Air Force Officer Management Flexibilities

Modeling Potential Policies

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For more information on this publication, visit www.rand.org/t/RR1921

Library of Congress Cataloging-in-Publication Data is available for this publication.
ISBN: 978-0-8330-9862-7

Published by the RAND Corporation, Santa Monica, Calif.
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Preface

The U.S. Air Force faces both internal and external challenges to move toward greater flexibility in managing its military workforce. External influences include the National Commission on the Structure of the Air Force, which recommended reduced impediments to movement and utilization of personnel across component boundaries, and the Force of the Future initiative from the Office of the Under Secretary of Defense for Personnel and Readiness, which advocates both greater statutory flexibility and increased use of available or emerging flexibilities by the military services.

The objective of this project was to assess the effect that proposed military human resource–management flexibilities have on Air Force accessions, promotions, separations, and other force-management outcomes. The assessments are intended to help in determining which flexibilities might be beneficial to the Air Force and to identify subsets of the military workforce to which they might be advantageously applied.

The research reported here was commissioned by the Air Force Director of Military Force Management Policy, Deputy Chief of Staff for Manpower, Personnel and Services, U.S. Air Force, and conducted within the Manpower, Personnel, and Training Program of RAND Project AIR FORCE as part of a fiscal year 2015–2016 project Assessment of Military Human Resource Management Flexibilities.

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This report documents work originally shared with the U.S. Air Force on September 14, 2016. The draft report, issued in September 2016, was reviewed by formal peer reviewers and U.S. Air Force subject-matter experts.

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Summary

The Air Force has been challenged by U.S. Department of Defense Force of the Future proposals, the recommendations of the National Commission on the Structure of the Air Force (National Commission on the Structure of the Air Force, 2014), and its own Human Capital Annex (Department of the Air Force, 2015b) to its Strategic Master Plan (Department of the Air Force, 2015a) to move toward greater human resource–management (HRM) flexibilities in managing its active-duty military workforce. Proponents of HRM flexibilities argue that today's policies are insufficient to meet current force requirements and will become more inadequate for addressing the challenges of an increasingly complex national security environment. Proposals include

- implementing separate promotion tracks for officers with technically narrower and deeper competency-development patterns
- replacing "up-or-out" provisions of the Defense Officer Personnel Management Act (Pub. L. 96-513, 1980)
- implementing milestone-based promotions
- increasing the use of lateral entries into the line-officer force
- increasing the permeability between the active component and reserve components
- extending the maximum length of officer service from 30 to 40 years
- developing a more robust talent-management system to support these proposals.[1]

To assist in determining which proposals might be beneficial for force management, the Air Force Director of Military Force Management Policy asked RAND Project AIR FORCE to formulate representative policy particulars and assess their likely impacts on the force. Toward that end, we interviewed selected Air Force career field managers (CFMs) and adapted two inventory projection modeling methodologies to this context.

The CFMs we interviewed were skeptical about many of the initiatives, such as eliminating up-or-out provisions or extending service to 40 years, that would reduce current promotion opportunities. They were generally against the idea of milestone-based promotions because of worries about the possibility that communities would "game the system" by making the milestones increasingly easy to fulfill. However, we found selective support for other initiatives that might help to match human capital to their requirements.

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[1] A talent-management system would be used to manage the match of people to job requirements, at both individual assignment and collective workforce levels. A more robust system would provide more-detailed information on individual talents and on the talents required for various jobs.

Modeling the Flexibilities

We used two inventory projection models—an optimization model and a simulation model—to examine the proposals' impacts on accessions, promotions, and other related force-management outcomes. We contrasted these outcomes across three scenarios—a baseline scenario reflecting current policies, a scenario incorporating the proposed HRM flexibilities, and a scenario that increases field-grade strength ceilings to restore promotion opportunities reduced by the HRM flexibilities.

Modeling the flexibilities required that we operationally define them. To simplify the modeling, our operational definitions are narrower or less varied than might be likely in actual practice. Key features, using assumptions we made in consultation with our sponsor regarding how these policies might be shaped, are as follows:

- We simulated technical tracks by transitioning specified proportions of officers at various career points: 30 percent of captains at commissioned year of service (CYOS) 6, 20 percent of majors at CYOS 12, and 10 percent of lieutenant colonels at CYOS 16. Table S.1 shows the flows observed in the two scenarios we simulated.
- To simulate suspension of up-or-out separation policies and removal of stigma for those not promoted, we changed the loss rates of nonpromoted technical-track officers to be the same as those of traditional-track officers who were promoted.
- To simulate extending maximum tenures to 40 years of service (YOSs), we created loss rates that are roughly comparable to those observed in dynamic retention modeling of 40-year pay-table outcomes (Asch et al., 2016).
- We simulated 50 lateral entrants per year into the technical track in the nonpilot occupational category, evenly split among grades O-3, O-4, and O-5 and distributed evenly across appropriate CYOS windows within those grades.[2]
- We simulated 150 reserve component entries per year—100 pilots and 50 nonpilots—split 70 percent to the traditional track and 30 percent to the technical track, then split evenly across grades and across appropriate CYOS windows within grades.

Table S.1. Flows from Traditional to Technical Tracks

Scenario and Occupation	O-3	O-4	O-5
HRM flexibilities			
Nonpilot	357	110	32
Pilot	192	64	19
Restore promotion opportunities			
Nonpilot	338	121	36
Pilot	192	71	22

NOTE: Average flows in 2013 to 2050 modeled years.

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[2] A lateral entrant is an officer commissioned with constructive YOS credit based on prior experience or advanced education, generally at grades above O-1.

Evaluating the Alternatives

Technical Tracks for Promotion

This proposal received mixed reviews from CFMs, with managers of more–technically oriented career fields being generally more open to it. Our modeling revealed several key issues that would have to be addressed in implementing a technical track:

- To differentiate the timing of technical- and traditional-track promotions and to reinforce the need for promotion boards to apply different criteria to promotions in the two tracks, officers on a technical track must be separated into their own competitive categories.
- Depending on how officers either self-identify or are selected for branching into a technical track, an inversion of talent and grade attainment could occur—in which more-talented officers in the traditional track fare worse in promotion and retention outcomes than less talented officers in the technical track. This effect is worse with strong aptitude stratification when selecting officers to branch into the technical track. To avoid it, added incentives will likely be required to attract some higher-aptitude officers to the technical track.
- To provide the required flexibility in timing of promotions, changes will be required in statutory provisions tying promotion zones to date of rank and establishing separation as the default outcome for officers twice nonselected for promotion.
- Flexibilities in promotion timing and elimination of promotion zones will require an improved method of calculating promotion opportunity. We recommend a cumulative promotion rate, defined as the complement of a weighted cumulative nonselection rate.
- If promotion rates are to be differentiated among line functional areas that now compete together, a defensible basis for disaggregating available Defense Officer Personnel Management Act grade ceilings must be found. Our modeling and other analyses we performed indicated that manpower grade authorizations, as currently constructed, provide an inadequate basis.

Replace Up-or-Out Provisions

CFMs were generally wary of this proposal because of its potential to slow promotions. However, we found that liberal use of selective continuation has minimized up-or-out losses. If the Air Force continues this policy, eliminating up-or-out statutory provisions would have little impact on promotion outcomes.

Milestone-Based Promotion Opportunity

Several CFMs observed that milestones would evolve to be easily achievable so that promotion timing of officers in a career field would not be disadvantaged relative to officers in other career fields. We see this alternative as unlikely to be adopted for traditional-track promotions and a potential but unessential element in technical-track promotions.

Increased Use of Lateral Entries

Constructive credit in determining YOSs for base pay might be needed to make this alternative attractive to any but the least experienced lateral entries. Other alternatives, such as military-to-civilian conversions, can be used to meet the same human-capital needs. On balance, the likely uphill fight to change constructive credit provisions and availability of other alternatives make this a less attractive alternative.

Increased Use of Reserve Component Entries

Greater permeability between active and reserve service is a worthwhile objective. All of the functional managers we interviewed saw benefits in it. Impediments include transitioning between disparate promotion systems, strength-management issues, and rescrolling (documentation of presidential or secretarial appointments) issues.

40-Year Careers

The opportunity to retain experience longer would be beneficial, especially if it could be done selectively and if the promotion impacts were very limited. To provide a greater incentive to stay beyond 30 YOSs, additional steps in the pay table would have to be considered.

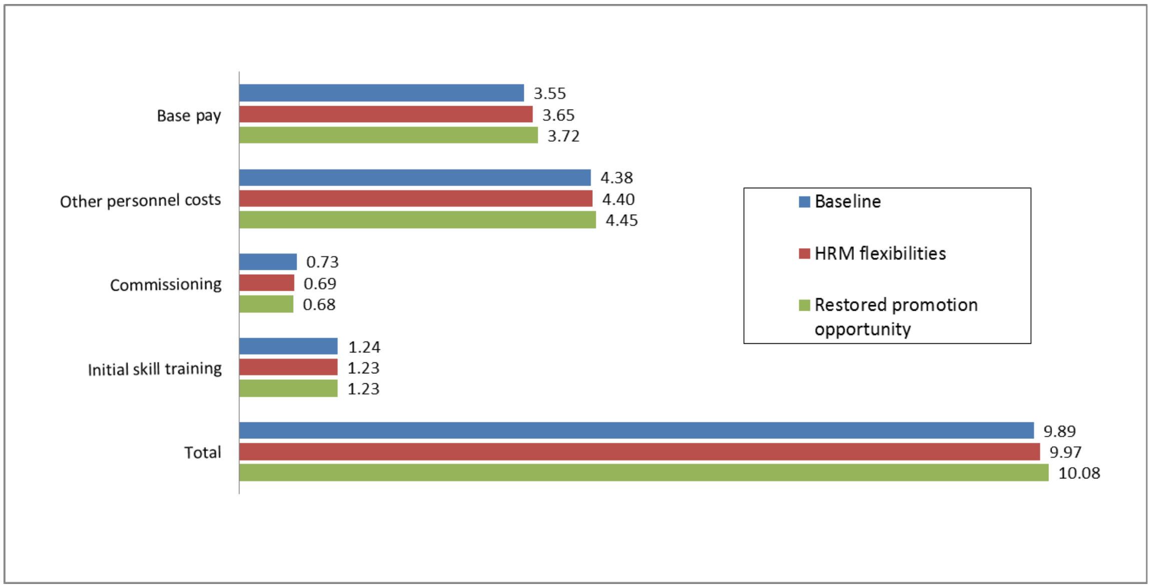
Talent-Management System

Adoption of a more deliberate approach to matching individuals to billets got mixed reviews from CFMs, who raised concerns over both cost and loss of functional-manager influence.

Net Impacts

We found that the alternatives would have modest promotion impacts—opportunity for promotion to O-4 in a traditional track would be reduced by 10 percent and to higher grades by even less, with no significant change in the timing of promotions for those in the traditional track. The impact is modest in part because promotions in the technical track would occur later and with reduced opportunity. We also found that the lost promotion opportunity could be restored for those in the traditional track with grade increases of 21.6 percent, 8.6 percent, and 5.1 percent, respectively, for grades O-4, O-5, and O-6. As shown in Figure S.1, net cost in the HRM flexibility case was found to be greater than the baseline case because of the higher force costs related to better retention. The net cost of the scenario with increased grade ceilings was even more expensive because of both the higher cost of the richer grade distribution and the additional retention improvement associated with better promotion outcomes.

Figure S.1. Force and Accession Costs, in Billions of Dollars



SOURCE: Costs are based on fiscal year 2016 pay tables and other cost factors.

NOTE: Because of rounding, some figures do not sum to the totals.

A Related Observation

One of the underlying principles we had hoped to incorporate in our modeling was using the force-management alternatives to optimize the match of inventories to requirements by grade and occupational category. We had to depart from that concept because grade requirements for pilots do not provide sufficient field-grade headroom to accommodate needed and observed pilot retention and are thus inconsistent with the Air Force's strategic human-capital needs.

The Air Force is weighing proposals to create additional competitive categories within its line-officer force. To move in that direction, as our modeling revealed, it will have to make manpower grade requirements in various career fields more compatible with strategic needs or find a basis other than manpower requirements for allocating grade ceiling among the competitive categories.

Acknowledgments

The sponsor of this project, Brig Gen Brian T. Kelly, Air Force Director of Military Force Management Policy, in addition to providing us a challenging task, engaged fully in helping us identify key issues and flesh out the particulars of potential policies to be examined. He and several members of his staff, including Mark R. Engelbaum, Col Rob Romer, Gerald Diaz, Col Daniel J. Knight, and Lt Col Jon Mizell, met with us periodically to provide perspectives on the work. In-progress reviews provided by our colleagues Lawrence M. Hanser and Peter Schirmer helped shape our analysis, and our final report was sharpened by reviews provided by James Hosek and Mary E. Chenoweth. The document also benefited from careful editing by Lisa Bernard. Any remaining errors are, of course, our own.

Abbreviations

AC	active component
ADSC	active-duty service commitment
APZ	above the promotion zone
BPZ	below the promotion zone
CCR	cumulative continuation rate
CFM	career field manager
CPR	cumulative promotion rate
CYOS	commissioned year of service
DOPMA	Defense Officer Personnel Management Act
FY	fiscal year
HRM	human-resource management
IPZ	in the promotion zone
MAJCOM	major command
OSD	Office of the Secretary of Defense
PA	public affairs
RC	reserve component
tech	technical
trad	traditional
UPT	undergraduate pilot training
YOS	year of service

Chapter One. Introduction

Background

The Air Force faces both internal and external challenges to move toward greater human resource–management (HRM) flexibilities in managing its active-duty military workforce. A set of proposals from the U.S. Department of Defense, unpublished but informally conveyed to the military services as a collection of proposals entitled *Force of the Future*, seek to provide the services with talent-management flexibilities that will make them more competitive with private-sector employers (Reserve Officers Association, 2016). Proposals include increased flexibilities in promotion and retention processes, better matching of individual talents to job demands, and benefits that might be more appealing than current offerings to younger generations of potential service members. The Air Force included similar calls for force-management flexibilities in the Human Capital Annex (Department of the Air Force, 2015b) to its Strategic Master Plan (Department of the Air Force, 2015a). Additionally, the National Commission on the Structure of the Air Force recommended reduced impediments to movement and utilization of personnel across component boundaries (National Commission on the Structure of the Air Force, 2014). Proponents of the various proposals cite deficiencies in current HRM policies and argue that those deficiencies will become greater given the challenges of an increasingly complex national security environment.

The Air Force Director of Military Force Management Policy requested RAND's assistance to determine which of these proposals might be beneficial in force management and to gain insight into how they should be implemented. The study also evaluated which segments of the workforce might benefit from the proposals.

The study focused on seven policy alternatives:

- Implementing separate promotion tracks for officers with technically narrower and deeper competency-development patterns would allow some officers to pursue technical depth rather than the broader leadership and management competencies traditional promotion boards favor.
- Replacing "up-or-out" provisions of the Defense Officer Personnel Management Act (DOPMA) would allow greater retention of developed human capital.
- Implementing milestone-based promotions would allow officers to develop in more-individualized patterns before being considered for promotion.
- Increasing the use of lateral entries into the line-officer force would provide greater access for people with advanced technical skills.
- Increasing the permeability between the active component (AC) and reserve components (RCs) would allow the AC to more easily tap into talent available in the RCs.
- Extending the maximum length of officer service from 30 to 40 years is another way of providing greater retention of developed human capital.

- Developing a more robust talent-management system to support these proposals is a Force of the Future proposal intended to enable or enhance the other policy alternatives.[3]

These proposals have been presented in only very general terms. Accordingly, part of our research required that we formulate and recommend representative policy particulars on which to base our assessments. To formulate the policy particulars, we consulted with our sponsors, other Air Force representatives, and RAND Project AIR FORCE colleagues conducting a parallel project to help the Air Force flesh out and implement objectives contained in the aforementioned annex. Our sponsor clarified some of the policy particulars during the course of the project through his interaction with the Office of the Secretary of Defense (OSD) staff and with staffers from congressional armed services committees.

Methodologies

Our research included familiarizing ourselves with unpublished Force of the Future draft materials, the Air Force Human Capital Annex, the National Commission report, and material thought to be formative in Force of the Future proposals (Kane, 2012, 2015). After agreement with the sponsor on specific proposals to be examined, we interviewed career field managers (CFMs), from both more technical and less technical functional areas and those with known human capital–management challenges and those without such challenges, to gain their perspectives on whether and how the proposals might be beneficial in managing their workforces. Using insights gained from these interviews and discussions with our sponsor, we fleshed out the policy alternatives in sufficient detail to permit estimation of their impacts.

We estimated impacts using two personnel inventory projection models modified for use in this project.[4] These models—a SAS-based linear programming model and a Java-based simulation model—are described in Appendix A. We used the models primarily to quantify the impact that proposed flexibilities would have on officer promotion and retention outcomes if the proposed flexibilities were implemented at scales anticipated by our sponsor and us.

In addition to estimating HRM outcomes, our modeling brought to light risks and implementation issues that can helpfully guide policy formulation. One example is a need to develop a new metric for promotion opportunity suitable for the more-flexible promotion practices envisaged in the proposals. Other examples include issues that will be encountered in splitting the line-officer competitive category into two categories—one for officers remaining in a traditional DOPMA-based track and one for officers in a technically oriented track. We found that how officers are sorted into those two tracks has significant implications.

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[3] A talent-management system would be used to manage the match of people to job requirements, at both individual assignment and collective workforce levels. A more robust system would provide more-detailed information on individual talents and on the talents required for various jobs.

[4] A personnel inventory projection model is a compilation of data and mathematical relationships that explores how the size and composition of a workforce might change in response to internal policies or exogenous influences.

Organization of the Report

Chapter Two reports findings from our discussions with Air Force officer CFMs. Chapter Three describes how we modeled the policy alternatives, provides the proposals' expected impacts on the Air Force officer force, and discusses the risks and implementation issues that were revealed through our modeling efforts. Chapter Four integrates conclusions and recommendations from our discussions with CFMs and from our modeling efforts. Detailed specifications of the optimization and simulation models we used are provided in Appendix A. Statutory impediments to implementing a technical track for promotions are discussed in Appendix B. Alternatives for computing promotion opportunities in the wider promotion windows associated with technical-track promotions are discussed in Appendix C. Issues regarding promoting to requirements are discussed in Appendix D.

Chapter Two. Career Field Managers' Perspectives

Our interviews with CFMs provided insight into how proposed HRM flexibilities might be useful for various segments of the Air Force officer workforce.[5] Our sponsor identified the CFMs we interviewed based in part on current or anticipated HRM challenges.[6] The selected career fields are

- pilot
- acquisition manager
- personnel officer
- cyberspace operations officer
- public affairs (PA) officer.

We also discussed these issues with officials from the Air Staff's Total Force Aircrew Management office and with the director of assignments at the Air Force Personnel Center.

Our interviews were semistructured. After describing each of the proposed flexibilities, we asked the CFMs to address the following questions:

- What do you think would happen if this proposal were implemented in your career field?
- What would be the advantages to this proposal, if any?
- What would be the disadvantages, if any?
- Would your career field be a good candidate for this proposal? Why or why not?
- Would there be other career fields (not yours) that would be good candidates for this proposal?
- Can you think of any changes or variations in this proposal that would make it more beneficial to the Air Force or to your career field?

Findings

Table 2.1 summarizes the findings. The cells highlighted in green contain areas where the CFMs thought there might be advantages to a proposal. Cells highlighted in yellow contain comments suggesting potential pitfalls or limits to the proposals we discussed.

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[5] The alternative of extending careers to 40 years of service (YOSs) was added to our list after most of our career field interviews were completed. Thus, we do not address it in this chapter.

[6] Some career fields need to retain officers with specialized experience that, although valuable, tends to be less rewarded in conventional Air Force line-officer promotion considerations, which emphasize broader leadership and management skills.

Table 2.1. Summary of Career Field Manager Interviews

Topic	Pilots	Acquisition	Personnel	Cyber	PA
Technical tracks	This would be a "fly-only" track for the rated community; it could create absorption problems.	It might work with scientists and engineers, but not acquisition managers.	This would be the staff track in a three-track system (generalist, staff, and command).	This would be useful for cyber for "coders."	PA is too small for more than one track. There are so few opportunities for command.
Replace up-or-out	CFMs worry about problems with absorption, about pilots being older or more experienced than their commanders, and about motivation and physical fitness of older officers. People would stay around longer, so the field would need relief from field-grade caps.	The field needs "churn" in order to open up opportunities for career development. CFMs worry that "plucking boards" would add to uncertainty for officers even after promotion. This would not be that different from the current system. Not very many officers are truly separated.	This would work only if the field had tracks and a talent-management system.	Cyber officers tend to fare well in selective continuation boards, so replacing up-or-out would produce little change.	Up-or-out causes no problems. CFMs worry that replacing up-or-out would lead to slower promotions—the opposite of what they want. CFMs worry that plucking boards would force people to jump even before being considered.
Milestone-based promotions	The field already has a milestone-based system, to an extent.	There would be competition between career fields to make milestones easier to reach. There is no problem to be fixed—the field is already promoting fast enough; it is not a good idea to promote when someone is too young.	Competency-based promotions are better than milestone-based promotions. CFMs worry that people would make it all a race to check the box quickly.	Milestones should be "smart," having both "check-the-box" and experience components. CFMs would like cyber to be its own competitive category so they can determine career field–specific milestones.	Career progression is already pretty regimented—e.g., wing PA chief, post–wing PA chief. CFMs might want to implement milestones for cross-flow officers because PA chief should not be someone's first job.[a] They would like to see "promote to requirements" because commanders think they should get more-senior PA officers.
AC–RC permeability and lateral entries	Why would a pilot who goes to RC ever come back to the AC?	Reservists are not helpful unless they are assigned for 365 days a year.	Lateral entry from other career fields might be useful, and some reserve entries might help, too.	AC–RC permeability could help to bring in private-sector technologists.	CFMs are not interested in greater AC–RC permeability but would like more access to civilian lateral entries.

Topic	Pilots	Acquisition	Personnel	Cyber	PA
			Guard–AC permeability is proving to be very difficult.		Interested in cross flow to PA from other Air Force career fields.
Bottom line	CFMs have little enthusiasm; pilot shortages are caused by lack of training and absorption capacity.	CFMs see no problem to be fixed; making APZ harder for boards to distinguish has increased APZ promotions.	Proposals for promotion tracks and human-capital management are necessary for other proposals to work.	This is a growing community willing to experiment with technical tracks and AC–RC permeability as a way to grow.	This is a small community that has trouble with attrition and with getting promoted; proposals are helpful, but CFMs would like to see promotion to requirements.
Talent-management system	CFMs would like to see improvements to assignment system so officers can see vacancies earlier.	This is a good idea but difficult to do in practice—it is more than putting a puzzle together.	A talent-management system is needed in order to use tracks properly.	CFMs do not want talent management (e.g., development panels) taken out of their hands.	CFMs do not want talent management (e.g., development panels) taken out of their hands or for receiving commanders to choose replacements—central managers know the needs for career progression.

NOTE: APZ = above the promotion zone. Green indicates that the interviewees saw possible merit in the proposal. Yellow indicates a comment that suggests pitfalls or limits.

[a] *Cross flow* refers to officers from one career field moving into another.

Pilot

The rated officer community has three CFMs covering combat, mobility, and special operations communities. We interviewed the three together in one session.

The rated CFMs were generally unsupportive of the idea of creating technical tracks for their career fields. They felt that having a technical or fly-only track would result in pilots staying in the force who were older than and not as motivated as young pilots constantly replenishing the force.

These CFMs believed that replacing up-or-out might slow promotions and reduce opportunities for absorption (units' ability to utilize new personnel). These CFMs thought that the Air Force might have to reduce accessions in order to correct for the reduced turnover, exacerbating problems in building inventories large enough to meet all pilot needs. They also worried about the motivation and physical fitness of older officers who remained in the force because of the elimination of up-or-out. What incentive would these older officers have? Last, CFMs expressed concern that slower promotions and reduced promotion opportunity would create greater stress on younger pilots.

On the other hand, the rated CFMs were more positive about milestone-based promotions because they felt that their career fields currently have a milestone-based promotion system, in which pilots need to fulfill certain roles (e.g., instructor pilot, standardization and evaluation pilot, squadron commander) before they are competitive for promotion to certain grades. Promotion boards are aware of and sensitive to completion of these milestones.

The rated CFMs were not enthusiastic about increasing the permeability of AC and RCs. First, they thought that there is a mismatch between promotion standards in the AC and RCs. Second, they worry that allowing AC officers to have an earlier "off-ramp" to the RCs would adversely affect AC manning. One AC officer asked whether any officer would ever come back to the AC after transferring to the RC.

Talent-management initiatives, as we discussed them in the interviews, can be of two types: (1) allowing commanding officers to pick the best available candidates for their upcoming vacancies or (2) allowing officers to see and choose which billets they might wish to fill. The rated CFMs did not see much potential in the first type of talent-management system because they thought it would place more burden on commanding officers to sift through the qualifications of officers who want to join the unit. The second kind of talent-management system, on the other hand, has more promise: If officers could be made aware of upcoming vacancies sooner and more widely, the CFMs believed, some otherwise hard-to-fill billets might become easier to fill.

In summary, the rated CFMs were generally unfavorable toward the proposals that we discussed. They were more concerned about shortages of pilots that were caused by insufficient training and absorption capacity, and they did not see how the proposals would help with that problem. The rated CFMs' only interest was in making it easier for officers to be aware of upcoming billet vacancies, particularly reservists being more aware of upcoming billets in the AC force for which they would be eligible.

Acquisition Manager

The CFM and deputy CFM for the acquisition community thought that replacing the current up-or-out system would be a bad idea because the system needs churn in order to provide officers with a chance for experiential development. Unless the up-or-out system forces people to move to different billets, it will be even more difficult for assignment officers to fill undesirable assignments. Officers will want to stay in the same job for longer periods of time, making it difficult for younger officers to get the experience of working in those billets. These CFMs were also unenthusiastic about having plucking boards for officers (for selective separation of low performers). In the current system, officers know when they will be considered for promotion and what criteria will be used to evaluate them. The acquisition management CFM was concerned that a plucking board would have unclear criteria and thus add to the uncertainty of having a career as an officer.

The acquisition management CFM did not like the idea of milestone-based promotions, either. He felt that career fields would compete with one another to make milestones easier to reach. This competition to get their officers promoted faster could make milestones meaningless.

The acquisition management CFMs were not interested in increasing AC–RC permeability. They believed that RC officers are often not very helpful to the active units to which they are assigned because of differences in the motivations and experiences of AC and RC officers. They did not see AC–RC permeability as answering a need.

Talent management—better systems for matching officers to billets—seems like a good idea in theory. However, the acquisition management CFMs believed that it is difficult to do in practice because it is difficult to describe the requirements of any particular billet in sufficient detail to make a good match.

In summary, the acquisition management CFM and deputy CFM were not interested in experimenting with the proposals we discussed. They did not believe adopting any of these proposals would solve any challenges to their career field.

Personnel Officer

The personnel officer CFM thought that there could be merit in creating separate career tracks. Some officers might decide that they are not good matches for command positions, so someone might want a final billet to be as staff at a major command (MAJCOM) or perhaps in an institutional requirement, such as a professor at the Air Force Academy. By creating career tracks, the field would have officers who could make contributions in ways other than command.

The personnel officer CFM thought that replacing up-or-out would work properly only if it were accompanied by adopting career tracks and had a good talent-management system. The career tracks would allow an officer to follow a path that suits that officer’s particular interests and abilities, rather than everyone competing on the basis of leadership skills. And having a good talent-management system would enable an officer to be placed in a billet that is a good match for that officer’s goals and strengths.

The personnel officer CFM did not like the idea of milestone-based promotions: He thought that these would encourage a check-the-box mentality in developing milestones within each community. As milestones lose their meaning, officers would appear on paper to have developed more human capital than they would actually have.

The personnel officer CFM thought that his career field might benefit from cross flow from other Air Force career fields. An Air Force officer who did not start as a personnel officer might bring useful experiences to the career field. He thought that some reserve officers might be able to help with active-duty responsibilities, too, so he saw potential in greater AC–RC permeability. He thought that the permeability would extend between AC and the Air Force Reserve, but not to the Air National Guard, which is completely different because the latter is usually under state, not federal, oversight.

He was particularly supportive of the idea of a talent-management system that would do a better job of matching people to billets. With improvements to the talent-management system, it would be possible to place officers into different career tracks and maintain understanding of the opportunities at the next billet that they might fill.

In summary, the personnel officer CFM thought that his career field might benefit from greater AC–RC permeability, an improved human capital–management system, and career tracks that would allow some officers to select a noncommand track. However, he was not in favor of milestone-based promotions. Furthermore, he felt that replacing up-or-out would work only if the Air Force had a better talent-management system and career tracks.

Cyberspace Operations Officer

We interviewed the cyber community CFM and a group of officers from the cyber community. These cyber community members did not see a need for replacing up-or-out because selective continuation boards, which select officers for retention after nonselection for promotion, achieve the same end by generally treating cyber officers favorably.

The cyber community is particularly interested in the idea of having a technical track. The CFM said that many in the cyber community would like the idea of a technical track for coders. These people would be given the opportunity to remain coders, without the need to obtain command experience.

With respect to milestone-based promotions, these officers indicated that they would like a separate competitive category for cyber officers so that they could make the milestones specific to the cyber community. They were also concerned that milestones be smart, including both experiential and more-customary check-the-box components.

The cyber community was interested in increasing AC–RC permeability because it might allow it to gain cyber personnel from private-sector technology firms. The community saw this as an area it would be willing to explore.

The cyber community CFM did not want to have talent management—the matching of individuals with billets—taken out of the CFM's hands. The CFM was concerned that a more mechanistic talent-management system might make it more difficult to match people with billets that are a good match.

In summary, the cyber community sees itself as growing and having challenges in obtaining, maintaining, and retaining needed talent. It would be willing to experiment with career tracks and AC–RC permeability in order to address these difficulties.

Public Affairs Officer

The PA field has difficulty filling higher-grade billets because of insufficient retention. On the other hand, its CFM does not believe that the up-or-out system causes the field problems or that replacing the system would solve its problems. The field worried that replacing up-or-out might exacerbate its problems by slowing the promotion rates for PA officers. Slower promotions could mean more officers leaving the career field. The field believed that deployments and demand for PA officers outside the military are the major reasons it has trouble holding onto some of its best officers.

The PA CFM did not like the idea of a technical track. The field sees itself as such a small community that breaking it up into two or more tracks would make it even more difficult to manage.

On the other hand, the PA CFM would very much like to have a system in which the Air Force promotes to requirements. She believed that PA officers do not compete well for promotion and thus are often in the position of having to substitute an officer of a lower rank than the requirement.

The PA CFM was lukewarm about milestone-based promotions. She saw milestone-based promotions as being helpful in managing cross-flow officers (officers from other career fields moving into PA) because it would require these officers to attain certain experiences before competing for higher-grade positions in the PA community.

The PA CFM was not very interested in increased AC–RC permeability but was interested in officers from other Air Force career fields entering the PA community. She thought that the RC is different enough (e.g., grade structure) that it is too difficult to implement AC–RC permeability. On the other hand, an entrant from another Air Force community would be welcome.

In similar fashion, the PA CFM did not like the idea of talent-management systems. Much like the cyber community, the PA community does not want talent management taken out of its hands by a computer system. Furthermore, it does not like the idea of commanders having the power to decide whether they want a particular PA officer. They think that the PA CFM has a better understanding of the career experiences and goals necessary for a successful career, so commanders should defer to their greater knowledge in the area of PA officer career management.

In summary, PA is a small community that has trouble with attrition and with getting its officers promoted. It would like to see the Air Force adopt a policy of promoting to requirements. It would be willing to expand the possibility of AC–RC permeability or civilian–AC permeability, although it thinks that there would be difficulties with those two proposals because of the incompatibility of AC and RC grade structures and civilian–AC compatibility, as well.

Assignments Director

A final interview that we performed was with the director of assignments at the Air Force Personnel Center. He was included because his position provides a perspective that spans all career fields.

He was not in favor of replacing up-or-out with another system because he believes that up-or-out is one of the ways in which the Air Force encourages officers to accept less-than-desirable assignments. Similarly, he was not interested in converting to a milestone-based promotion system. He would like to see officers promoted when they are ready, not when they have fulfilled some list of assignments or experiences.

The assignments director was not particularly enthusiastic about the idea of technical tracks. He was concerned that the technical track would be so attractive to officers that too many would choose it. He felt that one would need to limit the number who could enter the technical track because the Air Force needs broadly developed leaders.

He felt that a talent-management system for matching individuals to billets would be very expensive—too expensive for the Air Force to afford. In principle, however, he believed that a better system for matching people to jobs could be useful.

The assignments director was not interested in the idea of increasing AC–RC permeability. He was concerned that, once an AC officer went to an RC, he or she would never want to come back to active duty. Furthermore, he wondered whether the AC would want the officer to come back, given that a year of RC duty involves many fewer experiences than a year of AC duty would.

He thought that all of the proposals we discussed were based on the assumption that there are enough officers to fill all the billets and that all the billets are desirable. In fact, there are not enough officers to fill all the jobs that need to be done, and there are billets that are undesirable. The current system encourages officers to take some of the important but less-than-desirable assignments. Many of the proposals would undermine the Air Force’s ability to make officers take those less-than-desirable assignments.

Conclusions

In summary, our interviews with CFMs uncovered considerable skepticism about the desirability of the HRM flexibilities we discussed. The communities were generally unenthusiastic about the idea of replacing up-or-out because they see it as an essential way for the Air Force to maintain a steady supply of younger officers and to reduce the complacency that might occur without it. They were generally against the idea of milestone-based promotions because of worries about the possibility that communities would “game the system” by making the milestones increasingly easy to fulfill, at the expense of having officers spend sufficient time in billets to really learn from those experiences.

However, with the exception of eliminating up-or-out, every proposal had support from at least one CFM. Some communities with special circumstances expressed a willingness to experiment with particular proposals because they believed that they might prove beneficial to the career field:

- The rated community CFMs were interested in improvements to the assignment system—specifically, information technology solutions that would allow officers to view billet opportunities earlier and more widely.

- The personnel officer CFM was intrigued by the possibility of experimenting with a technical track, increased lateral entry and AC–RC permeability, and a better talent-management system. However, he acknowledged that these reforms might be difficult to implement in practice.
- The cyber community was enthusiastic about the idea of having a technical track, greater AC–RC permeability, and increased lateral entry to cyber from the civilian community. It was also interested in having its own competitive category for promotion consideration.
- The PA community was not interested in increased AC–RC permeability but was interested in lateral entry from the civilian community. It was also interested in having the Air Force adopt a promote-to-requirements system because it believed that such a move might help its officers be promoted in greater numbers than it experiences now.

To be fair, we note that the caution that some CFMs expressed was based on their impression of the impacts, uninformed by analysis or trial demonstration. As indicated in the following chapter, we found both positive and negative impacts, as well as methods to mitigate the negative impacts. As the workings of these proposals become more widely understood, we would anticipate a broadening sense of where and how they might be helpful to the Air Force.

Chapter Three. Modeling Policy Alternatives

We developed models to estimate how personnel inventories and the flows that shape them might change with implementation of the policy alternatives we examined. Of the seven proposals introduced in Chapter One, five were of a nature to permit evaluation through simulation modeling (all except milestone-based promotions and a talent-management system). Our tools were two inventory projection models. One of these is a new linear programming model, embedded in the SAS programming language, to which we refer as the HRM flexibility model. The other is RAND's military career model, a Java-based simulation model. Both are multiyear models that take user-specified manpower requirements as inputs. By varying flows, such as accessions, separations, and promotions, the models shape projected inventories that attempt to match requirements while also meeting constraints and conditions on either the flows or the inventories. Specifications for both models are provided in Appendix A.

The models differ in some important respects. The military career model is at an *entity* level of detail—it simulates inventories as sets of individual members, each with a vector of fixed or changing characteristics, as they move through a career. It allows a rich depiction of how individual differences might play out as a result of policy changes. The HRM flexibility model is at an *aggregate* level—it simulates inventories as groups of people with identical characteristics. At the sacrifice of some fidelity, the HRM flexibility model allows simpler, more-straightforward representation of variations in policy, permitting efficient exploration of a larger decision space. Most of our findings were derived using the HRM flexibility model; unless otherwise indicated, the outcomes depicted in this chapter are from that model.

Three Scenarios

To provide insight into the potential outcomes of the policy alternatives, we developed three contrasting scenarios. First, we constructed a scenario that uses historical retention and promotion patterns to provide a baseline of outcomes given a continuation of current policies. In a second scenario, we modified model inputs to simulate the effects of proposed flexibilities. Because many of the proposed flexibilities would tend to slow promotions to higher grades (reduced up-or-out losses, lateral and RC entries at higher grades, longer careers), we focused primarily on promotion outcomes. In a third scenario, we adjusted higher grade ceilings upward in order to restore promotion opportunities to their approximate levels in the base case, observing how this would affect costs.

In each scenario, we start with the Air Force line-officer inventory at the end of fiscal year (FY) 2015. We project the inventory forward in one-year increments to FY 2060 (long enough to allow the force to reach relatively steady flows after implementation of changed policies). In each simulated FY, the model determines losses from total strength based on historical or modified loss rates. Cross flows (permanent transitions from one occupational category to another) are also based on historical rates. After losses, the model promotes the number of officers required to maintain specified field-grade ceilings, with promotions distributed across commissioned years of service (CYOSs) in historically determined or modified patterns. Promotions are distributed across occupational categories by setting floors and ceilings on selection rates for each occupational category so that historical or desired relative promotion opportunities are maintained.

Baseline Scenario

In the baseline scenario, we used historical loss rates at occupational category, promotion track, grade, and CYOS detail averaged over selected FYs that are relatively free of policy-driven losses (stop-loss or force shaping).[7] We based cross-flow rates on the same YOSs as loss rates. Promotion distributions across CYOSs were based on 2013–2015 data.[8] Because lateral entries and longer-term entry on active duty from the RC are rare, we assumed that none of these flows occurs in the base case.[9] For total strength requirements, we used the appropriate line-officer share (49,301) of a total active-duty strength of 321,000 (the Air Force's desired strength level—slightly larger than the 317,000 authorized for FY 2016) and the field-grade ceilings associated with 49,301 officers.[10]

For most of our analyses, we modeled the force using two occupational categories: pilot and nonpilot.[11] By virtue of their ten-year active-duty service commitment (ADSC) following pilot training, followed by strong incentives to separate to pursue airline careers, pilots have a much different retention pattern from those of other officers. Although there are retention differences among nonpilot career fields, they are much less pronounced than the differences between pilots and nonpilots. We fixed pilot accessions at projected production levels (with the FY 2020 programmed level carried for the remaining years of the model). The model determines nonpilot accessions to maintain specified total strengths, after allowing for lateral and RC entries.

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[7] We used FYs 2003–2005, 2008–2011, and 2013.

[8] The CYOS distribution of promotions shifted to earlier points during the past decade as a result of force drawdowns, at least partly as a function of DOPMA's nonlinear relationship between total officer strength and field-grade ceilings (as force size decreases, the proportion allowed in field grades grows larger). Consequently, we considered more-recent distributions to be more representative of the baseline case than distributions observed with larger force sizes.

[9] Reservists can perform active-duty stints ranging from brief activations to multiyear statutory tours or recalls to active duty. A variety of complex and interlocking statutory and legislative provisions govern when reservists performing active duty will be counted in authorized active-duty end strength and when they will compete for promotion along with other active-duty officers on the active-duty list versus continuing to compete for promotion against other reservists on the reserve active-status list. The RC entries we address in our model are those of longer term, which would entail inclusion in active-duty end strength and the active-duty list.

[10] The Air Force Force Management and Enterprise Readiness Analysis Division, Directorate of Force Management Policy, provided us with the 49,301 line-officer strength and the associated grade ceilings.

[11] In some of our work, we broke out cyber and acquisition career fields from the nonpilot category. However, project resources were not sufficient for in-depth exploration of those career fields.

The CYOS numbering convention we adopted uses 0 to indicate the first YOS—the part of the inventory with less than one YOS. Those in CYOS 1 have at least one complete year but less than two complete YOSs. Thus, in modeling conventional 30-year careers, CYOSs range from 0 to 29.

The Human Resource–Management Flexibility Scenario

In the HRM flexibility scenario, a separate promotion track is specified for officers who pursue more–technically oriented career patterns. DOPMA governs promotions in the *traditional* track. Those on the *technical* track are promoted in a window with a wider, flatter distribution across CYOSs that opens up two years later than in-the-promotion-zone (IPZ) years for those on the traditional track and at lower promotion-opportunity levels than officers who remain on the traditional track.[12] In actual implementation of this policy, transition from traditional to technical tracks can occur at many career points, but, to simplify the modeling, we assumed that these transitions would occur for 30 percent of captains at CYOS 6, 20 percent of majors at CYOS 12, and 10 percent of lieutenant colonels at CYOS 16. The average annual flows from traditional to technical tracks were as shown in Table 3.1. Although transition from a technical back to a traditional track might be a feature of future policies, we did not model it.

Table 3.1. Flows from Traditional to Technical Tracks

Scenario and Occupation	O-3	O-4	O-5
HRM flexibilities			
Nonpilot	357	110	32
Pilot	192	64	19
Restore promotion opportunities			
Nonpilot	338	121	36
Pilot	192	71	22

NOTE: Average flows in 2013 to 2050 modeled years.

In the current environment, loss rates go up for those not selected after IPZ or below-the-promotion-zone (BPZ) considerations, likely in part because of up-or-out policies and in part for personal reasons. To simulate suspension of up-or-out separation policies, removal of stigma for those not promoted, and an alternative retention-supporting compensation structure for those in the technical track, we changed the loss rates of nonpromoted technical-track officers to be the same as those of traditional-track officers who were promoted.[13] We assumed that retention of officers not selected for promotion in the traditional track would continue to reflect current continuation policies and personal choices, i.e., they would continue to experience somewhat higher loss rates than officers selected for promotion have.

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[12] The technical-track promotion window for each of the field grades is six years wide, with promotions distributed 25, 30, 20, 10, 10, and 5 percent to each of the six years, respectively. The model determines the total number of promotions required in each FY to maintain field-grade strength ceilings and tries to mirror this distribution but can deviate from it to find a feasible solution or to better meet other specified objectives. The user chooses the selection-rate floors and ceilings that control distribution of promotions between traditional and technical tracks.

Another important change in retention patterns was introduced by extending the maximum career length from 30 to 40 years. To do this, we needed to identify loss rates for those beyond 30 YOSs and to modify the loss rates of those with 20 to 30 YOSs, some of whom would be expected to extend their service, given the opportunity to serve beyond 30 years.[14] To simulate this, we created loss rates that are roughly comparable to those observed in dynamic retention modeling of 40-year pay-table outcomes (Asch et al., 2016).

We simulated lateral and RC entries numbering 50 and 150 per year, respectively, in the model. Because lateral entrants at advanced grades would lack the military experience required to perform effectively on a traditional leadership track, we modeled them as flowing into only the technical track and only into the nonpilot occupational category; evenly split among grades O-3, O-4, and O-5; and distributed evenly across appropriate CYOS windows within those grades. The 150 RC entries, who would have military experience, were split more broadly—100 for pilots and 50 for nonpilots—given the greater need for experienced rated officers. Within occupational categories, the entries were split 70 percent to the traditional track and 30 percent to the technical track, then split evenly across grades and across appropriate CYOS windows within grades.

Restored Promotion Outcome Scenario

In this scenario, we continue all of the force-management policies introduced in the HRM flexibility scenario but raise field-grade ceilings until we bring traditional-track promotions up to promotion-opportunity levels comparable to those of the baseline case and technical-track outcomes to levels appropriately diminished from those of the traditional track.

Conceptual and Modeling Issues

Developing and exercising our models led us to confront a range of conceptual and modeling issues. We anticipated some of these before we constructed the models; others emerged as we exercised them.

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[13] This was a strong assumption on our part. Careful, detailed modeling of retention and compensation relationships, or actual experience with various policies, might reveal a different outcome.

[14] Most officers would be 50 to 55 years of age if they retired with 30 YOSs. Most retire before reaching 30 years, perhaps so that they can start a second career at a younger, more propitious age. But given the opportunity to serve until age 60 or 65, some might opt to remain beyond 30 years, obviating the need for a second career.

Fundamentally, we had to visualize how various HRM flexibilities might be shaped by as-yet-unspecified statutory and policy changes and how the Air Force might implement them. Our interviews with CFMs and consultation with our sponsors helped in this regard. In general, we sought to operationalize the flexibilities using simplified, representative parameters. Often, these parameters required us to simulate patterns of behavior outside of historically observed ranges or patterns. Where possible, we summoned empirical data as the basis for constructing parameters. But where data were lacking, we constructed what we considered to be plausible representations of expected behavior.

Promotion Flexibilities

During the course of this project, our sponsor participated in discussions with OSD and other service counterparts regarding promotion flexibilities. His and others' interactions with congressional staffers also provided insight into prospects for statutory change. His conclusion was that, in the near term at least, most officers will remain in a traditional track and this track will continue to be managed under DOPMA statutory provisions. However, the services might be given authority for limited testing of some departures from DOPMA.[15] The flexibilities would apply to selected career fields and would permit implementation of something similar to what we have simulated as the technical track in our models.

Under DOPMA, both promotion-management processes and promotion metrics are anchored to a single IPZ consideration. Promotion quotas are tied, by means of a nominal promotion opportunity, to the number of eligibles in this zone.[16] Selections below and above this zone are included in the quota that is derived from eligibles IPZ and thus result in one-for-one reductions in selections from IPZ. The range of dates of rank declared (at service-secretary discretion) eligible for promotion in this zone also sets the timing of promotion in all three zones. The nominal promotion opportunity used in this process is cited in promotion-related policies as an approximation of the actual opportunity an officer would experience after competing in all three zones.[17]

Promotion in the technical track, as we envision it, would not be defined by strict zones of eligibility delineated by date of rank. Rather, officers might become eligible individually through processes yet to be defined, possibly including either completion of career-development milestones or self-declaration of readiness for consideration. We also assume that statutory up-or-out provisions will not apply to officers in the technical track and that the policies adopted for this track will remove the stigma of nonselection. To model this, we made the retention profile for nonselected technical-track officers the same as that of officers who have been selected for promotion. In our modeling, we do not address promotion eligibility directly other than to stipulate that the beginning of the technical-track promotion window is lagged two years behind IPZ eligibility in the traditional track. See "The Human Resource–Management Flexibility Scenario" for more detail regarding the wider, flatter distribution of promotions across CYOSs targeted in the model. Figure 3.1 indicates how these distributions were distributed across occupational categories, CYOSs, and grades in the HRM flexibility scenario. Also, Appendix B provides a discussion of how DOPMA statutory provisions would have to change to accommodate a technical track.

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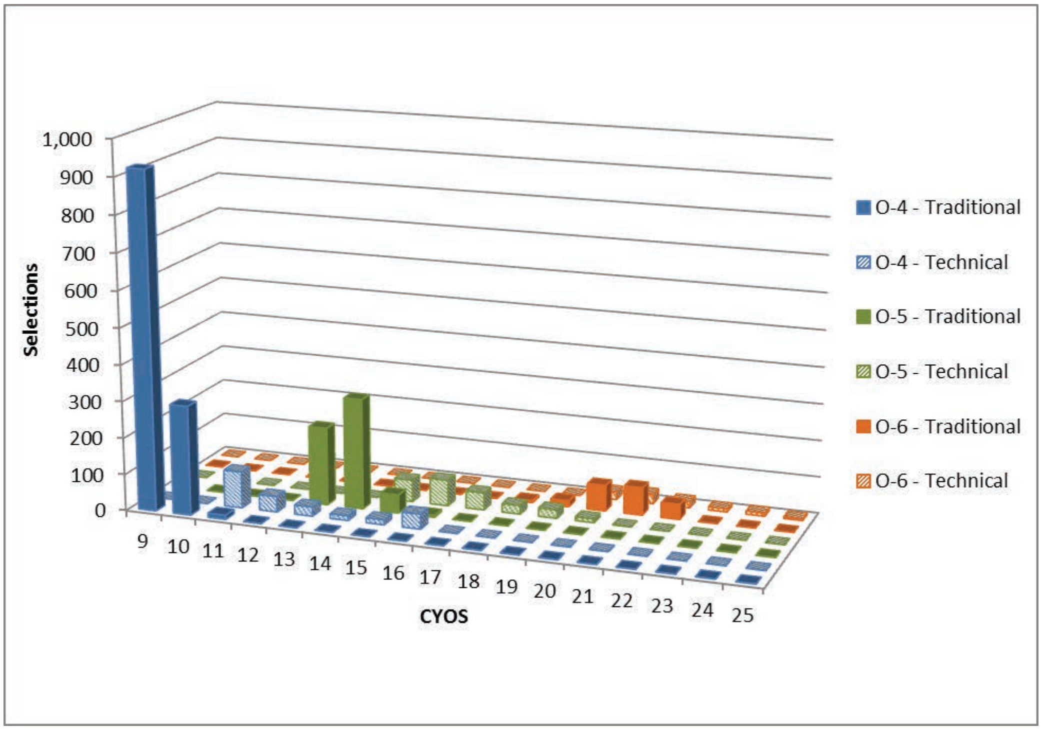
[15] The annual National Defense Authorization Act does not provide this flexibility for FY 2017, but future legislation might do so.

[16] Eligibles, or promotion eligibles, are all inventory in a promotion window.

[17] As documented in Appendix C, the nominal promotion opportunity is actually not an accurate indicator of overall promotion opportunity.

Figure 3.1. Promotion Distributions: Human Resource–Management Flexibility Scenario



NOTE: Average promotions in modeled FYs 2031 to 2050.

Promotion Metrics

Conventional measures of promotion opportunity and timing, tied to a single IPZ promotion consideration, will not work with patterns like those shown in Figure 3.1. New metrics will be needed to permit cross-sectional comparisons among career fields and demographic groups, between traditional and technical tracks, and to track longitudinal changes over time.

The conventional definition of promotion opportunity, found in Department of Defense Instruction 1320.14, is

> The cumulative opportunity for selection for promotion of officers who have competed for promotion to the next higher grade. For the Commissioned Officer Promotion Program, it is calculated by taking the maximum number of recommendations that may be made by the promotion selection board and dividing that number by the number of officers in the zone. General and flag officer boards include above-zone eligibles; all other boards exclude below- and above-zone eligibles. (U.S. Department of Defense, 2013, p. 28)

Our proposed metric for promotion opportunity, freed from reference to the count of IPZ officers, is similar to the cumulative continuation rate (CCR) used to measure retention outcomes. The CCR is the product of annual continuation rates for a year-group cohort as it passes through a specified CYOS window (e.g., the six- to 14-YOS continuation rate has been used to measure a pilot's propensity to remain in service through a critical retention window). We propose a similar cumulative promotion rate (CPR) to measure net promotion opportunity after all considerations in a window of eligibility. A CPR calculation would treat the selection rates for boards held in a CYOS window similarly to how it treats annual retention rates in a CCR calculation. It would differ slightly from a CCR calculation in that it must be defined as the complement of the product of the nonselection rates rather than as the product of the selection rates (i.e., the CPR is 1 – the probability of not being selected after all considerations in the promotion window). This modification of the calculation accounts for the fact that the CPR involves ternary outcomes: From one year to the next, people can be selected and retained, nonselected and retained, or separated. Because separations occur during the promotion window, a simple product of selection rates would understate actual promotion opportunity across the window.

If promotion policies are flexible enough to permit people to enter the eligibility window at various CYOSs (e.g., some captains in a technical track might enter the window for promotion to major at CYOS 11, while others, through personal choice or milestone completion, would not enter it until CYOS 12 or more), an additional refinement is needed in this calculation. The calculations must be performed from each entry point to the end of the window, then weighted by the proportion of new eligible captains at each entry point. If the end of the promotion window varies because of individual circumstances, yet another complexity is introduced in the calculation.

In measuring both retention and promotion, it is possible to measure the outcome for a single cohort as it traverses an entire window; we can call this a *cohort* CCR or CPR. Of generally greater interest, however, is measurement of retention or promotion outcomes for a range of cohorts in a single year or on a single promotion board, to permit either cross-sectional comparisons among subgroups competing for promotion or longitudinal comparisons of outcomes across a series of boards. For this purpose, synthetic CCRs and CPRs can be calculated using multiple cohorts' experiences in a single year or promotion board. For promotion measurements, we can call this a *board* CPR.

We arrived at the concept of a CPR after considering several other options. Appendix C describes the other options, provides more information on why we settled on the CPR, and provides an example of how cohort and board CPRs would be calculated.

Measurement of promotion timing, defined in Department of Defense Instruction 1320.14 (U.S. Department of Defense, 2013, p. 28) as a "12-month average of the total active commissioned service for due-course officers (i.e., those whose prior promotions have all been IPZ) promoted during each month of the fiscal year," is more straightforward. Except for reference to due-course officers, the same definition can be used in a more flexible promotion context. For those promoted in wider technical-track windows, it would also be useful to measure and track distributions across CYOSs at pin-on.

Controlling Promotion Outcomes

In our modeling, we faced a challenge that foretells what military force managers will also encounter if given the authority to implement the flexibilities described above. They will want promotion decisions to yield outcomes that are considered healthy for the force. Air Force functional managers generally pay attention to how officers in their associated career fields fare in promotions relative to officers other career fields. Persistently unfavorable comparisons are viewed as problems to be addressed. As a result, both the expectation and the generally realized outcome is that promotion opportunity and timing are relatively consistent across career fields (perhaps with some career fields intentionally favored relative to others for strategic reasons).

In discussing the concept of a technical track with senior officers and personnel officials in the Air Force and OSD, we have commonly encountered the sense that technical-track promotion outcomes should be tempered relative to the traditional track. The view is that most senior leadership and management positions would be filled from the traditional track and, therefore, a greater proportion of the DOPMA-constrained grade structure should be allocated to the traditional track. Negative retention impacts of lowered promotion opportunity in the technical track would be offset as necessary by other mechanisms.

Given these considerations, Air Force force managers would want technical-track outcomes to lag traditional-track outcomes in measured amounts. Timing can continue to be managed in a straightforward way by setting the CYOS eligibility ranges for each promotion board, similar to what is done under current statute and policy. But opportunity outcomes result from decisions made by multiple promotion boards as a cohort passes through a window of eligibility and thus cannot be readily stipulated in an instruction to a board. However, board instructions can stipulate the number of eligibles and the number of selections to be made or, equivalently, the selection rate.

To place ourselves in the same position as a force manager, we modulated promotion opportunity by setting floors and ceilings on selection rates.[18] In practice, because pilots have better retention rates than nonpilots, this generally required us to set pilot selection rates higher than nonpilot selection rates in order yield equivalent promotion opportunities. Also, in order to allow comparable specifications for both traditional- and technical-track promotions, we set selection rates so that they applied to the full count of eligibles in a promotion window, not just to an IPZ cohort. Because of this, we used the new promotion metrics described above rather than currently used zone-based promotion metrics. If a technical track is adopted, force managers will have to do the same.

Timing was more easily managed. As described above, we stipulated the promotion window and the desired distribution of selections across the CYOS in a window but allowed the model to deviate from the desired distribution to maintain feasibility or as a trade-off to reach other optimality goals. The policy changes simulated in our HRM flexibility scenario were of a scale that allowed us to preserve essentially the same timing for traditional-track promotions that we used in the baseline scenario. For technical-track promotions, as described above, and as illustrated in Figure 3.1, we provided a lagged, wider window with a flatter CYOS distribution.

The resulting promotion opportunities in our baseline and HRM flexibility scenarios are shown in Figure 3.2. In the traditional track in the HRM flexibility scenario, promotion opportunities to grade O-4 were about 10 percentage points lower than in the baseline scenario, opportunities to advance from O-4 to O-5 differed by a smaller amount, and opportunities to advance from O-5 to O-6 remained about the same. However, because lowered opportunity for promotion to O-4 reduces the number of eligibles competing for higher-grade promotions, the opportunity for an O-3 to reach O-5 or O-6 is diminished by a greater amount than these nominal changes in one-grade promotion opportunities. By design, the number of promotion opportunities in the technical track was roughly 10 percentage points below the number of opportunities in the traditional track.

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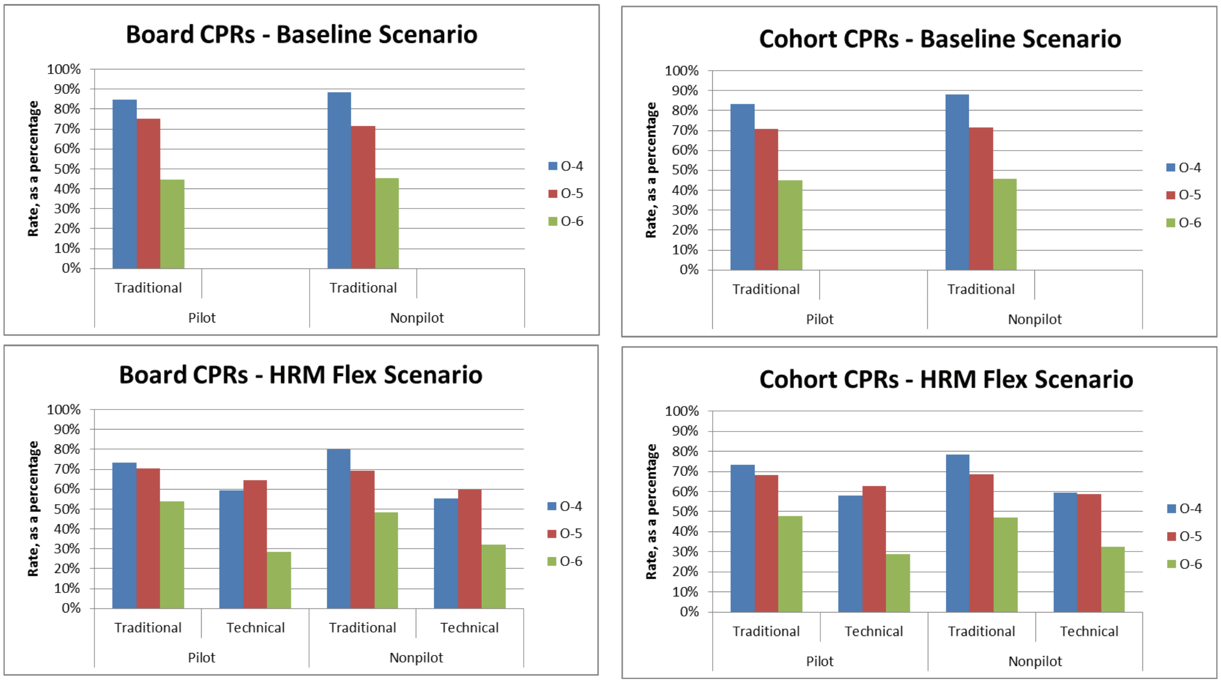
[18] Another consideration is that the CPR, as described in Appendix C, would have been very difficult to express in a constraint and would make the HRM flexibility model nonlinear, rendering it much more difficult to reach optimal solutions.

Figure 3.2. Board and Cohort Cumulative Promotion Rates, Baseline and Human Resource–Management Flexibility Scenarios


Board CPRs - Baseline Scenario

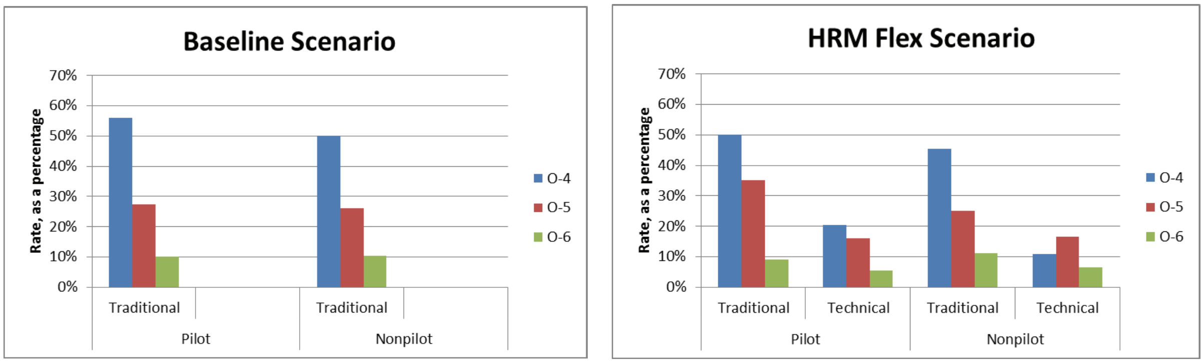
Cohort CPRs - Baseline Scenario

Board CPRs - HRM Flex Scenario

Cohort CPRs - HRM Flex Scenario

As described above, we varied selection rates in order to produce the promotion-opportunity outcomes shown in Figure 3.2. Figure 3.3 shows the selection rates for the two scenarios. Note again that these selection rates apply to all eligibles in a promotion window, regardless of promotion zone. Because there are no zones of consideration in technical-track promotions, this approach allows the selection rates in traditional and technical tracks to be compared. As noted above, because pilots have better retention rates than nonpilots in the promotion windows for each grade, this generally required us to set pilot selection rates higher than nonpilot selection rates in order to yield equivalent promotion opportunities. Also, as noted earlier, floors on pilot selection rates were needed in lieu of promoting to requirements because the ratio of field-grade to company-grade pilot requirements, as represented in manpower authorizations, does not meet the Air Force’s strategic human-capital needs (see Appendix D).

Figure 3.3. Selection Rates, Baseline and Human Resource–Management Flexibility Scenarios



Selection rates in the HRM flexibility scenario do not differ consistently from rates in the baseline scenario. This is because, to produce the intended promotion-opportunity outcomes, they are offsetting multiple other policy changes (technical tracks, fewer separations, 40-year careers, and lateral and RC entries) that affect promotions in different directions and to different degrees in different grades.

Promoting to Requirements

Our original modeling concept was to minimize inventory deviations from manpower requirements by grade and occupational category. We soon realized that doing so would cause all of the available flexibilities in the model, including promotions, to drive pilot field-grade inventories well below current levels. Moreover, as discussed in Appendix D, pilot grade requirements seem to be inconsistent with the retention patterns required for the pilot force, given training pipeline costs and the capacity of operational units to absorb new pilots. Accordingly, we resorted to establishing artificial floors for pilot promotion selection rates in order to keep pilot promotion opportunity roughly comparable to nonpilot opportunity.[19]

Inventory and Retention Outcomes

The Baseline and Human Resource–Management Flexibility Scenarios

Most of the features introduced in the HRM flexibility scenario tend to increase the proportion of the inventory at higher YOSs. Figure 3.4 shows pilot and nonpilot distributions by CYOS and grade in the baseline scenario. Figure 3.5 shows the contrasting distributions in the HRM flexibility scenario. The retention impacts of the ten-year ADSC following pilot training clearly distinguish the pilot from the nonpilot distributions. The differences in experience levels between the two scenarios can be gauged by noting the number of accessions (roughly the year 0 inventory) and the level of the slightly sloping plateau in the five years before the 20-year retirement eligibility point. In the baseline scenario, the pilot plateau is around 500; with accessions held constant between the two scenarios, it edges closer to 600, indicating better retention. A more precise indicator of experience levels in a profile can be formed by showing CYOS 19 inventory as a proportion of CYOS 0 inventory.[20] This proportion is 56 percent for pilots in the baseline scenario and 64 percent in the HRM flexibility scenario. Nonpilot proportions are 38 percent and 43 percent, respectively, for the two scenarios.

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[19] In our optimization model, setting a constraint such that pilot promotion opportunity would equal or exceed nonpilot promotion opportunity could be done only with nonlinear expressions. To avoid difficulties in solving a nonlinear model, we chose instead to indirectly moderate promotion opportunities by manually adjusting selection rate floors and ceilings, which we could do with linear expressions.

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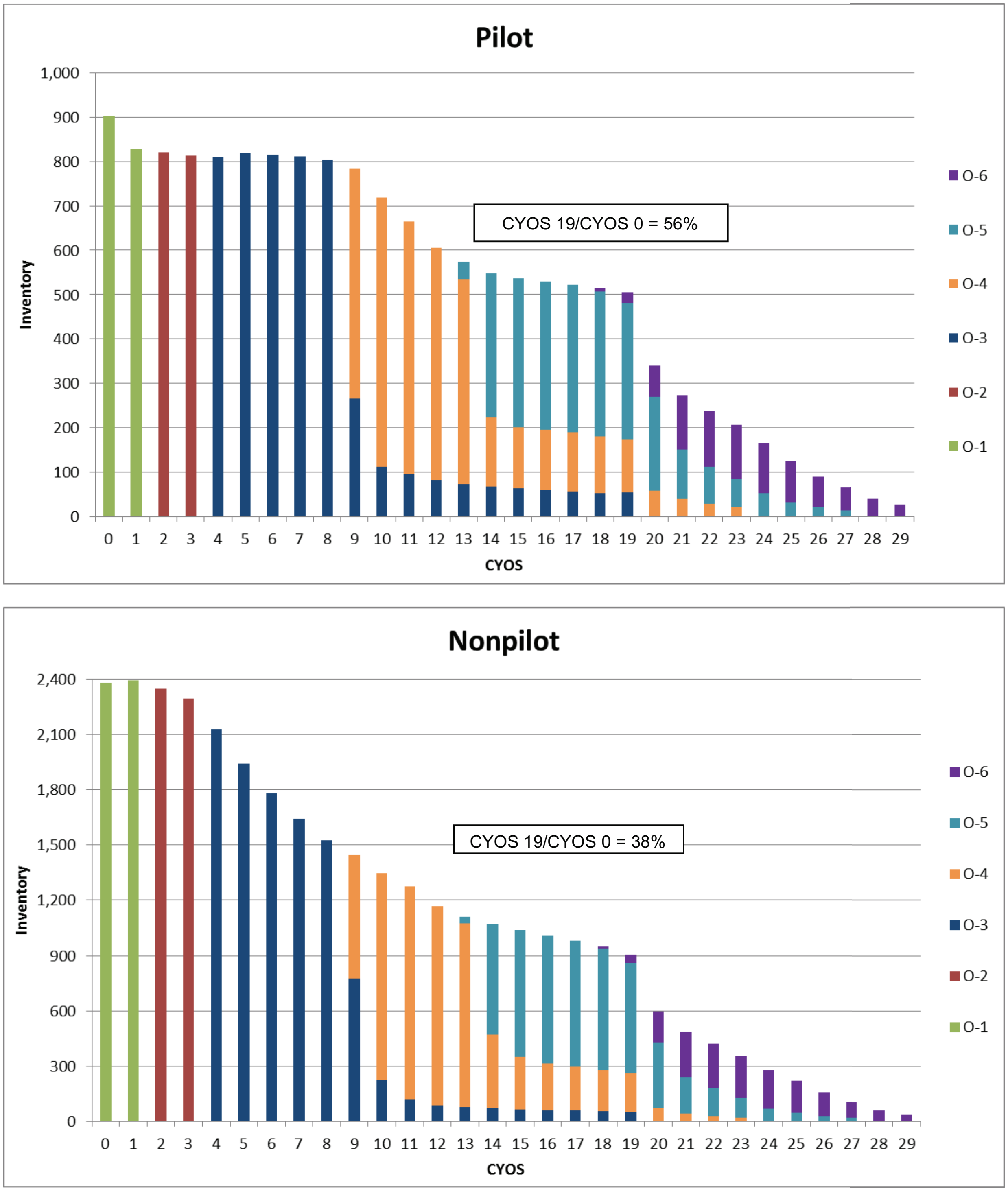
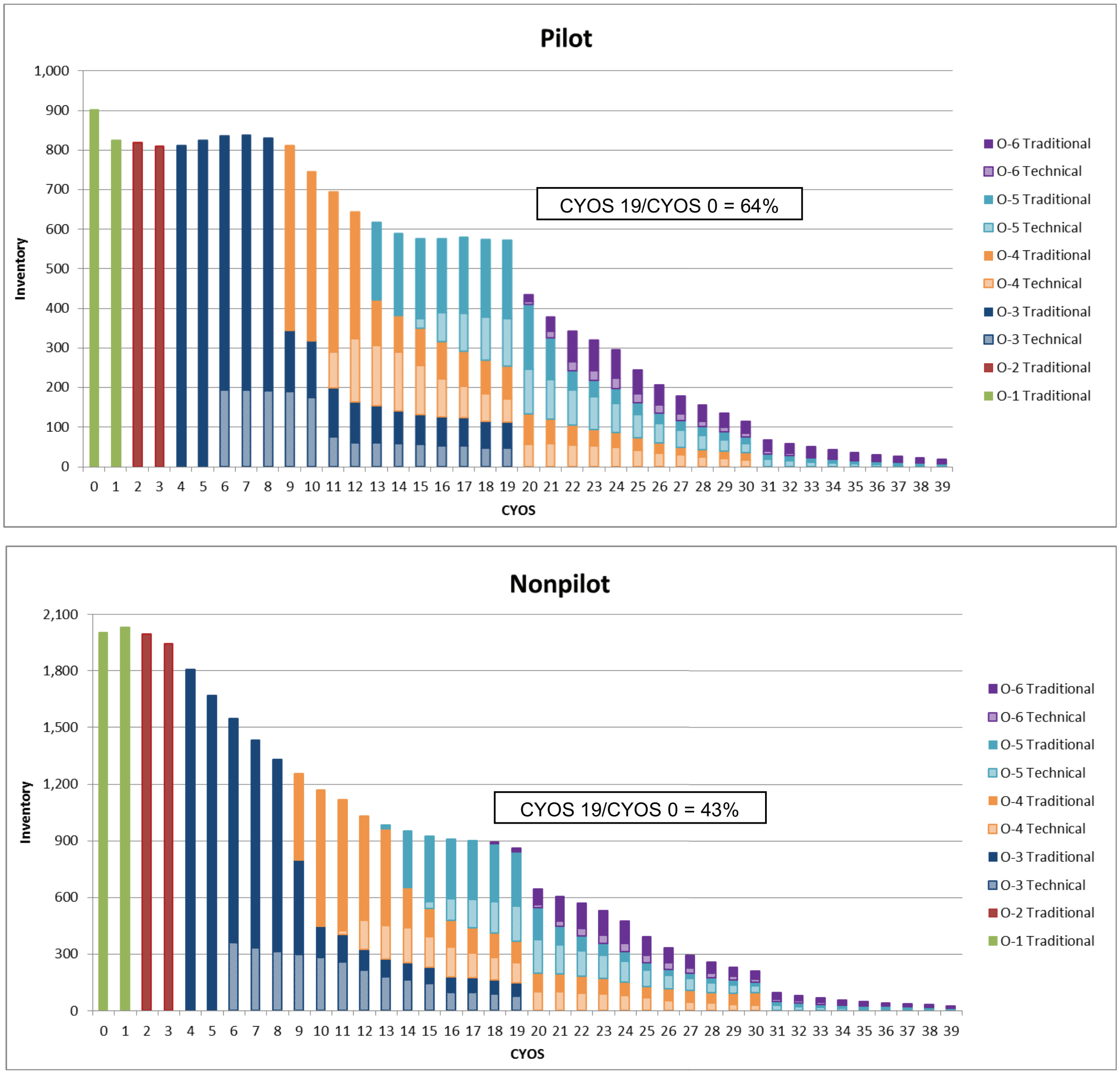
[20] In our baseline scenario, this proportion is equivalent to a CYOS 0-to-CYOS 19 CCR. In our other scenarios, lateral and RC entries also affect the ratio.

Figure 3.4. Commissioned Year of Service and Grade Profiles, Baseline Scenario



NOTE: Bars indicate average size of inventory in modeled years 2013 to 2050.

Figure 3.5. Commissioned Year of Service and Grade Profiles, Human Resource–Management Flexibility Scenario



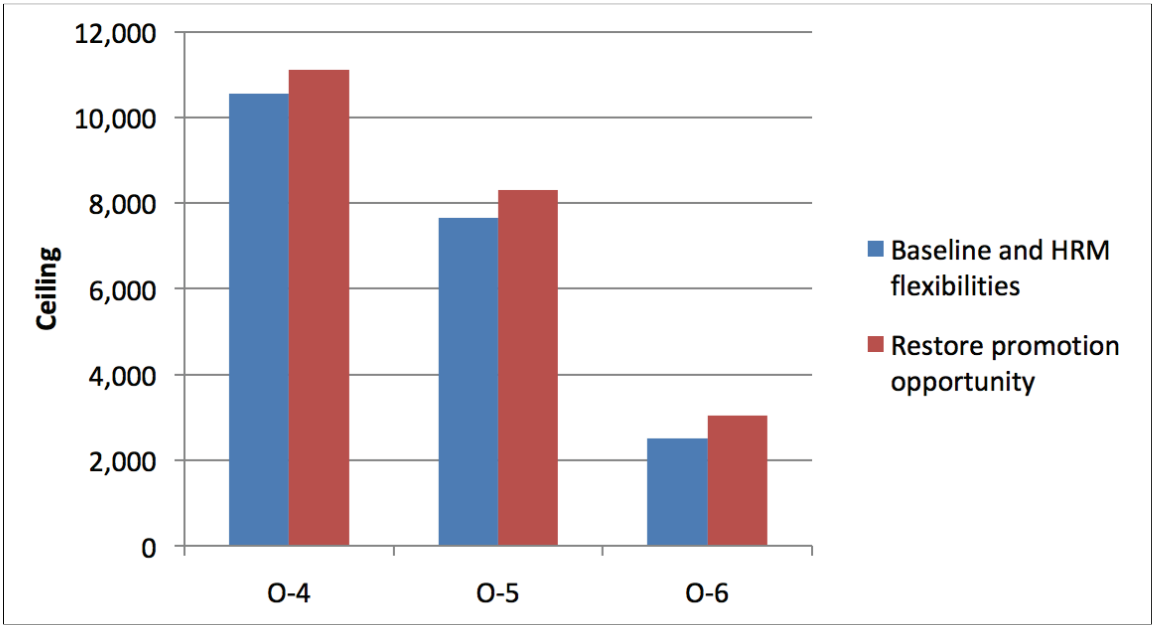
NOTE: Bars indicate average size of inventory in modeled years 2013 to 2050.

Restoring Promotion Opportunity

As discussed above, the HRM flexibility scenario features O-4 promotion opportunities that were about 10 percentage points below the baseline scenario level and a lesser decline in O-5 opportunities. Our third scenario examined how grade ceilings would have to increase in order to restore promotion opportunity to approximately the same level as the baseline scenario while maintaining the HRM flexibilities introduced in our second scenario. The required grade-ceiling changes are shown in Figure 3.6. The ceilings for grades O-4, O-5, and O-6 increased

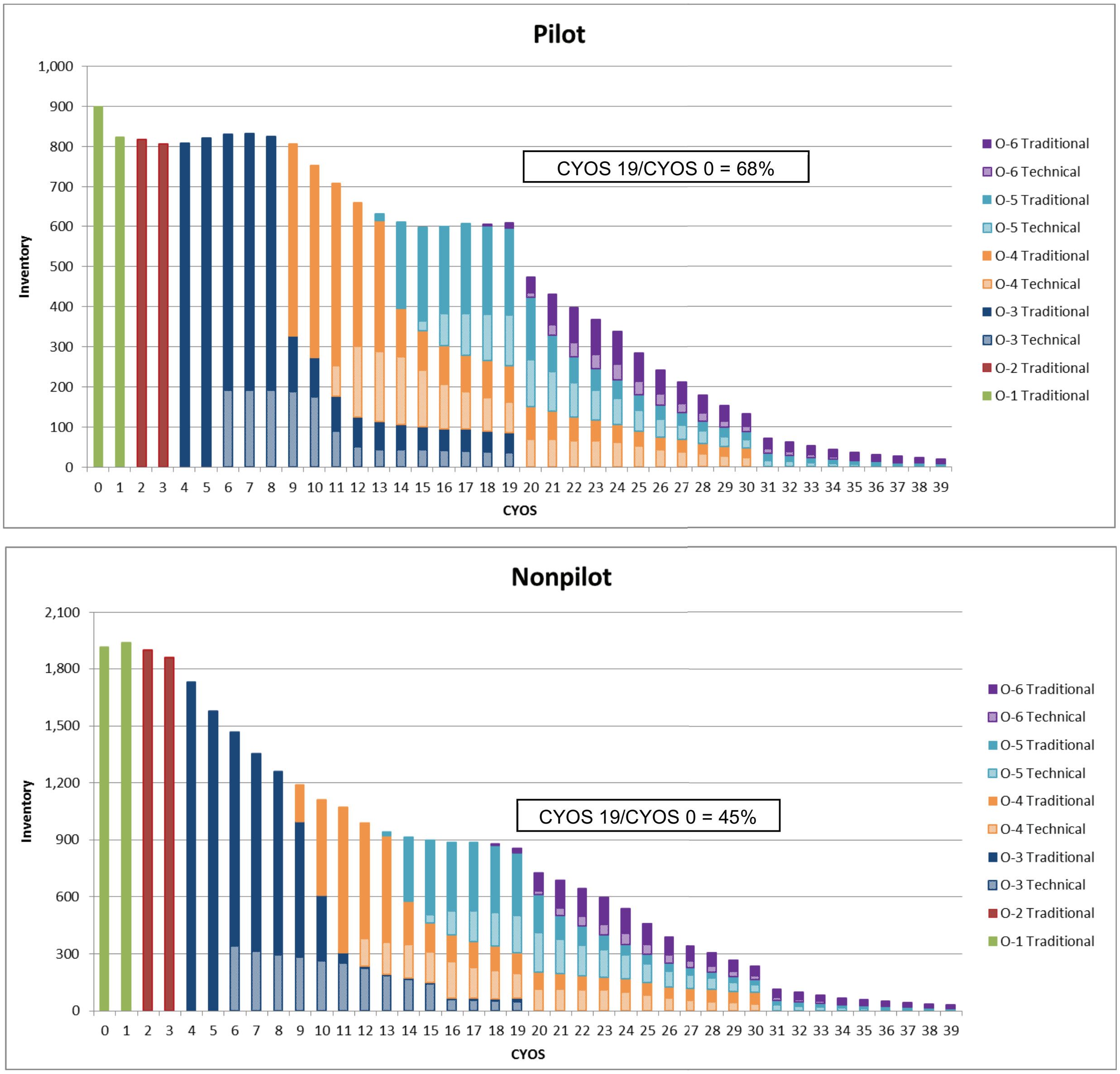
21.6 percent, 8.6 percent, and 5.1 percent, respectively, in the scenario that restored promotion opportunity.

Figure 3.6. Grade Ceilings



The inventory profiles for the scenario that restored promotion opportunity are shown in Figure 3.7. The increased grade ceilings result in more promotions and consequently higher retention. CYOS 19 strengths as proportions of CYOS 0 strengths increase to 68 percent and 45 percent, respectively, for pilots and nonpilots.

Figure 3.7. Commissioned Year of Service and Grade Profiles, Restored Promotion-Opportunity Scenario



NOTE: Bars indicate average size of inventory in modeled years 2013 to 2050.

Force and Accession Costs

The relative costs of the three scenarios can be estimated using an officer pay table by grade and YOS available from the Defense Finance and Accounting Service (Defense Finance and Accounting Service, 2017) and other personnel and accession cost factors available from the Air Force (Department of the Air Force, 2016). Base pay is readily determined by multiplying the pay table by the CYOS and grade inventory matrices produced by our model.[21] We supplemented this with computations using the following tables from the Air Force:

- A19-2, "Active Air Force Standard Composite Rates by Grade": This table separates composite rates into base pay and ten other components. Because we calculated base pay using the pay table, we use all components except base pay found in Table A19-2.
- A17-1, "Typical Acquisition and Training Costs": This table provides a weighted average cost and course length for nonrated-officer initial-skill training.
- A34-1 "Representative Officer Aircrew Training Costs Variable": This table does not provide a weighted average, so we constructed one using exemplary weapon-system course costs provided in the table and the FY 2016 distribution of undergraduate pilot training (UPT) graduates by major weapon-system categories. The published training costs in these tables include the pay of students; because student base pay and other personnel costs are also captured in our base-pay and composite-rate calculations, we subtract standard composite-rate costs, factored to typical pipeline lengths, from the training cost factors.

The resulting cost comparisons are shown in Figure 3.8. Starting from the baseline scenario, the other two scenarios provide progressively richer grade and CYOS profiles and fewer accessions. Thus, force costs (base pay and other personnel costs) rise while accession costs (commissioning and initial-skill training) decline. The force cost increases dominate the accession cost decreases. The HRM flexibility and restored promotion-opportunity scenarios increase costs by 0.8 percent and 1.9 percent, respectively, relative to the baseline scenario. Although the percentage increases are small, force costs are quite large, so the dollar amounts of the increases are also large: \$82.4 million and \$183.2 million per year, respectively.[22]

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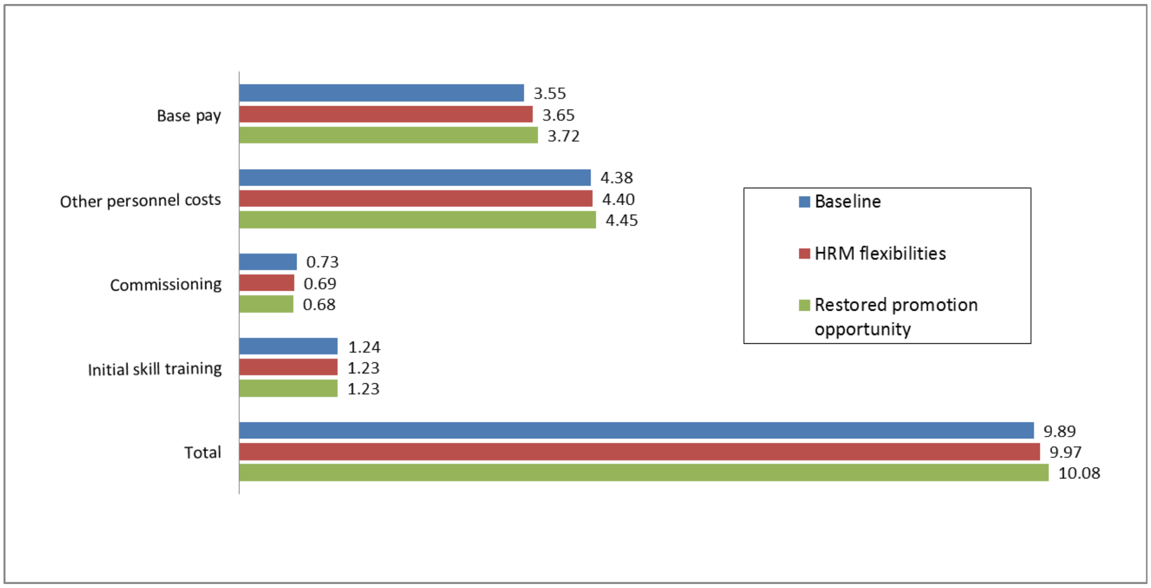
[21] The officer pay table is based on total military YOSs rather than CYOSs. For our calculations, we make the simplifying assumptions that no prior enlisted members are serving in the officer force and that lateral entries will be paid based on constructive years of commissioned service, which we discuss later in this report.

[22] We based costs on FY 2016 pay tables and other cost factors.

These cost comparisons mask an important difference between pilot and nonpilot inventories. Because of the high cost of UPT and follow-on weapon-system training, lowered pilot accession costs can overwhelm higher force costs when the experience mix increases *if the force size is held constant*. Because the Air Force faces perennial pilot shortages, we chose instead to hold pilot accessions constant, allowing total pilot force size to vary as a function of retention and RC entries. In the base case, total pilot inventory builds and stabilizes at about the level of current pilot requirements, including a share of institutional requirements (positions open to all or many career fields) historically occupied by pilots. In the HRM flexibility and restored promotion opportunity scenarios, holding pilot accessions constant results in pilot overstrengths that build and stabilize at about 2,000 and 2,500, respectively, in the two scenarios. However, the requirements with which these strengths are compared are partially a product of historical pilot representation in institutional and developmental positions that are not pilot-specific. Pilot representation in

Figure 3.8. Force and Accession Costs



SOURCE: We based costs on FY 2016 pay tables and other cost factors.

NOTE: Because of rounding, some figures do not sum to the totals.

This analysis revealed an issue that will make lateral entry less attractive to the more experienced technical workforce for which it is envisioned. Current statutory provisions limit constructive credit—adjusting YOSs to account for preservice education or experience—to use only in determining initial grade, rank in grade, and service in grade for promotion eligibility (10 U.S.C. 533). Constructive credit is not used to determine where a lateral entrant falls in the pay table, and it does not reduce the amount of service required to qualify for the defined-benefit component of the military retirement system. Thus, an expert with 14 years of civilian experience, if accessed at the grade of major, would receive base pay of $4,507.70 per month (FY 2016 rate for a major with less than two YOSs) rather than the $7,314.80 received by his or her peers with purely military experience and would have to serve an additional 20, not six, years to attain eligibility for a defined retirement benefit. A case can be made to change the way in which constructive credit relates to the pay table, although such a change might be expensive,

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those positions is considered suboptimal because of past shortages that have driven sharp rationing of scarce pilot resources. Thus, with larger pilot inventories, the non–pilot-specific component of pilot requirements will grow, perhaps significantly. It is also possible that our pilot retention rates, based on recent history, underrepresent the future retention environment such that our models overstate expected pilot inventories. Given these uncertainties and the lack of project resources to explore them fully, we reasoned that holding pilot accessions constant was prudent, particularly with respect to cost considerations. Our force cost calculations are unaffected by the pilot/nonpilot inventory mix because the personnel costs available to us were not differentiated between pilots and nonpilots. However, initial-skill training costs were differentiated between pilots and nonpilots. Reducing pilot accessions in order to hold pilot strength constant, when such a course seems less likely than holding pilot accessions constant, would have made the cost of HRM flexibility and restored promotion-opportunity scenarios less representative of potential outcomes.

given the currently extensive use of constructive credit for accessions in professional (medical, legal, and chaplain) career fields. Because the retirement system now provides an earlier-vested defined-contribution component, the case for making constructive credit applicable to retirement-benefit determinations is less compelling.

Sorting Individuals into Promotion Tracks

So far, our modeling efforts have relied on our aggregate HRM flexibility model. The model's unit of analysis is a cell defined by occupational category, promotion track, grade, and CYOS, keeping track of counts of the number of officers who serve in that cell as it transitions through the FYs represented in the model. In that model, we cannot explore some important questions, such as how different types of people will fare under the HRM flexibilities, or how different officers will be selected into the technical track. To better understand how new promotion policies might affect different types of people, and to examine the implications of different rules for sorting people into tracks, we simulated the effects of the HRM flexibilities using a different model: RAND's military career model.

In Appendix A, we briefly describe the military career model and explain how it was calibrated to incorporate the new HRM flexibilities. Instead of modeling the entire force, we focus in this analysis on only the aggregate behavior of pilots. Then, we simulate different ways in which officers can be sorted into tracks and focus on how these choices might affect the distribution of talent in the officer pool.

When simulated officers are accessed in the military career model, they are endowed with a fixed aptitude score, z, which is drawn randomly from a normal distribution. The model assumes that officers with higher levels of z will tend to be promoted more often and more rapidly and that, through systematic selection processes, they will tend to serve in more-important positions in the Air Force.

We make two major simplifying assumptions in specifying aptitude in the model. The first is that each officer gets a single draw of z, which does not change over the course of his or her career.[23] The second assumption is that z is one-dimensional. In practice, officers have many different abilities for performing different types of tasks; for example, some officers might be better at leadership tasks, while others might be better at technical tasks.[24] A different modeling approach might have specified a joint distribution between leadership and technical abilities, using the former for promotion decisions and the latter for sorting into tracks. However, both for simplicity and to better highlight the consequences of using stricter sorting rules, we focus on the single-index case. Nevertheless, if the Air Force moves in the direction of implementing technical tracks, it will need to develop and institutionalize the capacity for sensing and managing these qualitatively different talents in its officer pool. After specifying the distribution of officer talent, we use the military career model to mimic the steady-state distributions of pilots in the HRM flexibility model's baseline and HRM flexibility cases. To do so, we matched both models' predicted accessions, retention patterns, and grade structure. One big difference between the HRM flexibility model and the military career model is that, in the latter, we specify the set of positions that officers have to fill while serving in the force. At low grades, this does not make much of a difference, but, by O-3, we separate positions into aptitude categories, labeling them as AA, A, B, and C. For each grade, we coded 5 percent of positions AA, 10 percent of positions A, 35 percent of positions B, and the remaining 50 percent C.

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[23] In this discussion, we use *ability* as a summary indicator that reflects both innate characteristics and developed skills or talents. We intend it to mean something similar to what the Air Force seeks to measure in its *whole-person concept*:

> Subjective assessment of each officer's relative potential to serve in the next higher grade that requires careful review of the officer's entire selection folder to assess such factors as job performance, professional qualities, leadership, job responsibility, depth and breadth of experience, specific achievements, and academic and professional military education. (Air Force Instruction 36-2501 [Department of the Air Force, 2009], p. 93)

As a simplifying assumption in our modeling, we treat ability as fixed through a career, but we also introduce developmental effects as a function of career paths through jobs of varying ability categories, as discussed in the rest of this section.

When assigning officers to positions, the model selects the most-talented officers to serve in the small set of AA positions. The next most–talented officers will serve in A positions, and, after those positions are filled, the model selects the most-talented officers who remain to fill B positions, and so forth. This process creates a talent hierarchy across positions within a grade, and we use this as a way to encode and determine how officers are sent to the technical track when we incorporate promotion flexibilities. It also simulates the process by which highly capable officers are selected for assignment to more-critical or demanding jobs, which, in turn, contributes to their development to serve in even more-demanding positions in the future.

In our baseline scenario, without promotion flexibilities, the military career model's grade and YOS distribution for pilots are represented in Figure 3.9. Comparing this with the pilot distribution in Figure 3.4, we see that the military career model delivers a similar profile for pilots, except that the number of pilots in their first YOS is much larger in the HRM model than it is in the military career model. This is because, for simplicity, when we model pilots in the military career model, we exclude people eliminated from undergraduate pilot training and ignore cross flow to and from different career fields.

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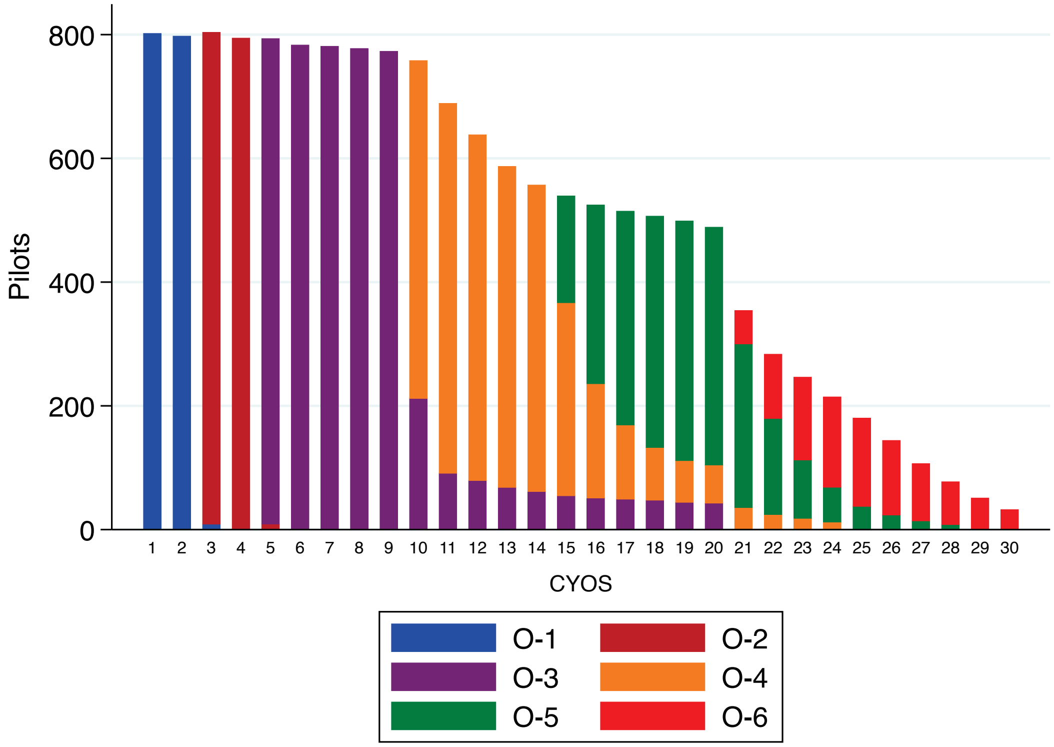
[24] With pilots having many different abilities, one way to think of *z* is as a weighted average of a large number of attribute scores (e.g., one score for leadership ability, a second score for perseverance, a third for technical aptitude), with fixed weights measuring the Air Force–specified importance of those scores.

Figure 3.9. Grade and Year of Service for Pilots, Baseline Scenario, Military Career Model



An important issue regarding a technical promotion track is the question of how officers are sorted into the technical track. We examine two alternatives. The first, which we call *strong aptitude stratification*, involves selecting officers who tend to have lower aptitude scores for transition to the technical track.[25] Although it might not be likely for this sort of aptitude stratification to be adopted in practice, we model it to illustrate some of the adverse consequences of using binding decision rules for sorting people between the tracks.

To implement this, for officers who have served in initial O-3 positions, the model selects approximately 30 percent of those officers to move into the technical track. It chooses them from those who have previously served a C-coded O-3 position. In grades O-4, and O-5, when additional officers are selected to move to the technical track as this track grows, selected officers are all chosen from the pool of officers with previous C-coded position experience.

As shown in Figure 3.10, this selection process results in an aptitude distribution that is stratified between the traditional and technical tracks, with the technical track populated by lower-aptitude officers. Note that this selection procedure does not mean that the lowest-aptitude officers are always assigned to the technical track; because officers are randomly selected from the C-coded positions, some officers who stay in the traditional system might have lower talent scores than officers who move to the technical track. However, choosing officers from those who have served in C-coded positions tends to truncate the aptitude distribution, and, on average, technical-track officers have lower talent scores than traditional officers have.

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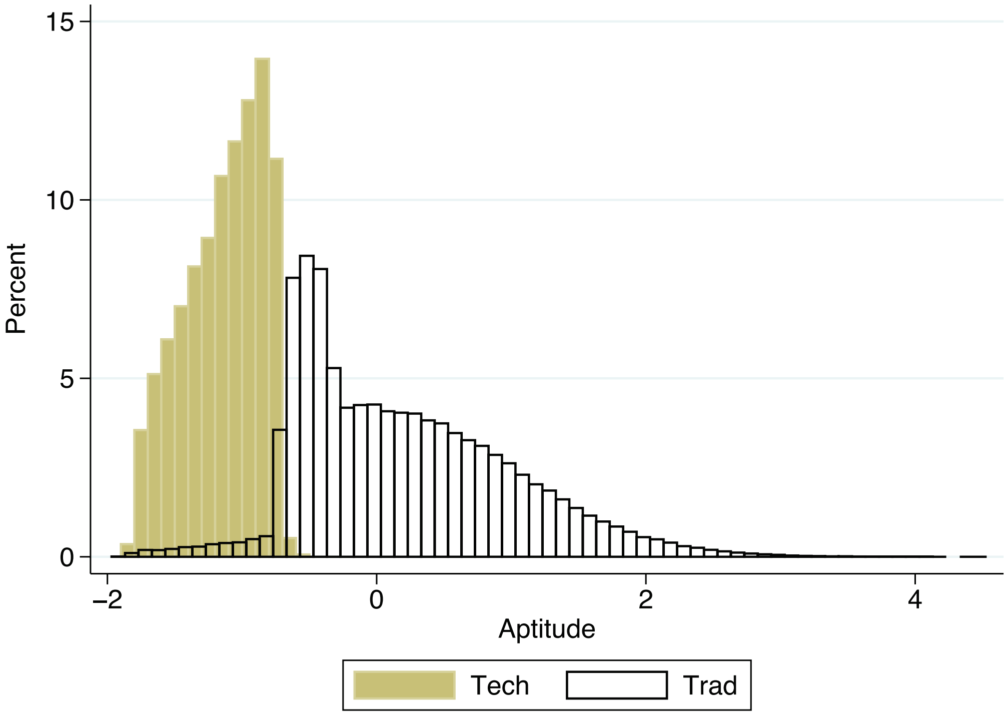
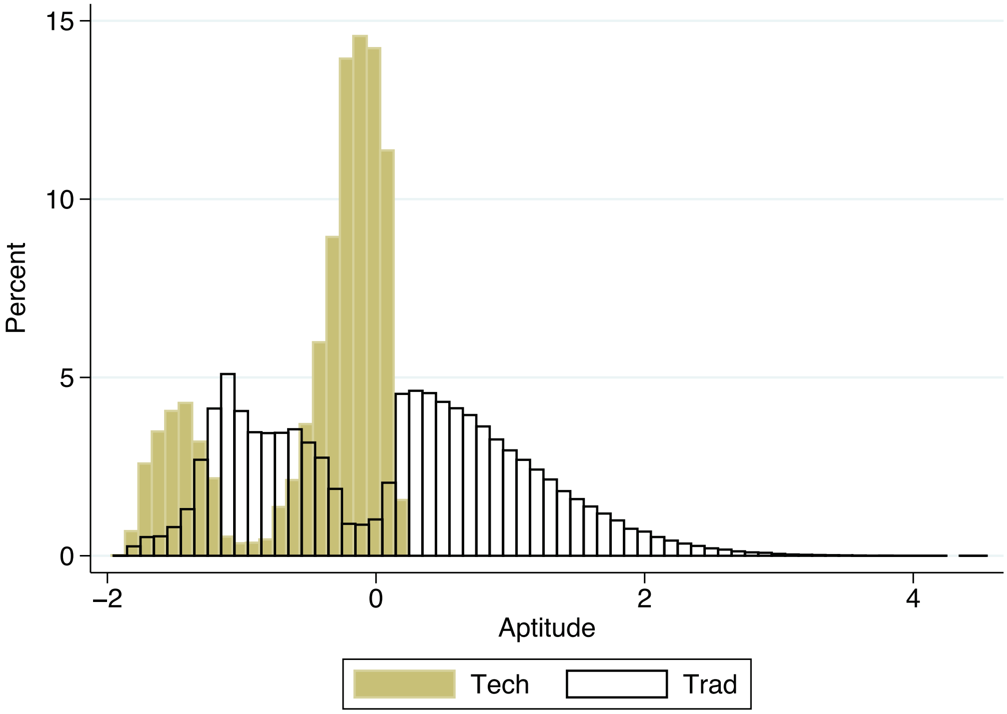
[25] Recall that our aptitude construct is comparable to the whole-person concept used in Air Force officer promotion considerations.

Figure 3.10. Aptitude Distribution, O-3, with Strong Aptitude Stratification



In the second alternative for selecting officers, we relax the requirement that officers who move to the technical track have had previous C-coded position experience. Instead, we allow the technical positions to be filled by officers with either B- or C-coded experiences. The resulting aptitude distribution is depicted in Figure 3.11. This still tends to result in a lower average aptitude among officers in the technical track, but there is considerable overlap in the aptitude distribution between the traditional and technical tracks. We call this *weak aptitude stratification*.

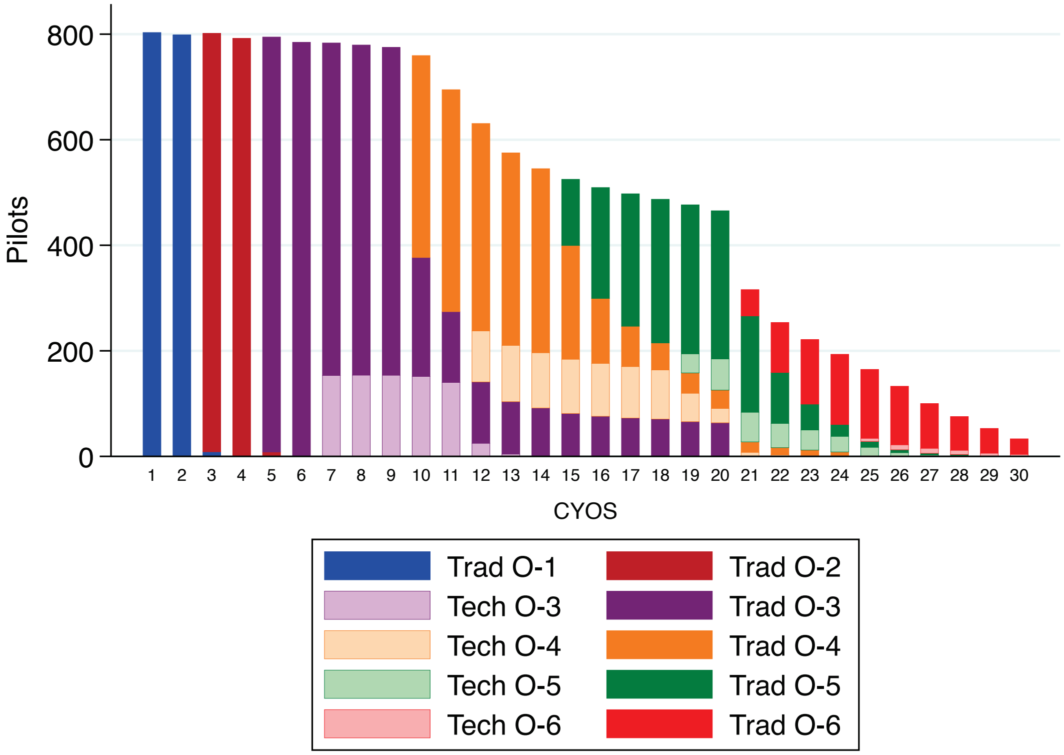
Figure 3.11. Aptitude Distribution, O-3, with Weak Aptitude Stratification



NOTE: The bimodal appearance of the aptitude distributions merits some explanation. In the weak aptitude stratification alternative, technical-track jobs are filled at the same time as B- and C-coded jobs, from the list of officers who have had either B or C experience. The model fills positions in two iterations; after trying to fill positions in the first iteration, it goes back and looks at the remaining unemployed officers and fills those slots. This is why the bimodal distribution appears; the first hump is due to the first position fill for the technical track, and the second hump is the second fill, after the model has gone back and filled B- and C-level positions.

In Figure 3.12, we plot the grade and YOS profile for pilots under the HRM flexibility scenarios; note that this figure is the same regardless of how officers are selected into the technical track. Again comparing this with the pilot distribution in Figure 3.5, we see that the military career model delivers a similar profile for pilots, but, because we do not model washout or cross flow, our model displays some discrepancies.

Figure 3.12. Grade and Year of Service for Pilots, Human Resource–Management Flexibility, Military Career Model

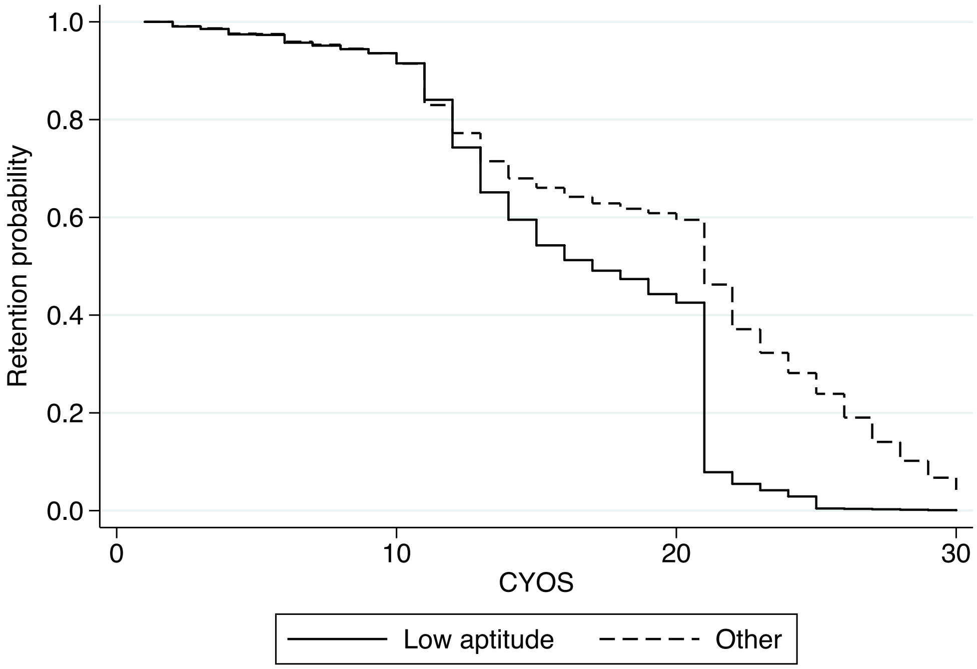


NOTE: This grade and YOS distribution is identical for both the strong and weak aptitude stratification alternatives.

Retention of Lower-Aptitude Officers

An important question is whether the HRM flexibilities under the new promotion system could increase promotion outcomes of low-aptitude officers. In the baseline system with no tracks, aptitude is used in determining promotion decisions, and lower-aptitude officers will tend to be promoted at lower rates than higher-aptitude officers. Because nonpromoted officers have historically had lower retention than promoted officers, the result is that lower-aptitude officers will have lower retention than higher-aptitude officers. This is demonstrated in Figure 3.13, in which we plot the retention curves of Air Force officers by aptitude. The solid black line in the figure estimates the retention probability of the bottom 10th percentile of the aptitude distribution, while the dashed black line estimates the retention probability for everyone else. It is easy to see that, around 11 YOSs, retention probabilities begin to diverge, and, by 21 YOSs, there are very large discrepancies, with considerably lower retention of low-aptitude officers. This reflects the promotion system, in which higher-aptitude officers are promoted and increasingly retained over lower-aptitude officers.

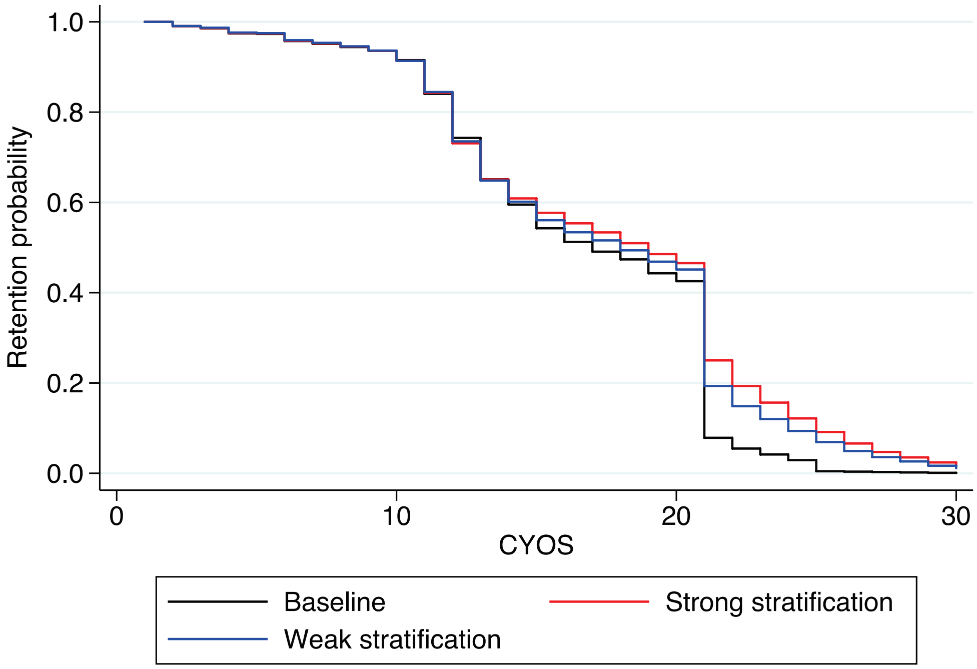
Figure 3.13. Retention Curves by Aptitude, Baseline Scenario



NOTE: This figure produces the Kaplan–Meier estimator of the retention probability of a pilot officer, by CYOS. The line is plotted as a step function, with a series of declining horizontal steps, because the value of the retention probabilities between successive steps is assumed to be constant. Low-aptitude officers are defined as officers with aptitudes in the bottom 10th percentile of the aptitude distribution. The solid black line in the figure estimates the retention probability of the bottom 10th percentile of the aptitude distribution, while the dashed black line estimates the retention probability for everyone else.

How do the changes in retention assumptions for officers in technical tracks (i.e., that nonpromoted officers will be retained at the same rates as promoted officers) affect the retention of lower-aptitude officers? Figure 3.14 focuses on the low-aptitude officer retention curves. The black line is the same curve as the solid black line in Figure 3.13, but we add two more curves, which are the retention of low-aptitude officers in the HRM flexibility scenario with strong aptitude stratification (red line) and weak aptitude stratification (blue line). Under both stratification alternatives, the technical track increases the retention of low-aptitude officers. However, when comparing between the two alternatives, weak aptitude stratification tends to lead to less retention of low-aptitude officers than strong aptitude stratification (i.e., the red line is always higher than the blue line). This makes sense: Because officers are imperfectly sorted into the different tracks, some of the low-aptitude officers will stay in the traditional track, where they face higher loss rates if not promoted.

Figure 3.14. Retention Curves for Low-Aptitude Officers, by Aptitude Stratification Method



NOTE: This figure produces the Kaplan–Meier estimator of the retention probability a pilot officer, by CYOS. The line is plotted as a step function, with a series of declining horizontal steps, because the value of the retention probabilities between successive steps is assumed to be constant. Low-aptitude officers are defined as officers with aptitudes in the bottom 10th percentile of the aptitude distribution. The solid black line estimates the retention probability of the bottom 10th percentile of the aptitude distribution. The red line shows retention of low-aptitude officers in the HRM flexibility scenario with strong aptitude stratification and the blue line with weak aptitude stratification. To construct this figure, we ran the baseline scenario 20 times, with different levels of θ for each simulation. Along a vertical line, each set of dots corresponds to the same simulation.

Noisy Measures of Aptitude

One assumption we have made so far is that the Air Force is perfectly able to measure officer aptitude, z. However, in practice, aptitude might not be easy to observe. In the simulations discussed below, we sometimes assume that officer aptitude is not accurately measured but is instead measured with noise.[26] Instead of being able to perfectly observe officer aptitude, the Air Force has *noisy* signals of aptitude that are imperfectly correlated with actual aptitude.

How does measurement error affect the retention of low-aptitude officers? Appendix A provides a brief technical discussion of how we modified the military career model to examine this question. We introduce a term, θ, to express the signal-to-noise ratio in measurement of aptitude. Higher θ indicates a better measurement of aptitude. Recall that, in the baseline scenario, promotion decisions are based on aptitude. As the Air Force becomes worse at observing aptitude (as the signal-to-noise ratio, θ, falls), a greater proportion of lower-aptitude officers are promoted, at the expense of higher-aptitude officers. Under traditional promotion and continuation policies, some of the higher-aptitude officers are not promoted and thus have a higher propensity to leave, while some of the lesser-aptitude officers are promoted and have a lower propensity to leave. Greater measurement error also tends to lead to higher retention of low-aptitude officers, similarly to how technical tracks increase the retention of low-aptitude officers.

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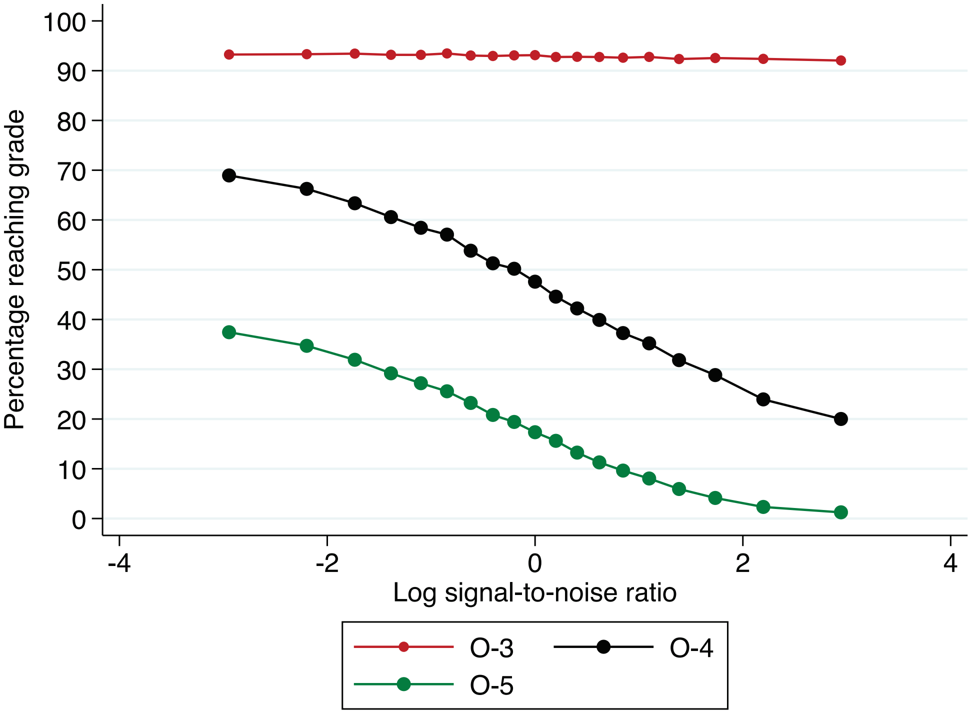
[26] To conduct these simulations, we made a few modifications to the original military career model. These modifications included adding noise to the ability score and allowing the variances of both the noise and the signal to be specified, as parameters, by the user. See additional discussion in Appendix A.

This is illustrated in Figure 3.15, in which we plot the percentage of low-aptitude officers who make it to grades O-3, O-4, and O-5 in the baseline scenario against the signal-to-noise ratio, θ. Although promotion to grade O-3 does not depend on θ, the proportion of low-aptitude officers reaching O-4 and O-5 clearly rises as θ falls. At the lowest levels of θ (the left side of the chart, in which aptitude is very inaccurately observed), selection for promotion is almost random with respect to aptitude: Low-aptitude officers are selected at about the same rate as other officers are.

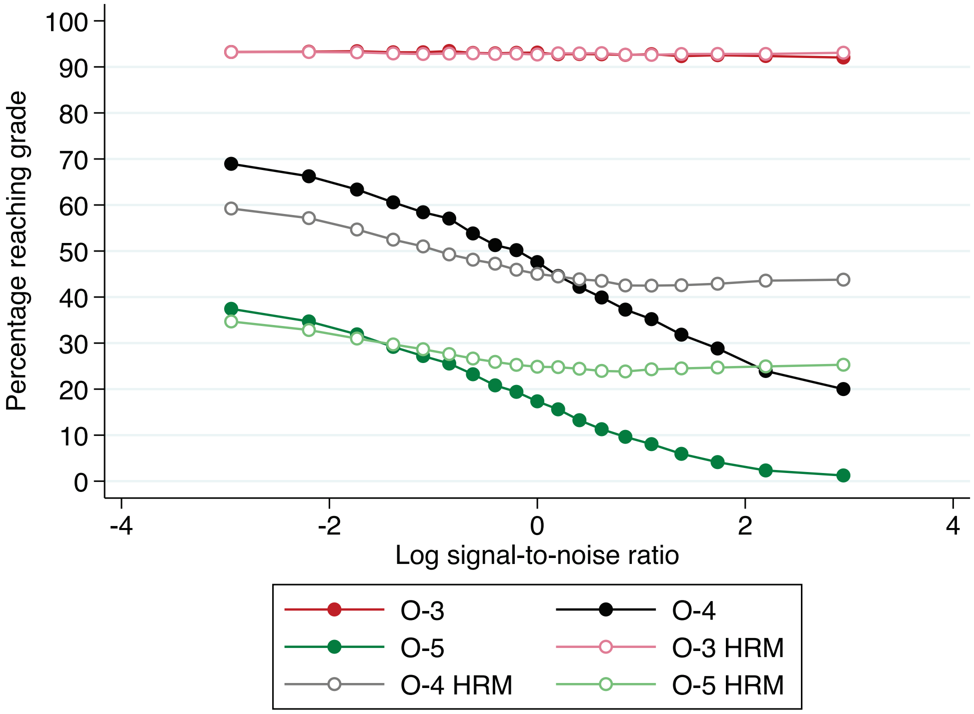
Figure 3.15. Proportion of Low-Aptitude Officers Reaching Grades O-3, O-4, and O-5 with Varying Signal-to-Noise Ratios, Baseline Scenario



NOTE: To construct this figure, we ran the baseline scenario 20 times, with different levels of θ for each simulation. Along a vertical line, each set of dots corresponds to the same simulation. At the lowest levels of θ (the left side of the chart, in which aptitude is very inaccurately observed), selection for promotion is almost random with respect to aptitude: Low-aptitude officers are selected at about the same rate as other officers are.

To understand the relationship between the measurement error and the introduction of technical tracks, we created Figure 3.16, which reproduces the lines drawn in Figure 3.15 but also draws the same lines for the strong aptitude-stratification alternative (in the chart, solid circles indicate baseline scenario outcomes, and open circles indicate HRM flexibility scenario outcomes). In this graph, the far right of the *x*-axis represents a $\log\theta$ of 3, or a signal-to-noise ratio of about 20. This corresponds to roughly 95-percent accuracy in measuring talent. At this ratio, in the baseline scenario, only 20 percent of low-aptitude officers reach grade O-4. However, in the HRM flexibility scenario with strong stratification, this percentage more than doubles, increasing to 43 percent. As described above, the higher promotion of low-aptitude officers under the HRM flexibility scenario results from aptitude stratification; more lower-aptitude officers are sent to the technical track, and promotion decisions are based on relative aptitude from among the officer pool in each track.

Figure 3.16. Percentage of Low-Aptitude Officers Reaching Grades O-3, O-4, and O-5 with Varying Signal-to-Noise Ratios, Baseline Scenario Versus Human Resource–Management Flexibility Scenario



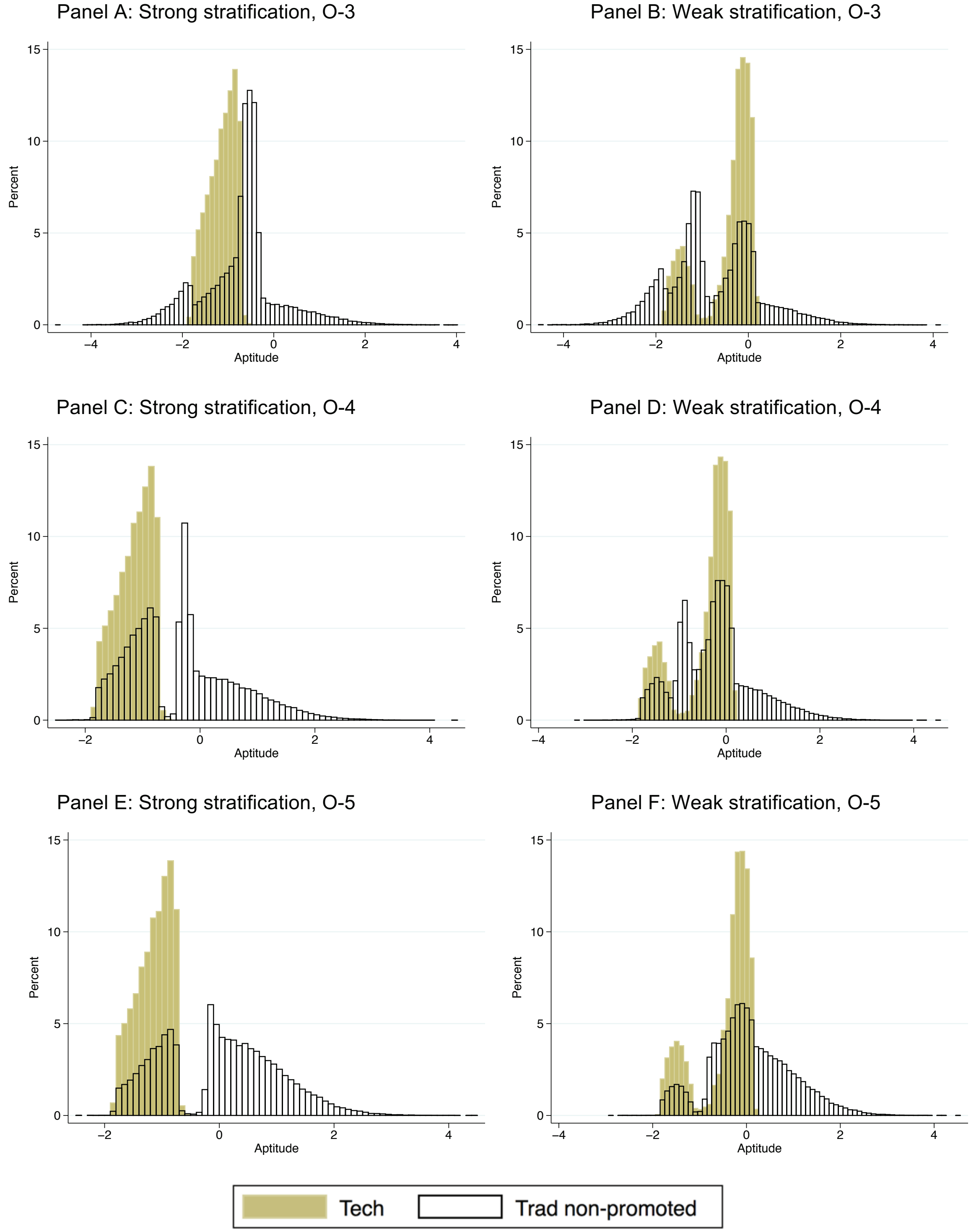
NOTE: To construct this figure, we ran the baseline scenario 20 times, with different levels of θ for each simulation. Along a vertical line, each set of dots corresponds to the same simulation. Solid circles indicate baseline scenario outcomes, and open circles indicate HRM flexibility scenario outcomes.

Under the baseline scenario, how much measurement error does there have to be to generate a low-aptitude officer promotion rate that matches the rate observed under the HRM flexibility scenario? Moving to the left on the *x*-axis, we see that at roughly a $\log\theta$ of 0, or a 50-percent measurement accuracy, the promotion rates of low-aptitude officers to O-4 reach about 43 percent. In this sense, the technical-track features introduced in our HRM flexibility scenario would tend to benefit low-aptitude officers in the same way that significant amounts of imperfect measurement of aptitude would also benefit them.

Lost Opportunities: Comparing Technical-Track and Nonpromoted Officers

So far, we have modeled the HRM flexibilities by negatively selecting officers into the technical track. This tends to increase the promotion outcomes of low-aptitude officers. Here, we emphasize that this selection procedure could lead to a situation in which nonpromoted traditional-track officers end up having higher aptitude than retained and potentially promoted technical-track officers. This represents potentially lost opportunity; the system is passing up the opportunity to utilize objectively higher-aptitude officers in higher-grade jobs and retaining and, in some cases, promoting lower-aptitude officers in the technical track. We expect that this problem would be worse under strong aptitude stratification—the more stringent the selection of lower-aptitude officers into the technical track, the more likely lower-aptitude officers will be to have better retention and promotion outcomes than those of higher-aptitude officers. Figure 3.17 plots the aptitude distribution of technical-track officers (in yellow) and traditional-track officers who were not promoted in due course (in white). Panels A and B look at these distributions for O-3s, panels C and D focus on O-4s, and panels E and F focus on O-5s. The strong aptitude-stratification scenario is depicted in the left column (panels A, C, and E), while the weak aptitude-stratification scenario is depicted in the right column (panels B, D, and F).

Figure 3.17. Aptitude Distribution for Technical Versus Nonpromoted Officers



NOTE: Yellow bars indicate technical-track officers, some of whom will eventually be promoted. White bars indicate traditional-track officers not promoted in due course. Panels A and B look at these distributions for O-3s, panels C and D focus on O-4s, and panels E and F focus on O-5s. The strong aptitude-stratification scenario is depicted in the left column (panels A, C, and E), while the weak aptitude-stratification scenario is depicted in the right column (panels B, D, and F).

The amount of lost opportunity in Figure 3.17 is represented by the area of the white histogram that is to the right of the area of the yellow histogram. This is the portion of the distribution of nonpromoted traditional-track officers who are "better" than the best technical-track officers, some of whom will be promoted through the course of their wider promotion window.

Figure 3.17 has two main features. The first is that the amount of lost opportunity is largest for the strong aptitude-stratification scenario; this is because the strong aptitude-stratification scenario maximizes the combined effects of aptitude stratification and greater retention in the technical track. A weaker aptitude stratification reduces the amount of lost opportunity, as the lines between who is selected into which track blurs, and the lower-aptitude officers do not always find themselves in the technical track with its reduced promotion opportunity. The second feature is that, for both scenarios, as grades increase, the lost opportunity grows. This is because, as grades grow higher, officers who are not promoted at higher grades tend to be better than officers who were not promoted at lower grades. So, the implementation of a technical track, especially with strong aptitude stratification, could create greater lost opportunities at more-senior grades, presumably at which decisions about who should remain in the force are most crucial.

Discussion

In this section, we have used the military career model to investigate how different ways of selecting officers into the technical track could create some undesirable outcomes. If officers are sorted into the technical track by aptitude, with lower-aptitude officers being more likely to serve in the technical track, and if the technical track has larger promotion windows, this can increase retention for low-aptitude officers. It can also lead to lost opportunities, in which nonpromoted officers in the traditional track are better than retained and sometimes promoted officers in the technical track. These lost opportunities are highest at higher grades, which is unfortunate.

These two related problems are exacerbated by hard and fast rules determining how people sort across tracks. The weak aptitude-stratification scenario tends to reduce the retention of low-aptitude officers and results in less lost opportunity than strong aptitude stratification does. *The implication is that the Air Force should avoid strong aptitude stratification for the technical track.* Some proportion of higher-aptitude officers should find their way into the technical track, either through self-selection or some other method of matching individual skills and interests to positions in the technical track.

These two different methods of sorting officers into tracks are obviously not the only selection rules that are available. For example, officers can have different capabilities for performing different tasks (e.g., leadership abilities and technical skills), and these different capabilities could be used to determine sorting into tracks. Sorting decisions could be governed by technical skill, while promotion decisions could be determined by leadership aptitude.

Whether different tracks lead to greater retention of the right kinds of officers depends on the different mix of tasks associated with different billets (positions), the joint distribution of these two different talents, and selection and promotion rules.

Although we focus on only a simple, stylized way of modeling aptitude and sorting officers into tracks, we want to emphasize that some sorting rules could lead to inversions of grade and talent, while others could lead to lost opportunities. More research into better understanding and measuring officers' multifaceted talents, understanding which billets require officers with relatively more or less talent in certain areas, and greater evaluation of different sorting and promotion rules is needed to ensure that the HRM flexibilities do not have unintended consequences, such as talent inversions or lost opportunities.

Chapter Four. Conclusions and Recommendations

Our purpose with this project was to assess the impact of proposed military HRM flexibilities on Air Force officer accessions, promotions, separations, and other force-management outcomes. In our examination of the proposed flexibilities, we drew insights primarily from two sources. First, we interviewed selected CFMs to determine whether they saw utility in the proposals. Although their embrace of the proposals was not universal, we did find willingness to consider most of them and suggestions on how they might be implemented. Second, we modeled the proposals using two forms of inventory projection models. The models helped us gauge the proposals' impacts on force-management flows (primarily separations, accessions, and promotions) while also revealing issues that need to be addressed in implementing the policies.[27]

We summarize our findings in this chapter first by reviewing each of the proposed HRM flexibilities we examined. We then present crosscutting or more-general observations. The policy alternatives we addressed are

- implementing technically oriented promotion tracks
- replacing up-or-out provisions of DOPMA
- implementing milestone-based promotions
- increasing the use of lateral entries into the line-officer force
- increasing the permeability between AC and RC
- extending the maximum length of officer service from 30 to 40 years
- developing a more robust talent-management system.

The Alternatives Considered

Technical Tracks for Promotion

This proposal was clearly favored by only one CFM (cyber), with three (rated, acquisition, and PA) seeing difficulties in implementing it, one (acquisition) seeing it applicable to only certain subcommunities (scientists and engineers) within the functional area, and one (personnel) who was open to the possibility that it might be beneficial. All saw the proposal as applicable to only a portion of the officers in their career field. Accordingly, we modeled the technical track as a path for a minority of the officer inventory.

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[27] As discussed in Chapter Three, to operationalize potential statutory and policy changes, we frequently simulated patterns of behavior outside of historically observed ranges.

Our modeling revealed several issues that a service will face in implementing a technical track:

- To differentiate the timing of technical- and traditional-track promotions and to reinforce the need for promotion boards to apply different criteria to promotions in the two tracks, officers on a technical track must be separated into one or more competitive categories.
- Depending on how officers either self-identify or are selected for branching into a technical track, an inversion of talent and grade attainment could occur—in which more-talented officers in the traditional track fare worse in promotion and retention outcomes than less talented officers in the technical track. This effect is worse with strong aptitude stratification. To avoid it, added incentives will likely be required to attract some higher-aptitude officers to the technical track.
- To provide the required flexibility in timing of promotions, changes will be required in statutory provisions tying promotion zones to date of rank and establishing separation as the default outcome of a second failure of selection.
- Flexibilities in promotion timing and elimination of promotion zones will require an improved method of calculating promotion opportunity. We recommend a CPR, defined as the complement of a weighted cumulative nonselection rate.
- If promotion rates are to be differentiated among line functional areas that now compete together, a defensible basis for disaggregating available DOPMA grade ceilings must be found. Our modeling and other analyses we performed indicated that manpower grade authorizations, as currently constructed, do not provide an adequate basis.

Replace Up-or-Out Provisions

CFMs were generally wary of this proposal, fearful that it could cause stagnation—an unacceptable slowdown—in promotions. However, as one functional manager noted, the Air Force’s liberal use of selective continuation means that statutory up-or-out provisions have actually had little practical impact. In our modeling, we also saw how limited the impact has been. Historical continuation rates for officers passed over for promotion are lower than those for officers who have been promoted, but not markedly so. To model the potential policy change, we substituted the continuation rates for promoted officers in place of the historical rates for nonpromoted officers. As expected, the impacts on promotion opportunity were modest. We see no reason that elimination of these provisions should be controversial. If the Air Force continues its liberal selective continuation policies, eliminating up-or-out statutory provisions would have little impact on promotion outcomes.

Milestone-Based Promotion Eligibility

Several CFMs pointed to a practical problem that would likely emerge with milestone-based promotion eligibility. To be meaningful, milestones would have to go beyond conventional promotion box-checking to include talent development indicators that are specific to career fields. However, because CFMs would not want to establish milestones that would make their officers’ paths to promotion longer or more difficult than the paths faced by officers in other career fields, there would be a natural tendency to make the milestones easily achievable rather than challenging. We did not explicitly model milestones. In the technical track, we did model the wider, flatter distribution of promotion selections across CYOSs that could arise either from challenging eligibility milestones or from deemphasis of seniority in promotion-board considerations. We see this alternative as unlikely to be adopted for traditional-track promotions and a potential but unessential element in technical-track promotions.

Increased Use of Lateral Entries

Interest in this alternative was limited to CFMs who currently have difficulty filling requirements for experienced, technically proficient personnel, for which there are qualified pools of candidates in the private or nonmilitary public sectors. Accordingly, we modeled a modest number of lateral entries across the line-officer force (50 per year) and channeled them all into the technical promotion track. We found, however, that statutory provisions preventing the use of constructive credit for YOSs in determining pay and retirement benefits would likely make lateral entry unattractive for experts with more than just a few years of experience. Allowing constructive credit in determining YOSs for base pay might be needed to make this alternative attractive to any but the least experienced lateral entries.

Advocates for more-liberal use of lateral entries must answer the criticism that other alternatives, such as military-to-civilian conversions, can be used to meet the same human-capital needs. It is possible that more–technically experienced military members gained through lateral entries would be needed to meet military essentiality requirements, such as frequent or short-notice deployment or a direct role in causing combat effects, but exploring those demands and the salience of those arguments was beyond the scope of our project.

On balance, an uphill fight to change constructive credit provisions and the other alternatives readily available to meet higher-experience human-capital needs make this a less attractive alternative.

Increased Use of Reserve Component Entries

Greater permeability between active and reserve service has long been an objective of advocates for greater total force integration. All of the functional managers we interviewed saw benefits in it. Movement from active to reserve service is prevalent and relatively unencumbered, subject only to ADSCs and availability of suitable positions in RC units. Movement in the opposite direction can occur through several channels but is far less common and subject to far more impediments. Impediments include transitioning between disparate promotion systems, strength-management issues, and rescrolling (documentation of presidential or secretarial appointments) issues. Untangling those impediments is beyond the scope of our project, but recognizing that they exist led us to model this alternative at a relatively modest level—150 entries per year, spread among pilots and nonpilots, in all grades, and in both traditional and technical tracks. However, we assumed that, unlike most current RC entries, these would not be time-limited, so the entering officers would compete for promotion on the active list rather than the reserve list.[28]

40-Year Careers

We added this alternative to our list to explore after we had completed most of our visits to functional managers. Generalizing from our broader discussions with them, they would support the opportunity to retain experience longer, especially if it could be done selectively, if the promotion impacts were very limited.

Implementing this alternative would require changes to 10 U.S.C. 632, 633, and 634, which, with certain exceptions, limit service as an O-3 or O-4 to 20 years of commissioned service, as an O-5 to 28 years, and as an O-6 to 30 years. The current pay table extends to 40 years of military service, but step increases top out at 30 YOSs for O-6s and at less than 30 years for grades below O-6. To provide a greater incentive to stay beyond 30 YOSs, additional steps in the pay table would have to be considered.

Talent-Management System

Adoption of a more deliberate approach to matching individuals to billets got mixed reviews from CFMs, who raised concerns over both cost and loss of functional-manager influence. Because our modeling methodologies do not provide a basis for evaluating a talent-management system, our evaluation of this proposal was limited to capturing CFMs' perspectives.

Net Impacts

We found that the alternatives, if scoped and implemented as described above, would have modest promotion impacts—opportunity for promotion to O-4 in a traditional track reduced by 10 percent and to higher grades by less than that, with no significant change in the timing of promotions for those in the traditional track. The impact is modest in part because promotions in the technical track would occur later and with reduced opportunity. We also found that the lost promotion opportunity could be restored for those in the traditional track with grade increases of 21.6 percent, 8.6 percent, and 5.1 percent, respectively, for grades O-4, O-5, and O-6. The net cost increase, considering the force costs associated with increased grade ceilings and modified CYOS profiles and the savings associated with reduced accessions, was 1.9 percent relative to the baseline scenario, or a total of $183.2 million per year.

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[28] Title 10 of the U.S. Code, Section 620, allows a service secretary to exclude a reserve officer, ordered to active duty, from the active list for up to 24 months. This allows the reserve officer to continue competing in the reserve officer promotion system for that period rather than in the active-duty officer promotion system.

Recommendations

We concluded that the alternatives are selectively attractive to at least some CFMs. Additionally, the net cost of implementing all of them on the scale we modeled is affordable, so selective implementation of some of them for selected career fields would also be affordable. Therefore, we recommend that the Air Force and OSD pursue the statutory changes or exceptions that will, in some cases, enable and, in other cases, enhance their implementation.

A Related Observation

One of the underlying principles we had hoped to incorporate in our modeling was using the force-management alternatives to optimize the match of inventories to requirements by grade and occupational category. We had to depart from that concept because grade requirements for pilots do not provide sufficient field-grade headroom to accommodate needed and observed pilot retention patterns and are thus inconsistent with the Air Force's strategic human-capital needs. In our modeling, we set artificial floors on pilot selection rates to keep the promotion opportunities for pilots roughly comparable to opportunities for nonpilots.

The Air Force is weighing several merited proposals to create additional competitive categories within its line-officer force. To move in that direction, as our modeling revealed, it will have to make manpower grade requirements in various career fields more compatible with strategic needs or find a basis other than manpower requirements for allocating grade ceiling among the competitive categories. An alternative is to use observed retention patterns as the basis for distributing grade ceilings. But this alternative then raises the question of whether observed retention patterns meet strategic human-capital needs. Defining a strategically sound objective force, using either grades or CYOSs or a combination of the two, remains an important challenge for the future.

Appendix A. Model Specifications

The primary tool used in this project is a linear programming model embedded in the SAS programming language. We refer to it as the HRM flexibility model. We explored other aspects of officer force management using RAND's military career model.

HRM Flexibility Model

RAND has developed a family of inventory models, implemented as SAS-based linear programming models, with very similar characteristics. The first of these was built to project total force (AC and RC) aircrew inventories. In Air Force aircrew-management matters, line graphs depicting projected manpower requirements and inventories conventionally use a red line (RL) for the requirements and a blue line (BL) for the inventories. Consequently, this model became known as the Air Force RL/BL model. A variation of the model was later adapted for more-detailed analysis of the Air Force's remotely piloted aircraft crew force. For the project underlying this document, we adapted the model with several added dimensions, one of which contributed greatly to its complexity: It includes a military grade dimension in both its requirements and inventory arrays.

A linear programming model can be specified using the following constructs:

- *Scalars* are single values defined for recurring use in various expressions. For example, the scalar *fyfirst* is defined to have a value of 2015, which is the first FY represented in the model.
- The demographic subgroups represented in the model are referred to as its *dimensions*.
- *Parameters* are fixed values provided as inputs to the model. Inputs to the HRM flexibility model include arrays of officer end strengths, grade ceilings, historical retention rates, the beginning inventory, and other empirical or policy-related values.
- *Variables* are values that change as the model's solving algorithm seeks an optimal solution.
- *Indices* identify the various arrays of values—parameters and variables—used in the model. For example, arrays of manpower requirements used as inputs to the model are indexed by occupation, grade, and FY dimensions. In the expressions used in this appendix to define the model, indices appear as subscripts.
- An *index set* specifies the members of a dimensional index or a combination of indices. For example, the index set representing grade contains the members O-1 through O-6.
- By systematically changing the values of the variables, the model minimizes or maximizes an *objective function*, a value equal to a sum of selected variables.
- *Boundary conditions* fix the values of certain subsets of variables. For example, inventories in the first FY represented in the model are fixed to equal the initial inventories entered as parameters in the model.
- The model adheres to *constraints*—equations expressed using parameters and variables.

Demographic Dimensions

The model includes four dimensions of officer requirements: occupation, promotion track, grade, and FY. For inventories, a fifth dimension is included: CYOS. These dimensions are defined as follows:

- **occupation.** The model can be extended to include any desired occupational disaggregation. For this project, we determined that two broad occupational categories, *pilot* and *nonpilot*, would be sufficient to explore the varying impacts of HRM flexibilities. In the expressions below, the subscript o identifies this dimension.
- **promotion track.** An important flexibility explored using the model is a split of inventories into a traditional, DOPMA-based promotion track and a modified promotion track designed for officers who pursue a more technically oriented track with less emphasis on competition for promotions. We refer to these as *traditional* and *technical* tracks, respectively. The subscript t identifies this dimension.
- **grade.** The model covers officer grades from O-1 to O-6. The subscript g identifies this dimension.
- **CYOS.** In order to explore the impacts of lengthier careers beyond the conventional 30 years, the model includes up to 40 years of commissioned service. This model employs CYOS = 0 for inventory with less than one YOS. CYOS = 1 indicates inventory with service greater than or equal to one but less than two. The subscript c identifies this dimension.
- **FY.** The model can be extended for any number of FYs. For this project, the starting inventory was taken from the end of FY 2015, and projections are made through FY 2060. The subscript f identifies this dimension.

Sets, Scalars, Parameters, Variables, Objective Functions, Constraints, and Boundary Conditions

This section consists of unedited excerpts of earlier work on this model.

Sets

We will use the following sets in the model:

- s_cat = {pilot, nonpilot} representing occupational categories
- s_trk = {trad, tech} representing promotion tracks
- s_grd = {grdfirst, …, grdlast} representing grades
- s_cy = {cyfirst, …, cylast} representing commissioned years of service (CYOS)
- s_fy = {fyfirst, …, fylast} representing fiscal years (FY) modeled
- s_Inv ⊆ s_cat × s_trk × s_grd × s_cy × s_fy
- s_Access ⊆ s_cat × s_trk × s_grd × s_cy × s_fy
- s_Rqmt ⊆ s_cat × s_grd × s_fy
- s_PromCeiling ⊆ s_cat × s_trk × s_grd × s_fy
- s_PromFloor ⊆ s_cat × s_trk × s_grd × s_fy
- s_PromYrLim ⊆ s_cat × s_trk × s_grd × s_cy × s_fy
- s_PromDist ⊆ s_cat × s_trk × s_grd × s_cy × s_fy
- s_Track ⊆ s_cat × s_trk × s_grd × s_cat × s_trk × s_grd × s_cy × s_fy
- s_Cross ⊆ s_cat × s_trk × s_grd × s_cat × s_trk × s_grd × s_cy × s_fy
- s_Loss ⊆ s_cat × s_trk × s_grd × s_cy × s_fy
- s_ARCs ⊆ s_cat × s_trk × s_grd × s_cy × s_fy
- s_Lateral ⊆ s_cat × s_trk × s_grd × s_cy × s_fy
- s_InitInv ⊆ s_cat × s_trk × s_grd × s_cy
- s_grd_ceilings ⊆ s_grd × s_fy
- s_end_strength ⊆ s_fy
- s_Allow_FY ⊆ s_cat × s_trk × s_grd × s_cat × s_grd
- s_not_cy ⊆ s_cat × s_trk × s_grd × s_fy
- s_AggInv ⊆ s_cat × s_trk × s_grd × s_fy
- s_AggInvFY ⊆ s_cat × s_trk × s_grd × s_cy
- s_vld_inven_cat ⊆ s_cat × s_trk × s_grd
- s_vld_rqmt_cat ⊆ s_cat × s_trk × s_grd
- s_FG_inv ⊆ s_cat × s_trk × s_cy.

Scalars

- cyfirst = 0
- cylast = 39
- fyfirst = 2015
- fylast = 2060
- grdfirst = 1
- grdlast = 6
- prom_limit = 10000.

Parameters

We will use the following parameters in the model:

- p_prom_ceiling$_{otgf}$ is the maximum promotion selection rate used to shape promotion outcomes in occupational category $o \in$ s_cat, promotion track $t \in$ s_trk, grade $g \in$ s_grd, and FY $f \in$ s_fy.
- p_prom_floor$_{otgf}$ is the minimum promotion selection rate used to shape promotion outcomes in occupational category $o \in$ s_cat, promotion track $t \in$ s_trk, grade $g \in$ s_grd, and FY $f \in$ s_fy.
- p_PromYrLim$_{otgcf}$ is a binary control limit that allows promotions to occur only in specified windows where the value is 1 if promotions are allowed and 0 if not allowed in occupational category $o \in$ s_cat, promotion track $t \in$ s_trk, grade $g \in$ s_grd, CYOS $c \in$ s_cy, and $f \in$ s_fy.
- p_PromDist$_{otgcf}$ is a historical or user-determined distribution of promotions across CYOS $c \in$ s_cy in occupational category $o \in$ s_cat, promotion track $t \in$ s_trk, grade $g \in$ s_grd, and $f \in$ s_fy.
- p_Track$_{o_1 t_1 g_1 o_2 t_2 g_2 cf}$ is the proportion of officers to be moved from one occupational category $o_1 \in$ s_cat, promotion track $t_1 \in$ s_trk, and grade $g_1 \in$ s_grd to another occupational category $o_2 \in$ s_cat, promotion track $t_2 \in$ s_trk and grade $g_2 \in$ s_grd for a particular CYOS $c \in$ s_cy and FY $f \in$ s_fy.
- p_Cross$_{o_1 t_1 g_1 o_2 t_2 g_2 cf}$ is the historical proportion of officers moving from one occupational category $o_1 \in$ s_cat, promotion track $t_1 \in$ s_trk, and grade $g_1 \in$ s_grd to another occupational category $o_2 \in$ s_cat, promotion track $t_2 \in$ s_trk and grade $g_2 \in$ s_grd for a particular CYOS $c \in$ s_cy and FY $f \in$ s_fy.
- p_Loss$_{otgcf}$ is the historically-derived loss rates for in occupational category $o \in$ s_cat, promotion track $t \in$ s_trk, grade $g \in$ s_grd, and FY $f \in$ s_fy.

- p_ARCs$_{otgcf}$ is the maximum number of Air Reserve Command officers entering active duty in occupational category $o \in$ s_cat, promotion track $t \in$ s_trk, grade $g \in$ s_grd, and FY $f \in$ s_fy.

- p_Lateral$_{otgcf}$ is the maximum number of lateral entries allowed in occupational category $o \in$ s_cat, promotion track $t \in$ s_trk, grade $g \in$ s_grd, and FY $f \in$ s_fy.

- p_Access$_{otgcf}$ is the number of accessions in occupational category $o \in$ s_cat, promotion track $t \in$ s_trk, grade $g \in$ s_grd, and FY $f \in$ s_fy. For pilots, it is implemented in the model as a specified UPT entry number; for nonpilots, it is an upper bound which was not set to a constraining level in this project.

- p_InitInv$_{otgc}$ is the inventory as of 30 Sept 2015 used to initialize the model in occupational category $o \in$ s_cat, promotion track $t \in$ s_trk, grade $g \in$ s_grd, and CYOS $c \in$ s_cy.

- p_grd_ceilings$_{gf}$ is the field-grade ceiling, derived from statutory DOPMA provisions applied to the officer end-strengths used in the model for grade $g \in$ s_grd and FY $f \in$ s_fy.

- p_end_strength$_f$ is the specified total year-end inventory strength used in the model for FY $f \in$ s_fy.

- p_Rqmt$_{ogf}$ is the manpower requirement for active-duty line officers as projected from the end of FY 2015 for occupational category $o \in$ s_cat, grade $g \in$ s_grd, and FY $f \in$ s_fy.

Variables

We will use the following variables in the model:

- v_unfill$_{o_r g_r f} \geq 0$ is the number of unfilled requirements (meaning that there is not an officer available to be assigned to the requirement) for $(o_r, g_r, f) \in$ s_Rqmt.

- v_asgn$_{o_i t_i g_i o_r g_r} \geq 0$ is the number of officers assigned from inventory occupational category o_i, promotion track t_i, and grade g_i to requirement occupational category o_r and grade g_r for $(o_i, t_i, g_i, o_r, g_r) \in$ s_Allow_FY.

- v_unasgn$_{o_i t_i g_i c f} \geq 0$ is the number of officers unassigned from inventory occupational category o_i, promotion track t_i, grade g_i, CYOS $c \in$ s_cy and FY $f \in$ s_fy for $(o_i, t_i, g_i, c, f) \in$ s_Inv.

- v_inven$_{o_i t_i g_i c f} \geq 0$ is the number of personnel in the inventory at the end of each FY $f \in$ s_fy for occupational category o_i, promotion track t_i, grade g_i, and CYOS $c \in$ s_cy for $(o_i, t_i, g_i, c, f) \in$ s_Inv.

- v_sep$_{o_i t_i g_i c f} \geq 0$ is the number of personnel who separate or retire each FY $f \in$ s_fy for occupational category o_i, promotion track t_i, grade g_i, and CYOS $c \in$ s_cy for $(o_i, t_i, g_i, c, f) \in$ s_Inv.

- v_loss$_{o_i t_i g_i c f} \geq 0$ is the total number of personnel who are lost (separations and retirements plus crossflow out of plus promotions out of plus switching out of tracks) from each occupational category o_i, promotion track t_i, grade g_i, CYOS $c \in$ s_cy, and FY $f \in$ s_fy for $(o_i, t_i, g_i, c, f) \in$ s_Inv.

- v_gain$_{o_i t_i g_i c f} \geq 0$ is the total number of personnel who are gained (crossflow into plus promotions into plus switching into another track) into each occupational category o_i, promotion track t_i, grade g_i, CYOS $c \in$ s_cy, and FY $f \in$ s_fy for $(o_i, t_i, g_i, c, f) \in$ s_Inv.

- v_access$_{o_i t_i g_i c f} \geq 0$ the number of accessions each FY $f \in$ s_fy and each occupational category o_i, promotion track t_i, grade g_i, CYOS $c \in$ s_cy for $(o_i, t_i, g_i, c, f) \in$ s_Access.

- v_lateral$_{o_i t_i g_i c f} \geq 0$ is the number of personnel who enter active duty into a higher grade than O-1 from outside the military in each occupational category o_i, promotion track t_i, grade g_i, CYOS $c \in$ s_cy, and FY $f \in$ s_fy for $(o_i, t_i, g_i, c, f) \in$ s_Inv.

- v_ARCflow$_{o_i t_i g_i c f} \geq 0$ is the number of personnel who enter active duty from the Air Reserve Component in each occupational category o_i, promotion track t_i, grade g_i, CYOS $c \in$ s_cy, and FY $f \in$ s_fy for $(o_i, t_i, g_i, c, f) \in$ s_Inv.

- v_cross$_{o_1 t_1 g_1 o_2 t_2 g_2 c f} \geq 0$ is the number of personnel who crossflow out of occupational category o_1, promotion track t_1, grade g_1 and into occupational category o_2, promotion track t_2, grade g_2 in CYOS $c \in$ s_cy and FY $f \in$ s_fy for $(o_1, t_1, g_1, o_2, t_2, g_2, c, f) \in$ s_Cross.

- v_track$_{o_1 t_1 g_1 o_2 t_2 g_2 c f} \geq 0$ is the number of personnel who switch out of occupational category o_1, promotion track t_1, grade g_1 and into occupational category o_2, promotion track t_2, grade g_2 in CYOS $c \in$ s_cy and FY $f \in$ s_fy for $(o_1, t_1, g_1, o_2, t_2, g_2, c, f) \in$ s_Track.

- v_proms_in$_{o_i t_i g_i c f} \geq 0$ is the number of personnel who are promoted out of each occupational category o_i, promotion track t_i, grade g_i, CYOS $c \in$ s_cy, and FY $f \in$ s_fy for $(o_i, t_i, g_i, c, f) \in$ s_Inv.

- v_proms_out$_{o_i t_i g_i c f} \geq 0$ is the number of personnel who are promoted into each occupational category o_i, promotion track t_i, grade g_i, CYOS $c \in$ s_cy, and FY $f \in$ s_fy for $(o_i, t_i, g_i, c, f) \in$ s_Inv.

- v_pos_dev$_{o_i t_i g_i c f} \geq 0$ is the positive deviation from the desired promotion distribution used in objective function, along with the corresponding negative deviation, to minimize deviations from desired promotion distribution across CYOS for each occupational category o_i, promotion track t_i, grade g_i, CYOS $c \in$ s_cy, and FY $f \in$ s_fy for $(o_i, t_i, g_i, c, f) \in$ s_Inv.

- v_neg_dev$_{o_i t_i g_i c f} \geq 0$ is the negative deviation from the desired promotion distribution used in objective function, along with the corresponding positive deviation, to minimize deviations from desired promotion distribution across CYOS for each occupational category o_i, promotion track t_i, grade g_i, CYOS $c \in$ s_cy, and FY $f \in$ s_fy for $(o_i, t_i, g_i, c, f) \in$ s_Inv.

- v_proms_out_sum_cy$_{o_i t_i g_i f} \geq 0$ is the number of personnel summed across CYOS who are promoted out of each occupational category o_i, promotion track t_i, and grade g_i for $(o_i, t_i, g_i, f) \in$ s_not_cy.

- $\text{v\_prom\_elig}_{o_i t_i g_i c f} \geq 0$ is the number of promotion eligibles in the inventory at the end of each FY $f \in \text{s\_fy}$ for occupational category o_i, promotion track t_i, grade g_i, and CYOS $c \in \text{s\_cy}$ for $(o_i, t_i, g_i, c, f) \in \text{s\_Inv}$.
- $\text{v\_prom\_elig\_sum\_cy}_{o_i t_i g_i f} \geq 0$ is the number of promotion eligibles summed across CYOS for each occupational category o_i, promotion track t_i, grade g_i, and FY $f \in \text{s\_fy}$ for $(o_i, t_i, g_i, f) \in \text{s\_not\_cy}$.

Objective Function

As is typical in an inventory flow model with requirements and personnel inventory, we will minimize the unfilled requirements (jobs that cannot be filled because of a shortage of personnel), minimize the excess number of inventory (the number of personnel who do not have jobs), minimize production of inventory (the number of personnel produced into the system), minimize the number of lateral entries coming in, minimize the number of ARC cross-flows coming in, and, lastly, minimizing the deviation from the desired promotion distribution.

$$\begin{aligned}
\min \quad & \sum_{(o,g,f)\in \text{s\_Rqmt} \ni f > \text{fyfirst}} \text{v\_unfill}_{ogf} \\
+ \quad & \sum_{(o,t,g,c,f)\in \text{s\_Inv} \ni f > \text{fyfirst}} \text{v\_unasgn}_{otgcf} \\
+ \quad & \sum_{(o,t,g,c,f)\in \text{s\_Access} \ni f > fyfirst} \text{v\_access}_{otgcf} \\
+ \quad & \sum_{(o,t,g,c,f)\in \text{s\_Inv} \ni f > \text{fyfirst}} \Big(\text{v\_lateral}_{otgcf} + \text{v\_ARCflow}_{otgcf} \Big) \\
+ \quad & \sum_{(o,t,g,c,f)\in \text{s\_Inv} \ni f > \text{fyfirst}} \Big(\text{v\_pos\_dev}_{otgcf} + \text{v\_neg\_dev}_{otgcf} \Big).
\end{aligned}$$

Constraints

1. Total strength in each fiscal year equals user-specified parameters:

$$\sum_{(o,t,g,c)\in \text{s\_AggInvFY}} \text{v\_inven}_{otgcf} = \text{p\_end\_strength}_f \quad \forall f \in \text{fy} \ni f > \text{fyfirst}.$$

2. Total strength in each of the field grades (O-4 through O-6) equals user-specified parameters:

$$\sum_{(o,t,c)\in \text{s\_FG\_inv}} \text{v\_inven}_{otgcf} = \text{p\_grd\_ceilings}_{gf}$$

$$\forall g \in \text{s\_grd}, f \in \text{s\_fy} \ni g \geq 4, f > \text{fyfirst}.$$

3. Unfilled requirements plus filled requirements (which are equal to assigned personnel) equal total requirements:

$$\sum_{(o_i,t_i,g_i)\in \text{s\_vld\_inven\_cat} \ni (o_i,t_i,g_i,o_r,g_r,f)\in \text{s\_Allow\_FY}} \text{v\_asgn}_{o_i t_i g_i o_r g_r f}$$

$$+ \text{v\_unfill}_{o_r g_r f}$$

$$= \text{p\_Rqmt}_{o_r g_r f}$$

$$\forall (o_r, g_r, f) \in \text{s\_Rqmt} \ni f > \text{fyfirst}.$$

4. Assigned personnel (which is equal to filled requirements) plus unassigned personnel equal total inventory:

$$\sum_{(o_r,g_r)\in \text{s\_vld\_rqmt\_cat} \ni (o_i,t_i,g_i,o_r,g_r,f)\in \text{s\_Allow\_FY}} \text{v\_asgn}_{o_i t_i g_i o_r g_r f}$$

$$+ \sum_{c\in \text{s\_cy} \ni (o_i,t_i,g_i,c,f)\in \text{s\_Inv}} \text{v\_unasgn}_{o_i t_i g_i c f}$$

$$= \sum_{c\in \text{s\_cy} \ni (o_i,t_i,g_i,c,f)\in \text{s\_cy}} \text{v\_inven}_{o_i t_i g_i c f}$$

$$\forall (c_i, t_i, g_i, f) \in \text{s\_AggInv} \ni f > \text{fyfirst}.$$

5. Nonpilot accessions are less than user-specified parameters:

$$\text{v\_access}_{\text{'nonpilot'}tgcf} \leq \text{p\_Access}_{\text{'nonpilot'}tgcf}$$

$$\forall(\text{'nonpilot'}, t, g, c, f) \in \text{s\_Access} \ni f > \text{fyfirst}.$$

6. Cross-flows occur at user-specified rates:

$$\text{v\_cross}_{o_1t_1g_1o_2t_2g_2cf} = \text{p\_Cross}_{o_1t_1g_1o_2t_2g_2cf} * \text{v\_inven}_{o_1t_1g_1c-1f-1}$$

$$\forall(o_1, t_1, g_1, o_2, t_2, g_2, c, f) \in \text{s\_Cross} \ni c > \text{cyfirst} \wedge f > \text{fyfirst}.$$

7. Track splits occur in user-specified proportions:

$$\text{v\_track}_{o_1t_1g_1o_2t_2g_2cf} = \text{p\_Track}_{o_1t_1g_1o_2t_2g_2cf} * \text{v\_inven}_{o_1t_1g_1cf}$$

$$\forall(o_1, t_1, g_1, o_2, t_2, g_2, c, f) \in \text{s\_Track} \ni f > \text{fyfirst}.$$

8. The fundamental inventory aging relationship specifies that Inventory(t) = Inventory($t-1$) + Gains(t)− Losses(t):

$$\begin{aligned}\text{v\_inven}_{otgcf} = {} & \text{v\_inven}_{otgc-1f-1} \\ & + \text{v\_gain}_{otgcf} \\ & - \text{v\_loss}_{otgcf} \\ & \forall(o, t, g, c, f) \in \text{s\_Inv} \ni c > \text{cyfirst} \wedge f > \text{fyfirst}.\end{aligned}$$

9. Total gains at a disaggregate level are equal to accessions plus lateral entries plus ARC entries plus cross-flows in plus promotions into a grade plus track changes into a track:

$$\begin{aligned}
\text{v\_gain}_{o_2t_2g_2cf} = {} & \text{v\_access}_{o_2t_2g_2cf} \\
& + \text{v\_lateral}_{o_2t_2g_2cf} \\
& + \text{v\_ARCflow}_{o_2t_2g_2cf} \\
& + \text{v\_proms\_in}_{o_2t_2g_2cf} \\
& + \sum_{(o_1,t_1,g_1)\in \text{s\_vld\_inven\_cat} \ni (o_1,t_1,g_1,o_2,t_2,g_2,c,f)\in \text{s\_Cross}} \text{v\_cross}_{o_1t_1g_1o_2t_2g_2cf} \\
& + \sum_{(o_1,t_1,g_1)\in \text{s\_vld\_inven\_cat} \ni (o_1,t_1,g_1,o_2,t_2,g_2,c,f)\in \text{s\_Track}} \text{v\_track}_{o_1t_1g_1o_2t_2g_2cf} \\
& \forall (o_2, t_2, g_2, c, f) \in \text{s\_Inv} \ni c > \text{cyfirst} \wedge f > \text{fyfirst}.
\end{aligned}$$

10. Total losses at a disaggregate level are equal to separations plus cross-flows out of plus promotions out of each grade plus track changes out of a track:

$$\begin{aligned}
\text{v\_loss}_{o_1t_1g_1cf} = {} & \text{v\_sep}_{o_1t_1g_1cf} \\
& + \text{v\_proms\_out}_{o_1t_1g_1cf} \\
& + \sum_{(o_2,t_2,g_2)\in \text{s\_vld\_inven\_cat} \ni (o_1,t_1,g_1,o_2,t_2,g_2,c,f)\in \text{s\_Cross}} \text{v\_cross}_{o_1t_1g_1o_2t_2g_2cf} \\
& + \sum_{(o_2,t_2,g_2)\in \text{s\_vld\_inven\_cat} \ni (o_1,t_1,g_1,o_2,t_2,g_2,c,f)\in \text{s\_Track}} \text{v\_track}_{o_1t_1g_1o_2t_2g_2cf} \\
& \forall (o_1, t_1, g_1, c, f) \in \text{s\_Inv} \ni c > \text{cyfirst} \wedge f > \text{fyfirst}.
\end{aligned}$$

11. Separations and retirements occur at user-specified rates:

$$\text{v\_sep}_{o_1t_1g_1cf} = \text{v\_inven}_{o_1t_1g_1c-1f-1} * \text{p\_Loss}_{o_1t_1g_1c-1f-1}$$

$$\forall (o_1, t_1, g_1, c, f) \in \text{s\_Inv} \ni c > \text{cyfirst} \wedge f > \text{fyfirst}.$$

12. Promotions are summed across CYOS for use in the next constraint:

$$\text{v\_proms\_out\_sum\_cy}_{otgf} = \sum_{c \in \text{s\_cy}} \text{v\_proms\_out}_{otgcf}$$

$$\forall (o, t, g, f) \in \text{s\_not\_cy} \ni g > 2 \wedge f > \text{fyfirst}.$$

13. Field-grade promotions are spread across CYOS so as to match as closely as possible to user-specified distributions:

$$\text{p\_PromDist}_{otgcf} * \text{v\_proms\_out\_sum\_cy}_{otgf} - \text{v\_proms\_out}_{otgcf} =$$

$$\text{v\_pos\_dev}_{otgcf} - \text{v\_neg\_dev}_{otgcf}$$

$$\forall (o, t, g, c, f) \in \text{s\_Inv} \ni g > 2 \wedge f > \text{fyfirst}.$$

14. Promotions are allowed only in desired CYOS:

$$\text{v\_proms\_out}_{otgcf} \leq \text{p\_PromYrLim}_{otgcf} * \text{prom\_limit}$$

$$\forall (o, t, g, c, f) \in \text{s\_PromYrLim} \ni g > 2 \wedge f > \text{fyfirst}.$$

15. Promotion eligibles (all inventory in a promotion window) are calculated for use in the next constraint:

$$\text{v\_prom\_elig}_{otgcf} = \text{p\_PromYrLim}_{otgcf} * \text{v\_inven}_{otgc-1f-1}$$

$$\forall (o,t,g,c,f) \in \text{s\_Inv} \ni g > 2 \land g < 6 \land c > \text{cyfirst} \land f > \text{fyfirst}.$$

16. Promotion eligibles are summed across CYOS for use in the next constraint:

$$\text{v\_prom\_elig\_sum\_cy}_{otgf} = \sum_{c \in \text{s\_cy}} \text{v\_prom\_elig}_{otgcf}$$

$$\forall (o,t,g,f) \in \text{s\_not\_cy} \ni t \neq \text{lead} \land g > 2 \land g < 6 \land f > \text{fyfirst}.$$

17. Promotion rates are above user-specified floors:

$$\text{v\_proms\_out\_sum\_cy}_{otgf} \geq \text{p\_prom\_floor}_{otgf} * \text{v\_prom\_elig\_sum\_cy}_{otgf}$$

$$\forall (o,t,g,f) \in \text{s\_not\_cy} \ni t \neq \text{lead} \land g > 2 \land g < 6 \land f > \text{fyfirst}.$$

18. Promotion rates are below user-specified ceilings:

$$\text{v\_proms\_out\_sum\_cy}_{otgf} \leq \text{p\_prom\_ceiling}_{otgf} * \text{v\_prom\_elig\_sum\_cy}_{otgf}$$

$$\forall (o,t,g,f) \in \text{s\_not\_cy} \ni t \neq \text{lead} \land g > 2 \land g < 6 \land f > \text{fyfirst}.$$

19. Promotions from O-1 to O-2 occur in CYOS = 2:

$$\text{v\_proms\_out}_{otgcf} = \text{v\_inven}_{otgc-1f-1} * (1 - \text{p\_Loss}_{otgcf})$$

$$\forall (o,t,g,c,f) \in \text{s\_Inv} \ni g = 1 \land c = 2 \land f > \text{fyfirst}.$$

20. Promotions from O-2 to O-3 occur in CYOS = 4:

$$\text{v\_proms\_out}_{otgcf} = \text{v\_inven}_{otgc-1f-1} * (1 - \text{p\_Loss}_{otgcf})$$

$$\forall (o, t, g, c, f) \in \text{s\_Inv} \ni g = 2 \wedge c = 4 \wedge f > \text{fyfirst}.$$

21. Promotions into grade $g + 1$ = promotions out of grade g:

$$\text{v\_proms\_in}_{otg+1cf} = \text{v\_proms\_out}_{otgcf}$$

$$\forall (o, t, g, c, f) \in \text{s\_Inv} \ni g < 6.$$

22. To prevent apparent promotion rates greater than 1 in post-processsing data, inventory gained in a fiscal year cannot be promoted out in the same fiscal year:

$$\text{v\_proms\_out}_{otgcf} \leq \text{v\_inven}_{otgc-1f-1} - \text{v\_sep}_{otgcf}$$

$$\forall (o, t, g, c, f) \in \text{s\_PromYrLim} \ni g > 2 \wedge c > \text{cyfirst} \wedge f > \text{fyfirst}.$$

23. For cross-flows and separations in $c = 0$, parameter rates are multiplied by .5. This is done because the parameter rates are calculated over a full-year period (i.e., the rate is the proportion of those with less than one year of service at the end of year y who are gone at the end of year $y + 1$) but the rates are applied to a slightly different population in the model-those assessed throughout a fiscal year-who are exposed to loss probabilities for an average of only half a year. Accordingly, the first-year cross-flow constraint is

$$\text{v\_cross}_{o_1 t_1 g_1 o_2 t_2 g_2 cf} = 0.5 * \text{p\_Cross}_{o_1 t_1 g_1 o_2 t_2 g_2 cf} * \text{v\_access}_{o_1 t_1 g_1 cf}$$

$$\forall (o_1, t_1, g_1, o_2, t_2, g_2, c, f) \in \text{s\_Cross} \ni c = \text{cyfirst} \wedge f > \text{fyfirst}.$$

24. Similarly, the first-year loss constraint is:

$$\text{v\_sep}_{otgcf} = 0.5 * \text{p\_Loss}_{otgcf} * \text{v\_access}_{otgcf}$$

$$\forall (o,t,g,c,f) \in \text{s\_Inv} \ni c = \text{cyfirst} \wedge f > \text{fyfirst}.$$

25. Inventories in a CYOS and FY equal the inventories in the next lower CYOS and next lower FY minus total losses plus total gains during the FY:

$$\text{v\_inven}_{otgcf} = \text{v\_gain}_{otgcf} - \text{v\_loss}_{otgcf}$$

$$\forall (o,t,g,c,f) \in \text{s\_Inv} \ni c = \text{cyfirst} \wedge f > \text{fyfirst}.$$

Boundary conditions

1. Initial inventories equal user-specified parameters:

$$\text{v\_inven}_{otgc\text{'fyfirst'}} = \text{p\_InitInv}_{otgc} \quad \forall (o,t,g,c) \in \text{s\_InitInv}.$$

2. Accessions are zero for CYOS $c > 0$:

$$\text{v\_access}_{otgcf} = 0 \quad \forall (o,t,g,c,f) \in \text{s\_Access} \ni c > 0.$$

3. Accessions are zero for grade O-2 and higher:

$$\text{v\_access}_{otgcf} = 0 \quad \forall (o,t,g,c,f) \in \text{s\_Access} \ni g > 1.$$

4. Accessions are allowed only in traditional tracks:

$$\text{v\_access}_{otgcf} = 0 \quad \forall (o,t,g,c,f) \in \text{s\_Access} \ni t \neq \text{trad}.$$

5. Promotions into grade O-1 are zero:

$$\text{v\_proms\_in}_{otgcf} = 0 \quad \forall (o,t,g,c,f) \in \text{s\_Inv} \ni g = 1.$$

6. Promotion eligibles in CYOS $c = 0$ are zero:

$$\text{v\_prom\_elig}_{otgcf} = 0 \quad \forall (o,t,g,c,f) \in \text{s\_Inv} \ni c = \text{cyfirst}.$$

7. Promotions to O-2 and O-3 allowed only in specified grade/CYOS combinations:

$$\text{v\_proms\_out}_{otgcf} = 0$$

$$\forall (o,t,g,c,f) \in \text{s\_Inv} \ni g \leq 2 \wedge f > \text{fyfirst} \wedge \neg(g = 2 \wedge c = 4) \wedge \neg(g = 1 \wedge c = 2).$$

8. Pilot accessions equal user-specified parameters:

$$\text{v\_access}_{otgcf} = \text{p\_Access}_{otgcf} \quad \forall (o,t,g,c,f) \in \text{s\_Access} \ni f > \text{fyfirst} \wedge o = \text{pilot}.$$

9. Lateral entries equal user-specified parameters:

$$\text{v\_lateral}_{otgcf} = \text{p\_Lateral}_{otgcf} \quad \forall (o,t,g,c,f) \in \text{s\_Inv} \wedge f > \text{fyfirst}.$$

10. ARC gains equal user-specified parameters:

$$\text{v\_ARCflow}_{otgcf} = \text{p\_ARCs}_{otgcf} \quad \forall (o, t, g, c, f) \in \text{s\_Inv} \wedge f > \text{fyfirst}.$$

Military Career Model

The military career model was designed to simulate the career histories of officers as they serve in different positions during their tenure in the Air Force. It is a vacancy-based model that attempts to fill each position with the best officer available, and it does so over a discrete, finite time horizon. In each period, the model determines how many new officers to access, which officers to assign to the different positions that are available, which officers to promote to different grades, and which officers to retire or separate. During the assignment process, some officers will be assigned to fill low-level positions, while others will take higher-level positions after being promoted based on grade, experience, and aptitude. By altering the various policy routines in the model that determine how officers are promoted, accessed, or retained, we can use the model to simulate what might happen to officer careers under a variety of different policy scenarios.

The military career model was originally developed to study how changes to DOPMA could affect career path alternatives (Schirmer et al., 2006). Since then, the model has been extended and recalibrated to explore many different policies' effects on the careers of military personnel (see, for example, O'Neill, 2012, and Rothenberg et al., 2017).

During each simulation run, the model records the history of assignments, promotions, and separation decisions for all simulated officers. From this detailed simulation data, it is possible to construct various measures to highlight different aspects of the personnel system. In this work, our focus will be on the distribution of talent, or aptitude, by grade and across the different traditional and technical tracks. By changing the parameters of the model to mimic policy changes and by examining the model outputs that result from such changes, we can study how specific policy changes could affect different aspects of a career field's health.[29]

Specifying the Model

We use the military career model to simulate pilots' careers under both the current system and also under proposed new HRM flexibilities. Focusing on pilots as a subset of officers in the

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[29] Note that, although the model operates at the individual level, with a sequence of assignments given to each simulated officer, the model is not equipped to make predictions about an actual individual's career. All individuals in the model are simulated and hence do not have exact real-world counterparts.

Air Force enables us to reduce simulation time and increase the number of simulations that we run. The basic questions on which we focus, relating to how people are selected into the technical track and the implications of different decision rules, should readily transfer over to other career fields.

Our focus was to use the military career model to investigate how changes to promotion policies can affect the distribution of talent, or aptitude. In an officer career, talent is a fuzzy, multidimensional concept, embodying an officer's aptitude to lead and manage others, to work as a member of a team, to think strategically, to respond to pressure, and to persevere, among others. As a result, talent is difficult to quantify, but we assume that officer talent can be captured by a single variable, *z*, which is normally distributed across officers, with mean 0 and variance σ_z^2:

$$z \sim N\left(0, \sigma_z^2\right). \tag{A.1}$$

The fact that this *z* is just a one-dimensional scalar is not very important. We could think of *z* as a weighted average of a large number of attribute scores (e.g., one score for leadership aptitude, another score for perseverance), with fixed weights measuring the importance of those scores specified by the Air Force. What is important about *z* is that it represents a way of making aptitude comparisons between officers; officers with higher levels of *z* are "better" than officers with lower levels of *z*. By using *z* to measure officer aptitude, we are assuming that officers can be compared with and ranked against one another in a systematic way. Although this is clearly a nontrivial assumption, it accords with certain features of how Air Force officers are currently promoted, at least as a rough approximation.

Noisy Measurement of Aptitude

One segment of our analysis introduces the notion that the Air Force imperfectly perceives aptitude. In this section, we describe how we modeled that imperfection.

We assume that *observed aptitude*, *z**, is given by

$$z^* = z + v, \tag{A.2}$$

where *v*, the noise, is also normally distributed, independent of *z*, with mean 0 and variance σ_v^2. The signal-to-noise ratio is given by

$$\theta = \frac{\sigma_z^2}{\sigma_v^2}, \tag{A.3}$$

where σ_z^2 is the variance of true aptitude, as defined in Expression A.1. As θ rises, observed aptitude becomes closer to true aptitude, and the Air Force become increasingly good at identifying talent.

Figure A.1 presents a scatterplot of true aptitude, *z*, and observed aptitude, *z**, under a relatively low signal-to-noise ratio (panel A, with

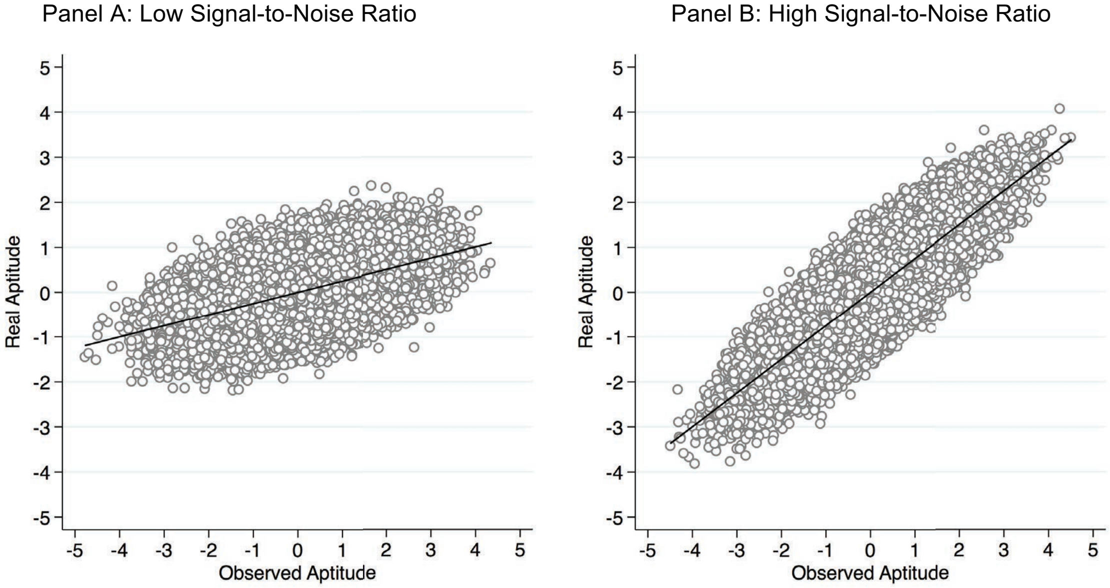
$$\theta = \frac{0.25}{0.75} = \frac{1}{3})$$

and under a relatively high signal-to-noise ratio (panel B, with

$$\theta = \frac{0.75}{0.25} = 3).$$

It is easy to see that, as the signal-to-noise ratio falls, measured aptitude becomes less correlated with actual aptitude. Another way to think about this is that, for a given level of real aptitude, there is a much longer range of observed aptitude in panel A than in panel B. For instance, at $z = 0$ in panel A, z^* ranges from –3.5 to 3.5, while, in panel B, at $z = 0$, z^* ranges from only –2 to 2.

Figure A.1. Observed Versus Actual Aptitude



NOTE: In panel A, $\theta = \frac{1}{3}$, while, in panel B, $\theta = 3$.

Appendix B. Statutory Issues Regarding Technical-Track Promotions

To implement a technical track for officer promotions, some provisions of Title 10 of the U.S. Code would have to be changed, or, as a test, legislative authorization would have to be provided for demonstrations that vary from standing provisions. In this appendix, we describe the provisions that would have to be relaxed.

A technical track for promotions would be characterized by some or all of the following:

- a wider, flatter distribution of promotions across years of commissioned service
- reduced or eliminated retention consequences for those not selected
- eligibility based on certification or attainment of other technical milestones
- self-identification for promotion consideration
- assignment patterns that emphasize development and utilization of functional depth rather than broader leadership and management competencies.

Statutory provisions regarding officer promotions were significantly revised in 1980 in DOPMA. The law established a table of authorized active-duty field-grade strengths for each service, tied to overall authorized officer strengths. It revised or restated provisions regarding promotion zones and conduct of promotion boards. Following that enactment, and continuing to the present, the officer promotion system has been characterized as DOPMA-based.

The strongest statutory impediment to a technical track is the requirement for a distinctly defined promotion zone in which most promotion selections are expected to be made, with explicit or implicit limits on selections below and above this zone. The provision that is perhaps least compatible with a technical track requires that service secretaries specify a promotion zone for each board by designating the "name and date of rank of the junior officer, and of the senior officer, in the promotion zone" (10 U.S.C. 614[a]). The definition of *promotion zone* in 10 U.S.C. 645) makes clear that officers can be considered IPZ only once (i.e., the secretary cannot specify overlapping promotion zones on different boards such that an officer would be considered IPZ on more than one consideration). The statutory requirement to use date of rank to define the promotion zone precludes either milestone-based eligibility or self-identification for promotion consideration.

Shifting the timing of technical-track promotions could be accomplished to a limited degree within existing legislation. A separate competitive category (10 U.S.C. 621) could be established for technical-track promotions in which the promotion zone, defined by dates of rank, could lag BPZ for those in a traditional promotion track. By using the maximum proportion of promotions allowable BPZ ("not to exceed 15 percent" [10 U.S.C. 616(b)]) and conditioning board members to more favorably consider APZ selections, the distribution of promotions could be flattened somewhat. However, officers not selected for promotion IPZ or APZ would still carry the statutory stigma of having “failed of selection” (10 U.S.C. 627). The default outcome after the second failure of selection is separation or retirement within seven months (10 U.S.C. 632) unless selected for continuation (10 U.S.C. 637). Continuation is generally limited to five years (10 U.S.C. 637[a][4])[30] and to high years of tenure—20 years of commissioned service for captains (10 U.S.C. 637[a][2]) and 24 years for majors (10 U.S.C. 637[a][3]).

Continuation boards impose a measurable but manageable administrative burden on the services. Far more consequential, however, is that current failure-of-selection provisions would undermine the tenure presumptions of officers in the technical track, particularly if the services deliberately fostered a greater proportion of selections APZ. Most conceptions of a technical track include some notion that entering the track would be mutually beneficial to individual officers and the services. People with a taste for technical depth would trade off the rewards of more-favorable promotion outcomes for the inherent rewards of technically challenging work and other inducements. Failure-of-selection provisions, through both continued social stigma and abbreviated tenure, would undermine other inducements to enter and provide motivated performance in a technical track. Moreover, the sharp limits on tenure would counterproductively limit extended utilization of the technical depth that could be developed.

In summary, a demonstration of technical-track flexibilities will require legislative relief from two key provisions of Title 10. First, the services must be given flexibility to define promotion eligibility without respect to promotion zones defined by years of commissioned service. Second, failure-of-selection provisions must be suspended or significantly modified so that selected officers can develop and provide lengthy periods of motivated service at high levels of technical proficiency.

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[30] Title 10 Section 632(a)(3) would allow officers to remain on active duty until retirement if they would otherwise be separated within two years of retirement eligibility.

Appendix C. Promotion Metrics

In this appendix, we examine various ways to measure promotion opportunity and provide rationale for our recommended method—the CPR. As discussed in Chapter Three, the conventional DOPMA promotion-opportunity metric, used in conjunction with a count of IPZ eligibles to determine the total number of promotions to be awarded by a board, is not suitable for promotions in an extended promotion window, as would be used for officers in a technical track.

Our criteria for a useful metric are as follows:

- is suitable for an extended promotion window
- is suitable for a traditional DOPMA window
- can be calculated as a longitudinal measure for a single cohort that has passed through a promotion window
- can be calculated as a cross-sectional measure for multiple cohorts considered by a single promotion board
- can be calculated using readily available promotion-board results
- faithfully represents promotion opportunity for comparison of different cohorts across time, among demographic components of a single cohort over multiple considerations, and among demographic components of the eligibles meeting a single board.

Readily available promotion-result data include the eligible and selectee counts for each CYOS included in a promotion window. From these data, an overall selection rate and a selection rate for each CYOS cohort can be calculated. The challenge is to find a suitable way to combine these data to obtain a measure of opportunity across multiple promotion considerations.

Selection Rate

The simplest indicator of promotion opportunity is the selection rate observed in a single board—the number of selections divided by the number of eligibles. This rate, however, does not provide a good indicator of overall promotion opportunity because it does not account for the mix of cohorts that a board considers, which can vary in size and might have experienced unusually high or unusually low selection rates in previous boards. It also does not account for multiple considerations of the same cohort. If the distribution of promotions by CYOS across a promotion window is relatively flat, the selection rate in any board might be well below the opportunity for promotion after all considerations. Thus, a board selection rate is a poor indicator of promotion opportunity.

Proportion of an Entering Cohort Surviving in a Higher Grade

A better indicator of promotion opportunity would be the proportion of a promotion cohort entering a CYOS-defined promotion window (the denominator) that is in a higher grade after all promotion considerations in the window (the numerator). The formulation is

$$\text{CPR} = \frac{\text{inventory}_{k,g,y_2}}{\text{inventory}_{k,g-1,y_1}},$$

where k designates a promotion cohort defined by CYOS, g is the grade to which promotions are being made, y_2 is the last year in the promotion window, and y_1 is the first year of the promotion window, prior to any promotions from the cohort.

This measure would be incomplete for several reasons. First, if milestone-based eligibility criteria were established, some officers would not be eligible at the beginning of a window; if they were included in the denominator regardless of eligibility, true promotion opportunity could be understated. Second, some promoted officers might separate prior to the end of the window and thus be excluded from the numerator. Third, lateral and RC entries gained after the start of a window would not be in the denominator. For promotions with high selection rates, this computation could easily, but nonsensically, exceed 100 percent.

Selections as a Proportion of Unique Eligibles

Another approach would define the calculation's numerator as the total selections from a cohort at any point in a window, with the denominator defined as the count of unique eligibles in a cohort as it passes through a promotion window. The formulation is

$$\text{CPR} = \frac{\sum\limits_{k,g} \text{selects}_{k,g}}{\sum\limits_{k,g-1} \text{unique eligibles}_{k,g-1}}.$$

This would be a valid longitudinal measure of opportunity for a single cohort, but it would require retention of individual-level data for all promotion considerations throughout a window in order to determine the count of unique individuals considered. It would not be a valid cross-sectional measure because there would be no straightforward way to approximate, from multiple cohorts, the count of unique individuals required for the denominator.

Complement of Cumulative Nonselection Rates

A third approach would calculate a cumulative nonselection rate across a window, then subtract it from one to determine the CPR. The formulation is

$$\mathrm{CPR} = 1 - \prod_i \frac{\text{eligibles}_{k,g-1,y_i} - \text{selects}_{k,g,y_i}}{\text{eligibles}_{k,g-1,y_i}},$$

where y_i indicates the annual (or other frequency) boards within a promotion window.

For longitudinal measures, the cumulative nonselection rate for a single promotion cohort passing through a window would be the product of the nonselection rates for each board in which the cohort competed. For cross-sectional measures, it would be the product of nonselection rates for each CYOS cohort competing in a single board. The flaw in this approach is that it assumes that all eligibles have the same number of considerations. Those entering the cohort after the beginning of a window or leaving the cohort before the end of a window would have cumulative nonselection rates greater than those exposed to all considerations in the window (each additional nonselection rate included in the product lowers the joint nonselection rate). If we do not take those higher cumulative nonselection rates into consideration, promotion opportunity would be overstated.

Complement of *Weighted* Cumulative Nonselection Rates

Our recommend approach remedies this flaw by considering the actual or expected number of promotion considerations each portion of a cohort would have as it passes through a window. This method calculates a different nonselection rate for each portion of a cohort that has a unique exposure to parts of the promotion window (i.e., it has the same first and last promotion consideration within the window). The various nonselection rates are then weighted by the proportion of the cohort in each unique exposure portion. This introduces an additional term in the equation above, w_j, to provide weights for various cumulative nonselection rates:

$$\mathrm{CPR} = 1 - \sum_j w_j \prod_i \frac{\text{eligibles}_{k_j,g-1,y_i} - \text{selects}_{k_j,g,y_i}}{\text{eligibles}_{k_j,g-1,y_i}},$$

where i in the product term includes only those years or boards in which the portion of the cohort indicated by the j subscript competed. The weights can be calculated as

$$w_j = \frac{\text{new eligibles}_{k_j,g-1}}{\sum_{k_j,g} \text{new eligibles}_{k_j,g-1}},$$

where the numerator is the count of new eligibles the first time a portion of a cohort is considered (e.g., in the second or third year of a cohort's promotion window) and the denominator is the sum of first-time eligibles in all cohort portions within the window. If the number of separations prior to the end of the window is small, a good approximation of promotion opportunity can be obtained by ignoring exits prior to the end of the promotion window; if so, the cumulative nonselection rate can be calculated for a cohort portion from the beginning of its eligibility to the end of the window. For board CPRs, for which subsequent separations are unknown, this simplifying assumption would avoid the necessity of predicting the number and timing of losses within the window. If the number of exits during the window is large, the weights and joint nonselection rates would have to be calculated for each combination of entering and actual or estimated exiting points.

In our modeling, we calculated both cohort (longitudinal) and board (cross-sectional) CPRs and found that they were reasonably similar (i.e., a cohort's longitudinal CPR was similar to the board CPRs experienced during its promotion window). We conclude from this that board CPRs provide a reasonable benchmark for comparing promotion opportunities across boards or across demographic groups within a single board.

Although our CPR is designed to accommodate the flexibilities in technical-track promotions, it also represents cohort promotion opportunity far better than the conventional DOPMA-based measure for officers promoted in a traditional track.[31] Consider the example in Table C.1. A cohort of 1,000 officers is considered twice BPZ, once IPZ, and twice APZ.[32] The nominal DOPMA promotion opportunity is 80 percent, which is multiplied by 855 IPZ eligibles to determine that the board quota will be 684 selections. Promotions BPZ and APZ take part of the quota, leaving 505 selections from the IPZ eligibles. The CPR calculation would be 1 minus the cumulative nonselection rate for each of the five promotion considerations in this example, weighted by the number of new eligibles in each consideration. Because this is a traditional DOPMA example, there are no new eligibles after the first BPZ consideration. Thus, the CPR equals 1 minus the cumulative nonselection rate (31.6 percent) observed from the first BPZ consideration.[33] The CPR is 68.4 percent, which corresponds exactly to the number eventually selected from the original cohort of 1,000 officers and is considerably different from the nominal promotion opportunity of 80 percent. The minor inaccuracy in this example is that it includes no officers separating or otherwise becoming ineligible for promotion before completing all five considerations. Accounting for separations and ineligibilities within the promotion window could either raise or lower the CPR, depending on the number of separations and whether they occurred before or after the cohort's IPZ consideration.

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[31] A conventional assumption is that the DOPMA promotion-opportunity rate approximates the cumulative opportunity after all of a cohort's considerations. The flaw in this assumption is that the promotion quota is determined using the IPZ eligibility count, from which previous BPZ selections from the cohort have already been removed. If, instead, the promotion quota was based on the original size of the cohort before BPZ selections, the conventional assumption would be truer.

[32] A cohort might be considered more than twice APZ, but, if selection rates diminish to a negligible level in those additional considerations, they would have a negligible impact on the CPR computed as we describe here and could thus be ignored.

[33] The cumulative nonselection rate across all five considerations (31.6 percent) is the product of the five nonselection rates in this example (95, 90, 41, 95, and 95 percent). In calculating a weighted CPR, and assuming no additions to or deletions from the cohort as it passes through the five promotion considerations, the cumulative nonselection rate from the first BPZ consideration would have a weight of 1, and all other cumulative nonselection rates would have weights of 0. The weighted average is thus equal to the rate with a weight of 1.

Table C.1. Cumulative Promotion Rate Applied to the Traditional Promotion Track

Zone	Eligibles	Selection Rate, as a Percentage	Selections	Nonselection Rate, as a Percentage	Cumulative Nonselection Rate to End of Window, as a Percentage	New Eligibles
BPZ	1,000	5	50	95	31.6	1,000
BPZ	950	10	95	90	33.3	0
IPZ	855	59	505	41	37.0	0
APZ	350	5	17	95	90.3	0
APZ	333	5	17	95	95.0	0
Total			684			
Board quota (percentage of IPZ eligibles)	855	80	684			

NOTE: In this example, CPR = 1 – 31.6% = 68.4%.

The figures in Table C.1 rest on the simplifying assumption of steady-state conditions: Five cohorts of equal size proceed through the promotion window, and all cohorts experience the same BPZ and APZ selection rates. Without this simplifying assumption, the count of IPZ eligibles would vary. Consequently, the promotion quotas would vary, and the selection rates in each of the five cohort components would vary. The CPR, multiplied by the size of the cohort at first BPZ consideration, would no longer exactly equal the total number of selections after all considerations. Nonetheless, in either longitudinal or cross-sectional comparisons, the complement of weighted cumulative nonselection rates would provide a faithful representation of overall promotion opportunity.

Hazard Function

A more analytic approach to evaluating and comparing promotion outcomes could be afforded by use of hazard functions based on micro longitudinal data. A hazard function indicates the probability that an event (e.g., a promotion or a separation) will occur in a specified time interval. Event probabilities can be modeled as a function of relevant covariates. Such models would provide a flexible way of handling data for multiple, overlapping, different-sized cohorts at risk of promotion and incorporating person-level covariates, such as education, training, and specific experiences. Although the technical skills required for model estimation and interpretation make this method inadvisable for standard reporting and comparison promotion-board results, it is a useful tool for deeper analytic probing of promotion outcomes.

Appendix D. Promoting to Requirements

Stimulated by OSD's Force of the Future proposals and the Air Force's Human Capital Annex to its Strategic Master Plan, Air Force personnel managers and CFMs are entertaining changes in long-standing Air Force promotion policies and practices. Heretofore, the Air Force has promoted most line officers (all except legal officers) in one competitive category, with separate competitive categories established only for professional (medical, chaplain, and legal) career fields. For various reasons, separate competitive categories are being considered for a few career fields perceived to be at an unfair disadvantage when competing against other line officers. Additionally, a proposed technical track seems workable only if it is carved out as a separate competitive category. Those contemplating additional competitive categories generally envision some form of *promoting to requirements*.

Promoting to requirements would be straightforward if manpower authorizations provided feasible and appropriate targets. Unfortunately, field-grade manpower authorizations, when combined with the number of field-grade students, transients, and others not covered by manpower authorizations, generally exceed DOPMA grade ceilings (10 U.S.C. 523) and are therefore partially infeasible.[34] Additionally, as discussed below, field-grade manpower authorizations for pilots are demonstrably inappropriate.

Because DOPMA grade ceilings cover a range of competitive categories (all except medical and dental officers), they must be allocated among the competitive categories on some rational basis. The allocated grade ceilings are then used in setting selection quotas, promotion-board timing, and monthly promotion increments. For the current professional competitive categories, the grade ceilings are allocated through processes that consider both manpower grade authorizations and expected career patterns. Whatever remains after these allocations is used for the line of the Air Force competitive category.

A common objective of those advocating new competitive categories is that the process will promote enough officers to fill the field-grade authorizations in the associated career fields.

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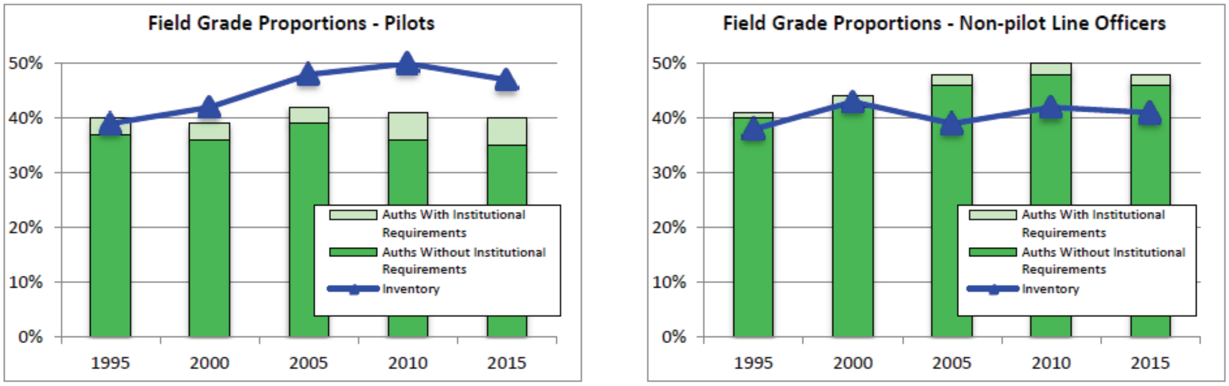
[34] Air Force manpower demand signals are constructed through a series of imperfectly joined steps. In each year's National Defense Authorization Act, Congress stipulates the number of officers and enlisted personnel authorized in the forthcoming FY. The Air Force, through its budget process, sets aside part of the total number to cover the average number of people (students, patients, prisoners, and transients) who, at any time, are not occupying an established position. The remainder of the congressionally authorized number is allocated to the MAJCOMs and other users at a very aggregate level of detail (total officer and enlisted counts by program element). The MAJCOMs and other users then extend these allocations to include detail, such as unit, duty location, grade, occupational code, and other qualification or administrative characteristics. The results are shown as manpower authorizations in a comprehensive manpower requirement system. Finally, in the case of officers especially, authorizations that can be filled by officers from any or many career fields must be allocated to the career fields in order to determine how many officers are needed in individual career fields. The process is not zero-based—in practice, most changes to manpower authorizations occur as programs expand or shrink.

Unfortunately, because field-grade manpower authorizations in total exceed what can be accommodated under DOPMA grade ceilings, a competitive category can be allocated a sufficient share of the ceilings to meet its requirements only if other competitive categories are allocated less than their requirements. Additionally, as we noted during our research, field-grade manpower authorizations for an important segment of the Air Force's human capital—pilots—are significantly understated relative to strategic human-capital needs. A process for allocating grade ceilings to any segment of the nonpilot force must accommodate the need for the pilot force to exceed its manpower grade authorizations. This appendix explains why.

MAJCOMs and other users determine the details of manpower authorizations (such as grade, Air Force specialty code, and organization), generally but loosely adhering to allocations, policies, and guidance from the Air Staff. Comprehensive reviews are rare, so long-established requirements tend to persist. For pilots, the current distribution of manpower requirements between company grades and field grades appears to be a relic of a time when ADSCs for pilot training were much shorter than they are today. With lower retention in that era, pilot career fields had lower proportions of field-grade officers.[35] Figure D.1 show how proportions for field-grade authorizations and inventories have changed over time for pilots and nonpilot line officers.

Figure D.1. Pilot and Nonpilot Inventories and Authorizations


Field Grade Proportions - Pilots

Field Grade Proportions - Non-pilot Line Officers

NOTE: Institutional requirements are distributed based on proportions of pilot and nonpilots assigned; inventories exclude students and transients for which there are no matching authorizations; line excludes legal officers.

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[35] Increasing the ADSC for pilot training from eight to ten years was effective for those *entering* training after October 1999, but with Air Force Academy and Reserve Officer Training Corps graduates in 1998 and 1999 classes grandfathered with eight-year commitments. Thus, the ten-year commitment began to have a partial impact nine years later (because the ADSC starts upon *completion* of training) and probably did not have a full impact until 11 or so years later. The 2000, 2005, and 2010 data points on the left panel of Figure D.1 would have been due to retention trends emerging prior to the effects of the ten-year ADSC. They can be partially attributed to the ADSC increase from six to eight years, which took effect for those completing training in 1988. The inventory represented by the 1995 data point had mostly six-year ADSCs.

In current practice, these grade mismatches between authorizations and inventories do not matter very much. Promotion boards (taking into account the need for senior warfighting leadership requirements) select pilots for promotion at rates well above what is needed to fill stated field-grade authorizations, including the pilot share of institutional requirements. Assignment staffs use grade substitutions to accommodate inventory/authorization mismatches, with the most-common substitutions being below requirements for pilots and above requirements for nonpilots.

However, in a changing environment, grade authorizations might play a much more important role. The HRM flexibilities evaluated in this document are intended to yield a closer match of human capital to organizational requirements. If manpower grade authorizations—a very visible representation of organizational requirements—do not reflect true needs, flawed signals could guide these initiatives. For example, following the authorization signal for pilots would mean reducing pilot retention (unacceptable because of training and absorption constraints) and limiting promotions (unacceptable because of warfighting leadership needs)—a poor alignment of human capital to the Air Force's strategic needs.

To address these concerns, the Air Staff must assume greater authority over manpower processes, give greater weight to strategic HRM concerns in setting grade and career field requirements, and bring grade authorizations in line with true needs.

Unless and until pilot grade authorizations are brought in line with strategic human-capital needs, any grade allocation to new competitive categories must leave sufficient room for pilots in the line of the Air Force competitive category to be promoted in numbers that well exceed their field-grade authorizations. Otherwise, nonpilots who continue to be considered in the same competitive category with pilots will face unfairly diminished promotion opportunity relative to those in other competitive categories.

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The Air Force faces both internal and external challenges to move toward greater flexibility in managing its active-duty military workforce. The research underlying this report assessed the impact that proposed military human resource management flexibilities could have on Air Force officer accessions, promotions, separations, and other force management outcomes. The assessments identified flexibilities that would benefit the Air Force and characterized subsets of the military workforce to which they could be advantageously applied. Research included interviews with Air Force career field managers and developing and exercising optimization models to estimate the impacts of new flexibilities. The research examined policies, such as moving away from up-or-out separations following promotion nonselection, extending maximum career lengths from 30 to 40 years, and increasing the midcareer entries to the active officer force from either civilian or reserve status. The authors also estimated declines in promotion opportunity or, alternatively, additional grade ceilings required to avoid these impacts.

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ISBN-10 0-8330-9862-4
ISBN-13 978-0-8330-9862-7

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RR-1921-AF