INSTITUTE FOR DEFENSE ANALYSES

Assessing the Economic Efficiency of the 2007 U.S. Army Menu of Incentives Program

Julie Lockwood
James Bishop
Alan Gelder
Christopher Oswald

November 2021
Approved for public release;
distribution is unlimited.
IDA Paper P-22820
Log: H 21-000348

INSTITUTE FOR DEFENSE ANALYSES
4850 Mark Center Drive
Alexandria, Virginia 22311-1882

The Institute for Defense Analyses is a nonprofit corporation that operates three Federally Funded Research and Development Centers. Its mission is to answer the most challenging U.S. security and science policy questions with objective analysis, leveraging extraordinary scientific, technical, and analytic expertise.

About This Publication
This work was conducted by the Institute for Defense Analyses under contract HQ0034-14-D-0001, project BE-6-4810, "Prediction Retention Toolkit and Evaluation for Targeted Army Talent Management" for the Army Talent Management Task Force and the Office of the Under Secretary of Defense for Personnel and Readiness (OUSD (P&R)). The views, opinions, and findings should not be construed as representing the official position of either the Department of Defense or the sponsoring organization.

Acknowledgments
We would like to thank Joseph Adams, Matthew Goldberg, and R. Abraham Holland for their careful review and helpful comments. We are also grateful for the feedback provided by researchers at the Office of Economic and Manpower Analysis (OEMA) at the U.S. Military Academy (USMA), including Matthew Gudgeon and Kyle Greenberg, and by Beth Asch of the RAND Corporation at the Western Economic Association International (WEAI) 96th Annual Conference. This acknowledgement does not indicate endorsement by these reviewers.

For More Information:
Dr. Alan B. Gelder, Project Leader
agelder@ida.org, 703-845-6879
ADM John C. Harvey, Jr., USN (Ret), Director, SFRD
jharvey@ida.org, 703-575-4530

INSTITUTE FOR DEFENSE ANALYSES

IDA Paper P-22820

Assessing the Economic Efficiency of the 2007 U.S. Army Menu of Incentives Program

Julie Lockwood
James Bishop
Alan Gelder
Christopher Oswald

This page is intentionally blank.

Executive Summary

The U.S. Army implemented the Menu of Incentives Program (MOIP) in September 2007 to improve retention of Army captains. Eligible officers could select one of five incentive options in exchange for a non-concurrent Active Duty Service Obligation (ADSO). More than 90 percent of participants selected the Critical Skills Retention Bonus (CSRB), which ranged from $25,000 to $35,000 and carried a three-year ADSO requirement. Institute for Defense Analyses researchers estimate that the Army could have expected to gain about 3,750 marginal service years from the initial cohort of program participants (or 4.0 months per bonus-accepting officer), at a cost of about $92,000 in bonuses per service year gained. We also find that the Army could have expected to pay about 62 percent of the program's direct costs in economic rent.

When offering any bonus, the Army inevitably pays more than the minimum amount required to obtain an additional service obligation from bonus-accepting officers. These economic rents arise because some participants would have accepted a smaller bonus in exchange for the incurred service obligation. However, our estimates also reflect the finding that most officers who were eligible for the MOIP were expected to serve a large portion of their ADSO extension period anyway (absent the program). The more time an officer would have served anyway, the less they stand to lose from enrolling in the program, and the less the Army stands to gain from enrolling them.

We suggest several steps the Army can take to better understand the return on investment of various retention incentives. First, the Army could conduct controlled trials to understand the causal impact of particular interventions on retention, without relying on the assumptions required for our analysis. Second, the Army could create a comprehensive plan to collect and archive detailed data from future retention programs to enable further research and analysis, such as understanding both short- and long-term retention and performance outcomes. Third, the Army could develop the capability to simulate and estimate expected outcomes from future incentive programs. Models facilitating forward-looking, prospective analysis can be used to better anticipate the impact and cost effectiveness of various incentives prior to implementation, with the underlying modeling assumptions iteratively validated, refined, and improved as policies are implemented and their actual results are realized.

Finally, we note that the Army did not differentiate between high and low performers when determining eligibility for an incentive. Assuming that high performers have more

attractive career opportunities outside the military, not differentiating based on quality likely results in a lower average quality of those participating in the program relative to those who are eligible. We recommend that the Army develop a framework for identifying officers it would most like to retain based on quality and performance metrics, thereby enabling the Army to make the most effective use of its limited financial resources to develop a high-quality force.

Contents

This page is intentionally blank.

1. Introduction

In September 2007, the U.S. Army implemented the Menu of Incentives Program (MOIP) to improve officer retention.[1] Under the MOIP, eligible Army captains could accept one of five incentive options in exchange for an additional, non-concurrent active duty service obligation (ADSO). Graduate school, military training (Ranger School or Defense Language Institute), career branch of choice, and duty station of choice were offered as non-monetary incentives. However, more than 90 percent of program participants selected the Critical Skills Retention Bonus (CSRB), which ranged from $25,000 to $35,000 depending on career branch.[2] The Army estimates that it paid $443.5 million in cash bonuses as part of the program from September 2007 to November 2008, averaging more than $30,000 per bonus.[3]

When offering any bonus, the Army inevitably pays more than the minimum amount required to obtain the additional service commitment from bonus-accepting officers. This is because some participants would have accepted a smaller bonus in exchange for the incurred ADSO. Additionally, since some participants would have served at least a portion of their obligated time anyway (absent the bonus), the number of service years truly gained by the Army is less than the length of the incurred ADSO. However, service members who are more likely to remain in the military longer without an incentive will consider an ADSO extension less detrimental, and are thus more likely to accept the bonus. Therefore, bonus programs are most likely to enroll and compensate those who would have stayed anyway. This type of adverse selection exacerbates the disparity between a bonus program's intended outcome of enticing service members to remain in uniform longer than they otherwise would have, and the realized outcome of retaining service members who would have continued to serve anyway.

This paper estimates the share of the MOIP's direct costs that the Army could have expected to pay in economic rent prior to program implementation. Here, we define economic rent as the payment in excess of the minimum bonus amount an officer would accept in exchange for an additional ADSO. This minimum acceptable bonus amount is

---

1 Department of the Army, *Implementation of the Army Officer Menu of Incentives Program (Regular Army)*, MILPER 07-237 (Alexandria, VA: Army Human Resources Command, September 2007), 1.

2 Samuel T. Piper III, *Improving Retention under the US Army's Captain Incentive,* 9; Army Human Resources Command (HRC), "Army Offers Renewed Incentives for Captains to Stay."

3 Government Accountability Office (GAO), *Military Personnel: Army Needs to Focus on Cost-Effective Use of Financial Incentives and Quality Standards in Managing Force Growth,* 38.

the officer's "reservation price." We also estimate the total number of marginal service years the Army could have expected to gain through the program, and we calculate the cost per service year gained.

Our analysis requires three primary pieces of information for each eligible officer:

(1) The officer's counterfactual survival curve (i.e., the probability that the officer would have remained in service for each future time period, absent the MOIP);

(2) The officer's existing ADSO immediately prior to program implementation; and

(3) The officer's reservation price for accepting an additional ADSO of a given length.

Counterfactual survival curves are needed to determine how many months of the ADSO extension each officer would likely serve anyway. The existing ADSO is needed to determine the relevant portion of the survival curve to consider, since the service obligation from the MOIP was to be served non-concurrently (i.e., it would begin when an officer's existing service obligation ended).[4] Finally, the officer's reservation price is needed to determine if the bonus is high enough to induce the officer to accept.

We estimate each eligible officer's survival curve as of August 2007 (the month prior to the MOIP implementation) using the Retention Prediction Model – Army (RPM-A), a machine learning model for survival analysis applied to detailed Army personnel records. The Army did not archive officers' ADSOs as of August 2007, so we impute each officer's ADSO based on commissioning source and date.[5]

Since each officer's reservation price for accepting an additional ADSO is not observable, estimating these reservation prices requires strong assumptions.[6] We therefore

---

[4] In contrast, some service obligations are served concurrently. For example, if an officer has a two-year service obligation and incurs a one-year concurrent service obligation, then the officer can serve the one-year and the two-year obligations at the same time; so the officer effectively has only a two-year obligation. If, on the other hand, the additional one-year obligation is non-concurrent, then it would begin when the original two-year obligation ended – making a three-year obligation in total.

[5] This imputation captures the most significant ADSO that many junior officers have, but it omits potential ADSO extensions due to a Permanent Change of Station (PCS), military schooling, civilian schooling, or other incentives and programs. We test the sensitivity of the results to our imputation choices in Section 4.B.5.

[6] Borgschulte and Martorell (2018) estimate enlisted service members' willingness to pay to avoid entering the civilian labor market during periods of higher unemployment in their home state. However, eligible officers who did not participate in the MOIP were not forced to separate from the military; they could continue to serve indefinitely without a formal contract (subject to promotion eligibility). Therefore, the decision model for officers considering whether to participate in the MOIP likely looks different from that of enlisted personnel choosing between reenlisting and exiting to the civilian labor market. Mark Borgschulte and Paco Martorell, "Paying to Avoid Recession: Using Reenlistment to Estimate the Cost of Unemployment," *American Economic Journal: Applied Economics*, 2018, 101-127.

simulate reservation prices from distributions that capture core underlying principles. We capture the pattern of adverse selection by assuming that, conditional on an officer's skill set, reservation prices are strictly decreasing in the amount of the additional ADSO that an officer would have served anyway. For officers who would have served the entire ADSO extension anyway, we assume a reservation price of zero.[7] We also assume that the Army can anticipate an expected overall acceptance rate for the MOIP, and that the distribution of reservation prices must match the expected acceptance rate. Our baseline for the expected acceptance rate is the actual acceptance rate of 68 percent. Although these assumptions guide the choice of a reservation price distribution, they do not define one.

We further parameterize the distribution of reservation prices by assuming that they are distributed according to an exponential distribution. The exponential distribution has a strictly decreasing probability density function, implying that lower reservation prices are more likely than higher reservation prices. The degree to which lower reservation prices are more likely than higher reservation prices is determined by the exponential distribution's sole parameter. We incorporate adverse selection by assuming that this parameter increases exponentially in the amount of the ADSO extension that the officer would likely have served anyway. The result is that the probability density function from which reservation prices are drawn becomes steeper (meaning that reservation prices are much more likely to be smaller) for officers who would have served longer anyway. We conduct sensitivity analyses using alternative distributional assumptions in section 4.B.

We use Monte Carlo sampling to simulate the expected outcomes of the program. For each eligible officer, we draw from a distribution of reservation prices conditional on the expectation of time served absent the MOIP. An officer is assumed to accept the MOIP if the bonus offered exceeds the reservation price. We calculate economic rents (i.e., bonus minus reservation price) and the amount of time in service gained through the MOIP relative to the amount of time that officers would have served anyway. We then summarize the distribution of estimates across all simulations.

We find that the Army could have expected to gain about 3,750 total service years from the initial cohort of program participants (or 4.0 months per bonus-accepting officer), at a cost of about $92,000 in bonuses per service-year gained. This high cost per service year reflects the finding that most officers who were eligible for the program were expected to serve a large portion of their ADSO extension period anyway (absent the MOIP).

[7] For our sensitivity analysis with alternative distributional assumptions, we make the further assumption that reservation prices must be able to approach zero with sufficiently high probability (this already holds for the exponential distribution, our primary distributional assumption). This is a limiting assumption to ensure that there is not a large jump between a reservation price of 0 for an officer who would have served 100 percent of the additional ADSO and an officer who would have served, say 99.9 percent of the additional ADSO.

Additionally, we find that the Army could have expected to pay about 62 percent of the program's direct costs in economic rent.

These metrics are useful for evaluating the cost-effectiveness of the CSRB relative to other retention incentives. We suggest three steps the Army can take to better understand the return on investment of various incentives. First, the Army could conduct a controlled trial in which it randomly selects officers to receive an incentive (i.e., in a manner uncorrelated with officers' characteristics, among a subset of officers the Army desires to retain). This framework would allow the Army to estimate the causal impact of an intervention on retention, without relying on the assumptions required for our analysis. Second, the Army could develop a comprehensive plan to collect and archive detailed data about individual-level eligibility, participation, and outcomes from future retention programs. These data would enable further research and analysis on both short- and long-term impacts of the program on retention, performance, and other pertinent outcomes. Third, the Army could develop the capability to estimate the expected outcomes of future incentive programs prior to implementation. Models facilitating forward-looking, prospective analysis can be used to better anticipate the impact and cost-effectiveness of various incentives prior to implementation. Following implementation, the Army could validate its assumptions about the retention impact and cost-effectiveness of various incentives, and leverage that information to design better programs and improve the underlying modeling assumptions for future estimations.

Finally, we note that the Army did not differentiate between high and low performers when determining eligibility for an incentive. To the extent that high performers have more attractive career opportunities outside the military, not differentiating based on quality will result in a lower average quality of individuals accepting a bonus, compared to the average quality of those who are eligible. We recommend that the Army develop a framework for identifying officers it would most like to retain based on quality and performance metrics. This type of framework would improve the return on investment of any retention incentive, and enable the Army to make more effective use of its limited financial resources to develop a high-quality force.

2. Overview of the Menu of Incentives Program

This section summarizes the historical context for the Army's Menu of Incentives Program (MOIP), as well as the eligibility criteria and incentive options for the initial cohort of Army captains targeted by the program in September 2007.

A. Historical Context

As of July 2006, the Army was projecting a shortfall of about 400 captains and 2,200 majors for Fiscal Year (FY) 2007, and 800 captains and 2,550 majors for FY2008. The expected fill rates for the rank of major in FY2007 and FY2008 were 82.6 percent and 80.5 percent, respectively—below the 85 percent threshold that the Army considered a critical shortage.[8]

The shortfall was likely due more to demand rather than supply factors. During the military drawdown of the 1990s (following the end of the Cold War), the Army reduced its officer accession targets to meet end-strength levels mandated by Congress. The Army steadily raised its targets in the early- to mid-2000s (and was within 95 to 100 percent of its target each year), but the long lead time required to produce a major (approximately 10 years) meant that the effects of under-accessing officers could not be quickly reversed.[9] Additionally, the Army embarked on a multi-year initiative in 2003 to restructure its forces around modular brigade combat teams (BCTs). This redesign increased the Army's manpower requirements – including demand for captains and majors. In FY2007, the Army received authorization to increase its active duty end strength from 482,400 to 547,000 to more effectively staff units under this new modular force structure.[10]

Despite high operational and deployment tempos during Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF), the Army did not observe higher attrition

---

8 Charles A. Henning, *Army Officer Shortages: Background and Issues for Congress*, 3.

9 Henning, *Army Officer Shortages,* 3-4. Officers must meet time-in-service requirements specified in DoD Instruction (DODI) 1320.13, as well as time-in-grade requirements specified in 10 U.S.C. § 619.

10 Stuart E. Johnson et al., *A Review of the Army's Modular Force Structure,* 7-44; Henning, *Army Officer Shortages*, 5.

rates among officers in the early- to mid-2000s.[11] Company-grade (O-1 to O-3) officer retention rates in FY2006 were below the 10-year historical average, and were similar to pre-9/11 levels at the time the MOIP was implemented.[12] While the Army had been executing its stop-loss authority[13] since December 2001 to retain service members (who had otherwise planned to separate) for the duration of their upcoming deployment, this policy was politically unpopular and the Secretary of Defense issued guidance to the Services in January 2007 to minimize its use.[14]

Given the increased demand for captains and majors, the Army started offering three new incentives to U.S. Military Academy (USMA) and Reserve Officers' Training Corps (ROTC) cadets to retain them beyond completion of their initial service obligation.[15] The program, now known as the Career Satisfaction Program (CSP), was first implemented in FY2006 and included the following incentives.[16]

(1) GRADSO: an option to attend a fully-funded, full-time graduate school program after six to ten years of commissioned service;[17]

(2) BRADSO: preferential consideration for the cadet's career branch of choice;

(3) PADSO: cadet's choice of posting (i.e., duty assignment).

---

[11] Henning, *Army Officer Shortages*, 6-7; See also Ronald D. Fricker, *The Effects of Perstempo on Officer Retention in the U.S. Military*.

[12] GAO, *Military Personnel: Strategic Plan Needed to Address Army's Emerging Officer Accession and Retention Challenges,* 51; Army HRC, "Captains Now Eligible for $25K Retention Bonus."

[13] Under 10 U.S.C. § 12305 and Executive Order 12728. Stop-loss can be used to retain both enlisted personnel and officers. While officers do not have established separation dates like enlisted personnel, an officer's approved retirement or resignation can be deferred under stop-loss until the officer's scheduled deployment is complete. Note also that service members can be recalled from the Individual Ready Reserve (IRR) to serve on active duty. Charles A. Henning, *U.S. Military Stop Loss Program: Key Questions and Answers*, 1-3.

[14] GAO, *Military Personnel: DoD Needs to Address Long-term Reserve Force Availability and Related Mobilization and Demobilization Issues,* 75; Robert M. Gates, "Utilization of the Total Force", 1-2.

[15] Attrition levels are perennially high at the end of initial service obligations, and the shortage of captains and majors occur in the years following that point. Section 3.B describes the initial service obligation in greater detail.

[16] Department of the Army, "Career Satisfaction Program"; Andrea Wales, "Grad-School Option Chosen as Cadet must be Scheduled when Selected for Captain."

[17] Note that the GRADSO incentive only gave cadets the *option* to attend graduate school; they could choose not to exercise this option and continue to serve or separate. Regardless, they still had to fulfill the three-year ADSO associated with this incentive. Officers who chose to exercise the option and attend graduate school incurred an additional ADSO after graduate school of three days for every day spent in school, up to a maximum of six years. The GRADSO incentive was suspended starting in FY2014 (although BRADSO and PADSO continued to be offered).

Cadets participating in the CSP could request up to two of these three incentives. If approved, cadets would incur an additional three-year, non-concurrent ADSO for each incentive.[18]

Regardless of the CSP's effectiveness in retaining officers long-term, its focus on USMA and ROTC cadets meant that it would not help resolve the Army's immediate officer shortfall problem in FY2007.[19] In this context, the Army designed the MOIP to immediately retain the captains it needed to support the Army's transformation to a modular force.

B. Eligibility Criteria

Eligibility for participation in the MOIP was primarily based on current rank and career branch at time of accession. Only captains (commissioned officers holding the rank of O-3) with a date of rank between 1 April 2002 and 1 November 2007 were initially eligible. Additionally, only officers who had accessed on active duty in one of 17 career branches were eligible.[20] Captains were not eligible if they had already been considered for promotion to the rank of major.[21] Service members enrolled in the Judge Advocate General (JAG)'s Corps legal education program or attending a college or university in the Army's Expanded Graduate School Program (EGSP) were not eligible.[22] Army Reserve and National Guard officers were also not eligible. Other than excluding officers who did

---

[18] An ADSO incurred by accepting a CSP incentive would be served sequentially with a cadet's accession source ADSO and any other CSP-related ADSOs (but concurrently with non-statutory ADSOs, such as a service obligation incurred from a PCS or military training). For example, a cadet who received the GRADSO and BRADSO incentives would have a six-year ADSO from the CSP program, to be served after the cadet fulfilled his or her accession source ADSO. If a cadet was not granted his or her branch or post of choice (e.g., due to the needs of the Army), the cadet would not incur the additional ADSO.

[19] The Army would not begin to realize the benefits of the CSP-related ADSOs until several years later, since officers had to fulfill their commissioning source ADSO first.

[20] Department of the Army, *Army Officer Menu of Incentives Program,* 2. Eligible career branches included air defense, adjutant general, armor, aviation, chemical, engineer, field artillery, finance, infantry, military intelligence, military police, ordnance, quartermaster, signal, and transportation. Officers who accessed into the Army Nurse Corps and Medical Service Corps were also eligible, depending on additional criteria. In addition, Army first lieutenants in year group 2004 who had been selected for promotion to captain could apply for the MOIP upon promotion to captain.

[21] This restriction excluded captains who had been considered for promotion to major in the primary zone (i.e., considered for promotion with their cohort). It also excluded captains who had been selected (and not just considered) for below-the-zone promotion to major (i.e., selected for promotion ahead of their cohort).

[22] Department of the Army, *Army Officer Menu of Incentives Program,* 3. Officers who were pre-selected for the EGSP for fiscal year 2008 or later could withdraw from the EGSP to participate in the MOIP. However, officers who surrendered their EGSP slot would not be allowed to participate in the EGSP again in the future.

not meet height and weight standards or who had significant disciplinary issues,[23] the program had no eligibility criteria that were tied to an officer's performance or potential. The Army did not consider the quality of the officers it was seeking to retain.

C. Incentive Options

The MOIP program offered officers a choice of the following five incentives:[24]

(1) A Critical Skills Retention Bonus (CSRB) of $25,000, $30,000, or $35,000, depending on the officer's accession branch, in exchange for a non-concurrent ADSO of three years.[25]

(2) The opportunity to attend graduate school, in exchange for an ADSO of three days for every one day in school.[26]

(3) The opportunity to attend one of two military schools: Ranger School or the Defense Language Institute. The Ranger School option incurs an ADSO of one year, while training at the Defense Language Institute incurs an ADSO of three days for every one day in school.

(4) A choice of career branch or functional area in exchange for a three-year ADSO.

(5) A choice of the officer's next duty station in exchange for a three-year ADSO.[27]

Only the CSRB was freely offered to all eligible officers. Officers could apply for the other options, but due to their limited availability, officers were notified that priority would be given to captains with a date of rank between 1 January 2006 and 1 November 2007. Given the limited availability of these other options, it is not clear from the official MOIP announcement whether an officer who was denied one of the non-CSRB options due to lack of availability could have subsequently applied for the CSRB. The staggering of some

---

[23] Officers were ineligible if they had received an Article 15 under the Uniformed Code of Military Justice or if they were "pending any adverse action." Department of the Army, *Army Officer Menu of Incentives Program,* 11.

[24] A subsequent phase of the program that ran from April to November 2008 did not offer the choice of branch/functional area or duty station. GAO, *Cost-Effective Use of Financial Incentives,* 38.

[25] Officers who initially accessed in the Army nurse and medical service corps were only eligible for the CSRB option. Department of the Army, *Army Officer Menu of Incentives Program,* 2.

[26] The graduate school option was run under the Expanded Graduate School Program, which has a minimum ADSO of two years upon completion of graduate school, and a maximum ADSO of six years. The ADSO is non-concurrent to the officer's commissioning ADSO, but it is concurrent to other ADSOs the officer may incur. Department of the Army, *Officer Active Duty Service Obligations (2007)*, 6.

[27] The ADSO was to begin after the officer's commissioning ADSO "or arrival at the selected installation, whichever is later." Officers could only move to their selected installation after completing at least one year at their current duty station. Even if an officer moved to an installation of choice, they could still be deployed. Department of the Army, *Army Officer Menu of Incentives Program,* 8.

of the application deadlines for the different options may have permitted this to some degree, but it is probable that many, if not all, officers only had one chance to select an option.[28] Whether because officers were dissuaded from applying for the other options due to their limited availability (and the potential to come away empty-handed), or due to the unattractiveness of the other options relative to the size of the CSRB, more than 93 percent of program participants chose the CSRB option.[29] The CSRB was to be paid as a taxable lump sum within 90 days of the contract approval date, and would be recouped on a prorated basis if the recipient failed to fulfill the resulting ADSO.[30] The payment of the CSRB within 90 days also made it the most immediate of the five options. Other options, such as graduate school or Defense Language Training, might not begin for years.[31] The immediacy of the CSRB relative to the other options may be another reason why most officers selected it.

---

[28] The CSRB, military school, and post of choice options all had an application deadline of 14 December 2007. The option for choosing a branch or functional area of choice had an application deadline of 23 November 2007, but it is unclear whether an officer would have received confirmation of a decision before the CSRB deadline in December. The graduate school option had a deadline of 19 October 2007, and applicant were supposed to receive notification of approval on 26 October. This would provide applicants with enough time to reapply for the CSRB option if they were denied the graduate school option (and if reapplying for the CSRB after being denied the graduate school option was permissible).

[29] Piper, *Improving Retention*, 9; Army HRC, "Army Offers Renewed Incentives for Captains to Stay."

[30] Department of the Army, *Army Officer Menu of Incentives Program*, 4.

[31] The program announcement for the MOIP noted that "officers will generally begin graduate school attendance between their 8th and 12th year of service" and "officers will generally attend Language Training between their 6-12th year of service." Department of the Army, *Army Officer Menu of Incentives Program*, 5–6.

This page is intentionally blank.

3. Methodology

We are interested in two outcomes of the MOIP, which we formalize here. Let b_i be the bonus amount offered to officer i. Let $x_i \geq 0$ be the minimum bonus amount the officer would have accepted (i.e., the officer's reservation price), and let $m_i \in [0, 36]$ be the amount of the 36-month additional ADSO that the officer would have served in the absence of the MOIP. The officer accepts the bonus, and the Army incurs the cost of the bonus and the benefit of the additional service obligation, if and only if $b_i \geq x_i$. We can define the following outcomes for officer i:

- Cost per month of service gained for officer i:

$$\begin{cases} b_i/(36 - m_i), & b_i \geq x_i \\ 0, & b_i < x_i \end{cases}$$

- Share of cost that is rent for officer i:

$$\begin{cases} (b_i - x_i)/b_i, & b_i \geq x_i \\ 0, & b_i < x_i \end{cases}$$

We can also define analogous program-level outcomes:

- Program cost per month of service gained:[32]

$$\sum_i b_i * 1(b_i \geq x_i) \Big/ \sum_i (36 - m_i) * 1(b_i \geq x_i)$$

- Program share of cost that is rent:

$$\sum_i (b_i - x_i) * 1(b_i \geq x_i) \Big/ \sum_i b_i * 1(b_i \geq x_i)$$

We do not observe the counterfactual service time m_i, the reservation price x_i, or even bonus acceptance $1(b_i \geq x_i)$. Our inability to observe the counterfactual service time is based on two challenges. First, we cannot observe retention in a hypothetical world without the MOIP, so we must forecast the officer's survival curve using information known immediately prior to the announcement of the MOIP. Second, the Army did not archive

[32] Note that we report cost per *year* of service gained in our results tables.

the existing ADSOs for each officer at the time of the MOIP was offered.[33] To estimate m_i, we must first estimate the officer's survival curve, and then estimate the point on the survival curve that represents the end of the officer's existing ADSO. From that point, we can then estimate the portion of the subsequent 36-month ADSO addition that the officer would have likely served. Later in the methodology section, we will describe both how we estimate the survival curve and how we impute each officer's existing ADSO.

The Army likewise did not archive data on who accepted the MOIP.[34] This prevents a retrospective analysis of the careers of those who accepted the MOIP. Ideally, we would like to be able to see an officer's forecasted survival curve at the time the MOIP was offered, see which officers accepted the MOIP, and then see subsequent changes to the survival curves and actual retention behavior over the ensuing years since the MOIP. For instance, since the MOIP was only offered to captains with a date of rank after 1 April 2002 who had not been considered for promotion, it would be interesting to compare the retention behavior of officers who were narrowly too senior to miss the eligibility requirement with those who were narrowly eligible. That is, comparing those with a date of rank in early 2002 to those with a date of rank in mid-2002, or those who had just been considered for promotion to those who were about to be considered for promotion. Such an analysis may have provided the random variation across officers offered the MOIP that is needed to identify the causal impact of the MOIP on short- and long-term officer retention. Information was likewise not archived on who accepted each of the five incentives in the MOIP program, so a retrospective analysis comparing the impacts of the different incentive options is also not possible. Also, no information was captured on the availability of the four non-bonus options – we do not know, for instance, the number of officers who may have applied for one of the non-bonus options but were denied due to limited availability. The lack of information kept on the MOIP was perhaps the biggest shortfall of the program, since it severely limited how much could be learned from the program for future retention initiatives.

Our analysis is therefore framed to estimate how much the Army could have anticipated paying in economic rents at the time the MOIP was offered. Although the program was partially extended in 2008, we focus on the initial 2007 phase. This allows a

---

[33] This information was apparently kept in a database that was updated dynamically, so that the information was always current. However, no static copies of the data at fixed points in time were preserved for archival purposes. Additionally, entire records for individual officers were removed from the system once the officers left military service, making it impossible to recreate ADSO information for the full population of officers who were serving at the time the MOIP was offered.

[34] Information on which officers accepted the MOIP was not recorded in any of the key Army databases, including the Total Officer Personnel Management Information System (TOPMIS) or the Total Army Personnel Database (TAPDB). CSRB payments were not recorded in the Defense Manpower Data Center (DMDC) Active Duty Pay (ADP) file prior to 2013.

more definitive look at the sudden change in incentives that officers faced at the start of this unique and substantial retention initiative. An estimated 17,700 officers were eligible for the initial 2007 phase of the MOIP program.[35] We identify 15,968 eligible officers in our data from this original cohort.[36] We do not have a way to reconcile the conflicting counts. We assume that the officers we observe are representative of the original cohort, and we scale our outcomes by an adjustment factor of approximately 1.108.[37]

This analysis considers only the direct costs of the MOIP, as opposed to costs associated with program development and administration. Additionally, since more than 93 percent of program participants selected the CSRB incentive, and calculating the direct cost of the CSRB is simple, we estimate outcomes only for the share of officers who selected the CSRB (rather than a different incentive option).[38] We assume all program participants incur a 36-month ADSO extension.

A. Forecasting Counterfactual Retention

Our analysis seeks to measure years of service gained through the MOIP. Years of service gained is the difference between how long each officer serves (the actual outcome) and how long they would have served in the absence of the MOIP (the counterfactual outcome). Our work is somewhat analogous to Deryugina et al. (2019), who measure life years lost due to acute air pollution exposure. Life years lost is the difference between how long an individual lives (the actual outcome) and how long they would have lived in the absence of exposure (the counterfactual outcome). Deryugina et al. (2019) do not observe the counterfactual, so they train machine learning models to estimate it. Similarly, we do not observe the counterfactual of how long accepters would have served in the absence of the MOIP, so we train a machine learning model to estimate it.

For model training, we need to observe service durations of officers prior to the MOIP and features of those officers that correlate to their service durations. Section 3.A.2 describes our training data. Two data characteristics complicate our model training choices. We observe all features of each officer repeatedly each month, from January 2000 through August 2007, in a panel (or "longitudinal" manner). Implementations for training machine learning models often do not accommodate panel data, but rather assume one observation and outcome value per individual. Second, many officers continue to serve after our data end (i.e., our outcome of service duration is right-censored); indeed, these are precisely the

---

35 Army HRC, "Army Offers Renewed Incentives for Captains to Stay."

36 After removing about 400 officers for whom we do not observe accession source in our data.

37 Calculated as the total number of eligible officers (17,700) divided by the number of eligible officers in our data (15,968). This adjustment factor is applied to outcomes which are summed over all individuals (e.g., total number of service years gained); outcomes expressed as a ratio (e.g., bonus cost per service year gained, share of costs that are economic rent) are not affected by this adjustment.

38 Piper, *Improving Retention,* 9.

officers for whom we want to estimate service duration in the absence of the MOIP. Handling censored outcomes is the domain of survival analysis.

Deryugina et al. (2019) handle the panel nature of their data by restricting their training data to observations from a single year. That is, they destroy the panel nature of their data by taking a cross-section. Then they handle censored outcomes by training models with loss functions that explicitly account for censoring. These methods for handling panel data with censored outcomes have three major opportunities for improvement. First, we prefer to maximize our observations available for training, rather than discarding data from all but one period, so that we can maximize model performance. Second, we prefer to use a universally implemented loss function, so that we can apply the best-performing training algorithms in machine learning. Third, we prefer to estimate not only a mean duration, but a statistical distribution of duration, so that we can capture aleatoric uncertainty in our estimates of counterfactual months served. Aleatoric uncertainty refers to the notion that, even if we produced the best-performing estimates possible given our features, we would still be uncertain about the realization of the outcome. Even if we are certain about the probabilities that a service member would serve one, two, three, etc., more months, we are uncertain about the realized number of months. To measure that uncertainty, we need those probabilities of the outcome, not only the mean. We adopt a method that achieves these three improvements, and describe that method in the next section.

1. Method for Forecasting Officer Service Durations with Panel Data

We observe when each officer enters and exits our panel data, and we use that information to calculate each officer's service duration in months. For each possible duration $t = 1, \ldots, T$ (where T is the finite maximum duration observed among all officers in our data), we construct a training set of person month observations for which the individual served at least $t - 1$ months into the future (from the date of observation), and for which we observe whether or not the individual served t months into the future (i.e., they are not "right-censored").[39] We can then train a separate binary classifier model on each training set to predict the probability of serving the last month of duration t, conditional on serving all months prior. In general, the number of possible forecast durations is one less than the number of periods. Our data encompass 92 months, with the longest duration spanning the 91-month interval from January 2000 to August 2007. We can therefore train up to 91 models to forecast retention up to 91 months into the future.

[39] For example, for duration $t = 12$, we train on person month observations of individuals who served at least 11 months into the future, and for which we observe whether or not they continued to serve into the 12th month. If the 12th month exceeded the maximum observation date in our data, the individuals serving through the 11th month (i.e., the maximum observation date) would be "right-censored", and we cannot calculate the probability that those individuals continue to serve into the 12th month.

Stated differently, our method transforms the right-censored numeric outcome (i.e., each officer's service duration, in months) into a vector of binary outcomes (i.e., whether the officer survived to month *t*, conditional on surviving to month *t* – 1). For a binary outcome, there is no concept of censoring: we observe each outcome value either fully or not at all. We train on the observations for which we observe the outcome. This transformation permits us to use any loss function compatible with a binary outcome, including the universally implemented binary cross-entropy loss function, or "log loss." Thus, we can employ state-of-the-art training algorithms, without being limited to training algorithms that account for censoring. The state-of-the-art training algorithm for tabular data is gradient-boosted trees,[40] for which we use the LightGBM implementation. We implement our method using an open-source Python package called the Finite-Interval Forecasting Engine (FIFE).[41] FIFE offers machine learning and other methods for forecasting any binary, multinomial, or continuous outcome in any periodic panel dataset. In particular, FIFE offers a machine learning framework for survival analysis. We refer to the vector of trained models we obtain by applying FIFE to forecast retention of Army personnel as the Retention Prediction Model-Army (RPM-A).

For a given officer i and vector of observed feature values $\boldsymbol{v_i}$, RPM-A produces a vector of marginal survival probabilities for forecast horizon $t \in \{1, \dots, T\}$:

$$\boldsymbol{p_i}(\boldsymbol{v_i}) = \langle\, p_{i,t}(\boldsymbol{v_i}) \,\rangle = \langle\, P(m_i \geq t \mid m_i \geq t-1)(\boldsymbol{v_i}) \,\rangle$$

The cumulative product of the marginal survival probabilities is an estimated survival curve s over the forecast horizon $t \in \{1, \dots, T\}$:

$$\boldsymbol{s_i}(\boldsymbol{v_i}) = \langle\, s_{i,t}(\boldsymbol{v_i}) \,\rangle = \langle \prod_{j=1}^{t} p_{i,j}(\boldsymbol{v_i}) \,\rangle$$

Thus, we estimate not only the mean expected survival duration, but a discrete statistical distribution over all possible durations in the forecast horizon. To estimate the mean duration within a given time frame – referred to as the "restricted mean survival time" (RMST) – we sum the values on the survival curve.[42] For this analysis, we are interested in the RMST within the 36-month time frame of the prospective ADSO:

---

[40] See, for instance, Francois Chollet, *Deep Learning with Python,* section 1.2.7.

[41] FIFE was developed by the Institute for Defense Analyses (IDA) for the U.S. Department of Defense. Source code is available on GitHub (https://github.com/ida-humancapital/fife) and through the Python Package Index (https://pypi.org/project/fife/). FIFE documentation is available on Read the Docs (https://fife.readthedocs.io/en/latest/).

[42] Restricted mean survival time is equal to the area under the survival curve from a base time (typically the start of the curve) to a specified future point in time. Here, the base time is when the officer's current ADSO ends and the point in the future is 36 months thereafter.

$$r_i(\boldsymbol{v_i}) = \sum_{j=g+1}^{g+36} s_{i,j}(\boldsymbol{v_i})$$

where g is the remaining number of months on officer i's existing ADSO, if any, and zero otherwise. In other words, we want to know how many of the 36 months of the offered ADSO we could have expected the officer to serve in the absence of the MOIP. Note that, although we observe time only in discrete durations, RMST is a real-valued weighted average of those durations.

2. Data Inputs

We use monthly administrative data on military personnel from the Defense Manpower Data Center (DMDC) to train the RPM-A. These data contain hundreds of features concerning career, demographics, family, and pay for all active duty Army officers since January 2000. Additionally, we engineer data on unit characteristics, deployments, casualties, and civilian employment conditions to incorporate into the model. Table 1 provides an overview of the types of features used to train the RPM-A.

Table 1. Retention Prediction Model (RPM) Data Inputs

Data Category	Types of Features	Source
Career	Pay grade, military occupation, accession source, assigned unit, duty station, education level, test scores	DMDC Active Duty Master (ADM) file
Demographics	Age, gender, race, ethnicity, faith group, citizenship status, home of record	ADM file
Family	Marital status; number, age, relationship, and location of dependents	IDA-engineered based on DMDC Active Duty Family (ADF) and ADM files
Pay	Allowance eligibility and amount (e.g., BAH, BAS, COLA, OHA), basic pay, skill-based incentive pay, hazard pay, select bonuses, federal and state tax withholdings	DMDC Active Duty Pay (ADP) file
Unit Traits	Unit size, demographics, education levels, test scores	IDA-engineered based on ADM and ADF files
Deployments	Frequency and duration of deployments (at the unit and individual levels), combat zone status	IDA-engineered based on DMDC Deployments file
Casualties	Frequency, severity, and cause of casualties (at the unit, occupation, and Service level)	IDA-engineered based on DMDC Casualties file
External Economic Conditions	Unemployment rates and earnings for civilian occupations (mapped to similar military occupation, state and experience level)	IDA-engineered based on data from the U.S. Bureau of Labor Statistics, O*NET OnLine,[43] and mappings from CNA[44]

[43] O*NET OnLine, "Military Crosswalk Search."

[44] Justin Ladner, "Estimating Occupation-Specific Civilian Outside Options for Military Personnel."

B. Imputing Active Duty Service Obligations

Since the MOIP-induced ADSO was to be served non-concurrently with an officer's existing ADSO (if any), the start and end date of the MOIP ADSO varied for each service member. We do not observe officers' existing ADSOs in our data; therefore, we impute them based on initial accession source.

First, we map an accession source ADSO to each service member: five years for service academy graduates; four years for Reserve Officer Training Corps (ROTC) scholarship recipients; and three years for non-scholarship ROTC graduates, Officer Candidate School (OCS) graduates, and officers commissioned by direct appointment.[45] We then calculate an accession source ADSO end date based on each service member's date of accession.[46] For officers who had already fulfilled their accession source ADSO by the time the MOIP was implemented, we assume their ADSO extension would start on November 15, 2007.[47] About 81.8 percent of eligible officers in our data fall into this category. For officers whose accession source ADSO end date was later than November 15, 2007, we assume the MOIP-induced ADSO extension would start immediately after they fulfilled their accession source ADSO. [48]

Commissioned officers can also incur an ADSO after completing formal training programs or undergoing a permanent change of station. These non-statutory ADSOs were typically served concurrently with other non-statutory and statutory (e.g., commissioning source) ADSOs.[49] However, the terms of the MOIP contract imply that the MOIP-induced

---

[45] Department of the Army, *Officer Active Duty Service Obligations (2007),* 2-7.

[46] Date of accession was missing for about 0.7% of eligible officers in our data. For those individuals, we calculate the end date from the first date that they appear in our data. Since the longest accession source ADSO we impute is five years, officers who are missing a date of accession value and first appear in our data in January 2000 (about 0.1% of all eligible officers) would have fulfilled their accession source ADSO by the time the MOIP was implemented (regardless of whether they commissioned prior to or in January 2000).

[47] The effective date of the program was September 13, 2007; however, officers could participate as long as they submitted the necessary paperwork by December 14, 2007. We have no information about when each participant submitted a signed contract, when the contract was approved, or how the approvals were distributed over the implementation period. Allowing about two weeks for the approval process, we assume that contract approvals are uniformly distributed between October 1, 2007 and January 1, 2008. For simplicity, we use the midpoint of the distribution (approximately November 15, 2007) as the minimum ADSO extension start date, and we test how this assumption affects our results in section 4.B.4.

[48] The ADSO extension for CSRB recipients started upon completion of their existing ADSO or the date that the officer's contract was approved by the Human Resources Command (HRC) Officer Retention Branch, whichever was later. Department of the Army, *Army Officer Menu of Incentives Program*, 3.

[49] "Multiple ADSOs resulting from career status, warrant officer promotion, PCS, and military schooling will be served concurrently. Additionally, these ADSOs will be served at the same time as those resulting from precommissioning and civilian schooling." Department of the Army, *Officer Active Duty Service Obligations (2007),* 6.

ADSO would be served sequentially with all other ADSOs (including non-statutory), rather than concurrently.[50] In any case, we do not attempt to impute non-statutory ADSOs due to the complexity of identifying events that would trigger such ADSOs in our data.[51]

C. Estimating Outcomes

For an officer who accepts the MOIP, the number of marginal service months gained by the Army equals the duration of the new ADSO (i.e., 36 months) minus the number of months the officer would have served anyway. The cost to the Army is the bonus amount the officer accepted. After using RPM-A to estimate the RMST for each program-eligible officer, we need to address two complications to achieve our objective of measuring the cost per service-year gained and the share of costs that are rent. First, we do not observe which officers accepted an incentive as part of the MOIP. Second, the economic rent depends on individual reservation prices, which are not observed.[52]

We address both complications by simulation. The fundamental idea is to draw a reservation price for each eligible officer from a specified distribution of reservation prices. If the bonus amount exceeds the reservation price, the officer accepts the bonus in exchange for the additional service obligation, and the economic rent is the difference between the bonus amount and the reservation price. Officers that do not accept the bonus generate no months gained for the Army, no bonus cost, and no economic rent. We perform more than 8,000 such simulations, then summarize the distribution of estimates across simulations.[53]

We have little information for specifying the distribution of reservation prices. One piece of information is quantitative – about 68 percent of officers accepted the MOIP.[54] Therefore, we fit our reservation price distribution such that 68 percent of officers accept the MOIP in expectation in our simulations. Another piece of information is qualitative –

---

[50] The contract states the following: "(8)(b) I understand that the ADSO incurred pursuant to the Army's Menu of Incentives Program as stated above will be in [*sic*] non-concurrent with any ADSO I have incurred as of submission of this contract. (8)(c) I understand that the ADSO incurred pursuant to the Army's Menu of Incentives Program will be served in addition to any other non-statutory ADSO." Department of the Army, *Army Officer Menu of Incentives Program*, 10.

[51] We attempt to bound the effects of this decision on the results in our sensitivity analyses (section 4.B.5).

[52] Recall that an officer's reservation price is the minimum bonus amount the officer would require to accept the additional ADSO, and the economic rent is the bonus amount minus the reservation price.

[53] Choosing the number of simulations entails a trade-off between precision and computational efficiency. In general, there is no way to compute precision for a given number of simulations before simulating (Oberle, 2015). After simulating, we can estimate our precision, and perform more simulations if we find our precision unsatisfactory. After 8,192 (2^13) simulations, we estimate that our mean estimate of cost per month of service gained is within 0.021 percent of the true mean under our data and assumptions. For the share of costs that are rent, we estimate that our mean estimate is within 0.0039 percent of the true mean under our data and assumptions. We find such precision satisfactory.

[54] Piper, *Improving Retention,* 1.

we should expect officers with greater RMSTs to be more likely to accept, since they would have served longer anyway. While months gained represents a benefit to the Army, it represents a cost to officers. At one extreme, for officers who are certain that they would leave the Army at the beginning of the prospective ADSO, accepting the bonus means serving 36 more months than they would have preferred. At the other extreme, officers who are already certain that they will serve through the prospective ADSO have a reservation price of zero, because accepting the bonus entails no divergence from their preference. Thus, the Army faces adverse selection in the form of a negative relationship between probability of acceptance and months gained. We do not have quantitative information on structure of this relationship or the distribution of officers' preferences. Our estimates are therefore based on the following assumptions.

Let x_i, the reservation price for officer i, depend on the officer's observed features $\boldsymbol{v_i}$ with some random mean-zero variation ε_i:

$$x_i = \mu(\boldsymbol{v_i}) + \varepsilon_i, \qquad E[\varepsilon_i] = 0$$

In general, we have no information about how x_i depends on a given feature. However, we presume that x_i depends on two functions of our features: first, the RMST r, which is a function of observed features through the RPM-A; and second, the bonus amount b, which is a function of accession branch a_i:

$$x_i = \mu(r(\boldsymbol{v_i}), b(a_i)) + \varepsilon_i = \mu(r_i, b_i) + \varepsilon_i, \qquad E[\varepsilon_i] = 0$$

The Army presumably varied the bonus amounts across accession branches based on the underlying skill sets required, the marketability of those skill sets, training costs, expected fill rates, and relative demand. The bonus amount becomes informative of the reservation price x_i through the overall acceptance rate. To meet the observed acceptance rate, the bonus amount is expected to exceed the reservation price for 68 percent of officers. Let N be the population of eligible officers. Then we assume the equation in A1:

A1. Expectation of 68 percent acceptance

$$\frac{1}{|N|} E\left[\sum_{i \in N} 1(b_i > x_i)\right] = 0.68$$

The RMST is informative of the reservation price x_i through our assumption of adverse selection. That is, x_i cannot increase with r, all else equal:

A2. Adverse selection

$$\frac{\partial x_i}{\partial r_i}(r_i, b_i) \leq 0 \text{ for all } r_i, b_i$$

We make two more core presumptions. First, an officer who would have served the entire additional 36-month ADSO anyway has a reservation price of zero and consequently will accept any bonus:

A3. Guaranteed acceptance of a free lunch

$$\lim_{r_i \to 36} x_i \text{ is deterministic with value } 0$$

This implies not only that $\mu(36, b_i) = 0$, but that ε_i collapses to a degenerate distribution as r_i approaches 36 months.

Second, reservation price is non-negative. No officer is willing to pay for an ADSO.

A4. Non-negative reservation price

$$x \geq 0$$

Assumptions A1 through A4 are not sufficient to define x_i, so we make the following stronger distributional assumptions.

A5. Exponential distribution of reservation prices

$$x_i \sim Exponential(\lambda_i)$$

Assumption A5 specifies that reservation prices follow an exponential distribution. Under this distribution, lower reservation prices are more likely than higher reservation prices, but there is no maximum possible reservation price. Most importantly, we can define the exponential distribution in terms of a single parameter λ_i. We have only one piece of information (Assumption A1) to fit the distribution of x_i, so we cannot afford more than a single parameter.

The exponential distribution with parameter λ_i has mean $1/\lambda_i$, which by our definition of x_i is $E[x_i] = \mu(r_i, b_i)$. Therefore, we need to specify λ_i as a function of r_i and b_i. We specify $\lambda_i(r_i, b_i)$ such that the probability of bonus acceptance increases exponentially with RMST:

A6. Acceptance probability increases exponentially with RMST

$$\lambda_i = \lambda_i(r_i, b_i; d) = -\frac{1}{b_i} \ln\Big(1 - \exp\big(d(36 - r_i)\big)\Big), \text{where } d < 0$$

This assumption is based on the quantile function for the exponential distribution. Specifically, for probability $p \in [0, 1]$ and an exponential distribution with parameter λ, the threshold denoting the p^{th} quantile of the distribution is $-\frac{1}{\lambda} ln(1 - p)$. That is, a random draw from the distribution would fall below $-\frac{1}{\lambda} ln(1 - p)$ precisely p percent of

the time. We assume that the probability p is given by $\exp\big(d(36 - r_i)\big)$. With $d < 0$ and $r_i \in [0, 36]$, $\exp\big(d(36 - r_i)\big) \in (0, 1]$. Assumption A6 sets the value of the bonus b_i as the threshold of the quantile distribution:

$$b_i = -\frac{1}{\lambda_i} \ln\Big(1 - \exp\big(d(36 - r_i)\big)\Big)$$

Hence, the probability that the reservation price is less than the bonus is $\exp(d(36 - r_i))$ and the probability that the reservation price exceeds the bonus is $1 - \exp(d(36 - r_i))$.[55] The parameter d is the exponential decay constant. Here, it may be interpreted as a measure of adverse selection in the sense that it connects the probability of accepting the bonus to the officer's RMST. In accordance with Assumption A3, λ_i tends toward infinity as the RMST tends toward 36 months, so that the reservation price tends toward a deterministic value of zero by L'Hopital's rule.

To compute each λ_i, we need values of r_i, b_i, and d. We observe r_i and b_i for each officer, so we need only find the value of d consistent with a 68 percent expected acceptance rate over all officers (Assumption A1). By Assumption A6 and the linearity of expectation, we can write Assumption A1 as:

$$\frac{1}{|N|} \sum_{i \in N} \exp(d(36 - r_i)) - 0.68 = 0$$

Note that the acceptance probability varies over officers. Officers with a relatively high RMST must have an acceptance probability above 68 percent, and vice versa. However, each officer's acceptance probability unambiguously decreases with d, so finding the value of d consistent with Assumption A1 is a simple root-finding exercise. We specify a beginning value for d, evaluate the left side of the above equation, then change d in the same direction as the result, repeating until the result is sufficiently close to zero.

D. Summary of Method

The following steps summarize our method:

1. Train the RPM-A machine learning models to forecast how long program-eligible officers would have served in the absence of the MOIP.
2. Impute the beginning month of the 36-month ADSO extension each officer would incur by accepting the MOIP.

[55] Assumption A6 specifies that $\exp(d(36 - r_i))$ gives an officer's probability of accepting their *assigned* bonus amount. This assumption implies that, all else equal, officer communities with different bonus amounts had the same expected acceptance rate. If the Army tailored bonus amounts to achieve equal acceptance rates for each community, this assumption is valid. In section 4.B.2, we show that our results are not sensitive to this assumption.

3. Use the trained RPM-A machine learning model to estimate how many of those 36 months each officer would have served in the absence of the MOIP.
4. Find a distribution of reservation prices consistent with the observed bonus acceptance rate of 68 percent and with adverse selection.
5. Repeatedly sample from the reservation price distribution to simulate the program many times.
6. Compute the mean cost per service-year gained and mean share of costs that were economic rent over all simulations.

Each step addresses a lack of information. Steps 1 and 3 address our lack of information about officers' counterfactual retention. Step 2 addresses our lack of information about the timing for the start of the additional ADSO if an officer were to accept the MOIP. Steps 4 and 5 address our lack of information about reservation prices. Steps 5 and 6 address our lack of information about who accepted the MOIP.

Some of this information would have been possible to collect, including ADSO timing and acceptance status. Our imputations of ADSO timing and simulations of acceptance status produce some error, but are unlikely to qualitatively impact our results. Both activities are grounded in proximate information. Our imputations of ADSO timing are grounded in our observation of commissioning sources and our knowledge of how commissioning sources map to ADSO durations. Our simulations of acceptance status are grounded in our observation of the overall acceptance rate and our knowledge that the overall acceptance rate is an unbiased estimate of the mean of acceptance probabilities over all officers.

On the other hand, counterfactual retention and the reservation price distribution are unobservable and do not follow a known process. Therefore, in estimating counterfactual retention and reservation price, we need to make some methodological choices that we cannot validate. To estimate counterfactual retention, we could have used any number of other statistical techniques, such as logistic regression. To estimate the reservation price distribution, we could have specified any number of other distributions with a non-negative support. We explore the results of alternative specifications in section 4.B.

Additionally, we do not measure officer quality, so we cannot measure any resulting variation across officers in the value of months gained. It may be that higher quality officers tend to have higher reservation prices due to greater career opportunities outside the military. In that case, the months gained by the MOIP would be served disproportionately by officers of lower quality. We also do not account for the indirect retention effects of the MOIP. For example, participating in the MOIP may have induced some officers to stay well beyond their incurred ADSO by moving them closer to retirement eligibility. We

underestimate months (and years) of service gained and overestimate cost per service year gained to the extent that the MOIP produced these types of secondary retention effects.

4. Findings

This section describes the outcomes of the MOIP simulation, together with a variety of sensitivity analyses.

A. Baseline Analysis

1. Expected Months Served

Figure 1 plots the distribution of restricted mean survival times (RMSTs), as estimated by the RPM-A over the ADSO extension period in the absence of the MOIP. That is, it plots the amount of the 36-month service obligation that officers would have likely served anyway. Officers are grouped according to the bonus amount for which they were eligible based on their accession career branch. The $35,000 bonus amount was most common, followed by $25,000, and then $30,000. For each bonus amount, RMST peaks between 33 and 34 months. Relatively few officers were expected to serve fewer than 24 months of the ADSO extension.

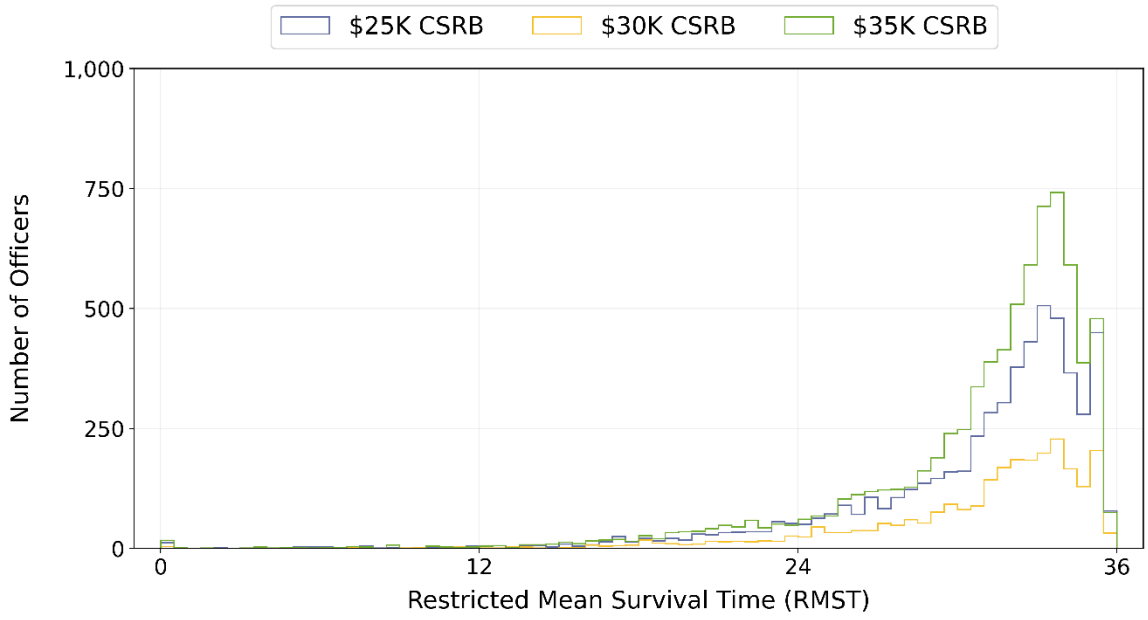

Figure 1. Predicted Restricted Mean Survival Time Distribution by Bonus Amount

2. Cost

We estimate the total cost of the MOIP bonuses as a calibration check for our methodology. The Army estimates that it paid $443.5 million in cash bonuses over the two phases of the program (September 2007 through November 2008), for an average bonus amount of $30,488.[56] Our aggregate cost estimate of $342.8 million differs from the actual cost for two reasons. First, as noted earlier, we limit our analysis to the cohort of officers eligible for the initial phase of the MOIP that ran from September to December 2007. Second, since we do not observe which officers participated in the program or the bonus amount paid to each individual, we simulate the MOIP and calculate the total bonus cost as the mean over thousands of simulations. An estimated 17,700 officers were eligible for the initial phase of the program. Assuming that 68 percent of eligible officers accepted an incentive, and 93 percent of participants choose the CSRB, that equates to 11,193 officers receiving an average bonus amount of about $30,626 (a difference of less than 0.5 percent from the Army's estimate).

3. Economic Rents and Years of Service Gained

We estimate that prior to program implementation, the Army could have expected to gain about 3,750 service years from CSRB-accepting officers. Dividing by our estimated bonus costs of $342.8 million implies a bonus cost per marginal service year gained of about $92,000. We estimate that the Army could have expected to pay 62 percent of these direct costs in economic rent. These results are summarized in Table 2.

Table 2. MOIP Simulation Outcome Estimates

Outcome Among the Studied Population	Estimate
Total bonus cost	$342.8M
Total years of service gained	3,750
Bonus cost per year of service gained	$92,000
Total rents paid	$213.1M
Share of costs that are rents	62.2%

The cost per service year gained exceeds the highest bonus amount of $35,000 because service years gained does not include the duration of the ADSO extension that an officer was expected to serve anyway. For example, suppose the Army could have expected a given officer to serve 30 months of the 36-month ADSO extension absent the MOIP. This officer's acceptance of a bonus entails 0.5 years gained. If the bonus amount was $35,000, the associated cost per year gained would be $35,000 / 0.5 = $70,000.

[56] GAO, *Cost-Effective Use of Financial Incentives,* 38.

The economic rent is necessarily a fraction of the bonus cost because reservation prices are non-negative, and an officer only accepts if the bonus exceeds their reservation price. For example, suppose we draw a reservation price of $14,000 for an officer offered a $35,000 bonus. The officer would accept the bonus in exchange for the ADSO because $35,000 is greater than $14,000. The rent is $21,000 (i.e., $35,000 - $14,000), or 60% of cost (i.e., $21,000 / $35,000). If we had drawn a reservation price of $40,000, the officer would not have accepted, and the rent would have been zero.

4. Implications of Adverse Selection

Having simulated the MOIP many times for each eligible officer, we can now illustrate how adverse selection can impair the cost effectiveness of broadly offered Army bonuses. Recall that we assumed a functional form for adverse selection and then fit a function of that form to an acceptance rate of 68 percent. Our assumption of adverse selection drives the results in this section. Therefore, the results we present in this section are not findings, but implications of adverse selection, assuming it exists.

Figure 2 shows the immediate implication of adverse selection: officers who would have served a greater number of months anyway have lower mean reservation prices.

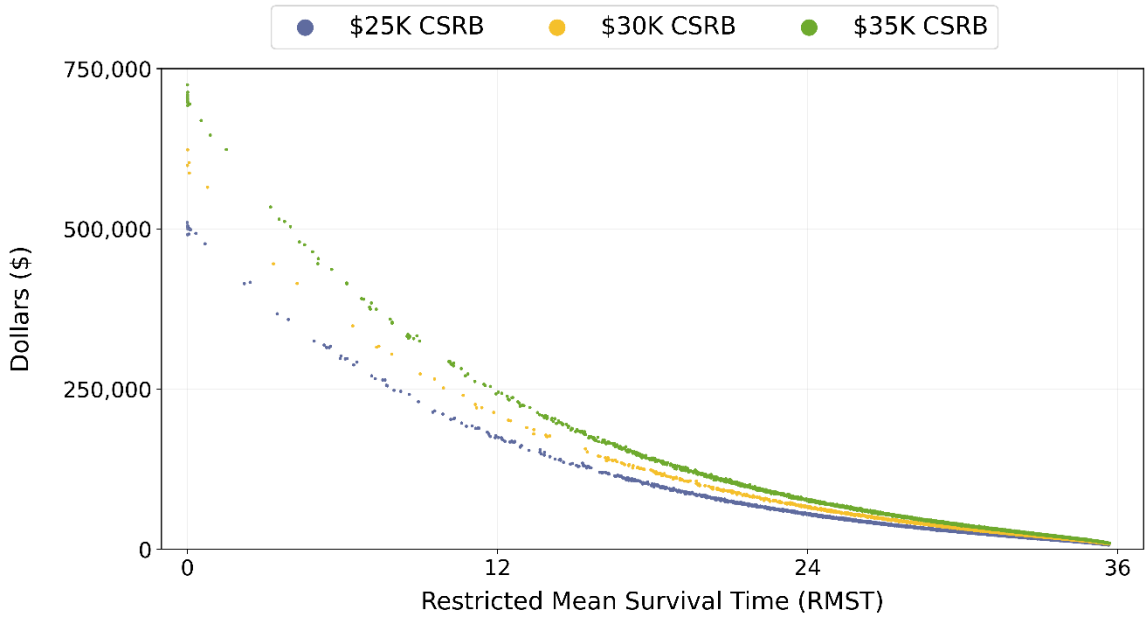

Figure 2. Officer Mean Reservation Price by Predicted RMST and Bonus Amount

Therefore, we should expect that bonuses accepted by officers who would have served longer anyway to produce higher mean economic rents. Figure 3 confirms this relationship;

each point represents the mean rent over our simulations for a specific officer, including simulations where the rent was zero because the officer did not accept the bonus.

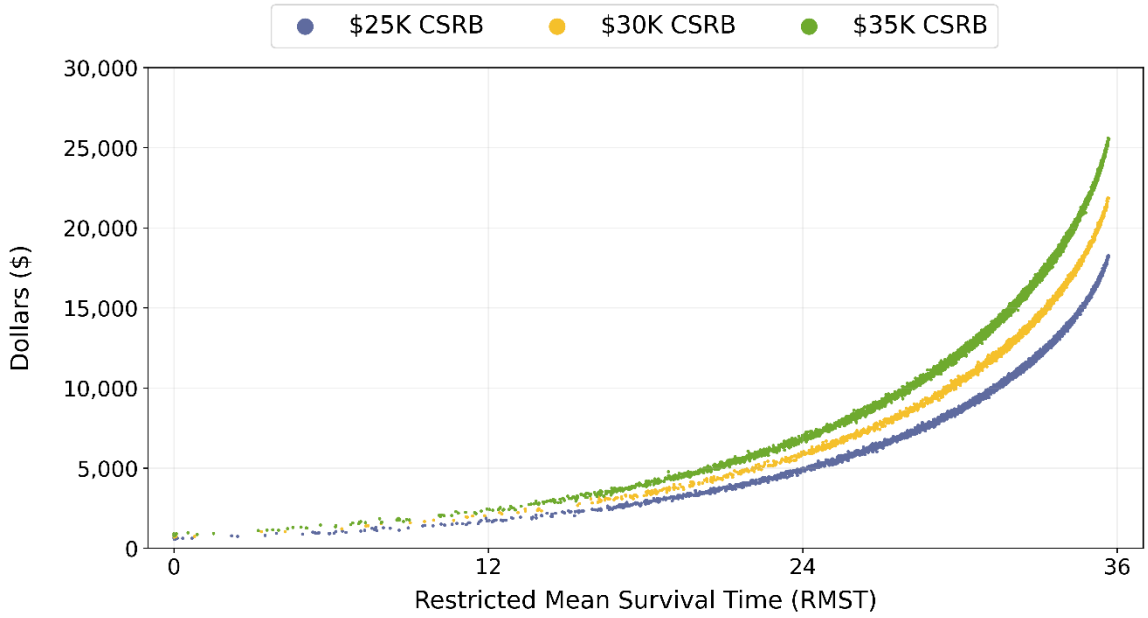

Figure 3. Officer Mean Economic Rent by Predicted RMST and Bonus Amount

Each point on the two plots represents an actual officer in our data. The left parts of the plots are sparse because very few officers could have been expected to serve so few months anyway (as shown in Figure 1). Figure 2 shows that an officer who would have served 24 months anyway would require roughly twice as large of a bonus, on average, as an officer who would have served 30 months anyway. This quantitative result depends on our assumptions about the extent of adverse selection and the distribution of reservation prices; we state it here only to assist in interpreting the figure.

Figure 4 summarizes and juxtaposes the information in the previous two figures. We bin officers by rounding each value of expected months served anyway to a whole number. Each point on the plot represents the mean over all officers in the given bin. Figure 4 emphasizes the inefficiency caused by adverse selection – the officers most likely to accept the CSRB are those who entail the greatest rents and the fewest months gained.

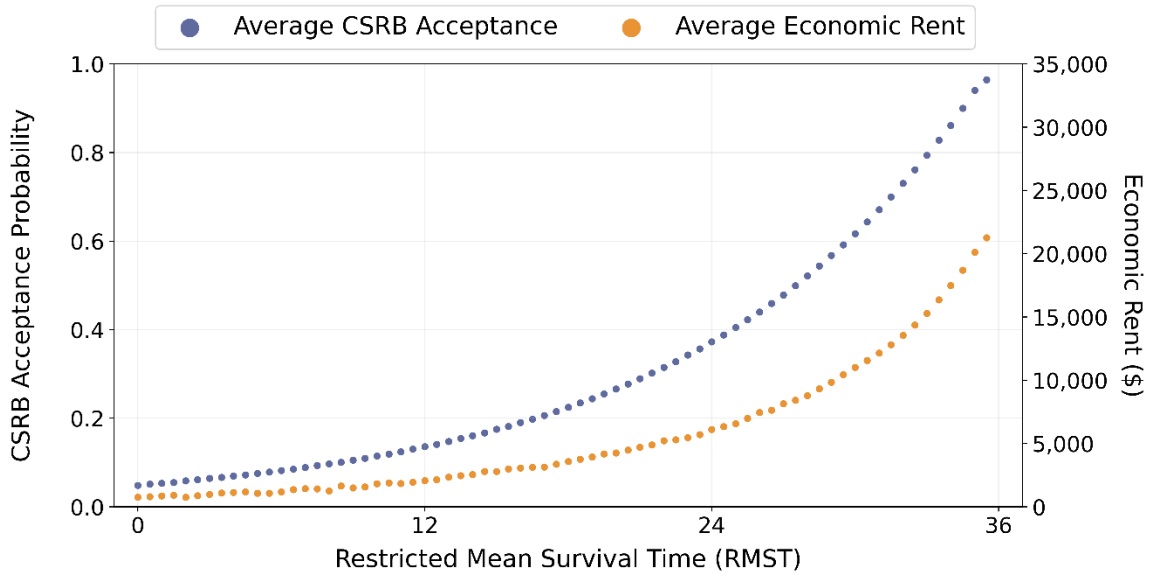

Figure 4. Mean Bonus Acceptance and Economic Rent by RMST

B. Sensitivity Analyses

Our analysis relies on two particularly strong, impossible-to-validate assumptions: that reservation prices are exponentially distributed (A5) and that the probability of acceptance increases exponentially with RMST (A6). In this section, we consider alternative assumptions. We have no information to evaluate which alternatives are more or less likely to be correct, but we can examine how sensitive our results are to those alternatives. We also explore how the overall acceptance share and our ADSO imputation choices affect the results.

1. The Functional Form of the Reservation Price Distribution

Assumption A5 specifies an exponential distribution for reservation prices. The exponential distribution is a special case of the gamma distribution with shape parameter α equal to one.[57] We can explore alternative shapes to the reservation price distribution by specifying gamma distributions with alternative values of α:

$$x_i \sim \Gamma(\alpha, \lambda_i)$$

As in our original specification, we wish to determine λ_i such that the probability of bonus acceptance is $\exp(d(36 - r_i))$. Doing so is as simple as replacing the negative

[57] For a shape parameter α, the gamma distribution can be interpreted as the additive sum of taking α independent draws from α different exponential distributions (each exponential distribution having the same shape parameter). However, α may be any positive number and not just an integer.

logarithm function in Assumption A6 with the inverse to the lower incomplete gamma function ("Q^{-1}").

$$\lambda_i(r_i, b_i; d) = \frac{1}{b_i} Q^{-1}(\alpha,\ \exp(d(36 - r_i))).$$

Note that the probability of acceptance remains a function of the RMST and the extent of adverse selection, neither of which depend on α. Therefore, cost and months gained do not change with α. Rather, α affects the spread of reservation prices on each side of the bonus amount. As α increases, reservation prices under the bonus amount concentrate closer to the bonus amount, leading us to estimate lower mean rents. We bound α with the following additional assumption:

A7. Reservation prices can approach zero

$$x_i \sim \text{ such that (10th percentile value / 1st percentile value)} > 2 \text{ and}$$
$$\text{such that 0 is within 3 standard deviations of the mean}$$

Although reservation prices at or near zero could technically be within the support of a distribution, they may be highly unlikely. Assumption A7 helps to ensure that reservation prices near zero are feasible in practice. The primary purpose of A7 is to prevent a precipitous jump between the average reservation price for an RMST that is slightly under 36 months (say 35.9 months) and the reservation price of zero for an RMST of 36 months. Such precipitous jumps can occur if the distribution is mostly vacant between zero and a larger reservation price. The first condition requires the 10th percentile reservation price value to be at least twice the value of the 1st percentile reservation price. For many distributions that have a lower bound of zero, this is sufficient to ensure that the lower end of the distribution is spread out sufficiently to prevent much of a vacant gap in the distribution near zero.[58] The second condition tethers the mean of the distribution to no more than three standard deviations above zero.[59]

Figure 5 plots the relationship between our assumed value of α and our mean estimate of the share of costs that are rents. The point at $\alpha = 1$ represents the result of our original specification. By increasing α up to 4.5, we can estimate rent shares as low as 39 percent.[60]

---

[58] For instance, among distributions with non-negative values, this condition permits all distributions that have a strictly decreasing probability density function (PDF), such as the exponential distribution; the uniform distribution, which has a flat PDF; and a variety of right skew distributions, such as a gamma distribution with a shape parameter below 4.5 or a Weibull distribution with a shape parameter below 3.3 (for either the gamma or the Weibull distribution, the scale parameter has no impact on this condition). The ratio of the 10th percentile value to the 1st percentile value is 10 in the uniform distribution and greater than 10 in distributions with strictly decreasing PDFs.

[59] This condition rules out distributions that have a sufficiently wide spread between the 1st and 10th percentile values, but are far enough away from zero to make bids near zero highly anomalous.

[60] Values of α above 4.5 severely restrict the amount of mass in the distribution near zero and violate Assumption A7.

By decreasing α to as low as 0.225, we can estimate rent shares as high as 84 percent. The range of values we consider is arbitrary; by considering more extreme values we could obtain more extreme rent shares. Figure 5 illustrates that our results are entirely sensitive to the shape of the distribution of reservation prices.

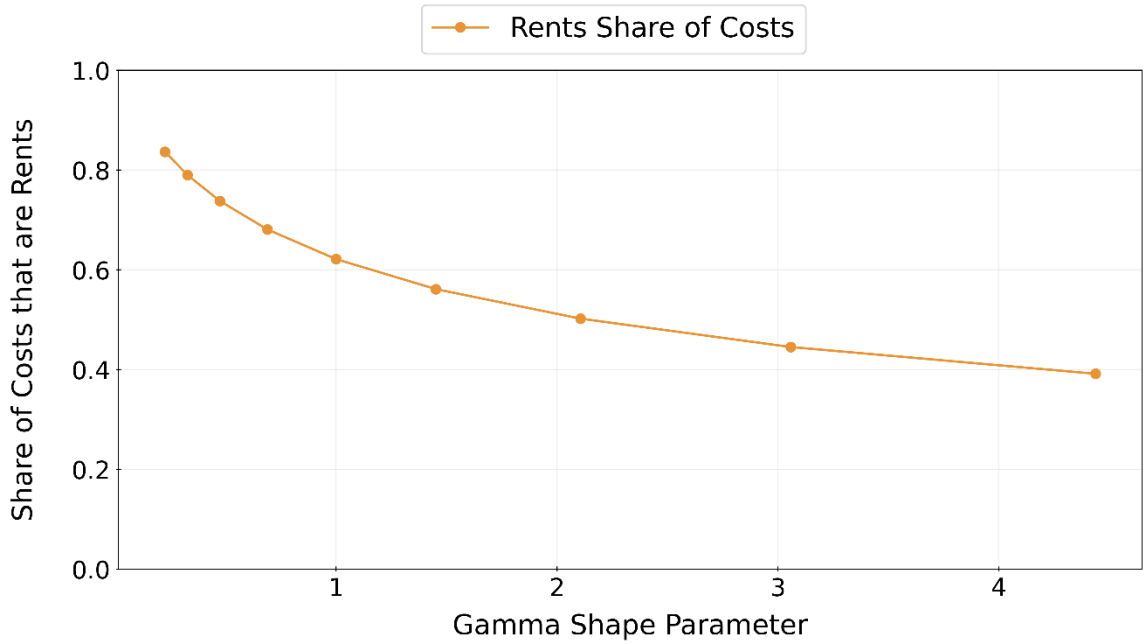

Figure 5. Sensitivity of Rents to Shape Parameter of Reservation Price Distribution

The spread of reservation prices around the bonus amount also affects the responsiveness of an individual's probability of acceptance to a change in the assigned bonus amount. For gamma shape parameter values ranging from 0.225 to 4.5, we calculate a point elasticity of acceptance relative to an instantaneous change in the assigned bonus amount for each individual. We then calculate the mean elasticity over all individuals and plot the elasticity by gamma shape parameter in Figure 6.

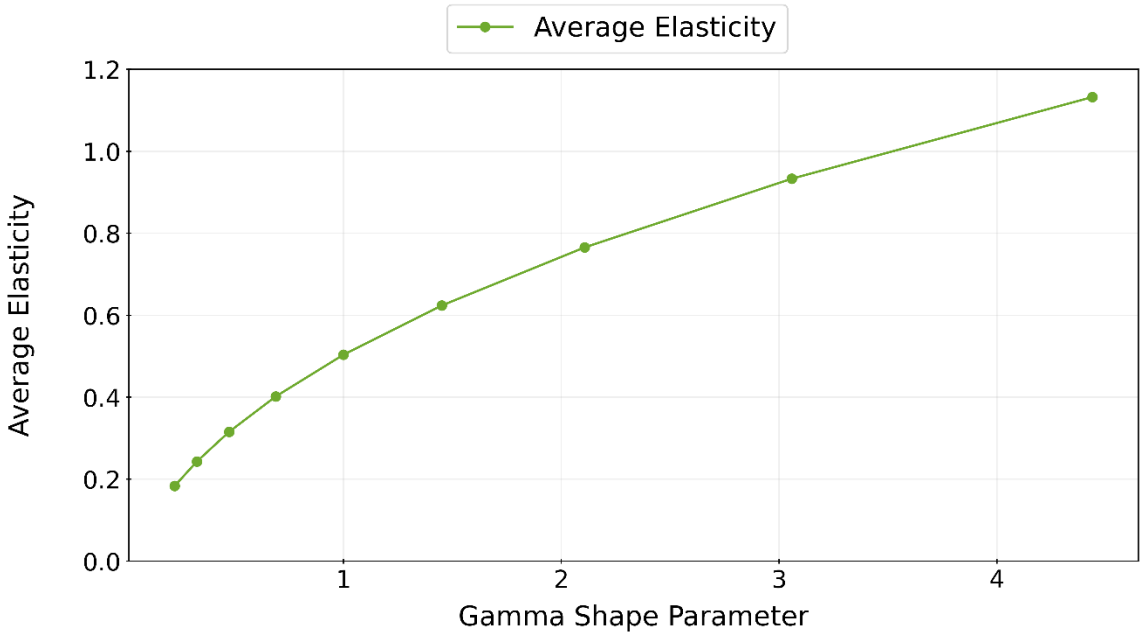

Figure 6. Average Elasticity Implied by Shape Parameter of Reservation Price Distribution

Under our original specification of exponentially distributed reservation prices (i.e., gamma shape parameter $\alpha = 1$), we calculate an average elasticity of about 0.50. In other words, a one percent increase in the assigned bonus amount for all individuals would result in a 0.5 percent increase in the overall acceptance probability. Evaluated at a baseline of 68 percent acceptance, a one percent increase in the bonus amount would increase the overall acceptance probability by 0.34 percentage points.

As an alternative to the exponential or gamma distributions, we could specify that reservation prices follow the uniform distribution with a lower bound of zero. Then we could solve for each officer's upper bound the same way we solve for each λ_i: letting the quantile $\exp(d(36 - r_i))$ be the bonus amount. In that case, we need not conduct any simulations to know that the rent would be one-half the cost, on average. To see this, note that the distribution of reservation prices conditional on acceptance of a bonus b is uniform with bounds $[0, b]$. In other words, a truncated uniform distribution is itself uniform. The expected value of that truncated distribution is $b/2$, or one-half the amount of the bonus.

2. The Relationship Between Acceptance Probability and Bonus Amount

Assumption A6 specifies that $\exp(d(36 - r_i))$ gives an officer's probability of accepting their *assigned* bonus amount. This assumption implies that, all else equal, officer communities with different bonus amounts have the same expected acceptance rate. If the Army tailored bonus amounts to achieve equal acceptance rates for each community, this assumption would be appropriate. For example, perhaps the Army offered a $35,000 bonus to aviation officers because those officers were less likely than other officers to accept a

given amount. However, if the Army tailored bonus amounts to achieve different acceptance rates in different communities, or if bonus amounts differed for reasons unrelated to the acceptance rate, our assumption would not be appropriate. If the probability of acceptance does not vary across *assigned* bonus amounts, then $\exp(d(36 - r_i))$ should give the probability of accepting not the assigned bonus amount, but a *constant* bonus amount. We replace b_i with a constant $\bar{b}$ in Assumption A6, then solve for the value of $\bar{b}$ ($30,193) that reproduces the actual overall acceptance rate as the mean acceptance rate across simulations. Under this alternative assumption, communities assigned a higher bonus have higher mean acceptance rates.

Table 3 reports our results under our alternative assumption, along with our original results from Table 2. Our results under our alternative assumptions are qualitatively similar to our original assumptions, with a 0.4 percentage point increase in the share of costs that are rents.

Table 3. Outcome Estimates by Assumed Relationship Between Acceptance Rate and Bonus Amount

Outcome Among the Studied Population	Equal Mean Acceptance Rates Given Assigned Bonuses	Equal Mean Acceptance Rates Given Equal Bonuses
Total bonus cost	$342.8M	$346.3M
Total years of service gained	3,750	3,750
Bonus cost per year of service gained	$92,000	$93,000
Total rents paid	$213.1M	$216.6M
Share of costs that are rents	62.2%	62.6%

Figure 7 shows the results of conducting our shape parameter sensitivity analysis under our alternative assumption of equal mean acceptance rates under equal bonuses. For $\alpha < 1$, our rent share estimates are practically unchanged. For $\alpha > 1$, our rent estimate is higher under our alternative assumption, but not by more than one percentage point, even for $\alpha = 4.5$. We conclude that our results are not sensitive to the relationship between bonus amount and the probability of accepting a given bonus.

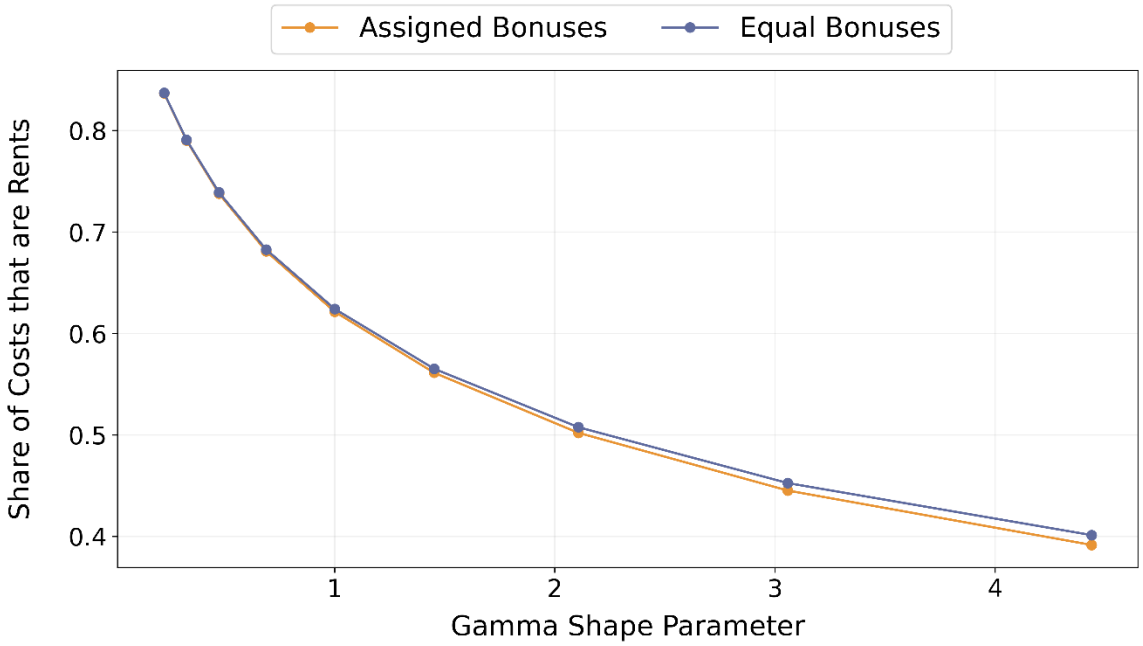

Figure 7. Sensitivity of Rent Share of Costs to Shape Parameter of Reservation Price Distribution and Assumed Relationship Between Acceptance Rate and Bonus Amount

3. Overall Acceptance Share

In our main specification, we fit officers' individual reservation price distributions to achieve an overall acceptance rate of 68 percent. However, prior to implementation, the Army apparently expected that as many as 80 percent of eligible officers would participate in the program.[61] Both program design and external factors could account for differences between actual and expected acceptance rates. Table 4 reports estimated outcomes for the MOIP program under various overall acceptance rates (holding constant all other aspects of the analysis).

[61] Piper, *Improving Retention,* 1.

Table 4. Outcome Estimates under Various Expected Acceptance Rates

Outcome Among the Studied Population	Expected Overall Acceptance Rate					
	60%	64%	68%	72%	76%	80%
Total bonus cost ($M)	302.5	322.7	342.8	363.0	383.1	403.3
Total years of service gained	3,050	3,350	3,750	4,100	4,500	4,950
Bonus cost per year of service gained ($k)	100	96	92	88	85	82
Total rents paid ($M)	183.3	197.9	213.1	228.9	245.6	263.4
Share of costs that are rents (%)	60.6	61.3	62.2	63.1	64.1	65.3

Relative to the actual 68 percent acceptance rate, the cost per service-year gained decreases by about $10,000 for an 80 percent acceptance rate ($82,000 per year gained instead of $92,000). Given our assumptions, the direction of this change is intuitive: higher overall acceptance rates indicate that the program is enrolling more individuals who would have served less time absent the MOIP. These individuals generate more service years gained for the Army, so the cost per service year gained decreases.

4. ADSO Extension Start Date

We do not observe when Army Human Resources Command (HRC) approved individual contracts, nor do we observe the distribution of contract approvals over the initial program implementation period (from September to December 2007). Therefore, we impute an ADSO extension start date of November 15, 2007, for the 81.8 percent of eligible officers who had already fulfilled their accession source ADSO. However, participants could submit their paperwork any time between September 13, 2007, and December 14, 2007. Allowing two weeks to account for the time required for HRC to approve the contracts, we report the sensitivity of our results to various minimum ADSO extension start dates in Table 5.

Table 5. Outcome Estimates under Various Minimum ADSO Extension Start Dates

Outcome Among the Studied Population	Minimum ADSO Extension Start Date[62]		
	1 Oct. 2007	15 Nov. 2007	1 Jan. 2008
Total bonus cost	$342.8M	$342.8M	$342.9M
Total years of service gained	3,550	3,750	4,050
Bonus cost per year of service gained	$96,000	$92,000	$84,000
Total rents paid	$213.4M	$213.1M	$212.5M
Share of costs that are rents	62.2%	62.2%	62.0%

Extending the minimum ADSO extension start date to January 1, 2008, for all MOIP participants increases the total service years gained by about 8 percent, and reducing it to October 1, 2007, for all participants decreases service years gained by about 6 percent (each of these month-and-a-half changes is equal to roughly 12 percent of a year). Total bonus costs remain relatively constant, and cost per service year ranges by about $12,000 (from $96,000 down to $84,000).

5. Non-Statutory ADSOs

We do not observe non-statutory ADSOs that officers incur through PCS or military training. Rather than attempting to impute these ADSOs for each officer in our data, we run additional simulations under the assumptions that (1) all officers incur a fixed-length, non-statutory ADSO immediately prior to when their MOIP contract is approved by Army HRC, and (2) this non-statutory ADSO is served sequentially (rather than concurrently) with the MOIP-induced ADSO.[63] This (extreme) scenario provides an upper bound for the effect of our decision not to impute non-statutory ADSOs.[64] Based on the ADSO durations enumerated for various types of permanent change of station and military training in Army Regulation 350-100,[65] we run the simulations with 1-year, 2-year, and 3-year non-statutory ADSOs, and report the results in Table 6.

---

[62] This date is used for the 81.8 percent of eligible officers who had fulfilled their accession source ADSO before this date. For the remaining officers, their MOIP-induced ADSO extension starts upon completion of their accession source ADSO.

[63] Based on the language of the MOIP contract (see footnote 50). Non-statutory ADSOs are typically served concurrently with statutory ADSOs (see footnote 49).

[64] Note that officers who have a statutory ADSO that exceeds the fixed-length, non-statutory ADSO still need to fulfill their statutory ADSO before starting the MOIP-induced ADSO.

[65] Department of the Army, *Officer Active Duty Service Obligations (2007)*, 7-8.

Table 6. Outcome Estimates under Various Fixed-Length, Non-Statutory ADSOs

Outcome Among the Studied Population	Statutory ADSO (baseline)	Additional Non-Statutory ADSO[66]		
		1-Year	2-Year	3-Year
Total bonus cost	$342.8M	$342.8M	$342.8M	$342.7M
Total years of service gained	3,750	6,000	7,800	9,600
Bonus cost per year of service gained	$92,000	$57,000	$44,000	$36,000
Total rents paid	$213.1M	$210.2M	$208.6M	$207.4M
Share of costs that are rents	62.2%	61.3%	60.9%	60.5%

We do not include the non-statutory ADSO period in the calculation of total service years gained. Extending the MOIP-induced ADSO window further into the future means that officers are less likely to serve through that window absent the MOIP. The median RMST over the MOIP ADSO window in the baseline analysis is 32.2 months; it decreases to 29.5 months for the 1-year additional ADSO scenario, 27.4 months for the 2-year scenario, and 25.3 months for the 3-year scenario. This change in RMST drives the increase in the total service years gained and the decrease in the cost per service year gained.

[66] Incurred immediately prior to contract approval (i.e., November 15, 2007) and served concurrently with existing statutory (e.g., commissioning source) ADSOs.

This page is intentionally blank.

5. Conclusions and Recommendations

The Army implemented the MOIP during a wartime crisis of high deployment when it simultaneously faced a critical shortage of mid-career officers. The Army does not currently face the crisis of high deployment, and its shortage of mid-career officers is considerably smaller. However, the Army still loses a sizeable fraction of its high-performing officers, resulting in a less competitive promotion process from captain to major and a subsequent shortage of higher-quality majors. This quality shortfall has both immediate and future performance costs to the Army. The Army has long-employed a strategy of over-accessing second lieutenants to increase the probability that a sufficient number will be retained as mid-career officers.[67] However, this strategy is quite expensive. The cost of providing an elite four-year education – together with training, housing, meals, and other expenses – to cadets at the U.S. Military Academy (USMA) is considerable.[68] The cost to commission an officer through the Reserve Officers' Training Corps (ROTC) is less expensive, but still significant.[69] Pre-commissioning costs are only one part of the equation. They do not include the cost of formal military training that officers receive after commissioning, nor do they reflect the significant investment of time and energy that senior officers make in early-career officers through mentoring and informal on-the-job training. Over-accessing officers also creates a crowding-out effect for the limited number of opportunities that early-career officers have to gain meaningful, operational experience.[70]

A more cost-effective strategy for retaining officers through promotion to major may be to offer additional incentives as officers near the end of their initial ADSO. The Army

---

[67] The practice of over-accessing second lieutenants goes back to at least the late 1990s. See Wardynski et al., "Towards a U.S. Army Officer Corps Strategy for Success: Retaining Talent," 6.

[68] Nearly two decades ago, the GAO reported that the average cost to commission an officer through the U.S. Military Academy was roughly $350,000 (an amount equivalent to more than $500,000 in 2021 dollars). See GAO, *Military Education: DoD Needs to Enhance Performance Goals and Measures to Improve Oversight of Military Academies*, 8.

[69] As of FY2012, the GAO estimated the average cost per ROTC cadet at $68,000 (about $80,000 in 2021 dollars) plus tuition expenses, which can be well above $100,000 in some cases. See GAO, *Military Personnel: Actions Needed to Improve Evaluation and Oversight of Reserve Officers' Training Corps Programs,* 17. See also, Cheryl Phillips, "ROTC Scholarship Helps Students Pay for College" 24 June 2020, https://www.army.mil/article/236736.

[70] Wardynski et al. (2010) document the decreased developmental opportunities available to lieutenants due to over-accession.

currently offers a few broad incentives to retain officers through that critical retention point. The Army Career Satisfaction Program allows USMA and ROTC cadets to request their branch or duty station of choice at the time of commissioning in exchange for an additional three-year ADSO.[71] The Post-9/11 GI Bill provides substantial education benefits to service members who have served on active duty; service members are fully vested after three years of active service.[72] Additionally, the significant retirement benefits offered to service members at 20 years of service (both under the legacy High-3 plan and the new Blended Retirement System) may entice some individuals to serve a full career in the Army. However, the combination of these incentives is still not enough to retain a sufficient number of high-quality, early-career officers to the rank of major.

Flexible and targeted retention programs have the potential to significantly improve the Army's ability to retain officers. Incentives in the form of direct compensation, additional career flexibility, development and training opportunities, and quality of life benefits could appeal to a wide range of service members with different preferences, career goals, and family situations. However, the Army implemented the 2007 MOIP without establishing a framework for assessing its return on investment and did not differentiate between high and low performers for determining incentive eligibility.[73]

The Army should seek to understand its return on investment from different retention incentives, as well as how that return on investment differs by the skills and characteristics of individuals that the Army is attempting to retain. Understanding its return on investment would enable the Army to make more appropriate and expeditious use of its limited retention resources so that it can preempt retention crises.

A primary scientific method for understanding the return on investment (ROI) from various retention incentives is to conduct a controlled trial, in which retention incentives are offered in a manner uncorrelated with officers' characteristics. Conducting trials where some officers are randomly selected to receive a retention intervention (and others are randomly not selected) enables a cause and effect framework for assessing how intervention actually impacts retention.[74] With that information, the Army could better

---

71 The graduate school option was discontinued in FY2014 (see section 2.A).

72 See, for example, U.S. Department of Veterans Affairs, "Post-9/11 GI Bill (Chapter 33)," https://www.va.gov/education/about-gi-bill-benefits/post-9-11/.

73 Assuming that higher performers, on average, have more attractive career opportunities outside the military (relative to their lower-performing peers), not differentiating based on quality further exacerbates the adverse selection of those who accept retention incentives. Not only will incentives be accepted disproportionately by those who are likely to stay anyway, but the average quality of individuals accepting the incentive may be lower than the average quality of those who are offered the incentive.

74 Researchers have used natural experiments involving choices among compensation alternatives to understand how service members trade off future versus current earnings. Warner and Pleeter (2001)

determine when and how to use various incentives in the future to achieve its retention goals.

Additionally, the Army could take several smaller steps to enable analyses of the ROI of various incentives. First, it could develop a comprehensive plan to collect and archive detailed data about eligibility, participation, and outcomes for any future retention programs. Ideally, the data would include longitudinal, disaggregated (i.e., person-level) records that would allow researchers to investigate the relationship between program participation, job performance, and retention over the course of an individual's career. Measures of job performance are important for understanding the quality of individuals that are being retained. Second, the Army could develop the capability to simulate the expected outcomes of a retention program prior to implementation (similar to the analysis in this paper), and then compare the simulated results against the actual outcomes. Richer structural models can capture critical aspects of individuals' decision-making processes to approximate the impact of potential future policies on retention and other personnel outcomes. This exercise would allow the Army to validate its assumptions about the retention effects and ROI of each incentive option, and use that information to design better programs in the future.

Finally, the Army should develop a framework for identifying the officers it would most like to retain based on quality. This type of framework would improve the return on investment of any retention incentive and enable the Army to better retain individuals who are most likely to have a positive impact on their subordinates, units, and the organization as a whole. The Army should carefully consider how to identify qualified individuals in an equitable manner; as a starting point, the quality measures used within this framework should be multidimensional, holistic, and forward-looking (e.g., assessing the officer's ability to perform the duties of the next rank to which he or she would be promoted). Targeting retention incentives based on quality would enable the Army to make more effective use of its limited financial resources to develop a high-quality force.

estimate personal discount rates for more than 60,000 service members who were offered the choice between a lump-sum payment and an annuity in exchange for voluntary separation during the U.S. military drawdown in the early 1990's. Similarly, Curtis, Warner, and Pleeter (2015) estimate personal discount rates for service members choosing between two retirement plan options in their 15th year of service (and who were not facing separation at the time of their decision). However, these studies did not look at the effect of various compensation alternatives on retention specifically.

This page is intentionally blank.

Appendix A.
Illustrations

Tables

Figures

This page is intentionally blank.

Appendix B.
References

Army Human Resources Command. “Army Offers Renewed Incentives for Captains to Stay.” April 15, 2008. https://www.army.mil/article/8506.

Army Human Resources Command. “Captains Now Eligible for $25K Retention Bonus.” September 13, 2007. https://www.army.mil/article/4848.

Borgschulte, Mark and Paco Martorell. “Paying to Avoid Recession: Using Reenlistment to Estimate the Cost of Unemployment.” *American Economic Journal: Applied Economics* 10, no. 3 (July 2018): 101-127. https://www.aeaweb.org/articles?id=10.1257/app.20160257.

Chollet, Francois. *Deep Learning with Python*. New York: Manning Publications Co., 2nd edn, 2020. https://livebook.manning.com/book/ deep-learning-with-python-second-edition/v-4/.

Coates, Hunter R., Teresa S. Silvernail, Lawrence V. Fulton, and Lana Ivanitskaya. "The Effectiveness of the Recent Army Captain Retention Program." *Armed Forces & Society* 37, no. 1 (2011): 5-18. https://doi.org/10.1177/0095327X10372599.

Department of the Army. *Officer Active Duty Service Obligations*. Army Regulation 350-100. Washington, DC: Department of the Army Headquarters, August 2007.

Department of the Army. *Officer Active Duty Service Obligations*. Army Regulation 350-100. Washington, DC: Department of the Army Headquarters, September 2017.

Department of the Army. *Implementation of the Army Officer Menu of Incentives Program (Regular Army).* MILPER 07-237. Alexandria, VA: Army Human Resources Command, September 2007.

Department of the Army. *Expansion of the Army Officer Menu of Incentives Program (Regular Army).* MILPER 07-350. Alexandria, VA: Army Human Resources Command, December 2007.

Department of the Army. *(Updated) FY 2008/2009 Officer Menu of Incentives Program (Regular Army).* MILPER 08-093. Alexandria, VA: Army Human Resources Command, April 2008.

Department of the Army. “Career Satisfaction Program.” Accessed August 30, 2021. https://www.career-satisfaction.army.mil/index.html.

Department of the Army. “Post-9/11 GI Bill.” Accessed August 27, 2021. https://www.armyg1.army.mil/post911gibill.asp.

Deryugina, Tatyana, Garth Heutel, Nolan H. Miller, David Molitor, and Julian Reif. "The Mortality and Medical Costs of Air Pollution: Evidence from Changes in Wind Direction." *American Economic Review* 109, no. 12 (December 2019): 4178-4219. https://www.aeaweb.org/articles?id=10.1257/aer.20180279.

Executive Order 12728. *Delegating the President’s Authority to Suspend any Provision of Law Relating to the Promotion, Retirement, or Separation of Members of the Armed Forces.* Washington, DC, August 1990.

Fricker, Ronald D., Jr. *The Effects of Perstempo on Officer Retention in the U.S. Military.* Santa Monica, CA: RAND Corporation, 2002.

Gates, Robert M. “Utilization of the Total Force.” Official memorandum. Washington, DC: Department of Defense, January 2007.

Government Accountability Office. *Military Education: DoD Needs to Enhance Performance Goals and Measures to Improve Oversight of Military Academies.* GAO-03-1000. Washington, DC, September 2003.

Government Accountability Office. *Military Personnel: DoD Needs to Address Long-term Reserve Force Availability and Related Mobilization and Demobilization Issues.* GAO-04-1031. Washington, DC, September 2004.

Government Accountability Office. *Military Personnel: Strategic Plan Needed to Address Army’s Emerging Officer Accession and Retention Challenges.* GAO-07-224. Washington, DC, January 2007.

Government Accountability Office. *Military Personnel: Army Needs to Focus on Cost-Effective Use of Financial Incentives and Quality Standards in Managing Force Growth*. GAO-09-256. Washington, DC, May 2009.

Government Accountability Office. *Military Personnel: Actions Needed to Improve Evaluation and Oversight of Reserve Officers’ Training Corps Programs.* GAO-14-93. Washington, DC, November 2013.

Henning, Charles A. *Army Officer Shortages: Background and Issues for Congress.* CRS Report No. RL33518. Washington, DC: Congressional Research Service, July 2006.

Henning, Charles A. *U.S. Military Stop Loss Program: Key Questions and Answers.* CRS Report No. R40121. Washington, DC: Congressional Research Service, July 2009.

Johnson, Stuart E., John E. Peters, Karin E. Kitchens, Aaron Martin, and Jordan R. Fischbach. *A Review of the Army's Modular Force Structure.* Santa Monica, CA: RAND Corporation, 2012.

Ladner, Justin. "Estimating Occupation-Specific Civilian Outside Options for Military Personnel." Official memorandum. DSA-2018-U-018274-Final. Arlington, VA: CNA,

Oberle, William. *Monte Carlo Simulations: Number of Iterations and Accuracy.* Aberdeen Proving Ground, MD: Army Research Lab, Weapons and Materials Research Directorate, July 2015. https://apps.dtic.mil/sti/pdfs/ADA621501.pdf.

O*NET OnLine. "Military Crosswalk Search." Accessed August 26, 2021. https://www.onetonline.org/crosswalk/MOC/.

Phillips, Cheryl. "ROTC Scholarship Helps Students Pay for College." June 24, 2020. https://www.army.mil/article/236736/rotc_scholarship_helps_students_pay_for_college.

Piper, Samuel T., III. *Improving Retention under the US Army's Captain Incentive.* Carlisle Barracks, PA: U.S. Army War College, March 2008. https://apps.dtic.mil/sti/pdfs/ADA478578.pdf.

Simon, Curtis J., John T. Warner, and Saul Pleeter. "Discounting, Cognition, and Financial Awareness: New Evidence from a Change in the Military Retirement System." *Economic Inquiry* 53, no. 1 (January 2015): 318-334. https://doi.org/10.1111/ecin.12146.

Title 10 U.S. Code § 610. *Eligibility for Consideration for Promotion: Time-in-Grade and Other Requirements.* https://www.law.cornell.edu/uscode/text/10/619.

Title 10 U.S. Code § 12305. *Authority of President to Suspend Certain Laws Relating to Promotion, Retirement, and Separation.* https://www.law.cornell.edu/uscode/text/10/12305.

Warner, John T., and Saul Pleeter. "The Personal Discount Rate: Evidence from Military Downsizing Programs." *American Economic Review* 91, no. 1 (March 2001): 33-53. https://www.aeaweb.org/articles?id=10.1257/aer.91.1.33.

Wales, Andrea. "Grad-School Option Chosen as Cadet must be Scheduled when Selected for Captain." August 8, 2012. https://www.army.mil/article/85204.

Wardynski, Casey, David S. Lyle, and Michael J. Colarusso, "Towards a U.S. Army Officer Corps Strategy for Success: Retaining Talent," Carlisle Barracks, PA: U.S. Army War College, Strategic Studies Institute, January 2010.

This page is intentionally blank.

Appendix C.
Acronyms

ADF	Defense Manpower Data Center Active Duty Family File
ADM	Defense Manpower Data Center Active Duty Master File
ADP	Defense Manpower Data Center Active Duty Pay File
ADSO	Active Duty Service Obligation
BAH	Basic Allowance for Housing
BAS	Basic Allowance for Subsistence
BCT	Brigade Combat Team
BRADSO	Branch of Choice for Active Duty Service Obligation Program
COLA	Cost of Living Allowance
CSP	Career Satisfaction Program
CSRB	Critical Skills Retention Bonus
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DoDI	Department of Defense Instruction
EGSP	Expanded Graduate School Program
FIFE	Finite-Interval Forecasting Engine
FY	Fiscal Year
GAO	Government Accountability Office
GRADSO	Graduate School Option for Active Duty Service Obligation Program
HRC	Human Resources Command
IDA	Institute for Defense Analyses
IRR	Individual Ready Reserve
MOIP	Menu of Incentives Program
OCS	Officer Candidate School
OEF	Operation Enduring Freedom
OHA	Overseas Housing Allowance
OIF	Operation Iraqi Freedom
PADSO	Post of Choice for Active Duty Service Obligation Program

PCS	Permanent Change of Station
PDF	Probability Density Function
RMST	Restricted Mean Survival Time
ROI	Return on Investment
ROTC	Reserve Officers' Training Corps
RPM-A	Retention Prediction Model - Army
TAPDB	Total Army Personnel Database
TOPMIS	Total Officer Personnel Management Information System
USMA	United States Military Academy

REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. REPORT DATE (DD-MM-YY)	2. REPORT TYPE	3. DATES COVERED (From – To)
XX-11-2021	Final	

4. TITLE AND SUBTITLE

Assessing the Economic Efficiency of the 2007 U.S. Army Menu of Incentives Program

5a. CONTRACT NO.

HQ0034-14-D-0001

5b. GRANT NO.

5c. PROGRAM ELEMENT NO(S).

6. AUTHOR(S)

Julie Lockwood
James Bishop
Alan Gelder
Christopher Oswald

5d. PROJECT NO.

5e. TASK NO.

BE-6-4810

5f. WORK UNIT NO.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Institute for Defense Analyses
4850 Mark Center Drive
Alexandria, VA 22311-1882

8. PERFORMING ORGANIZATION REPORT NO.

IDA Paper P-22820
Log: H 21-000348

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

USD(P&R)
1400 Defense Pentagon,
Arlington, VA 22202

10. SPONSOR'S / MONITOR'S ACRONYM(S)

USD(P&R)

11. SPONSOR'S / MONITOR'S REPORT NO(S).

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

In 2007, the U.S. Army implemented the Menu of Incentives Program (MOIP) to improve retention of Army captains. Eligible officers could select one of five incentive options in exchange for a non-concurrent Active Duty Service Obligation (ADSO). More than 90 percent of participants chose the Critical Skills Retention Bonus (CSRB), which entitled the officer to a payment of $25,000 to $35,000 in exchange for a three-year service obligation. In this paper, Institute for Defense Analyses researchers estimate the total number of service years the Army could have expected to gain from the MOIP prior to program implementation, as well as the share of total bonus costs the Army could have expected to pay in economic rent. We define economic rent as bonus costs in excess of accepting individuals' reservation prices. Since we are interested in the causal marginal impact of the MOIP on officer retention behavior, we estimate the number of months each officer would have served absent the MOIP using the Retention Prediction Model-Army (RPM-A). Our analyses suggest that the Army paid about $92,000 in bonuses per year of service gained, and that about 62 percent of the program's direct costs were in economic rents. We suggest several steps the Army can take to better understand the return on investment of various retention incentives.

15. SUBJECT TERMS

Retention Incentive, Bonus, Economic Rent, Menu of Incentives, Adverse Selection, Retention Prediction Model – Army, Service Obligation, Reservation Price, Survival Analysis

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NO. OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			LTC Kristin Saling
U	U	U	U	62	19b. TELEPHONE NUMBER (Include Area Code) 703-692-1407

This page is intentionally blank.