It is possible that the long-term benefit of the 1986 retirement reform was sacrificed because of a temporary concern about poor retention, even though the poor retention likely was not caused by the retirement reform and could have been addressed more effectively with reenlistment bonuses.

Under the NDAA of 1999, the military returned to the original High-3 retirement system, but with one difference: servicemembers can choose between the two plans. When servicemembers enter their 15th YOS, they can choose between going back to the High-3 plan and taking the *Redux* retirement plan, which is what the 1986 Retirement Reform plan became. Under Redux, servicemembers receive a $30,000 bonus at YOS 15 and, when they retire, receive the smaller annuity and reduced cost-of-living increases of the 1986 plan.

This system is still in place, but that is slated to change as of December 31, 2017. On December 26, 2013, Congress approved and President Obama signed House Joint (H.J.) Resolution 59, entitled the "Continuing Appropriations Resolution of 2014," which changes the current system. That new law, Public Law 113-67, reduces the annual COLA of the annuity to CPI minus 1 percentage point for retirees under age

[56] The mechanics of this system are similar to the plan that current servicemembers can choose that is called Redux, except that, as we'll see, under the current Redux, the servicemember receives a $30,000 bonus at YOS 15.

62.[57] At age 62, retirees under the new system receive a one-time increase to reflect total change in cost of living from the year of retirement. After age 62, COLAs begin rising with the CPI.

Public Law 113-67 was itself reversed by the current Retirement Reform Law, under the NDAA of 2015, which will override 113-67 when it takes effect on January 1, 2018.

[57] Information provided by Library of Congress website at https://www.loc.gov/. See http://thomas.loc.gov/cgi-bin/bdquery/z?d113:HJ00059:@@@D&summ2=m&.

Appendix B: Theoretical Underpinnings of the Model

As background to our simulation model, we present some underlying theory about how to value a retirement benefit.

Brief overview of the theory of valuing a retirement benefit

Present value of the military retirement benefit

In general, when servicemembers retire, they are eligible for a pension (which we will refer to as *A)* that is equal to 2.5 percent of the average of their highest three years of BP *(High3)* times the number of years of service at retirement. This is shown in equation (1).

$$A = 0.025 * YOS_R * High3 \quad (1)$$

where:

A = dollar amount of the servicemember's annual retirement payment (called the annuity)

$High3$ = the average of the highest three years (usually the last three years) of AC BP

YOS_R = the YOS at retirement

At YOS_R = 20, for example, servicemembers are eligible for 50 percent of their *High3*. The MCRMC suggests that this is an average of about $25,820 per year for roughly 46 years.[58] This is about $1,187,630 in total payments ($25,820 times 46).

However, the typical servicemember (or any person) would not place nearly that much value on this pension benefit. Because most of those payments are uncertain and would come far into the future, the value of the benefit—specifically, the present discounted value (PDV) of this benefit—depends critically on the personal discount rate (PDR).[59]

The authors of [1] presented the value of the military enlisted and officer pension as a lump-sum PDV. This has become a regular practice in communicating the value of the pension and for comparing the pension systems (see [10], [11], [12], [13] and [14]).

The lump-sum PDV of a pension is typically defined as the sum of future pension payments, each discounted from the beginning of the retirement to the future payment itself using a PDR. Using a PDV is important for distinguishing between nominal dollar amounts paid in the future and the real current value of these payments.

The military pension, when earned, is comparable to a guaranteed, inflation-indexed, lifetime annuity. In general, the PDV of this type of annuity is calculated as follows:

$$PDV(A_k) = \frac{A_k^0 * (1+d)}{(d-i)} * [1 - (\frac{1+i}{1+d})^T] \quad (2)$$

where:

A_k = the annual payment in real terms[60] (here we estimate it at $25,820)

[58] The *High3* is equal to the average of the servicemember's highest three years of BP, usually the final three years. The commission illustrated this in its final report by considering an E-7 who retires at age 38 and lives until age 85. According to [1], High3 for an enlisted person who was an E-7 for his or her last three years would be roughly $51,640. Half of that is $25,820. For a notional O-5 who retires at age 42, the analogous pension amount is estimated to be $49,485.

[59] There is uncertainty in any future payment. The military retirement benefit is uncertain, even for those who want to stay. Some career servicemembers may be involuntarily separated from the service, may change their life plans, or perhaps may die before reaching retirement eligibility.

[60] The real value of the military pension for any following year is equal to the dollar amount divided by the inflation rate for the previous year. Thus, the real value of the annuity is constant at $25,820 because the dollar amount received by the retiree will be increased each year by the inflation rate as estimated by the Consumer Price Index.

d = personnel discount rate (the commission assumes 12.7 percent for enlisted and 6.4 percent for officers)

T = number of years retirees expect to receive the pension (the commission assumes 46 years)

i = the annual rate of inflation

If we assume that the rate of inflation (i) = 0 (i.e., no inflation), the present value calculation becomes:[61]

$$PDV(A_k) = \frac{A_k^0}{d} * [1 - (\frac{1}{1+d})^T] \quad (3)$$

Thus, if A_k = \$25,820, d = 0.127, and T = 46 years, the estimated PDV of the typical enlisted person's pension is:

$$PDV = \frac{25{,}820}{.127} * \left(1 - \frac{1}{245}\right) = \$202{,}476 \quad (4)$$

This is *substantially less* than the \$1,187,630 of total payments calculated without discounting.

According to the commission, an O-5 officer who retires at age 42 would receive about \$49,485 in pensions. If he or she lives to 85, this is about \$2,078,370 in total payments. Again though, the PDV depends on the PDR. The commission assumes an average officer has a discount rate of about 6.4 percent.

As a result, the estimated PDV of the officer's pension is:

$$PDV = \frac{49{,}485}{.064} * \left(1 - \frac{1}{94}\right) = \$716{,}074 \quad (5)$$

Again, this is substantially lower than the \$2,078,370 in nondiscounted total payments.

[61] The MCRMC assumed zero inflation throughout its analyses. We use the same assumption. Real dollars are what matters for most behavioral responses. So, from a financial point of view, no real differences should occur as a result of this assumption.

Note that the PDV of the pension depends critically on the PDR. For the notional enlisted servicemember with a discount rate of 12.7 percent, the PDV is about 17 percent of the total payments ($202,476/$1,187,630). For the notional officer with a much lower PDR of 6.4 percent, the PDV is about 34 percent of total payments ($716,074/$2,078,370).

Discounting back to a servicemember's YOS

We have described the value of the pension for enlisted and officers at YOS 20. In other words, this is how the servicemember values the pension *at the moment they become eligible for it*. Younger servicemembers, for whom YOS 20 is still in the future and who still must earn the retirement benefit, will further discount that lump-sum PDV by the number of years until eligibility. Thus, a servicemember who is deciding whether to reenlist will look at the discounted PDV of the retirement benefit as described in equation (6):

$$\frac{PDV(A_k)}{(1+d)^{(20-y)}} \tag{6}$$

where:

y = the servicemember's current YOS

For example, an enlisted person at YOS 4 would estimate the discounted value of the retirement benefit as:

$$\frac{PDV(A_k)}{(1+d)^{(20-y)}} = \frac{= \$202{,}476}{1.127^{\wedge 16}} = \$29{,}894 \tag{7}$$

Consequently, although the lump-sum PDV of the benefit is $202,476 at YOS 20, it is worth less than $30,000 when discounted back to YOS 4, or about 15 percent of the lump-sum PDV of the benefit at YOS 20. For the notional officer, the PDV at YOS 4 would be about 37 percent of the lump-sum PDV of the benefit at YOS 20.

$$\frac{PDV(A_k)}{(1+d)^{(20-y)}} = \frac{\$716{,}074}{1.064^{\wedge 16}} = \$265{,}394 \tag{8}$$

Valuation of DOD's Thrift Savings Plan (TSP) contributions

The valuation of the TSP contributions and their effect on reenlistment (and continuation) is more complex than its valuation as a simple retirement benefit. Some servicemembers may perceive the benefit as a retirement instrument, while others may see it as a series of short-term investments that they can withdraw after separating from the service (albeit with some tax penalty).

The specific rule that complicates this valuation is that servicemembers are not allowed to withdraw the funds from their TSP accounts until and unless they separate from military service. This could create countervailing incentives at reenlistment. The DOD contributions, which range from 1 to 5 percent of BP, provide a positive incentive to reenlist. By the end of a term, however, servicemembers may have accumulated a sizable sum that they cannot withdraw unless they separate, providing an incentive to leave rather than reenlist.

To illustrate, consider servicemembers finishing a first term enlistment who are considering reenlisting for six additional years and contributing 3 percent of BP to their TSP fund. Under the new system, DOD will contribute 4 percent of BP. According to the MCRMC, contributions are expected to earn nominal market returns of 7.3 percent.[62] On average, total servicemember contributions in those six years will be about $6,500, and DOD's contributions will be about $8,500. At the end of the 12th year of service, the average servicemember will have more than $34,000 in his or her account.

The analytical question is: Would servicemembers consider the TSP as a full retirement benefit, for which DOD contributions over the next 14 years would accumulate an additional $35,000? Or do they consider the TSP benefit a short-term investment, in which case the DOD contributions will accumulate about $8,500 over the next 6 years? Clearly these different perceptions of the benefit would influence reenlistment in different ways. In the first case, servicemembers would look at the future value of 14 years of DOD contributions ($35,000) and discount them back 14 years. Using a discount rate of 12.7 percent, this amounts to a PDV of about $6,560.

In the second case, servicemembers only consider DOD contributions over the 6-year term of enlistment ($8,500) and discount them back by 6 years using a PDR of 12.7 percent, which amounts to a PDV of $4,150.

[62] For the calculations in the body of this report, we use a real market return rate of 4.95 percent.

There is a third possible method for assessing the value of the TSP benefit. At a reenlistment decision, servicemembers weigh the potential future DOD contributions against the $9,500 they currently have, which they can withdraw only if they leave. If they stay, their current account balance ($9,500) will earn 7.3 percent per year, which in six years is worth about $14,500. However, the value today of $14,500 six years from now requires discounting the amount by six years. Using a PDR of 12.7 percent, the discounted value of $14,500 is about $8,650 (i.e., less than $9,500). In addition, DOD will contribute about $9,000 more over the next six-year term, which, after accounting for market earnings, will increase the size of the account by about $11,400. However, the PDV is only about $6,900. The sum of these two PDVs—$8,650 and $6,900—is about $15,550.

Servicemembers compare $15,550 (if they reenlist) with $9,500 (if they leave the service and withdraw their TSP funds). The difference seems substantial: $15,550 – $9,500 = $6,000. But, servicemembers must also weigh $6,000 against the difference in the PDV of the current retirement system benefit and the BRS benefit, where the BRS benefit is 20 percent less than the current retirement system benefit.

Ultimately, we considered two possible methods of looking at valuation of the TSP benefit at the year of the decision:

1. Long-term method: Estimate the present value of the future value of funds accumulated from reenlistment YOS to year of retirement.
2. Short-term method: Estimate the present value of the future value of the funds accumulated from reenlistment YOS to the end of the enlistment term. For example, if the servicemember is deciding whether to reenlist for a 6-year term, then the value of the TSP today is the discounted value of the TSP account balance expected in 6 years.

In the calculations of the PDV of the TSP contributions in this report, we use a modified version of the long-term method.[63] We estimate the FV of the TSP account at 20 YOS. The formula is shown in equation (9:

[63] For the valuation of the TSP in our model, for Marines with less than 20 YOS, we discount the future value (FV) of the DOD TSP contribution amounts at 20 YOS to their current YOS. For Marines with 20 YOS or more, we estimate the value of the TSP account using two different methods. In the first, we calculated the FV of the DOD TSP contribution amounts at 30 YOS. Then, we discounted that amount to the Marine's current YOS (which is between 21 and 29 YOS). This method reflects the possibility that Marines' 20-29 YOS continuation behavior is affected by the value of TSP amounts accumulated after a full 30-YOS career. In the second method, we calculate the annual growth in their TSPs for each YOS between 21 and 29. This method reflects the possibility that, since these Marines are already eligible to retire, their 20-29 YOS continuation behavior may be affected by the yearly increments to their TSPs. Both methods result in nearly identical effects on 20-29 YOS continuation.

$$\text{FV(TSP)} = \sum_{yos=1}^{20}(c * BP_{yos}) * (1 + ROI)^{(20-yos)} \quad (9)$$

where:

BP = basic pay

ROI = the expected annual return on contributions

c = the DOD contribution rate (equals 0.01 for YOS before vesting and 0.01 plus the DOD matching contribution rate for YOS after vesting).[64]

Then, we discount the FV(TSP) to the YOS of interest, *i*, as shown by

$$\text{PDV(FV(TSP))}_i = \frac{FV(TSP)}{(1+d)^{(20-i)}} \quad (10)$$

where:

d = the servicemember's PDR.

Wage elasticities and inferred retention effects: estimates from the literature

Studies have estimated wage elasticities of retention using various methods. Ultimately, however, most translate the results into the implied effect of changes in RMC on reenlistment.

In a survey of the literature, we found that wage elasticities of reenlistment for enlisted personnel range from 0.40 to 2.80. For officers, the comparable range is 0.26 to 1.88. These elasticities vary by service, occupation group, economic conditions, and method of estimation (see [15], [16], [17], [18], and [19]). In these studies, the median estimate for first-term reenlistment is about 1.5 for enlisted personnel and about 1.2 for officers.

[64] We ignore penalties for early withdrawal of TSP funds.

In addition, a few studies include estimates of second-term retention ([17] and [18]). We expect that second-term reenlistment is less sensitive to pay than first-term reenlistment because reenlistment is often associated with a career decision.

In this report, for the AC enlisted and officer analyses, we use wage elasticities equal to 1.5 for servicemembers with YOS 0-5, 1.0 for servicemembers with YOS 6-9, 0.10 for servicemembers with YOS 10-13, 0.06 for servicemembers with YOS 14-19, and 0.02 for servicemembers with YOS 20-30.

Opt-in rates

In the year first year of implementation of the BRS (i.e., calendar year 2018), eligible servicemembers must choose between staying on the current retirement system and opting in to the BRS.[65] The services want to know who is likely to opt in, who is likely to stay, and how reenlistment rates might be affected by these choices.

Forecasting these kinds of choices is always risky. However, a thought experiment can give us some insight into probable outcomes. Consider three mutually exclusive and comprehensive categories of servicemembers making this decision: Category 1 is made up of servicemembers who are planning, with some certainty, to *not* make the military service a career. These servicemembers will not be swayed by changes in compensation to stay in the service. In economic parlance, their wage elasticity of retention is very low. Category 2 comprises servicemembers who *are planning,* with some certainty, to make the military a career. These servicemembers are also unlikely to change these plans for relatively small changes in their compensation. Finally, servicemembers in category 3 are *not sure* whether they do or do not intend to make the military a career and, thus, are on the economic margins of this decision. Their elasticity is relatively high, and they might be swayed one way or the other by a change in the value of their compensation.

We consider how each of these notional categories of servicemembers thinks about the choice and how the decision will influence his or her retention decision and thus the service's retention rates.

The first category is the easiest. Servicemembers who do not intend to stay in the military will not receive any pension benefits in either system. However, under the

[65] Servicemembers who access before January 1, 2018, and who have less than YOS 12 by that date are eligible to opt in to the BRS. Servicemembers with more than YOS 12 as of January 1, 2018, remain on the current retirement system, while those who access on January 1, 2018, and after are subject to the BRS.

new system, they would receive DOD contributions to their TSP accounts during the time they are in the AC. We estimate that first-term servicemembers could separate from the service with between $2,000 and $7,000, depending on the size of their own contributions, their YOS at the opt-in point, the length of their first-term contract, and the ROI on their TSP contributions. In any case, we expect that all of category 1 servicemembers will opt in to the new system in order to receive something rather than nothing. How would this change influence their stay/leave decision and thus retention rates? By definition, we expect that the opt-in decision will not influence the retention of these servicemembers.

The second category of servicemembers fully intends to stay in the AC. They compare the PDV of the current retirement plan and that of the BRS and choose the greatest. The opt-in choice depends on two parameters in the PDV calculations. First, it depends on servicemembers' PDRs. Those with low PDRs place a higher relative value on the long-term pension portion of the retirement system compared with the TSP contributions and CP and, thus, will usually prefer the current plan. By the same logic, those with high PDRs will tend to prefer the BRS.

However, a potential second parameter is the probability that servicemembers will be allowed to stay a full 20 years and become eligible for the pension. As we have seen in the past several years, involuntary separations, while uncommon, are nonetheless a consideration. In addition, servicemembers, particularly officers, may be separated despite their desire to stay if they fail to advance in paygrade on time. The expected PDV of the plans depends on the probability that they will be separated. In particular, the lower the probability of staying to YOS 20, the smaller is the expected PDV of the pension portion of the retirement plan.[66] Therefore, this uncertainty lowers the value of the current plan relative to the new plan. As a result, we expect to see many officers opt in to the BRS, even when they fully intend to make a career of military service.

What effect would this have on the probability of staying and, thus, on the retention rates for this category of servicemembers? Category 2 servicemembers plan to make the military a career, so minor differences in the expected PDV of the two systems are not likely to change this decision. As a result, while we expect that many of them will opt in to the BRS, we do not expect that many, if any, will change their decision to stay in the military. Thus, retention rates for this group are not expected to change.

[66] Uncertainty about the ability to stay in the AC can also lower the PDV of the future values of the CP and the TSP. However, the effect of the uncertainty is less than for the pension because the CP is closer to servicemembers' current YOS, and the TSP can be funded for as long as servicemembers are in the service.

The third category of servicemembers is more complex. These servicemembers are uncertain about whether they want to stay in the military until retirement. We assume that category 3 servicemembers, like those in the other two categories, will estimate the PDV of their lifetime military earnings under both retirement systems and choose the one that provides the greatest value. Because of the uncertainty of reaching YOS 20, either by choice or by fate, many may opt in to the BRS to ensure that they receive some financial benefit in retirement no matter how long they serve.

What about their retention decisions? Younger servicemembers in the third category could decide to reenlist and opt in at YOS 4 based on their estimate that they could accumulate $10,000 to $12,000 in their TSP account by YOS 8.[67] At that point, they may decide that separating is a less risky and potentially a more profitable decision. As a result, they may be less likely to reenlist than they would have been under the current retirement system. Yet, some of these servicemembers may find that a second term in the AC strengthens their desire to serve until retirement, a point of view they might never have discovered had they not chosen to reenlist and opt in at YOS 4. Thus, some servicemembers in category 3 might be more likely to reenlist because of the choice to opt in, while others might be less likely to reenlist because of the choice. The net effect on reenlistment is uncertain.

How many Marines could be in category 3? We examined data on enlisted Marine AC accession cohorts from FY90 to FY01. Across all cohorts, no more than 36 percent of those who were in the AC at YOS 5 were still in the AC by YOS 12. Some of these Marines (perhaps many) were careerists who had every intention of remaining in the AC until retirement (i.e., category 2 Marines). Thus, even if the net reenlistment behavior of category 3 Marines is uncertain, it seems likely that it will have a small effect on overall reenlistment rates.

The first two categories of servicemembers—those definitely staying and those definitely leaving the service—will by definition not change their stay/leave decisions based on the opt-in choice. The third category of servicemembers, those on the margin about whether or not to stay could go either way as a result of the opt-in choice. Some may be more likely to stay if the PDV of the BRS is sufficiently greater than the PDV of the current retirement system. Some may be less likely to stay to the extent that TSP contributions serve as a push factor at the reenlistment decision point. The net effect on reenlistment is uncertain, but, in any case, it is likely to be small. Consequently, throughout this report, we assume that retention rates will not change as a result of the opt-in decision.

[67] This estimate assumes that servicemembers contribute 5 percent to their TSP accounts and expect a 4.95-percent real rate of return.

Appendix C: Calculations in the AC Model

Lifetime military earnings

The current retirement system annuity paid from retirement until the retiree's death using YOS at retirement is A_1:

$$A_1 = 0.025 * \text{High\_3 BP} * \text{YOS} \tag{11}$$

The BRS annuity paid from YOS at retirement until the retiree's death using YOS at retirement is A_2:

$$A_2 = 0.02 * \text{High\_3 BP} * \text{YOS} \tag{12}$$

The PDV of lifetime military earnings under the current retirement plan for a servicemember is denoted as $PDV_1(Y_{YOS=y})$, and is described by equation (13):

$$PDV_1(Y_{YOS=y}) = \left[\sum_{t=1}^{20-y} \frac{W_{(y+t)}}{(1+d)^t}\right] + \left[\frac{PV(A_1)}{(1+d)^{20-y}}\right]. \tag{13}$$

This equation is the sum of annual wages, discounted by the PDR in each year, plus the PDV of the existing retirement pension, where:

$Y_{YOS=y}$ = lifetime military earnings

W_t = the military wage at YOS_t, also called regular military compensation (RMC), equals the sum of BP, basic allowances for housing and subsistence, and the tax advantage

(20 – YOS) = the number of years until retirement eligibility [68]

To calculate the PDV of lifetime military earnings under the BRS, we must also consider the valuation of the TSP and the CP. The future value (FV) of the TSP is the value of the TSP account balance at some point in the future. It depends on the TSP contribution amounts over time and the ROI. The PDV of the FV of the TSP is included in the servicemember's PDV of lifetime military earnings under the BRS. At the career decision point for servicemembers who plan to stay until retirement, we denote this by *PDV(FV(TSP))*. It is described in equation (10).

The PDV of the YOS 12 CP for servicemembers at the career decision point is *PDV(CP)* is described by equation (14):

$$PDV(CP_{YOS=y}) = \frac{CP}{(1+d)^{12-y}} \tag{14}$$

The PDV of lifetime military earnings under the BRS for a servicemember at a given YOS is denoted $PDV_2(Y_{YOS=y})$. It is the sum of equations (10) (described earlier), (13), and (14) and is shown in equation (15):

$$PDV_2(Y_{YOS=y}) = \left[\sum_{t=1}^{20-y} \frac{W_{(y+t)}}{(1+d)^t}\right] + \left[\frac{PV(A_2)}{(1+d)^{20-y}}\right] + \left[PDV(FV(TSP))_{YOS=y}\right] + \left[PDV(CP_{YOS=y})\right] \tag{15}$$

Equation (15) describes the sum of annual wages, discounted by the PDR in each year, plus the discounted sum of the PDV of the BRS pension, the PDV of the FV of the TSP, and the PDV of the CP.

To illustrate, consider an E-7 at YOS 16 with 4 YOS left until retirement and a PDR of 12.7 percent. His or her lifetime military earnings under the current retirement system are the sum of the discounted sum of career wages (sum of the terms in the

[68] Although the BRS allows servicemembers to take a lump-sum payment at retirement in exchange for a reduced stream of benefit payments in retirement, we do not model this feature of the BRS. Instead, in this report, we assume that no Marine Corps personnel who stay until retirement choose the lump-sum retirement benefit option.

first bracket = $245,555) and the discounted value of the pension (term in the second bracket = $125,510). Therefore, lifetime military earnings equal $371,065, as shown in (16):

$$PDV(Y_{YOS=16}) = \left[\frac{\$81{,}420}{(1.127)^1} + \frac{\$81{,}420}{(1.127)^2} + \frac{\$82{,}828}{(1.127)^3} + \frac{\$82{,}828}{(1.127)^4}\right] + \left[\frac{\$202{,}476}{(1.127)^4}\right] = \$245{,}555 + \$125{,}510 = \$371{,}065 \quad (16)$$

Equation (17) shows the percentage change in lifetime military earnings after a reduction in the pension benefit (denoted by α), the addition of the TSP, and the addition of the continuation bonus, which is denoted by δ:

$$\delta = \frac{\left[\frac{\alpha * PDV(A_1)}{(1+d)^{20-YOS}}\right] + [PDV(FV(TSP))] + [PDV(CP)]}{\left[\sum_{t=1}^{20-YOS} \frac{W_{(YOS+t)}}{(1+d)^t}\right] + \left[\frac{PDV(A_1)}{(1+d)^{20-YOS}}\right]}, \quad (17)$$

where:

α = change in the pension benefit under the BRS (20 percent)

δ = change in the PDV of lifetime military earnings brought about by the change in the retirement system

Using our example, a 20-percent reduction in the retirement benefit and an addition of the TSP and CP causes a 5.2-percent reduction in the PDV of lifetime military earnings for an E7 at YOS 16.[69] See equation 18.

$$\delta = \frac{-\left[\frac{0.20 * \$202{,}476}{(1.127)^4}\right] + [\$5{,}779]}{\$371{,}065} = \frac{-\$19{,}323}{\$371{,}065} = -5.2\% \quad (18)$$

Wage elasticities and change in reenlistment

The calculation in the compensation and reenlistment component of the simulation model is the effect of changes in lifetime military earnings on reenlistment rates.

[69] A servicemember at YOS 16 has already received his or her CP at YOS 12, so the PDV of the CP is zero in this equation.

Changes in lifetime military earnings affect reenlistment rates through the wage elasticity of reenlistment, or the responsiveness of reenlistment to compensation changes. Formally, wage elasticity of reenlistment is the percentage change in expected reenlistment given a 1-percent change in the present value of career compensation, as shown in equation 19.

$$\varepsilon = \frac{\%\Delta R}{\%\Delta PDV(Y)} \tag{19}$$

where:

E = wage elasticity of reenlistment

R = reenlistment rate, which is YOS-specific (R applies only to servicemembers in that YOS who are eligible to reenlist).

PDV(Y) = the PDV of lifetime military earnings described above

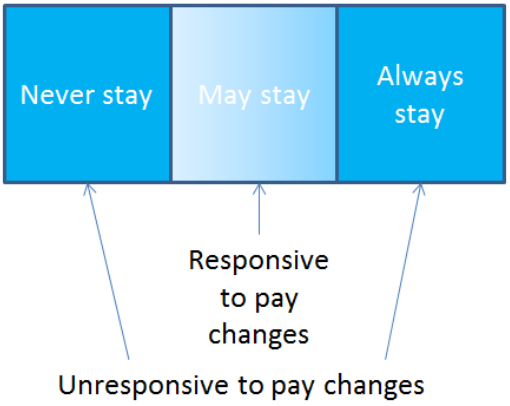
A wage elasticity of reenlistment of 2 means that a 1-percent change in lifetime military earnings causes a 2-percent increase in reenlistment rates.

Servicemembers can be sorted into three groups according to their responsiveness to changes in compensation (illustrated in Figure 28):

1. Those who have no intention of staying in the military
2. Those who fully intend to stay in the military
3. Those who may stay or leave (their decision depends on their wage elasticity of reenlistment)

Servicemembers who have no intention of staying or who have every intention of staying—no matter how their pay changes—are considered to have very low wage elasticities and are largely unresponsive to pay changes. Those who may stay—depending on pay changes—are considered to have relatively high wage elasticities of reenlistment. In theory, the Marine Corps could raise pay enough to make all of these Marines stay or could raise pay too little so that none of them stay.

Figure 28. Wage elasticity of retention: Responsiveness to pay changes



There are estimates of wage elasticities of retention at various career points in previous research. A brief summary of the research is found in Appendix B. Based on this previous research, the wage elasticities that we use are 1.5 for YOS 0-5, 1.0 for YOS 6-9, 0.1 for YOS 10-13, 0.06 for YOS 14-19, and 0.02 for YOS 20-30. We multiply δ in equation (18 by the wage elasticity of reenlistment in equation (19 to estimate the effect of the BRS on reenlistment rates.

Consider our earlier estimate of the change in the PDV of total compensation brought about by the BRS for an E-7 with YOS 16. To find the amount by which we must adjust reenlistment rates due to the BRS, we multiply δ (-5.2 percent) by the appropriate wage elasticity. In this case, -5.2 percent should be multiplied by the Zone D wage elasticity, or 0.6. Thus, we estimate that the historical reenlistment rate for Marines at YOS 16 should be adjusted downward by -5.2 percent x 0.6 = -3.12 percent.[70]

Using this method, we adjust all of the historical reenlistment rates across YOS 0-30. We use the adjusted reenlistment rates in the personnel aging component of the model to simulate short- and long-term future force profiles under the BRS.

[70] This is a *percentage* adjustment to the reenlistment rate, not a *percentage-point* adjustment to the reenlistment rate.

Appendix D: Calculations in the RC Model

We provide additional detail on the calculations in our RC model.

RC wage growth

To estimate the real BP growth rate, we use information on all of the servicemembers in our RC dataset from FY06 to FY14. We also use the real BP that we assigned to them when we first observe them in our data, as well as their YOS and their paygrade at that time.

We use nonlinear least squares regression to estimate equation (20), where g_{YOS} is the growth rate in BP due to an increase in YOS, g_{CY} is the growth rate in BP due to an increase in the calendar year (CY) (i.e., the year of the cohort), and a is the "baseline" real BP, or the average level of real BP for RC members at YOS 0.[71]

$$observed\ real\ BP = \{a\} * (1 + g_{YOS})^{YOS} * (1 + g_{CY})^{CY-2006} \quad (20)$$

The regression yields estimates for a, $g_{YOS,}$ and g_{CY} (which we indicate by $\hat{a}$, $\widehat{g_{YOS}}$ and $\widehat{g_{CY}}$). Combined, the estimated total annual growth rate in real BP equals $\hat{g}$, which is shown in equation (21).

$$\hat{g} = (1 + \widehat{g_{YOS}}) * (1 + \widehat{g_{CY}}) - 1 \quad (21)$$

Using data from MCTFS, we estimate annual growth rates in real BP for RC enlisted personnel and officers of 5.5 percent and 3.1 percent, respectively.

[71] Effectively, the term a represents the average real BP level for NPS Marines in their first YOS.

To calculate BP over an RC career, we assign an average real BP amount to each Marine based on YOS and paygrade at entry into the RC. We then apply the growth rate $\hat{g}$ to the Marines' entry BP for each year that they remain in the RC. Note that RC Marines with the same YOS at a point in time will have different levels of BP that vary by the amount of AC and RC experience they have acquired. For example, an NPS RC Marine with 6 YOS gained all of his YOS entirely in the RC. He is assigned the average real BP of an NPS Marine in the year that we first observe him in the RC (i.e., at YOS 0), and this average BP amount is grown for 6 years by the estimated growth rate described in equation (21). By contrast, another RC Marine with 6 YOS may have entered the RC at YOS 6 (i.e., his 6 YOS were gained entirely in the AC). His assigned BP at the time he enters the RC is the average BP level for all RC members with 6 YOS who entered the RC at the same time that he did. In this case, we do not have to apply the growth rate in equation (21) to this Marine's pay until his second year in the RC.

Lifetime RC military earnings

Under the current retirement system, the value of staying in the RC is the sum of the PDVs of drill pay and the stream of DBs.[72] Equation (22) shows the first part of the PDV calculation for RC Marines who are not yet eligible for retirement: the PDV of the stream of drill pay. We let g represent the growth rate in drill pay and d represent the PDR. The PDV of drill pay is

$$PDV(drill\ pay) = \sum_{i=current\ YOS}^{30} Real\ drill\ pay * points\ per\ year * \left(\frac{(1+g)}{(1+d)}\right)^{i-current\ YOS} \quad (22)$$

Equation (23) shows the second part of the PDV calculation for RC Marines with fewer than 20 YOS: the PDV of the stream of DBs that they will receive if they stay to 30 YOS.

[72] Although there are retention bonuses in the RC (separate from the CP in the BRS), our data do not allow us to identify Marines who are eligible for such bonuses. Therefore, we do not model these bonuses.

$$PDV(DBs) = \sum_{j=60}^{Age\ at\ death} .025 * \frac{(Expected\ retirement\ points)}{360} * Annual\ High\ 3\ pay * \left(\frac{1}{(1+d)}\right)^{j-current\ age} \quad (23)$$

Thus, under the current retirement system, the PDV of lifetime RC military earnings for Marines who have not yet reached retirement eligibility is the sum of equations (22) and (23).

For RC Marines who have already completed 20 YOS, the value of remaining in the military is less straightforward. Since some amount of DB will be paid regardless of whether the Marine remains in the RC, the value of staying in the RC under the current system is the sum of the PDVs of:

1. Drill pay
2. Increased value of DBs via higher High-3 pay
3. Increased value of DBs due to additional time served

The first item is the same as shown in equation (22). The last two items can be written as shown in equation (24).

$$PDV(additional\ DBs) = \sum_{j=60}^{Age\ at\ death} \left(.025 * \frac{(Expected\ retirement\ points)}{360} * Expected\ High\ 3\ pay * \left(\frac{1}{(1+d)}\right)^{j-current\ age} - .025 * \frac{(Current\ retirement\ points)}{360} * Current\ High\ 3\ pay * \left(\frac{1}{(1+d)}\right)^{j-current\ age}\right) \quad (24)$$

The PDV of lifetime RC military earnings under the current retirement system is the sum of equations (22), (23), and (24).

Under the BRS, the PDV of the stream of drill pay is the same as under the current retirement system (see equation (22)). The PDV of the stream of DBs under the BRS for Marines who are not eligible for retirement is shown in equation (25).

$$PDV(DBs) = \sum_{j=60}^{Age\ at\ death} .020 * \frac{(Expected\ retirement\ points)}{360} * Annual\ High\ 3\ pay * \left(\frac{1}{(1+d)}\right)^{j-current\ age} \quad (25)$$

The PDV of the stream of DBs under the BRS for Marines who are eligible for retirement is shown in equation (26).

$$PDV(additional\ DBs) = \sum_{j=60}^{Age\ at\ death} \left(.020 * \frac{(Expected\ retirement\ points)}{360} * Expected\ High\ 3\ pay * \left(\frac{1}{(1+d)}\right)^{j-current\ age} - .020 * \frac{(Current\ retirement\ points)}{360} * Current\ High\ 3\ pay * \left(\frac{1}{(1+d)}\right)^{j-current\ age}\right) \quad (26)$$

Under the BRS, we must also include the PDV of the future value (FV) of the TSP and the CP. These are shown in equations (27) and (28), respectively.

$$PDV(TSP) = \left(\sum_{i=0}^{30} Contribution_i * (1+ROI)^{60-age\ at\ YOS\ i}\right) * \left(\frac{1}{1+d}\right)^{60-current\ age} \quad (27)$$

$$PDV(CP) = 0.5 * BP_{YOS\ 12} * \left(\frac{1}{1+d}\right)^{12-current\ YOS} \text{ if YOS} \leq 12 \quad (28)$$

Thus, the PDV of lifetime RC military earnings under the BRS is the sum of equations (22), (25), (26), (27), and (28). We can then take the difference in the PDV of the stream of lifetime RC military earnings calculated under the current retirement system and under the BRS at every YOS.

YOS-specific affiliation rates

We estimate the probability of affiliating with a Selected Marine Corps Reserve (SMCR) unit or Individual Mobilization Augmentee (IMA) billet for Marines leaving the

AC. In particular, we estimate separate logistic regression (logit) models for the population of transitioning enlisted personnel and officers. Because these populations are inherently different (e.g., generally high school versus college graduates), they face different affiliation incentives and likely respond differently to changes in their environment.

Once in the RC, a Marine may move in and out of the Selected Reserve (SelRes).[73] As a result, an individual Marine may have multiple points of affiliation with SMCR units or IMA billets. For our analysis, we focus on Marines' first affiliations with an SMCR unit or an IMA billet.[74] Our logit models control for the number of months a Marine spent in the Individual Ready Reserve (IRR) before his or her first SelRes affiliation (i.e., time-to-affiliation). For Marines who never affiliate, time-to-affiliation defaults to either the number of months in the IRR before leaving the RC entirely or the end of the sample period, whichever comes first.

We estimate our affiliation model using data from the MCTFS database. Table 20 lists the MCTFS variables that we include in our affiliation model. We control for a Marine's demographic and service-related characteristics in the month that he or she transitioned to the RC. To control for the local economic environment, we include the state unemployment rate at the time a Marine left the AC as well as the change in the state unemployment rate in the six months before transition.

Our affiliation model yields estimates of YOS-specific affiliation rates that include the effects of demographic and service-related characteristics. Thus, our approach assumes that the RC of the future will have demographic and service-related characteristics similar to today's RC.

[73] The SelRes includes Active Reserve, SMCR and IMA positions.

[74] A Marine might enter the IRR after transitioning, then affiliate with an SMCR unit, leave the unit, and go back into the IRR, only to decide later to go into an IMA billet. For this Marine, the month of SMCR affiliation coincides with the month that he or she affiliated with an SMCR unit.

Table 20. Variables in our statistical model of RC affiliation

Variable	Variable description
Dependent variable	
SelRes affiliation	1 if transitioning Marine affiliated with SMCR unit or IMA billet; 0 if the Marine remains in the IRR
Explanatory variables	
Male	1 if transitioning Marine is male; 0 if Marine is female
Race	Two 0/1 variables indicating if the transitioning Marine is black or other minority (white is omitted category)
Ethnicity	1 if transitioning Marine is Hispanic; 0 if the Marine is non-Hispanic
Marital status	Two 0/1 variables indicating if the Marine is married or divorced/separated (single is the omitted category)
Number of dependents	Four 0/1 variables indicating if the transitioning Marine has 1, 2, 3, or 4 or more dependents (no dependents is the omitted category)
Enlisted education level	Three 0/1 variables indicating if the transitioning Marine is Tier 1 with a college degree, other Tier 1, or Tier 2/Tier 3 (Tier 1 with a traditional high school diploma is the omitted category)
Officer education level	1 if transitioning officer has a graduate or professional degree; 0 if officer has a bachelor's degree
Geographic region	Eight 0/1 variables that indicate the transitioning Marine's geographic area of residence based on his or her state of residence the first time he or she appeared in MCTFS after transitioning, defined using the Census Bureau's geographic divisions
State unemployment rate	Continuous variable indicating the unemployment in the state the transitioning Marine lived the first time he or she appeared in MCTFS after transitioning
Change in state unemployment rate	The change in the unemployment rate of the transitioning Marine's state of residence in the six months before transition
Enlisted AC separation reason and paygrade	Set of 5 variables for enlisted Marines and a set of 3 variables for officers equal to 1 if the transitioning Marine is in the specified grade
Recommended and eligible	1 if transitioning enlisted Marine was recommended and eligible for reenlistment at separation; else 0
Military occupational field (occfield)	A set of 26 variables for enlisted Marines and a set of 16 variables for officers indicating the Marine's 2-digit occfield
YOS	Twelve 0/1 variables indicating if the transitioning Marine has 1 YOS, 2 YOS, etc. (4 YOS is the omitted category)

Source: MCTFS end-of-month snapshots between October 2001 and September 2011.

Our affiliation model estimates the affiliation rate for a given YOS measured as a percentage-point difference from the YOS 4 affiliation rate. That is, each estimated YOS-specific affiliation rate is the estimated YOS 4 affiliation rate plus the estimated

percentage-point difference. Table 21 presents the estimated YOS-specific affiliation rates using the transitioning enlisted and officer populations, respectively. We estimate YOS-specific affiliation rates for YOS between 4 and 16 because that is the YOS range for the transitioning AC Marines in our data.

Table 21. YOS-specific affiliation rates, among enlisted and officers

YOS	Enlisted	Officer
Actual affiliation rate		
4[a]	0.089	0.341
Estimated affiliation rates		
5	0.052**	0.412**
6	0.066	0.376
7	0.044	0.423**
8	0.114**	0.498**
9	0.261**	0.574**
10	0.208**	0.558**
11	0.187**	0.556**
12	0.120**	0.627**
13	0.160**	0.583**
14	0.218**	0.673**
15	0.022	0.551**
16	0.08*	0.682**

Source: CNA estimation using MCTFS data.

[a] Actual average YOS 4 affiliation rate from MCTFS data.

[b] We use two asterisks (**) to indicate that a YOS-specific affiliation rate is statistically different from the YOS 4 affiliation rate at the 95-percent level of confidence. We use one asterisk (*) to indicate statistical significance at the 90-percent level.

For YOS greater than 16, we assume that affiliation rates are equal to zero. This assumption is not overly restrictive because, historically, very few Marines with YOS greater than 16 have left AC service and then affiliated with the reserves.

RC affiliation under the current retirement system

The next step is to estimate the RC affiliation YOS-profile under the current retirement system. We take the YOS-profile of Marines leaving the AC under the current retirement system from our AC model. For each YOS, we estimate the number of Marines who affiliate with the RC by the product of (1) the number of Marines leaving the AC and (2) the relevant YOS-specific affiliation rate. Equation (29) shows this step mathematically for the affiliation of Marines with 4 YOS.

$$\begin{aligned} &Number\ of\ Marines\ who\ affiliate\ with\ 4\ YOS \\ &\quad = Number\ of\ Marines\ with\ 4\ YOS\ leaving\ the\ AC \\ &\quad \times Affiliation\ rate\ of\ Marines\ with\ 4\ YOS \end{aligned} \tag{29}$$

RC affiliation under the BRS

To estimate the affiliation YOS-profile under the BRS, we begin with the affiliation rates observed under the current retirement system. We adjust the affiliation rates to account for estimated changes in Marines' decisions to affiliate due to the BRS's effect on RC compensation. Following the method we use for the AC, we first estimate the YOS-specific changes to RC compensation under the BRS. Second, we estimate how YOS-specific affiliation rates change with YOS-specific changes in RC compensation. The final step is to compute the affiliation YOS-profile using the estimated affiliation rates under the BRS.

BRS effect on lifetime RC military earnings

We estimate the change in expected lifetime RC military earnings of newly affiliating SelRes Marines using the same method described in the RC methodology section. We estimate the PDV of expected lifetime RC military earnings under the current retirement system (see equations (22), (23), and (24) and under the BRS (see equations (22), (25), (26), (27), and (28) for each YOS. We calculate the percentage difference in PDVs of the two streams of lifetime earnings for each YOS.

Responsiveness of affiliation rates to a change in lifetime RC military earnings

We rely on the existing literature for estimates of how YOS-specific affiliation rates will change with changes in YOS-specific lifetime military earnings. Specifically, the literature suggests that a 1-percent increase in compensation is associated with roughly a 0- to 2-percent increase in the probability of affiliation. Estimates depend on the service, occupation, and YOS ([20], [21], [22], [23], and [24]). This range of estimates for the elasticity of affiliation with respect to compensation is similar to the range of estimates for the wage elasticities of AC reenlistment and officer continuation, which we discussed in this paper's AC sections. For consistency, we use

the same values for the elasticity of affiliation that we use for the wage elasticities of reenlistment and continuation.[75]

The YOS affiliation profile under the BRS

The product of the wage elasticities and the percentage change in the PDV of the two streams of lifetime earnings for each YOS is the factor by which we adjust the estimated affiliation rates under the current retirement system. To create a YOS affiliation profile under the BRS, we apply the adjusted affiliation rates to the steady-state losses from the AC model (estimated under the BRS). This YOS affiliation profile under the BRS is an input to the RC force profile.

[75] For the AC enlisted and officer analyses, we use wage elasticities equal to 1.5 for YOS 0-5, 1.0 for YOS 6-9, 0.10 for YOS 10-13, 0.06 for YOS 14-19, and 0.02 for YOS 20-30.

References

[1] Military Compensation and Retirement Modernization Commission. 2015. *Report of the Military Compensation and Retirement Modernization Commission: Final Report.*

[2] Grefer, James, Shannon Desrosiers, and Jeff Peterson. 2016. *The Military Compensation and Retirement Modernization Commission's Blended Retirement Plan: A First Look at Marine Corps Implications.* CNA. DRM-2015-U-011370-Final-1Rev.

[3] Black, Matthew. 1983. "Appendix I: Personal Discount Rates: Estimates for the Military Population." *Fifth Quadrennial Review of Military Compensation.*

[4] Laibson, David. May 1997. "Golden Eggs and Hyperbolic Discounting." *The Quarterly Journal of Economics*: 443-477.

[5] Warner, John T., and Saul Pleeter. 2001. "The Personal Discount Rate: Evidence From Military Downsizing Programs." *The American Economic Review* 91 (1).

[6] Harrison, Glenn W., Morten I. Lau, and Melonie B. Williams. 2002. "Estimating Individual Discount Rates in Denmark: A Field Experiment." *The American Economic Review* 92 (5).

[7] Quester, Aline O., and Robert W. Shuford. 2005. *Get Paid Now or Get Paid Later: What Are Sailors Deciding?* CNA. Research Memorandum D0013312.A1.

[8] Moynihan, Gregory T. 2016. "Survival Analysis of the Modernized Retirement System for the United States Marine Corps." Master's thesis, Naval Postgraduate School.

[9] Simon, Curtis J., John T. Warner, and Saul Pleeter. 2014. "Discounting, Cognition, and Financial Awareness: New Evidence From a Change in the Military Retirement System." *Economic Inquiry.*

[10] Congressional Budget Office. 1999. *The Effects of the Military Retirement Reform Act of 1986 on Midcareer Retention.*

[11] Congressional Budget Office. 1984. *Modifying Military Retirement: Alternative Approaches.*

[12] Asch, Beth J., James Hosek, Michael G. Mattock, and Christina Panis. 2008. *Assessing Compensation Reform: Research in Support of the 10th Quadrennial Review of Military Compensation.* RAND Corporation. Monograph MG-764-OSD.

[13] Hudson, Rex, and Alice R. Buchalter. 2007. *A Summary of Major Military Retirement Reform Proposals, 1976-2006.* Federal Reserach Division, Library of Congress.

[14] Grefer, James E. 2008. *Comparing Military and Civilian Compensation Packages.* CNA. Research Memorandum D0016569.

[15] Warner, John T. 1995. "The Economics of Military Manpower." In *Handbook of Defense Economics.* Edited by Keith Hartley and Todd Sandler. 347-398. Amsterdam, NY: North-Holland.

[16] Warner, John T., Beth Asch, and James Hosek. 1994. "The Economics of Military Manpower." In *Handbook of Defense Economics.* Amsterdam, NY: Elsevier.

[17] Gray, Bradley M., and James E. Grefer. 2012. "Career Earnings and Retention of U.S. Military Physicians." *Defense and Peace Economics* 23 (1): 51-76.

[18] Goldberg, Matthew S. 2001. *A Survey of Enlisted Retention: Models and Findings.* CNA. Research Memorandum D0004085.

[19] Hansen, Michael L., and Jennie W. Wenger. 2002. *Why Do Pay Elasticities Matter?* CNA. Reserach Memorandum D0005644.

[20] Shiells, Martha E. 1986. *Affiliation of Navy Veterans With the Selected Reserve.* CNA. Research Memorandum 86-249.

[21] Asch, Beth. 1986. *Data and Preliminary Empirical Results for SELRES Affiliation Analyses.* CNA. Research Memorandum 86-43.

[22] Marquis, M. Susan, and Sheila Nataraj Kirby. 1989. *Accession and Attrition of Prior-Service Reservists.* RAND Corporation. AD-A215 685.

[23] Waite, Joseph P. 2005. "Affiliation of Naval Veterans With the Selected Reserve in the 21st Century." M.B.A. thesis, Naval Postgraduate School.

[24] Hosek, James, and Trey Miller. 2011. *The Effect of Bonuses on Active Component Reenlistment Versus Prior Service Enlistment in the Selected Reserve.* RAND Corporation. MG-1057-OSD.

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