I Want You! (But Not You): Selection in Military Retention *

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Abstract

Government workers provide essential goods and services, but how do public sector compensation policies shape workforce quality? We expand the existing literature, which has focused on compensation levels, by studying how the structure of retention incentives affects employee quality in the U.S. military. Combining administrative data with quasi-random policy variation, we find that low-ability soldiers are relatively more responsive to both lump-sum bonuses and early retirement benefits, and both effects are large enough to affect the organization's average ability level. We provide suggestive evidence that neither access to credit nor differences in personal discount rates explain these selection patterns.

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1 Introduction

The public sector is a large and important part of the economy. Approximately 15% of U.S. workers are employed by the federal, state, or local governments, and the public sector also produces public goods that are key to economic growth and societal well-being. Existing studies document the impact of public sector worker quality on a variety of important public sector outputs including education (Chetty et al., 2014), nursing (Aiken et al., 2003), law enforcement (Rydberg and Terrill, 2010), and political leadership (Besley et al., 2011). However, the public sector is unusual in the constraints it imposes on the compensation and management of personnel and in its relative insulation from direct competition. The determinants of selection into the public sector have thus posed a longstanding question in economics, spanning fields from labor and public finance (Katz and Krueger, 1991; Borjas, 2002) to development and political economy (Dal Bo et al., 2013; Deserranno, 2019) and national security (Friedman, 1967; Simon and Warner, 2007; Korb and Segal, 2011). Existing research has focused primarily on understanding how differences in the levels of compensation across the public and private sectors affect who decides to enter government service (see, e.g., Dal Bo et al., 2013; Finan, 2017; Nickell and Quintini, 2002; Bacolod, 2007).

We bring new evidence to this literature in the form of well-identified estimates of the effects of commonly used public sector compensation policies on the quality of public sector employees. Because public sector personnel managers typically lack the same tools as private sector managers to individually tailor compensation, they instead frequently rely on a limited menu of mostly lump sum and cash-based retention policies and incentives, including retention bonuses and cash inducements for early retirement. Existing research has shown that these policies are often effective when evaluated against the narrow goal of adjusting the quantity of retained workers in order to achieve desired retention rates (see, e.g., Knapp et al., 2018; Asch et al., 2010; Clotfelter et al., 2008). There is also a robust empirical (e.g., Asch et al., 2010; Gelber, 2007;

Warner et al., 2003; Brown, 1985)[1]and theoretical (e.g. Asch and Warner, 2001b; Daula and Moffitt, 1995; Gotz and McCall, 1984) literature on recruitment and retention in the U.S. military that has focused primarily on the quantity rather than the quality of recruits. In this paper we show that key public sector retention policies can also meaningfully affect the types of workers who elect to remain in the public sector. In particular, we study how retention bonuses and early retirement inducements affect worker sorting in the U.S. military. In contrast to much of the literature showing that higher levels of compensation induce higher quality workers to enter the public sector, we find that more generous lump-sum retention incentives actually induce lower ability workers to remain. Our findings highlight that both the level and the structure of compensation matter in determining the quality of retained public servants.

Our results are somewhat striking in light of both the existing empirical literature and predictions made by the simplest models of selection. In a simple model in which returns to individual ability are higher in the private sector than in the public sector (see (Borjas, 2002; Katz and Krueger, 1991)) and where workers differ only in their ability, one would expect any increases in public sector compensation—even those that are not specifically targeted towards higher ability workers—to increase the average ability of those who select into the public sector. Indeed, this prediction that higher wages attract higher quality workers is consistent with the selection patterns documented by Dal Bo et al. (2013) and throughout much of the literature on the personnel of the state (Finan, 2017), and as recently 2019, it appears to have been the consensus view of military researchers and policy advisers.[2] However, our results on the

[1]For a recent review of the literature, see Asch (2019b). Among the papers studying military personnel, our work is most closely related to Warner and Pleeter (2001) and Simon et al. (2015), who estimate personal discount rates using military drawdown policies—including those studied here. However, our paper is the first to establish the causal effects of these different types of compensation on the quality of retained workers and the implications this has for the quality of the public sector workforce.

[2]In March 2019, Beth J. Asch, Senior Economist at the RAND Corporation, testified before a subcommittee of the U.S. House of Representatives Armed Services Committee that a recent upward trend in military recruit quality was "not entirely surprising, as a large body of research shows that, all else the same, higher military pay is associated with an increase in the supply of higher-quality enlistments" (Asch, 2019a). For summaries of relevant studies, see Asch and Warner, 2018; Asch et al., 2007).

retention margin are inconsistent with this simple model of selection. Instead, we find that, because low-ability workers are more responsive than their higher ability peers to a lump sum retention bonus, generous retention incentives can actually reduce average ability levels. Similar to recent studies demonstrating the potential for extrinsic financial incentives to crowd out pro-sociality (Deserranno, 2019; Ashraf et al., 2020), our results support a richer model with additional dimensions of worker heterogeneity—including, for example, soldiers' unobservable taste for military service—and they demonstrate that the design of retention policies can be crucial for retaining high-ability workers.

Our setting is the U.S. Army, where we combine rich micro-data with a policy environment that generates plausibly exogenous variation in the relative returns to continued employment in the military. Specifically, we study how soldiers of different ability levels respond to two common types of retention policies: 1) lump-sum retention bonuses and 2) offers of early retirement benefits. The U.S. military provides a useful setting in which to study questions relating to the public sector more broadly, as key features of military compensation—a highly standardized pay scale, a generous but cliff-vested defined benefit pension,[3] and reliance on cash bonuses as blunt tools for meeting personnel targets—are common across the public sector but comparatively rare in the private sector. Indeed, defined benefit pensions are increasingly concentrated in the public sector (Poterba et al., 2007), and various public sector organizations have recently implemented retention bonuses (e.g., the U.S. Border Patrol) and early retirement incentives (e.g., the Postal Service and the Social Security Administration) like those we study. The military is additionally intriguing because military retirement typically occurs in middle age (Kamarck, 2018). In contrast to the existing retirement literature, which has been primarily concerned with workers at the very end of their careers, studies of the military may enhance our understanding of how retirement incentives affect the transitions of skilled workers in the mid-to-late parts of their careers.[4]

[3]In 2018 the military replaced its defined benefit system with a "blended" defined benefit and defined contribution system. Our data cover the years 1992–2016, before this change occurred.

[4]Specifically, our paper contributes to a larger literature quantifying the effects of

Far from just a case study, the military is also worth studying in its own right, especially given its size and economic importance. Recently, policymakers have expressed concern that the U.S. military in particular is failing to retain its best and brightest members (Wardynski et al., 2010; Kane, 2012). Indeed, our own data validates their concerns and shows that the enlisted soldiers who stay in the Army the longest tend to be the ones with the lowest scores on pre-enlistment aptitude tests (see Appendix Figure B1). Compared to soldiers who exit the Army after a single enlistment, soldiers who serve 20 years or more have an average Armed Forces Qualification Test (AFQT) score that is almost half of a standard deviation lower. Analysts have suggested that the military's retention policies should be redesigned to optimize both the quantity and quality of those retained, as they argue that retaining a more talented workforce increases productivity, boosts morale, and ultimately reduces costs (Wardynski et al., 2010; Wallace et al., 2015). However, there is little empirical evidence on the nature of selection in military retention. In Appendix A, we show that the key parameter to inform policy makers of how retention policies will affect the average quality of the retained soldiers is precisely the object we estimate—the differential sensitivity of soldiers of varying abilities to potential reenlistment incentives.

Our empirical strategy leverages two sources of quasi-random variation in the financial returns to reenlisting in the military. First we study Selective Reenlistment Bonuses (SRBs), which offer a lump sum payment to soldiers who choose to reenlist. SRB offers fluctuate frequently in response to changes in the Army's demand for soldiers of different ranks and skill sets, but importantly for our purposes, they are offered to all soldiers of a given rank and occupational specialty regardless of individual ability. Second, we study early retirement incentives, which offer soldiers immediate (but reduced) retirement benefits in exchange for early exit from the military. Like the reenlistment bonuses, they were applied without regard to individual ability. We document that, during the period relevant to our study, the Army implemented both policies in

retirement programs on labor supply, which has focused primarily on the relationship between retirement decisions and pensions (e.g., Brown, 2013). We add to this literature by studying mid-career workers and by studying the heterogenous response of workers of different ability levels.

a rigid and formulaic manner based on a limited set of observable characteristics. After conditioning on these observable variables, we show that the application of these policies was essentially independent of soldiers' ability levels as well as their individual reenlistment decisions.

Our analysis shows that low-ability soldiers are more responsive to both types of near-term reenlistment incentives and that the magnitude of the selection is large enough to affect the average ability of the Army. Specifically, a 10 point decrease in a soldier's AFQT score (approximately one-half of a standard deviation) is associated with a nearly one percentage point increase in the effect of a $10,000 SRB offer (relative to no offer at all) on a soldier's probability of reenlistment. Even more striking, soldiers with upper quintile AFQT scores are totally unresponsive to bonus offers. We find similar results using a soldier's speed of promotion as an alternative measure of ability. We also find that lower ability soldiers are more responsive to early retirement programs, and that of the soldiers who leave the military in direct response to early retirement programs, almost two-thirds have below-median AFQT scores.

We show that the increased sensitivity of low ability soldiers to lump-sum bonuses is not consistent with a simple model in which the return to ability is lower in the military than in the civilian sector. Rather, we show that this excess sensitivity could be due to differences in unobservable taste for the military. We also show that the observed selection patterns persist even after controlling for variables proxying for soldiers' access to credit and time preferences. This finding suggests that liquidity constraints and personal discount rates are not the primary explanations for the excess sensitivity of low-ability soldiers to lump-sum cash incentives. Our main results are also consistent with recent studies from the education literature showing that bonuses targeted at high-performing teachers were only modestly effective at boosting retention (Springer et al., 2016)[5] and non-targeted early retirement incentives appear to have elicited a stronger response from low- versus high-performing teachers (Fitzpatrick and Lovenheim, 2014). Thus, while our results are derived

[5]Despite modest and statistically insignificant effects of targeted SRBs on overall retention rates for high-quality teachers (Springer et al., 2016), a follow-up study of the same intervention finds greater test score gains in schools that participated in the SRB program versus those that did not (Swain et al., 2019).

from the U.S. military, they may provide broader lessons for public sector personnel management.

The rest of the paper proceeds as follows. Section 2 describes our institutional setting and Section 3 describes our data. We present our empirical strategies and results in Section 4. Section 5 explores explanations for our primary finding, and Section 6 concludes.

2 Institutional Setting

We analyze the reenlistment decisions of enlisted members of the all-volunteer U.S. Army from 1992–2016. Reenlistment is uniquely important in the military since, unlike private firms, which are free to hire at all levels, the military must promote from within. Enlisted soldiers serve for fixed terms, and the typical first term of service lasts four years. At the end of each term, soldiers deemed eligible to reenlist (based on their previous performance) meet with a counselor to discuss their options, which normally include opportunities to reenlist for an additional term of between two and six years. The counselors will discuss the monetary and other potential benefits of remaining in the Army as well as potential opportunities in the civilian labor market. While reenlistment policies have changed some over time, eligible soldiers can typically reenlist during a reenlistment "window" beginning 12-24 months before the end of their term and ending 90 days prior.[6] Another salient feature of a soldier's experience in the Army is her Military Occupational Specialty (MOS), the job assigned just after basic training. While mid-career changes are possible, they are not common, and reenlisting soldiers will typically maintain their MOS.

We utilize two measures of individual ability—the AFQT score and the soldier's speed of promotion in their first term. A substantial body of previous research has established that a soldier's cognitive ability affects her on-the-job performance (see Kavanagh (2005) for review). Wigdor and Green (1991) show that a soldier's AFQT is highly correlated with both hands-on performance and written knowledge of her job. Observed

[6] Figure B3 shows the distribution of reenlistment eligibility start-dates.

correlations range from 0.10 to almost 0.70, with higher correlations in combat occupations. (See Appendix Table B1.) Other studies have documented that AFQT scores explain individual and group performance in technical fields such as communications (Winkler et al., 1992; Fernandez, 1992), air defense systems (Orvis et al., 1992), and automotive and helicopter maintenance (Mayberry and Carey, 1997). AFQT scores also predict early service attrition (Flyer and Elster, 1983; Teachout and Pellum, 1991; Horowitz and Sherman, 1980).

Like many public sector compensation schemes, the military pay system has some unique features that distinguish it from the private sector. Military basic pay is a function of only rank,[7] years of service, and dependents status. The military also offers generous additional benefits, such as enlistment bonuses, periodic retention bonuses, education benefits, housing allowances, and a generous retirement program.

2.1 Variation in Military Retention Policies

We leverage two retention policies that generate quasi-random variation in the relative return to continued military service. Our first policy is the Army's Selective Reenlistment Bonus (SRB) program. SRBs are cash bonuses offered to certain soldiers in order to encourage reenlistment. SRB offers vary by the soldier's current rank, the MOS that the soldier chooses to fill upon reenlistment, the soldier's total years of service, certain specialty skills the soldier might possess (for example, "airborne" qualification), the number of years for which the soldier reenlists, and duty locations. Depending upon her characteristics, a soldier may be eligible for a "menu" of several SRB offers, and it is up to the soldier which SRB offer (if any) she accepts. Many soldiers are eligible for no bonus offer at all based on their characteristics and the timing of their reenlistment, but offers as high as $20,000 are not uncommon. In our sample, the average SRB offer was $2,459, but among the 25% of soldiers who received a non-zero SRB offer, the average was approximately $9,900.

[7] Throughout this paper we refer to ranks by their corresponding pay grades. A pay grade consists of a letter—"E" for enlisted personnel, and "O" for commissioned officers—followed by a number, denoting the relative position of the rank. For example, an E-5 (Sergeant) is superior by two ranks to an E-3 (Private First Class).

Similarly, of actual bonuses received, the average bonus was $1,973, but among the 20% of soldiers who received a non-zero bonus, the average was approximately $9,700. (See Appendix Figure B5 for histograms of SRB offers and actual SRB bonus amounts.) [8] Compared to a soldier's base pay (e.g., in 2015, an average soldier with four years of service earned approximately $28,000 annually), SRBs represent a sizeable share of overall compensation.

SRB offers varied with high frequency throughout the period relevant to our study, with new offers sometimes being announced and revised in the course of a single month. Important to our identification strategy, however, is that the Army was transparent about the goals and methods of its SRB program throughout the relevant period. Department of Defense guidance[9] established that SRB amounts for a particular MOS, rank, service cohort, and/or specialty skills group were to be determined by a combination of "inside" factors—i.e., the military's operational and strategic requirements—and "outside factors"—namely, labor market conditions and other economic trends affecting civilian labor market opportunities—none of which included a soldier's ability level.[10]

[8] Our summary statistics for the SRB program differ in some respects from the summary statistics contained in Borgschulte and Martorell (2018). For example, in their sample, they find an average SRB offer (conditional on receiving a non-zero bonus offer) of approximately $11,300. They also estimate a larger baseline effect of SRB offers on reenlistment rates. These differences are likely due to sample construction. Whereas they study all branches of the U.S. Armed Forces for the period 1993-2004, we study just the Army for the period 1992-2016. Moreover, whereas they restrict to first-term enlistees only, we include soldiers at later stages of their careers.

[9] Specifically, DoD guidance directed the Army and other branches to consider (1) the potential impact of a "critical personnel shortage" on the mission of the branch, (2) the degree to which current or historic retention in a particular military skill falls short of "established retention objectives," (3) the length and cost of training associated with a particular military skill, (4) any overall Army-wide personnel shortage and shortages within particular ranks, (5) the "relatively arduous or otherwise demanding nature of the military skill, as compared to other military or civilian alternatives," and, finally, (6) the degree of demand for the military skill in the civilian labor market. See Department of Defense Instruction (DoDI) 1304.31, "Enlisted Bonus Program"; DoDI 1304.29, "Administration of Enlistment Bonuses, Accession Bonuses for New Officers in Critical Skills, Selective Reenlistment Bonuses, and Critical Skills Retention Bonuses for Active Members." Of these six permissible criteria, none relate to individual ability or quality.

[10] In fact, our conversations with U.S. Army officials confirmed that inside factors—those reflecting the "needs of the Army"—predominated, and outside factors were incorporated only indirectly. Rather than directly adjusting SRB offers based on civilian labor market conditions or other economic indicators, the Army typically only adjusted

Further, Army regulations indicate that the SRB program's sole objective was to retain a sufficient quantity of personnel without regard to quality.[11] Additionally, the sheer size of the Army—more than 500,000 active duty soldiers were serving at any given time during most of the 1990s and 2000s, and even relatively small MOSs were likely to have hundreds or thousands of soldiers at each rank—suggests that, although SRBs were certainly a function of aggregate reenlistment patterns, high-frequency fluctuations in their amounts were essentially independent of soldiers' individual reenlistment choices. In Section 4.1 and Appendix Section 4.1 we document this empirical variation and depict the time series of SRB offers for two MOS-specific case studies.

The SRB program was also highly rigid. Once announced, the schedule of SRB offers was fixed until officially revised. A soldier could choose among her menu of SRB offers or even decline an offer altogether, but neither she nor her commander had any ability to override published bonus schedules by negotiating a custom bonus amount. Procedurally, Army reenlistment personnel had no data or authority to offer or provide retention incentives based on individual ability measures. Thus, SRB offers were completely independent of an individual soldier's ability or record of performance, and all eligible personnel received the same offers.

We also examine the military's early retirement programs. Before 2018—and for the entirety of our study period—the U.S. military offered only a defined benefit plan wherein soldiers were eligible for a retirement pension after 20 years of service, and those who separated prior to 20 years received no retirement pay whatsoever. A retired soldier with 20 years of service received an annual pension of approximately 50 percent of her final annual salary. In the early 1990s, after the Cold War ended, the Department of Defense implemented two programs—Voluntary Separation Incentives and Special Separation Benefits (VSI/SSB),

SRBs according to its own manning levels. Thus, to the extent that soldiers are more likely to exit the Army when the civilian labor market is strong (Borgschulte and Martorell, 2018), SRB offers indirectly reflected outside economic conditions by way of their effect on aggregate retention rates.

[11] Army Regulation 601-280 "Personnel Procurement: Army Retention Program" states that "The objective of the SRB Program is to increase the number of reenlistments in critical MOSs that do not have adequate retention levels to staff the force."

and the Temporary Early Retirement Authority (TERA)—as part of a larger "drawdown" strategy. In addition to reducing its overall size, the Army sought to reshape its force for the post-Cold War era by directing separation and retirement incentives at certain MOS and rank combinations. Asch and Warner (2001a) provide suggestive evidence that the Army's drawdown programs were successful at promoting separations. Our paper expands on Asch and Warner (2001a) in two important ways. First, we focus on a group of non-marginal soldiers who were not subject to compulsory separations, thereby addressing their stated concerns about "disentangl[ing] the pure inducement effect of the separation incentive from the compulsory effect" of subsequent drawdown measures like mandatory retirements for marginal performers. Second we analyze and integrate the effects of multiple types of retention programs and document their potential effect on aggregate organizational quality.

We focus primarily on a wave of VSI/SSB payment offers lasting from August 1993 to June 1995.[12] The purpose was to induce voluntary pre-retirement separation among mid-career soldiers. The program offered early retirement to soldiers who had completed their first full term of service and accrued more than 6 but less than 20 years of service. Eligibility was further restricted to certain occupation and rank combinations. Overall, 7,326 soldiers were eligible, covering 3.8 percent of all soldiers serving at that time and 11.7 percent of soldiers with at least 6 years of experience.

The VSI and SSB programs shared eligibility rules, but the benefits provided by the two programs differed significantly, with VSI offering an annuity payment and SSB offering a single lump-sum payment upon separation. Soldiers had the option of choosing between the two programs. A soldier electing the VSI program received an annual payment equal to 2.5% of their final annual base pay multiplied by her total years of service, paid out once a year for twice the number of years of service. For mid-career and senior soldiers, VSI/SSB eligibility had a major effect on the relative returns to continued military service. For example, a

[12]See Appendix for a complementary analysis of the TERA program. We relegate this analysis to the appendix because the program was small, with only 1,731 eligible soldiers, and our estimates for TERA are similar to, but noisier than, our estimates from VSI/SSB.

soldier with 7 years of service had an SSB payment just larger than her annual salary.[13]

We also exploit variation in the TERA program, which offered early retirement to soldiers with at least 18 but less than 20 years of service who also met specific service requirements within their occupation and rank. We focus on a wave of TERA offers lasting from August 1994 to July 1995. The benefits bestowed by TERA were generous. While soldiers are generally ineligible for retirement benefits prior to 20 years of service, TERA entitled recipients to an immediate military pension, albeit at a slightly reduced rate.[14] Since TERA was a relatively small program—only 1,731 soldiers met all eligibility requirements, representing 0.6 percent of all soldiers serving at that time and 6.8 percent of soldiers with at least 15 years of experience (see Appendix Table B5)—our results for TERA tend to be noisier than our results for the VSI/SSB program.

Like the reenlistment bonuses discussed above, early retirement incentives under the VSI/SSB program were highly regimented and, outside of the limited set of observables that determined program eligibility, essentially independent of individual soldier characteristics. Officials with knowledge of these early retirement programs described them to us as "blunt" policy tools. Importantly, eligibility for each program was fully determined by observable characteristics like MOS, rank, and years of service. And although eligible soldiers were technically required to "apply" to their commanders for early retirement under the VSI/SSB and TERA programs, conversations with Army officials as well as contemporaneous evidence from Army archives suggests that such applications were pro forma.[15] Thus, like the selective reenlistment bonuses

[13]Before being granted benefits, soldiers needed commander approval. It would be problematic for identification if commanders considered a soldier's performance when granting approval. Evidence from Army archives suggests this was not the case: according to the Army's Fiscal Year 1992 "Historical Summary," 100% of on-time VSI/SSB applications were approved that year, and an internal Army document assessing the success of the program states that "VSI/SSB stressed maximum approvals while accepting the inherent risk of a personnel shortfall."

[14]Specifically, a soldier retiring under TERA had her military pension reduced by approximately 5% for each year of service that she fell short of the standard 20-year career.

[15]Specifically, officials with knowledge of the programs indicated that commanders'

discussed above, eligibility for early retirement appears to have been independent of a soldier's abilities or other traits that might affect her propensity to reenlist. In fact, based upon lessons learned from the VSI/SSB and TERA programs of the 1990s—which Army planners considered to be poorly targeted and unpredictable due to its reliance on soldiers' choice—since the 2010s the Army has adopted a new approach to drawdowns (known as the "Qualitative Service Program") that attempts to target lower-performing soldiers for mandatory early retirement.

3 Data

We use the U.S. Army's Total Army Personnel Database (TAPDB) to construct a panel of enlistment spells from 1992 to 2016. Each observation (or "spell") corresponds to a single enlistment term for a soldier (e.g., a soldier who has served a single enlistment of four years will have just one observation, while a soldier in her tenth year of service will have multiple observations). We exclude all current enlistment spells (approximately 6%) since we do not observe their conclusion. We provide summary statistics for our sample in Table 1. The sample is primarily male with an average age of 28 and an average service duration of 6.33 years. For all analyses, we restrict our attention to those soldiers eligible to reenlist at the end of the term (Column 2), who tend to have slightly higher measures of ability than soldiers who are ineligible to reenlist. The last two columns show the average characteristics of individual spells that end in separation from the Army (Column 3) versus those ending in reenlistment (Column 4). Around 50 percent of soldiers never choose to reenlist, and the average number of enlistments per soldier is 2.8.[16] On average, soldiers deciding to reenlist are more likely to be married and slightly younger than those who do not.

approval was universal, and archival evidence supports this claim. For example, according to the Army's Fiscal Year 1992 "Historical Summary," 100% of on-time VSI/SSB applications were approved that year, and an internal Army document assessing the success of the program states that "VSI/SSB stressed maximum approvals while accepting the inherent risk of a personnel shortfall."

[16]See Appendix Figure B2 for the full distribution of the number of enlistments per soldier.

Our primary measure of ability is a soldier's AFQT score, which reflects the soldier's vocabulary, reading comprehension, and mathematical skills. The military uses the AFQT for initial selection (i.e., eligibility to join) and classification (i.e., eligibility for certain occupations), and labor economists have used these scores widely as a measure of individual cognitive ability (e.g., Grilliches and Mason, 1972). AFQT scores range from 0-99, corresponding to the percentile of the applicant's raw test score.[17] Table 1 shows that soldiers eligible to reenlist have higher scores than those who are ineligible (Column 1 vs. 2), and that those who choose to reenlist have lower scores than those who leave (Column 3 vs. 4). Indeed, Appendix Figure B6 shows that at every year of service, lower AFQT soldiers are more likely to reenlist.

While evidence suggests that AFQT scores are good predictors of military performance, cognitive measures may not capture all dimensions of ability relevant to the military. For that reason, we complement AFQT scores with a variable related to the speed of a soldier's promotions, which is commonly used to measure military aptitude. In particular, we observe the number of months in a soldier's first term that she spent below the rank of Sergeant, with larger numbers reflecting slower advancement. As expected, Appendix Figure B4 shows that AFQT and speed of promotion are positively correlated both overall and within a range of occupations.[18]

In addition to personnel data, we collect monthly SRB offers and eligibility criteria for the VSI/SSB and TERA programs from publicly available policy announcements ("U.S. Army Military Personnel Messages").[19] We record the amount of the offer and the eligibility require-

[17]Note that percentiles are determined with respect to the full population of test-takers. Because the military restricts enlistments to those above a minimum score—typically in the vicinity of 30—the median and mean AFQTs within the military exceed 50. It is also worth noting that the Army's minimum AFQT standard varies by MOS. As we discuss in Section 4.1 below, our analysis accounts for this fact by focusing on high-frequency within-MOS variation in retention incentives and reenlistment choices.

[18]We have also explored several alternative specifications of soldier promotion speed and find very similar results across alternative parameterizations. We chose the time the soldier took to get to rank E-5 (Sergeant) as a baseline because it is highly predictive of future promotion speeds and has a reasonable amount of variation among first term soldiers (See Table B2).

[19]We are grateful to the authors of Greenstone et al. (2018), who shared with us the

ments (i.e., MOS, rank, years of service, and any special conditions) for each SRB.

We construct the SRB offer data to isolate the exogenous aspects of the program (i.e., the variation in SRB offers that is uncorrelated with soldiers' choices). Specifically, we define the soldier's SRB offer as the bonus that is available for a 4-year reenlistment with the soldier's current occupation, rank, skill level, and tenure. This assignment process abstracts from the variation in SRBs from soldiers switching occupations in order to take advantage of a high SRB offer in a different occupation, and it also abstracts from the variation in SRBs that results from soldiers reenlisting for longer or shorter terms.[20] We also exclude SRB offers that require moving to a particular location or unit, as they might reflect endogenous location preferences.[21] Finally, since monthly bonus offers may vary throughout the reenlistment window, we expect that soldiers may delay reenlistment if they anticipate that a higher bonus offer is imminent, and this sort of behavior may be more common among high ability soldiers. To eliminate this strategic timing of reenlistment, we assign each soldier the SRB offer that was available in the first month of their reenlistment window.[22] By eliminating the endogenous determinants of actual SRB amounts—including choices to switch occupations, contract lengths, location choices, and strategic timing of reenlistment—we are able to isolate the exogenous variation in SRB offers. Even so, our assigned SRB offers are highly predictive of the actual received bonus amount for those who take up SRB offers,[23] and in Appendix Tables C3

bonus offer data for the period 1997-2010. We have extended the dataset through 2016. Eligibility criteria for the VSI/SSB and TERA programs were announced in two separate Military Personnel Messages, both published in 1993. Unfortunately, these memoranda were not stored electronically, and copies of the final messages were destroyed in the Pentagon during the 9/11 attack. We therefore constructed the eligibility criteria from a pair of draft messages, which the Army had preserved. While we are are confident that the final rules were similar to the draft messages, we cannot be certain that they were identical.

[20] In fact, 23 percent of soldiers in our sample switch occupations upon reenlistment, and the average reenlistment term in the sample is 4.18 years. Appendix Table B3 shows that SRB offers are highly correlated across the length of reenlistment terms.

[21] Appendix Table B4 shows that general bonus offers and simultaneously offered location-specific bonus offers are highly correlated.

[22] We show, however, that our results are not sensitive to the timing assumption for the SRBs. See Appendix Tables C5 and C6.

[23] The coefficient of a regression of actual bonuses on SRB offers is 0.236 and is highly

and C4 we replicate some of our main results with an instrumental variables specification that instruments for soldiers' actual bonus payments with their assigned SRB offers. The fact that our main specifications are robust to an instrumental variables approach provides further confidence that our estimates are unlikely to suffer from omitted variable bias due to other aspects of military compensation (including base salaries, location-based housing stipends, and other special retention incentives) which, in any case, are unlikely to be correlated with either SRBs or ability.

4 Empirical Strategy & Results

The following section provides evidence on the selection on ability induced by two of the Army's lump-sum retention policies—Selective Reenlistment Bonuses, which provide cash bonuses to soldiers who stay, and early-retirement programs, which provide cash bonuses to soldiers who leave. In Appendix section A, we show that the differential response of soldiers to lump-sum bonuses is the key statistic for understanding how the average ability of the military is affected by these reenlistment programs.

4.1 Evidence from Selective Reenlistment Bonuses (SRBs)

We begin by comparing the reenlistment decisions of soldiers according to the bonus amounts they are offered. In particular, we estimate the following equation:

$$\text{Stay}_{it} = \beta_0 + \beta_1 \text{SRB}_{it} + \beta_2 \text{SRB}_{it} * \text{AFQT}_i + \beta_3 \text{AFQT}_i + \gamma_{MOS,rank,yos} + \mu_t + \delta \mathbf{X}_{it} + \epsilon_{it}, \quad (1)$$

where Stay_{it} is an indicator for whether soldier i chooses to reenlist at time t; SRB_{it} represents a soldier's SRB offer as described above, and $AFQT_i$ is the soldier's raw AFQT score percentile. We restrict our sample to include only the set of soldiers eligible to enlist. Our coefficient of

statistically significant ($p < 0.01$).

interest is β_2, which reflects the differential responsiveness of high- and low-ability soldiers to reenlistment bonus offers.

The identification assumption underlying the estimation of β_2 is that SRBs are conditionally randomly assigned, and thus unrelated to both individual ability and non-monetary factors affecting the reenlistment decision. Since SRB offers vary by occupation, rank, year of service, and date, all of our specifications include offer-date fixed effects and MOS×rank×years-of-service (YOS) fixed effects. By controlling for MOS, we account for the fact that differences in SRB levels *across* MOSs may be correlated with ability due to the fact that a new recruit's eligibility for each MOS is partially determined by her AFQT score, and by controlling for YOS, we also ensure that the effect of SRBs will not be confounded by a soldier's distance to retirement. Moreover, by including time-varying MOS fixed effects in certain specifications, we address concerns that changes to MOS-specific SRBs may be correlated with changes over time to the Army's minimum AFQT standards for each MOS or that there is any time-varying demand for skills particular to a military job. We also include controls ($\mathbf{X}_{it}$) for marital status, gender, race, age, and special military skills designations. While the demographic controls are not necessary for identification, they nonetheless improve the precision of our estimates. Although we are unable to test whether SRBs are correlated with unobservable soldier characteristics, such as their taste for military service, in Columns (1) and (5) of Appendix Table D1 we document that, conditional on our interactions of occupation, tenure, and rank, higher SRBs are not offered to soldiers with *either* higher AFQT scores or speedier promotions. This test on observables strongly supports the identifying assumption, since the finding that SRBs are uncorrelated with our rich set of observables makes it unlikely that they are nonetheless correlated with potential unobservable characteristics (Altonji et al., 2005). These results provide strong empirical support for our identification strategy that is also consistent with the statutory and policy requirements for SRBs and our own study of the institutional setting.

Given these controls, our coefficient of interest β_2 will be identified off of high-frequency variation in SRB offers within an MOS, rank, and years-of-service cell and within a date. Two brief case studies (further

discussed in Appendix Section B.2) illustrate the extent of the variation as well as its key drivers. Throughout the late 1990s and early 2000s, the time series for SRB offers to E-4 infantrymen (Appendix Figure B7a) and E-4 Patriot missile operators (Appendix Figure B7b) were both erratic, often jumping by more than $10,000 in either direction in a given month. SRB offers to Patriot missile operators appear to primarily reflect changing operational requirements as well as large-scale changes to the Army's overall force structure (e.g., growth of the total air defense capability in response to missile threats during and after the first Gulf War), and SRB offers to infantrymen appear to vary more closely with secular trends (e.g., macroeconomic conditions, post-9/11 surges in military enlistment, and increased demand to support the wars in Afghanistan and Iraq). Neither time series appears to be plausibly driven by either individual reenlistment decisions (except in the aggregate) or soldiers' quality composition.

In the Summer of 2002, for example, the Army cut bonus offers for E-4 infantry soldiers with four years of service from approximately $13,000 to $0. SRBs were briefly reinstated before being reduced and then eliminated once again in late 2002. This appears to have been a response to the post-9/11 surge in military recruitment and retention. SRBs for Patriot missile operators were similarly eliminated in early 2002, but prior to 9/11, bonuses for Patriot missile operators had actually been among the highest in the Army. A major expansion in the Army's patriot missile capabilities during the late 1990s meant that SRBs for E-4 Patriot missile operators occasionally reached $25,000 in the pre-9/11 period. In early 2004, as the Army grappled with heightened operational demands in Iraq and Afghanistan, infantry SRBs were restored to just under $10,000. Patriot missile SRBs did not recover until almost 2006, likely because such soldiers were less critical than their infantry colleagues to the missions in Iraq and Afghanistan. Thus, considering only infantry soldiers and Patriot missile operators, β_2 is identified in part by comparing the differential reenlistment rates of high- and low-ability infantrymen in, for example, August 2000 or August 2006—when infantry SRBs were moderately high relative to other SRBs of the same era—with the differential reenlistment rates of high- and low-ability infantry soldiers in

August 2003, when SRBs were low; β_2 is also identified by comparing Patriot missile operators from, for example, August 2000 with Patriot missile operators from August 2003 when SRBs were unavailable and August 2006 when SRBs were non-zero but still relatively low.

Although the above-described events focus on the needs of the Army, in other cases variation in SRBs may be driven by outside factors reflecting the civilian labor market and other outside economic conditions. This, too, can be helpful to our identification. Since our main specifications will include date fixed effects as well as MOS×rank×years-of-service, outside economic conditions will only threaten our identification insofar as they vary at a high frequency and in a manner that is specific to soldiers of a particular MOS, rank, and tenure and that correlates with both ability and reenlistment. As discussed above in Section 2.1, the sheer size of the military also ameliorates concerns regarding reverse causality, since a single soldier's individual reenlistment decision is highly unlikely to meaningfully affect the time series of SRB offers.

In Figure 1 we provide descriptive evidence for the effect of SRBs on selection. Both the left and right panels depict the residualized AFQT distributions for soldiers who reenlist compared to those who stay. We residualize the AFQT scores by the soldier's occupation, rank, years of service, and the date of the reenlistment decisions—the very same variables that are used to determine a soldier's eligibility for the military's various incentive programs. This residualization removes, for example, any differences stemming from the fact that soldiers of higher ranks tend to have higher AFQT scores, are more likely to reenlist, and may also be eligible for different reenlistment incentives. Figure 1a plots the AFQT distributions for soldiers who were offered *no* SRB at the time of reenlistment, while Figure 1b plots the distributions for soldiers who were offered an SRB of at least $8,000. In both panels the stayer distribution (drawn in dashed lines) is shifted left relative to the leaver distribution (drawn in solid lines), meaning that the average ability of the soldiers who choose to reenlist is lower than those who chose to leave the military.[24] This comports with Table 1, which indicated that soldiers who

[24]Appendix Figure C2 shows the raw distribution of AFQT scores by reenlistment status.

reenlist tend to have lower AFQT scores than those who leave, but the residualized distributions plotted in Figure 1 show that, even within detailed occupation, rank, and tenure bins, soldiers at the higher end of the AFQT distribution are less likely to stay in the military. What is key from Figures 1a and 1b, however, is that the disparity between stayers and leavers is even greater for soldiers who receive a large SRB offer than it is for soldiers who receive no SRB offer. This suggests that when the SRB is higher, either lower ability soldiers are even more likely to stay, or higher ability soldiers are even more likely to leave.[25]

In Table 2 we formalize this descriptive result with a regression analysis. Column 1 first shows a benchmark specification relating bonus offers to average reenlistment without including the interaction between a soldier's AFQT score and their bonus offer. The coefficient on a soldier's AFQT score in Column 1 reiterates that soldiers with higher AFQT scores are less likely to reenlist—for each additional percentile point in the raw AFQT score, soldiers are 0.1141 percentage points less likely to reenlist. The Column 1 results also show that SRBs work as intended: on average, a $10,000 bonus offer[26] increases soldier retention by 1.5 percentage points (2.3 percent), relative to no bonus offer.[27][28]

However, as depicted in Figure 1, soldiers across the ability distribution are not uniformly responsive to SRBs. Column 2 of Table 2 cor-

[25]Appendix Figure C1 shows a similar pattern using a soldier's speed of promotion in their first term as their measure of quality.

[26]Note that the average non-zero SRB offer is $9,867 in 2015 dollars. About 75% of soldiers face no SRB offer in their current MOS at the beginning of their reenlistment window.

[27]In fact, in Appendix Figure C4 we show, somewhat surprisingly, that most of the effect of SRB offers on reenlistment choices is located at the extensive margin (i.e., in the difference between a positive bonus offer and no bonus offer), with little additional effect from higher bonus offers. Appendix Figure C4 plots the coefficients from regressing soldiers' reenlistment choices on dummies for $2,000 SRB offer bins. While noisy, the coefficients show that the effect of SRB offers on reenlistment appears to be limited to the extensive margin. While positive bonus offers are associated with higher reenlistment rates relative to no bonus offer, we see no evidence that the effect is increasing in the amount of the bonus offer.

[28]That a $10,000 bonus offer increases soldier retention by 1.5 percentage points may seem like a small effect, but it is important to recall that a large number of soldiers serve only a single term, and reenlistment is partially determined by non-monetary factors like a soldier's individual taste for service. This baseline estimate of the effect of SRB offers on reenlistment probabilities is similar to those reported in Greenstone et al. (2018).

responds to our baseline specification in Equation 1, and it shows that a soldier's responsiveness to the bonus offer is decreasing in her AFQT score. The point estimate on the interaction of the SRB offer and the soldier's AFQT score is negative and statistically significant – a soldier who has an AFQT score that is 10 percentiles higher is more than 0.7 percentage points less responsive to a $10,000 SRB bonus offer. Indeed, as we show in additional results below, soldiers with AFQT scores above the 80th percentile are not at all responsive to the SRB offer.

In Columns 3 and 4 of Table 2 we estimate the same model with additional fixed effects that control for potential confounding variables. Column 3 includes nonparametric time trends for each soldier's commuting zone of record (i.e., place of residence immediately prior to initial enlistment) to control for any reenlistment differences that are correlated with the soldier's local area. The point estimates are smaller, but, as we show in Appendix Table C1 (Column 3), this difference is entirely driven by changes in the sample induced by the additional fixed effects. Even so, the main pattern of lower responsiveness by higher-ability soldiers remains sizable and statistically significant. Column 4 includes nonparametric time trends for each occupation. This model identifies SRB effects from the differential time variation across ranks and tenures within an occupation and thus controls for anything that varies at the occupation level (e.g., changes in mortality risk, changes in outside employment opportunities for a given occupation). Once again, we find that soldiers with higher AFQT scores are less responsive to SRB offers. In Column 5 we measure a soldier's ability not by her AFQT score but by the number of months that the soldier spent below sergeant in her first term. Higher numbers imply slower promotion speeds and therefore lower military performance. Our results show that that soldiers who are promoted less quickly are more responsive to SRB offers, consistent with the AFQT findings in Columns 2-4.

In Appendix Tables C1 and C2 we document that the Table 2 results are robust to various alternative specifications and sample restrictions, including using the log rather than the level of the SRB offer, restricting to the 10 largest occupations, and dropping the Iraq War "surge" years (2007-2009). One of the more notable results from our robustness checks

is that the relationship between soldiers' ability and their responsiveness to SRB offers is much diminished when we restrict to a sample of soldiers with strictly positive bonus offers (see columns (7) and (6) of Appendix Tables C1 and C2, respectively). In fact, when we measure soldiers' ability by their speed of promotion, our results are very small and reverse in sign. We attribute this to the fact—which we document in Appendix Figure C4—that SRB offers are most effective along the extensive margin. Specifically, while positive bonus offers induce reenlistment (relative to no bonus offer at all), there is little additional effect from higher bonus offers. This may also be attributable, however, to the fact that we observe relatively little variation in non-zero bonus offers, with the vast majority of positive bonus offers falling between $4,000 and $12,000 (see Appendix Figure B5).

In Figure 2 we relax the imposed linear relationship between a soldier's ability and her responsiveness to bonus offers. The left panel presents results using AFQT scores, where we interact the SRB offer with dummies for ten equally sized AFQT score decile bins to reflect the soldier's relative position among those eligible to reenlist. The relationship is close to linear and decreasing throughout the distribution. Soldiers in the bottom decile are almost 5 percentage points more likely to reenlist when offered a $10,000 SRB versus no SRB, while soldiers in the middle of the distribution are only about 1 percentage point more likely to reenlist when facing the same incentive. Beginning at the 80th percentile of this AFQT distribution, we can no longer reject the hypothesis that SRBs have no effect on reenlistment rates. We find similar results in the right panel of Figure 2, which uses our speed-of-promotion-based ability measure. The effect of SRBs on reenlistment is almost entirely driven by soldiers in the highest three deciles (i.e., those with the slowest promotions).

4.1.1 Effect Magnitudes

The magnitude of this selection is substantial. If SRBs had a constant effect on reenlistment across the ability distribution, then offering higher SRBs would increase the average ability of soldiers in the military. In

fact, the self-selection we document above is large enough to imply that higher SRBs *decrease* average quality among retained soldiers. As shown in Appendix D, our estimates imply that if the Army offered enough positive SRBs to increase the average SRB offers by $10,000, it would retain 1,410 additional soldiers per year. However, the average AFQT score of marginally-retained soldiers would be 36, 1.1 standard deviations below the average AFQT for the typical reenlisting cohort in our data.

4.2 Evidence from early retirement incentives

While SRBs offer cash to those who choose to stay in the military, early retirement programs offer lump-sum payouts to those who choose to leave the military. Our analysis of the Army's early retirement programs is conceptually similar to our preceding SRB analysis, but the program details and structure of the data require a slightly modified approach. Rather than evaluating whether a soldier reenlists at the end of her spell, we evaluate whether or not she remained in the Army for the duration of the drawdown program eligibility window. This modification pools together soldiers who actively decide to reenlist with those who were not up for reenlistment during the program window but who nonetheless declined to take-up the early retirement program and leave the Army. We restrict our sample to spells that are active 6 months before the introduction of the early retirement program, thus counting each individual soldier only once. We make a few additional sample restrictions (described below) to isolate soldiers that are most similar to the eligible soldiers.

We first document that the program accomplished its objective of encouraging eligible soldiers to exit the military by estimating Equation (2):

$$\text{Stay}_{i,t_T} = \beta_0 + \beta_1 \text{ELIG}_i + \beta_4 YOS_{i,t_0} + \gamma_{MOS,rank} + \delta \mathbf{X}_i + \epsilon_i, \qquad (2)$$

where ELIG_i is an indicator for soldier i's eligibility for either VSI/SSB or TERA, YOS_{i,t_0} is the soldier's years of service as of the program el-

igibility date t_0, and Stay_{i,t_T} is an indicator for the solider remaining in the Army T months after the early retirement program went into effect (t_T). For example, the estimate for β_1 at 3 months shows the relative probability of being in the military, by program eligibility, 3 months after the program went into effect. We include occupation$\times$rank fixed effects to capture any average differences in retention probabilities, and we control for the soldier's tenure since reenlistment probabilities generally decrease with tenure. We identify the effect of program eligibility by comparing soldiers of different service tenures within an occupation-by-rank bin and by comparing soldiers with the same years of service across different occupation-by-rank bins. Our identifying assumption is that, after controlling for these observable determinants of program eligibility, eligibility for an early retirement program is correlated with neither an individual's ability level nor with the various unobservable determinants of her reenlistment decision. This assumption implies that, absent program implementation, reenlistment rates for eligible and ineligible groups would have followed parallel trends. This assumption is consistent with our review of the statutory and policy guidance for these programs, as well as with Army officials' descriptions of the early retirement programs as regimented and "blunt" (see Section 2.1 for further discussion).

We present our regression results in Figure 3. In Panel A, we first document the effects of the retirement programs on average retention. The left graph depicts the results for the VSI/SSB programs, which offered separation incentives to mid-career soldiers. Note that the small and statistically insignificant coefficient left of the zero-month threshold shows that, prior to the implementation of the VSI/SSB program, soldiers who were eventually eligible for the program had the same probability of staying in the military as those who would never be eligible, validating the primary parallel trends assumption underlying this specification. However, once the program comes into effect, eligible soldiers are more likely to leave the military, and by the time the VSI/SSB program expires, eligible soldiers were almost 15 percentage points less likely to remain in the military compared to ineligible soldiers. The right graph in Panel A depicts a similar analysis for TERA (which affected late-career

soldiers). While the results are noisier because the program was significantly smaller, the overall pattern is similar—retention rates for eligible and ineligible soldiers moved in parallel prior to the program, but after implementation, TERA induced eligible soldiers to retire at higher rates.

In Panel B of Figure 3 we present the retirement program effects by ability levels (specifically, upper and lower AFQT score terciles).[29] The left panel depicts the results for the VSI/SSB program. As before, there are no pre-program differences in reenlistment probabilities for each ability group, and both groups are more likely to leave the Army when offered early retirement. However, higher ability soldiers responded less to the early retirement offer than lower ability soldiers, as demonstrated by the coefficients for the bottom-tercile soldiers lying below the coefficients for top-tercile soldiers at all times after program implementation. Our results are consistent with the results of Asch and Warner (2001a), who found a stronger correlation between eligibility and separation for low-ability soldiers. The right panel documents similar results for the TERA program. Soldiers with lower AFQT scores are more responsive to the program than soldiers with comparatively higher scores..[30] In Appendix Figure C5, we show that patterns are similar when we split not by AFQT score but instead by soldiers' speed of promotion in their first term. Appendix Tables C7 and C8 provides regression estimates from a version of Equation (2) where VSI/SSB or TERA program eligibility is interacted with a soldier's ability, further documenting that high ability soldiers are less responsive to these programs.

[29]The estimates from these two groups were jointly estimated in a single regression, with soldiers belonging to the middle AFQT tercile as the omitted category.

[30]There are several reasons why the results would be stronger for the VSI/SSB program than the TERA program. As shown in Table B5, the VSI/SSB program affected more soldiers. Additionally, the VSI/SSB program ran for longer than the TERA program, perhaps giving soldiers more time to react. However, the programs also differed in the type of benefit—soldiers eligible for the VSI/SSB program had the option to get a large lump sum payment while soldiers in TERA were only entitled to the retirement annuity. Indeed, most soldiers who took up the VSI/SSB program chose the lump sum payment rather than the annuity.

4.2.1 Effect Magnitudes

The VSI/SSB program was relatively small, but the magnitude of its impact on the Army was far from trivial. As we discuss further in Appendix D, our results suggest that, were the Army to counterfactually extend VSI/SSB eligibility to an additional 10,000 soldiers, it would induce 990 soldiers to separate early. Among the 990 early separators, the average AFQT score would be 54.5, almost a third of a standard deviation below their cohort's overall average. Thus, in contrast to SRBs, the self-selection induced by VSI/SSB is large enough to *increase* the average quality of retained soldiers, since low-ability soldiers disproportionately take up early retirement.

5 Explanatory Mechanisms

The previous sections documents the perhaps surprising result that sensitivity of reenlistment decisions to near-term cash incentives is decreasing in individual ability. This selection pattern would seem to work against the positive effect of base wages on civil service recruit quality documented elsewhere (e.g., Dal Bo et al., 2013). Furthermore, in Appendix A, we demonstrate that this pattern of selection is inconsistent with a simple workhorse model of selection in which soldiers differ only in their ability.

In this section we explore the degree to which the above-documented selection patterns are driven by the specific lump-sum structure of Army retention incentives, which alter both the level and timing of compensation. Simple program take-up patterns strongly suggests that the structure of these benefits was important in inducing the observed selection patterns. Specifically, in the case of early retirement incentives, we find that lower AFQT scores strongly predict the take-up of the SSB lump-sum payment over the VSI annuity, revealing that the lump-sum payment was the appealing aspect of the program for low-ability soldiers (see Appendix Table C9 for details), and further suggesting that differences in taste for military service between high- and low-ability soldiers cannot fully account for the self-selection. Why lower-ability soldiers

value lump-sum payments more than their higher-ability peers is unknown.

One possibility is that low-ability soldiers exhibit differential sensitivity to cash incentives because they are more credit constrained than high-ability soldiers, meaning that they place a higher value on cash for precautionary savings or to finance a large household expenditure. In the case of the early retirement programs, more credit-constrained households may also value liquidity, as it enables them to prolong and optimize their job search in the civilian labor market. Given that family resources account for a large share of the variation in AFQT scores (Neal and Johnson, 1996) and that AFQT scores are themselves strongly correlated with future labor market outcomes (Heckman et al., 2006), access to credit is likely to be correlated with cognitive ability. We verify this positive relationship between credit access and AFQT scores in our sample by matching soldiers to their individual credit scores and balances, which were obtained from one of the major credit reporting agencies for soldiers who were eligible for reenlistment at any point between April 2007 and March 2015.[31]

We explore whether differences in credit constraints across the ability distribution explain our main results by adding additional controls to our baseline SRB regressions from Section 4.1. If differences in access to credit are driving low-ability soldiers' differential responsiveness to SRBs, then directly controlling for credit scores in our baseline regressions will correct for omitted variable bias and reduce the coefficient on SRB $*$ AFQT. The first three columns of Table 3 present estimates from Equation (1) after controlling for soldiers' credit scores. The key estimates are in Column 3, which shows that soldiers with more credit are less responsive to SRBs, as theory would predict, but that the coefficient on SRB $*$ AFQT is unaffected, suggesting that credit constraints are not driving our main finding. In Appendix Table C10 we show that these patterns persist when using alternative proxies for credit constraints.

Alternatively, selection patterns may stem from behavioral differences in decision-making between high- and low-ability individuals. Previous

[31]Our match rate is high (nearly 90%) for our main sample of reenlistment-eligible soldiers.

research has demonstrated that cognitive ability is correlated with a variety of decision-making characteristics, including greater patience and higher risk tolerance (see, e.g., Frederick, 2005; Benjamin et al., 2013). Importantly, in the context of the military, Warner and Pleeter (2001) and Simon et al. (2015) estimate servicemembers' personal discount rates (PDRs) using take-up of military retirement programs, and both studies document a negative correlation between AFQT scores and PDRs. We next explore the relationship between PDRs and our observed patterns of selection by controlling for proxies for discount factors in our baseline SRB regressions.

We proxy for discount factors with two measures that capture soldiers' willingness to transfer resources from the present to the future: first, an indicator variable for whether, upon initial enlistment, soldiers made an upfront investment (known as the GI Bill "buy-up") in order to enlarge their future GI Bill educational benefits; and second, by measuring soldiers' contributions over the course of an enlistment spell (as a % share of their base pay) into the Thrift Savings Plan (TSP), which is an optional 401(k)-style retirement savings plan offered to servicemembers since 2001.[32] We find that AFQT scores are indeed positively correlated with both proxies for soldiers' relative patience.

However, Columns 4 through 9 in Table 3 suggest that the correlation between discount factors and soldier ability cannot fully explain our main result—more patient soldiers (as reflected by our proxies) are less responsive to SRBs, but the coefficient on SRB $*$ AFQT remains unchanged across the columns. These patterns are largely robust to alternative specifications, including when we proxy for discount factors with the extensive margin of program participation in either the GI Bill or TSP (see Appendix Table C10). Note that while these proxies capture some measure of time preferences, the results above do not rule out all behavioral explanations. Individuals may discount hyperbolically (or quasi-hyperbolically) (Laibson, 1997), and since those with lower cognitive abilities may be more likely to do so (Benjamin et al., 2013; Shamosh and Gray, 2008; Parker and Fischhoff, 2005), low-ability soldiers' sensitivity to near-term incentives may still reflect these alternative time pref-

[32] See Section B.1.2 for additional details.

erences. Our data are unfortunately not well suited to formally test this possibility.

6 Conclusion

This paper explores the nature of selection in public sector employee retention with evidence from the U.S. Army. Our paper extends the literature on worker sorting between the public and private sectors. Relative to the existing research, which has focused on differences in the levels of compensation at the initial entry margin, our paper brings new attention to the retention margin, and in particular to the structure of commonly used retention incentives. Using variation in reenlistment bonuses and early retirement programs, we have shown that low-ability soldiers are more sensitive to immediate lump-sum transfers than their higher-ability peers. On the margin, lump sum bonus offers induce lower-ability soldiers to reenlist, while early retirement programs induce lower-ability soldiers to leave the Army. We provide suggestive evidence that these patterns do not arise from differences in either credit constraints or time preferences across the ability distribution. We nonetheless estimate that these effects are large enough to affect the average ability level of the military. Although our results are derived from the particular context of the U.S. military, we nonetheless view our findings as potentially relevant to other public sector organizations where personnel managers lack the ability to target incentives to individual high-performing workers.

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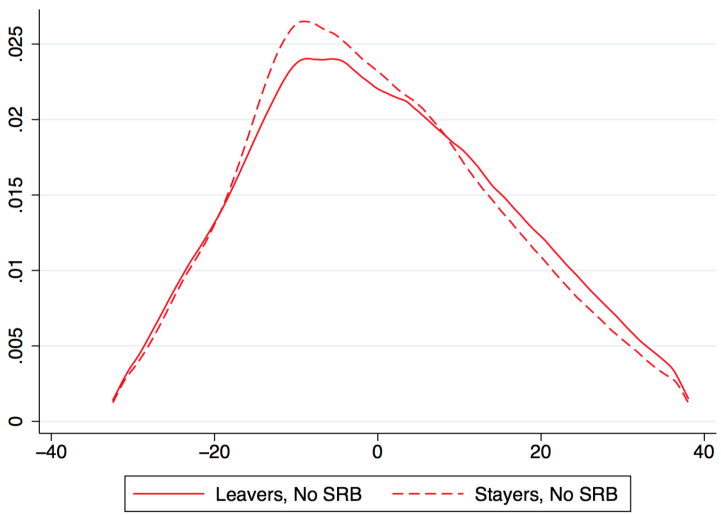
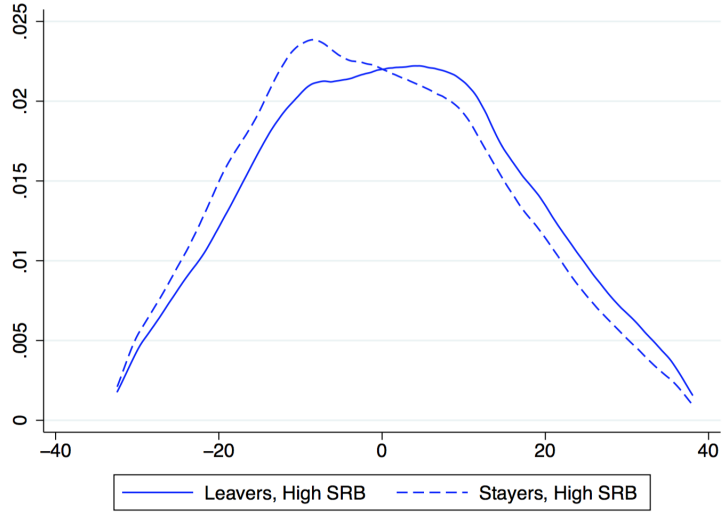
Figure 1: The Distribution of AFQT Scores for Soldiers, Split by Reenlistment Decisions and SRB Offers



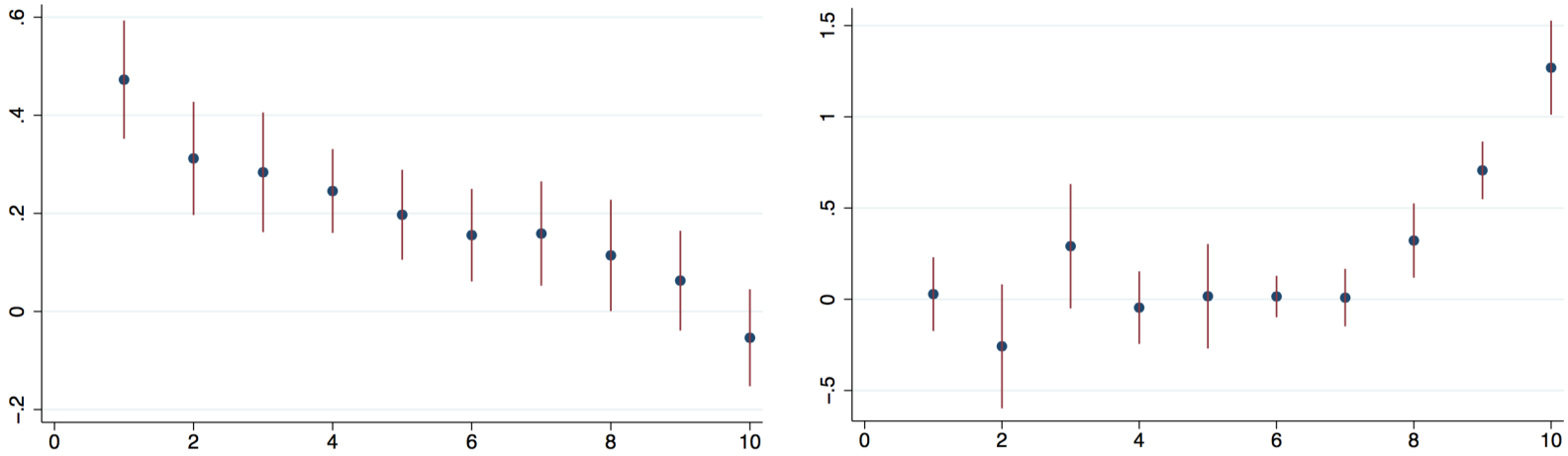
(a) Soldiers without an SRB offer



(b) Soldiers offered an SRB of at least $8,000

Notes: Figures 1a and 1b plot the residuals of a regression of AFQT score on MOS*rank*YOS dummies as well as date dummies. The sample includes only those soldiers who have a choice to reenlist. The left panel plots the distributions for the set of soldiers who do not have a SRB available at the start of their reenlistment window. The right panel shows the distributions for the set of soldiers who have an offered SRB of at least $8,000. The left figure includes 1.7 million observations (75% of the sample) while the right panel includes 300,000 observations (13% of the sample). Each distribution is truncated at the top and bottom 1%.

Figure 2: The Effect of Selective Reenlistment Bonuses on Soldier Retention, by Soldier Ability Deciles



(a) By Within-Military AFQT Score Decile

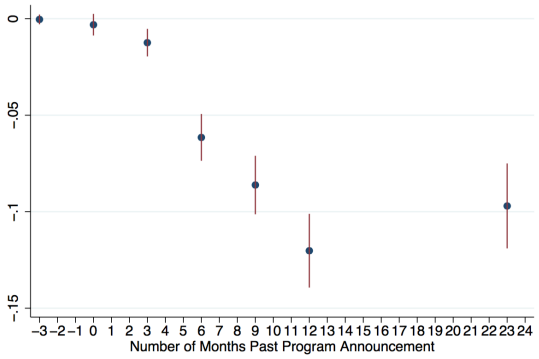
(b) By Speed-of-Promotion Decile

Notes: The left panel of this figure plots the coefficient estimates on the interaction of SRB offers and a dummy for each decile of the AFQT score distribution. Specifically, we construct ten equally-sized decile bins corresponding to the AFQT score distribution of those soldiers who are eligible to reenlist (which is higher than both the Army-wide and population-wide distributions of AFQT). The right panel plots similar regressions using the distribution of soldier's promotion speeds instead of AFQT scores. The promotion speed is measured by the number of months the soldier spend at a rank below a sergeant. In both panels, the red bars show 95 percent confidence intervals, clustering the standard errors at the MOS*rank*yos level. Reenlistment probabilities (the y-axis) are scaled by 100 and SRB values are in terms of thousands of U.S. dollars.

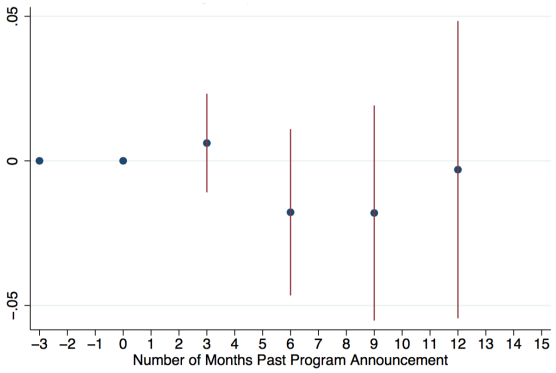
Figure 3: The Effect of Early Retirement Programs on Soldier Selection

Panel A: The Effect of Early Retirement Programs on Soldier Retention

(a) VSI/SSB

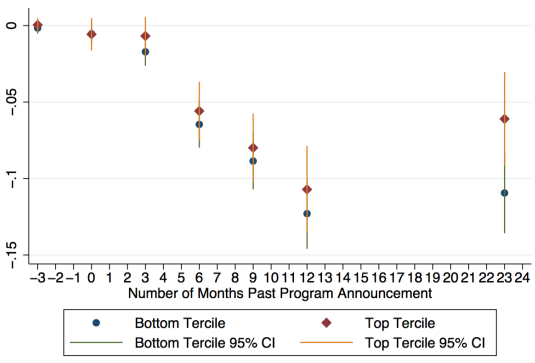


(b) TERA

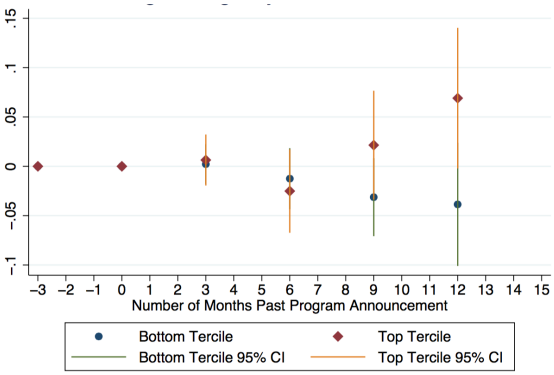


Panel B: The Effect of Early Retirement Programs on Retention by AFQT Scores

(c) VSI/SSB



(d) TERA



Notes: The left graph of each panel (VSI/SSB) shows the probability of remaining in the Army for each month relative to August 1, 1993, the start of the VSI/SSB program and includes soldiers with at least 6 years of experience. In Panel A, blue dots show the coefficient estimate on program eligibility from separate regressions on the probability of remaining in the military in period t. In Panel B, we split soldiers into terciles of the AFQT score distribution. In each time period, we run a regression of program eligibility interacted with the soldier's AFQT tercile on the probability of remaining in the military in period t. The right figures shows similar specifications, but defines the sample and the time period relative to August 31, 1994, the day the TERA program was introduced and includes only soldiers in the affected ranks and occupations, who have tenures that put them within 1 year of being eligible. In panel B, blue circles plot the coefficient on program eligibility interacted with the bottom tercile, and red diamonds plot the coefficient on program eligibility interacted with the top tercile. The middle tercile was also included in the regression but is not plotted here. Across all figures, regressions also includes occupation and rank fixed effects, a control for the soldier's tenure as of the program start date, dummies for the soldier's AFQT score tercile, and demographic controls (age, marital status, gender and race). Lines show the 95% confidence intervals, with standard errors clustered at the occupation*rank*year of service bin.

Table 1: Summary Statistics

	(1) Full Sample	(2) Soldiers with Reenlistment Choice	(3) Spells ending in exit	(4) Spells ending in Reenlistment
Fraction Male	0.85	0.85	0.85	0.86
Age	28.37	29.02	29.71	28.66
Years of Service	6.33	6.98	7.96	6.46
Fraction Married	0.57	0.60	0.52	0.64
AFQT Percentile	57.94	58.25	59.68	57.48
Months as Sergeant in First Term	2.51	2.99	1.95	3.55
Number of Soldiers	1,626,298	1,180,179	726,930	715,153
Number of Spells	2,765,755	2,102,206	734,972	1,367,234

Notes: Sample in Column 1 includes the enlistment spells for all enlisted soldiers from 1992-2016. Column 2 restricts to the enlistment spells at the end of which soliders have the option to reenlist. Column 3 includes the set of spells at the end of which the soldier decides to exit the military. Column 4 includes the set of spells that are followed by another term in the Army. Years of service are defined as of the end of the spell, and AFQT scores are measured at the time of entrance into the Army.

Table 2: The Effect of SRBs on Soldier Retention, by Soldier Ability

Dependent Var.: Reenlistment					
	(1)	(2)	(3)	(4)	(5)
Ability Measure:	AFQT Score				Months Below Sergeant in First Term
SRB	0.158	0.615	0.327	0.359	-0.607
	(0.042)	(0.078)	(0.066)	(0.085)	(0.108)
SRB * Ability		-0.710	-0.281	-0.745	0.015
		(0.116)	(0.102)	(0.117)	(0.002)
Ability	-11.411	-9.347	-14.312	-9.127	0.309
	(0.873)	(0.868)	(0.648)	(0.914)	(0.024)
R^2	0.157	0.157	0.189	0.195	0.171
Year * Month FE	Y	Y	N	N	Y
Year * Month * CZ FE	N	N	Y	N	N
Year * Month * MOS FE	N	N	N	Y	N
MOS * Rank * YOS FE	Y	Y	Y	Y	Y
Demographic Controls	Y	Y	Y	Y	Y
Avg. Reenlistment Rate	65.10	65.10	66.72	65.13	66.30
Avg. SRB	2.89	2.89	3.26	2.9	3.02
Observations	1,761,615	1,761,615	1,422,783	1,757,584	1,708,425

Standard errors are reported in parentheses. They are two-way clustered at the MOS*Rank*YOS and individual level. Sample is restricted to the soldiers who are eligible to reenlist in spells ending between 1997-2015. SRBs are in $1000s of 2015 dollars. Demographic controls include gender, age, marital status, race, and special skill dummies. "Ability" is defined as AFQT score for columns (1)-(4) and months below Sergeant for column (5). AFQT is on a scale from 0-1. See Table C1, Column 1 for evidence that the average SRB in a given period is conditionally uncorrelated with the average ability of the eligible soldiers.

Table 3: The Effect of SRBs on Soldier Retention, by AFQT
Including Credit Score, Montgomery GI Bill, and Thrift Saving Program Interactions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Credit Score			GI Bill "Buy-up"			TSP Contribution %		
SRB	0.477	0.472	1.488	0.198	0.169	0.163	0.365	0.363	0.367
	(0.145)	(0.145)	(0.221)	(0.114)	(0.116)	(0.116)	(0.093)	(0.094)	(0.093)
SRB * AFQT	-0.847	-0.839	-0.707	-0.483	-0.427	-0.368	-0.708	-0.706	-0.692
	(0.188)	(0.186)	(0.179)	(0.122)	(0.123)	(0.123)	(0.132)	(0.133)	(0.133)
AFQT	-9.652	-8.511	-3.126	-17.491	-16.735	-16.876	-10.171	-10.806	-10.212
	(0.955)	(0.884)	(3.585)	(0.813)	(0.814)	(0.815)	(0.907)	(0.905)	(0.924)
Mechanism Var.		-0.248	-0.161		-12.662	-9.727		29.542	56.600
		(0.020)	(0.041)		(0.797)	(1.388)		(1.303)	(3.769)
SRB * Mechanism Var.			-0.017			-0.584			-0.656
			(0.002)			(0.107)			(0.167)
AFQT * Mechanism Var.			-0.088			-0.608			-36.592
			(0.056)			(1.787)			(4.937)
R^2	0.207	0.209	0.209	0.221	0.223	0.223	0.232	0.232	0.232
Year * Month FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
MOS * Rank * YOS FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year * Month * MOS FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Demographic Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Avg. Reenlistment Rate	68.28	68.42	68.42	52.05	52.05	52.05	64.62	64.62	64.62
Avg. SRB	2.06	2.06	2.06	3.33	3.33	3.33	2.70	2.70	2.70
Observations	606,350	600,688	600,688	1,000,035	1,000,035	1,000,035	1,168,621	1,168,621	1,168,621

Standard errors are reported in parentheses. They are two-way clustered at the MOS*Rank*YOS and individual level. Sample is restricted to the soldiers who are eligible to reenlist in spells ending between 1997-2015. Samples for columns (1)-(3) are further restricted to soldiers with non-missing credit scores. Samples for columns (4)-(6) are restricted to soldiers with non-missing GI Bill participation data. Samples for columns (7)-(9) are restricted to soldiers with non-missing TSP contribution data. SRBs are in $1000s of 2015 dollars. Demographic controls include gender, age, marital status, race, and special skill dummies. AFQT and TSP contribution % are on scales from 0-1.

APPENDIX FOR ONLINE PUBLICATION

A Theoretical Framework for Public Sector Retention

The goal of this section is twofold. First, we demonstrate the importance of the parameter that we estimate, the differential sensitivity of soldiers to lump-sum bonuses by ability, for capturing how the quality of the military will change with various retention policies. Second, we show that in the simplest model of public sector retention, this key parameter is unambiguously positive – retention policies that increase the financial return should attract higher ability soldiers and increase the average quality of soldiers in the military. However, we show that away from that simple case, the theoretical predictions are ambiguous and depend on the underlying distribution of preferences across the population.

First, we relate the parameter that we estimate in Section 4 to the effect of retention policies on the average quality of the military $\overline{A}$, a parameter that analysis in the military is key for designing retention policies. Mechanically, the total quality of retained soldiers is

$$\overline{A} = \sum_{u} p_i(R) * a_i$$

where $p_i(R)$ is the probability that individual i reenlists and a_i is the ability of soldier i. The response of this average to a reenlistment bonus K is

$$\frac{d\overline{A}}{dK} = \sum_{i} \frac{dp_i(R)}{dK} * a_i = \sum_{i} \gamma_i a_i$$

where $\gamma_i = \frac{dp_i(R)}{dK}$. Using expectations, you can rewrite this as:

$$\frac{d\overline{A}}{dK} = \overline{\gamma}\,\overline{a} + cov(\gamma_i, a_i) = \overline{\gamma}\,\overline{a} + \beta Var(a_i)$$

where $\overline{\gamma}$ is the average response of soldiers to the bonus and $\overline{a}$ is average ability in the military. The key parameter that needs to be estimated to inform the effect of retention policies on average soldier quality is β, which is precisely the parameter we focus on estimating in Section 4.

Having established the importance of this parameter for the design of retention policies, we now explore a simple model of selection that underpins this parameter. Consider a soldier choosing whether to reenlist in the military for a fixed term. As discussed above, personnel management is notoriously rigid in the military. Although individual ability can indirectly influence compensation – for example, higher ability individuals might be promoted more quickly, entitling them to a steeper wage profile

– at least in the short term, military compensation is largely independent of individual ability. Alternatively, in a competitive civilian labor market, higher ability individuals earn their full marginal product. Therefore, in our simplified model, military compensation is independent of individual ability, whereas civilian wages are increasing in ability.

We will write the individual's military payoff as:

$$U_i(military) = W^m(\mathbf{X}_i), \tag{A1}$$

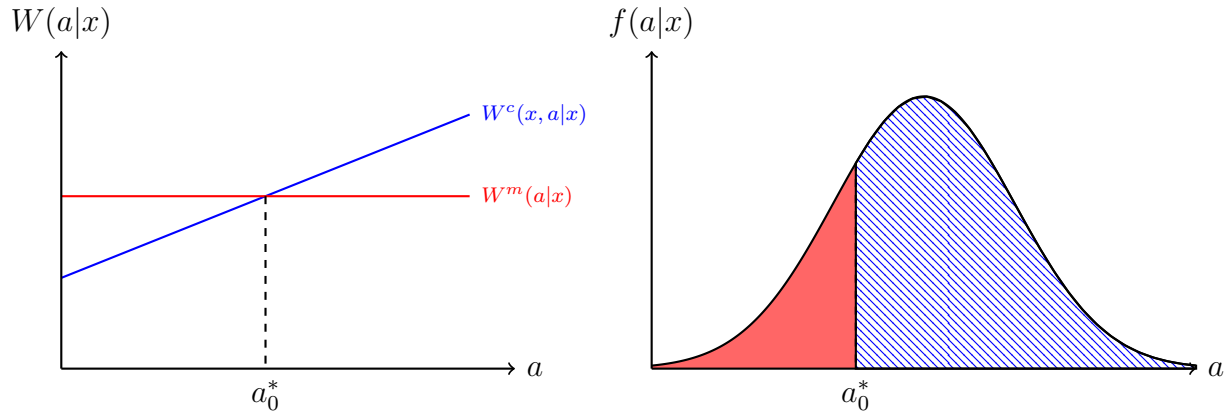
where W^m is the military wage function and $\mathbf{X}$ is a vector of individual characteristics affecting compensation (for example, rank, years of service, and military occupational specialty). Should she choose not to reenlist, the same individual earns a payoff of:

$$U_i(civilian) = W^c(\mathbf{X}_i, a_i), \tag{A2}$$

where W^c is the civilian wage function, and a reflects individual ability, and $\frac{\partial W^c}{\partial a} \geq 0$.

Figures A1a and A1b depict the civilian wage functions and the distribution of ability types, respectively. In this setting, there exists a threshold ability type a_0^*, such that soldiers of ability $a_i < a_0^*$ will always choose to reenlist, and soldiers of ability $a_i > a_0^*$ will always choose to separate from the military.

Figure A1: Simple Case



(a) Civilian Wage Functions

(b) PDF of Soldier Ability

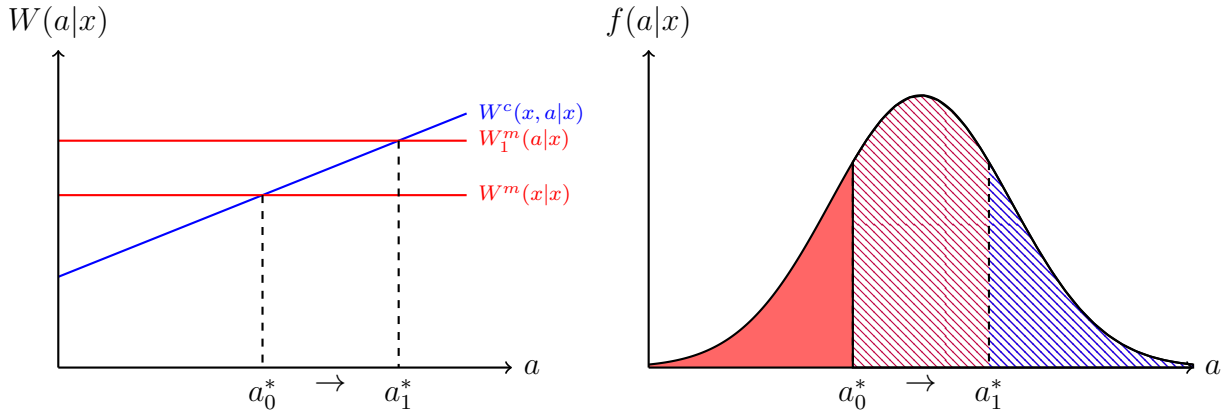
Now suppose that the military wants to attract more workers and therefore offers a lump-sum reenlistment bonus of K. The new military payoff is:

$$U_i(military) = W^m(\mathbf{X}_i) + K \tag{A3}$$

Figure A2a depicts the civilian wage functions subsequent to the level shift in mil-

itary wage. As illustrated by the figure, a level shift in the military wage generates a corresponding increase in the threshold ability type, a_1^*. Intuitively, as military wages increase, the military will tend to retain more service members. Only the most productive soldiers will be able to command a comparable wage in the civilian labor market. Figure A2b depicts the new cutoff rule. In this simple case, an increase to the relative military payoff generates an increase in the marginal ability type a^*, and implies that higher ability soldiers are more responsive to reenlistment bonuses than their lower-ability peers. It is only the higher-ability workers who are on the margin and thus affected by lump-sum bonuses. It also increases the average ability of the soldiers who the military retains, which is likely a key statistic that the policy-maker cares about.

Figure A2: Exogenous Shift in Relative Military Compensation



(a) Civilian Wage Functions

(b) PDF of Soldier Ability

While this simple model generates an unambiguous counterfactual prediction, a setting with richer soldier heterogeneity will produce theoretically ambiguous responses. Suppose that soldiers have heterogeneous "taste" for military service c_i drawn from a continuous distribution $F(\cdot)$. In particular, rewrite the military payoff function as

$$U_i(military) = W^m(\mathbf{X}_i) + c_i, \tag{A4}$$

Given heterogenous taste for service, a soldier i reenlists if her military payoff exceeds her civilian payoff, or $W^m(\mathbf{X}_i) + c_i > W^c(\mathbf{X}_i, a)$. This yields a cutoff rule for the soldier's reenlistment decision with respect to ability type a_i. Namely, conditional on individual characteristics $\mathbf{X}$, a soldier reenlists if

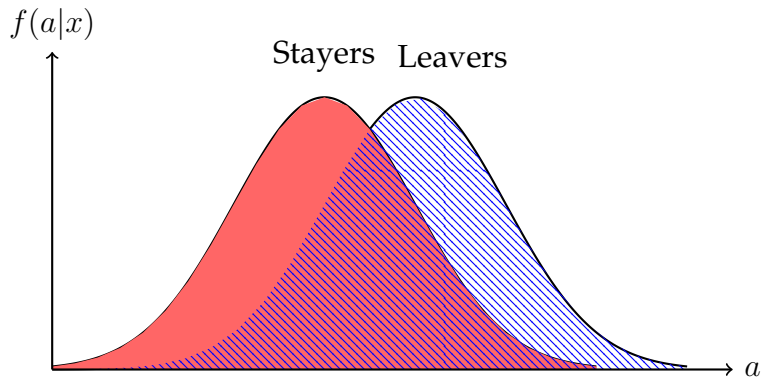
$$a_i < g(c_i), \tag{A5}$$

where $g(c_i) = W^{c^{-1}}\left(W^m(X_i) + c_i\right)$ and $g'(c_i) > 0$.

Figure A3 depicts stylized baseline ability distributions of stayers and leavers in

this continuous-type setting. As Equation (A5) demonstrates, conditional on a soldier's taste for the military (c_i), the sorting of stayers and leavers looks identical to our simple case in Figure A1b. However, in the continuous-type setting, we have to aggregate across values of taste-for-service types c_i in order to obtain the full distribution of ability types among either stayers or leavers. In other words, we obtain the "stayer" distribution in Figure A3 by adding up the areas left of the cutoff value $g(c_i)$ for each taste-for-service type c_i. Consistent with the preliminary prediction that those who reenlist are of lower average ability than those who do not reenlist, we draw the PDFs so that the stayer ability distribution peaks to the left of the leaver ability distribution. In this more general case, there are many ability types for which soldiers will either reenlist *or* separate, depending upon their individual taste for service. Stayers on the far right-hand tail of their ability distribution – that is, those who reenlist despite highly marketable private-sector job skills – have a very high taste for military service. Conversely, leavers on the far left-hand tail of their ability distribution – that is, those who separate from the military despite relatively low private-sector job skills – have a very low taste for military service.

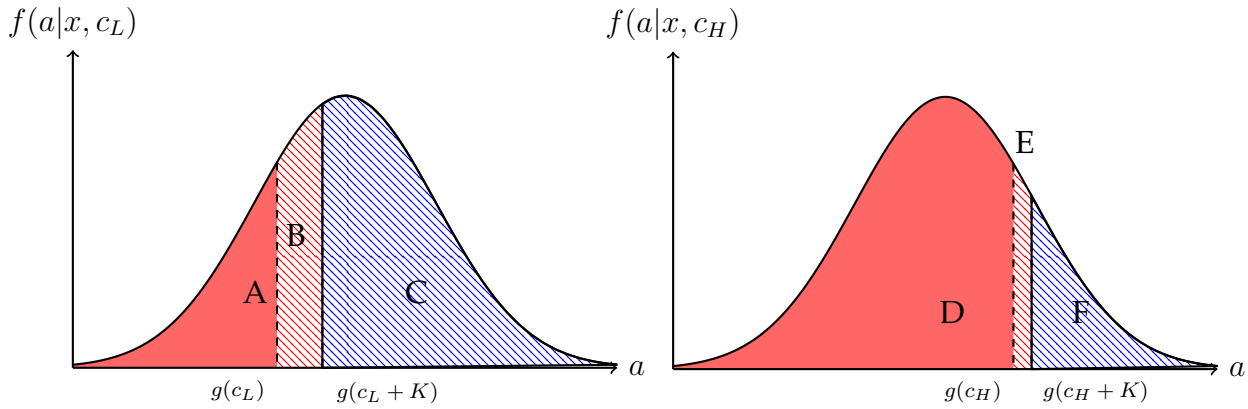
Figure A3: Stayer and Leaver Ability Distributions,
Continuous Taste Types (c_i)



Now consider the introduction of lump-sum bonuses K, again in the form of a positive level shift in the military wage, so that the military payoff is $W^m(\mathbf{X}_i) + c_i + K$. Under the new cutoff rule, a soldier reenlists if $a_i < g(c_i + K)$. Conditional on taste for service, the stark predictions depicted in Figure A2 from the simple case still hold. That is, for each value of c_i, an increase to the relative military payoff generates an increase in the marginal ability type a^* and increases in the average abilities of those who chose to reenlist. However, in aggregating the changes across soldier types, the predictions for how soldiers of different abilities respond to the bonus become ambiguous. What the differential elasticity to bonuses by ability will be will depend upon at least three factors: 1) the shape of the function $g(\cdot)$ (which incorporates both

how individuals trade off taste for military service with other types of compensation and how civilian employers reward ability), 2) the density of the ability distribution around cutoff values and 3) the correlation between ability a and taste for service c.[33]

Figure A4: Change in Relative Return to Military Service, Two-Type Case



(a) Low Taste for Military Service (c_L)

(b) High Taste for Military Service (c_H)

To fix intuitions, suppose there are just two types of taste for military service, $c_i \in \{c_L, c_H\}$, denoting either a low or high taste for military service. Figure A4a shows the new cutoff rule after the bonus K for individuals with a low taste for service c_L, and Figure A4b shows the new cutoff rule for individuals with a high taste for service c_H. Soldiers in areas A and D were always going to reenlist in the military, and soldiers in areas C and F were never going to reenlist. Areas B and E, on the other hand, correspond to soldiers who were induced to stay in the military due to the change in the compensation policy. The estimated differential response to the bonuses by ability will depends on the size and placement of these two areas. Specifically, the size of area B and E is going to depend on the distance between $g(c_L)$ and $g(c_L + K)$ or between $g(c_H)$ and $g(c_H + K)$. This is determined by the shape of the g function. The size of area B and E is also going to depend on the density of soldiers around these cutoffs (i.e the height of the distribution). Affecting parts of the ability distribution where there are more soldiers will have a bigger effect on the average quality of the group. Even in this simple two-type case, without further assumptions, there is no clear prediction for whether higher or lower skill soldiers will be more responsive to reenlistment bonuses. In this simple model, our empirical finding that lower ability soldiers are more responsive to these lump-sum bonuses corresponds to the case where B is larger than E.

[33] In the dynamic version of this static problem where soldiers consider the expected future stream of compensation, this would also depend on the correlation between discount factors and ability a.

B Data Appendix

B.1 Data Details

B.1.1 Reenlistment Data

The data for this analysis comes from the U.S. Army's Total Army Personnel Database (TAPDB), from which we have constructed a panel of enlistment spells between 1992 and 2016. We exclude from the analysis all current spells. For our analysis, the date of entry into the military is identified for each soldier according to the first month in which they received payments. This captures military service that the soldier may have preformed in the past either in nonconsecutive spells or in other branches of the military. We drop all observations where we observe only 1 spell for the soldier that is less than 3 months. These spells are likely soldiers who did not complete basic training. We also drop spells that are are the end of the soldier's tenure, are less than 3 months, and result in the soldier entering officer training. We code that soldier as reenlisting in our analysis.

In addition to making the choice of whether to reenlist at the end of their spell, some soldiers have the option of extending their contract by up to a year. We identify spells as extension if the entry date of the spell is the same as the extension date of the previous spell. Since we are interested in major reenlistment decisions, we absorb all extensions into the previous spell. For example, if a soldier served for 3 years and extended their spell for 1 year, but then left the military, we code the soldier as having 1 four year spell and then choose not to reenlist. The left panel of Figure B2 shows the distribution of spell length in the resulting sample, and the right panel of Figure B2 shows the distribution of enlistment terms in our sample.

In addition to knowing the date at which the soldier decided to reenlist and the date at which the term of service was due to end, we need to identify the date at which the soldier entered the reenlistment window. We use this date to assign the unemployment rate and SRB offer that the soldier faces. When in the reenlistment window the soldier decided to reenlist is the soldier's choice, and we want to abstract from variation in the relative military wage that are the result of strategic timing of the market. For each fiscal year, the Army announces in MILPER messages the date at which the soldier is eligible to enter their reenlistment window. Before fiscal year 2007, soldiers entered their reenlistment window 12 months before the end of their contracted service. However, for 2007, 2008 and 2009, the army extended this to 24 months. In the following years, all soldiers with terms expiring in the following year became eligible for reenlistment window on a given date. Figure B3 plots the distribution of the number of months in advance the end of service (ETS) date that the soldier enters their reenlistment window. Most soldiers enter 12 months in advance, with ad-

ditional masses at 15 and 24 months. Most soldiers also reenlist at some point in that window.

We use two main measures of soldier quality throughout our analysis: the soldier's AFQT score at entry and the number of months in their first term that the soldier spends below Sergeant (E-5). Table B1 shows estimates from Wigdor and Green (1991) showing that AFQT score are highly correlated with within-military hands on performance metrics. Figure B4 also shows that AFQT scores are highly predictive of being promoted quickly within the military. We chose the number of months below sergeant as our measure of military performance because it is highly correlated with future performance in the military. Table B2 shows the pairwise correlations for the number of months that it takes soldiers to get to each rank. The speed of promotion to E-3 or E-4 is not highly correlated with strong performance later in the soldier's career, as those promotions are more defaulted, so we use the speed of promotion to E-5.

B.1.2 Credit, GI Bill, and Thrift Savings Plan (TSP) Data

Credit data were obtained from a major credit reporting agency, which we then matched with the TAPDB enlistment database. Credit data consists of a panel of twice-annual observations for soldiers with service between April 2007 and March 2015. Among soldiers who were eligible for at least one reenlistment during that time period, we are able to match nearly 90% to credit reporting data. For each soldier facing a reenlistment choice, we match the soldier to her credit report that is closest in time to the beginning of her reenlistment window. In addition to individual credit scores, we observe open lines of credit, balances, and delinquencies, grouped by major lending categories. For simplicity, we focus our analysis on credit scores, but we have confirmed that our results are largely robust to proxying for credit constraints with past delinquencies.

GI Bill data are directly observable within the TAPDB enlistment database. Immediately upon enlistment, soldiers who meet minimum eligibility requirements are offered the opportunity to enroll in the Montgomery GI Bill (MGIB) benefits package. In order to enroll, a soldier must consent to having $1,200 deducted from her military pay, usually in equal $100 deductions from her first twelve monthly pay checks. Under 2016 rates, soldiers who enrolled in the basic MGIB package were eligible to receive up to $66,852 in total educational benefits (up to $1,857 per month for 36 total months of higher education). Soldiers who enroll in the MGIB are given the further opportunity to participate in the MGIB "buy-up" by consenting to an additional deduction of between $20 and $600. Soldiers who participate in the full $600 buy-up become eligible to receive up to $5,400 in total MGIB educational benefits ($150 per month for 36 months). In our data we observe whether a soldier is eligible to enroll in the stan-

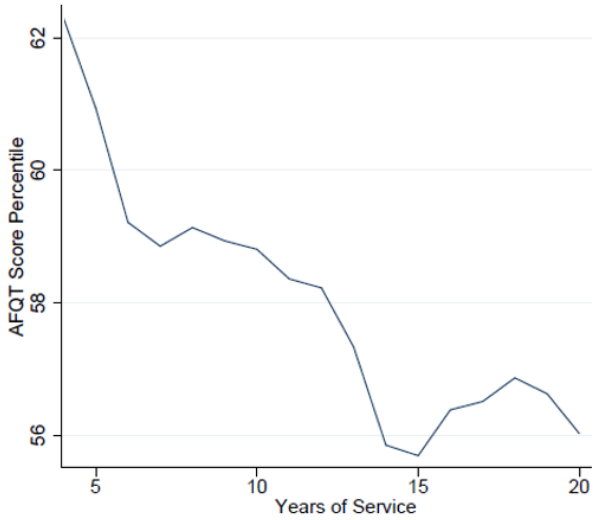
dard MGIB benefits package and whether she actually enrolls, as well as the amount of her total accrued MGIB contributions. We code soldiers as having participated in the buy-up when they have contributed a total of $1,800 towards the MGIB (the basic $1,200 contribution plus the full $600 buy-up contribution). Among our soldiers in our baseline sample, more than 93.3% enrolled in the basic MGIB, and among those, 3.3% participated in the full $600 buy-up.

We observe Thrift Savings Plan (TSP) contribution data using payroll data from the Defense Finance Accounting Service. The TSP is a 401(k)-like retirement savings plan available to many federal workers. First established for civilian workers in 1986, members of the military became eligible for the TSP in 2001. For each spell, we observe the soldier's total contribution to her TSP account. We also observe her total base military pay over the course of her spell, which we use to calculate her TSP contribution as a share of her total basepay. We also create an indicator variable for whether a soldier has made any contribution greater than zero to her TSP account over the course of her spell. Among enlistment spells since 2001, approximately 32% of soldiers make some positive contribution to the TSP, and the average contribution (as a share of total spell base military pay) is approximately 2.2%.

Appendix Table B6 shows pairwise correlations between credit score, basic MGIB enrollment, participation in the MGIB buy-up, participation in the TSP (i.e., any contribution), and total TSP contributions as a share of the servicemember's military pay. Credit scores are positively correlated with ability measures, as are participation in the MGIB buy-up and participation in the TSP. Enrollment in the basic MGIB is slightly negatively correlated with both of our ability measures.

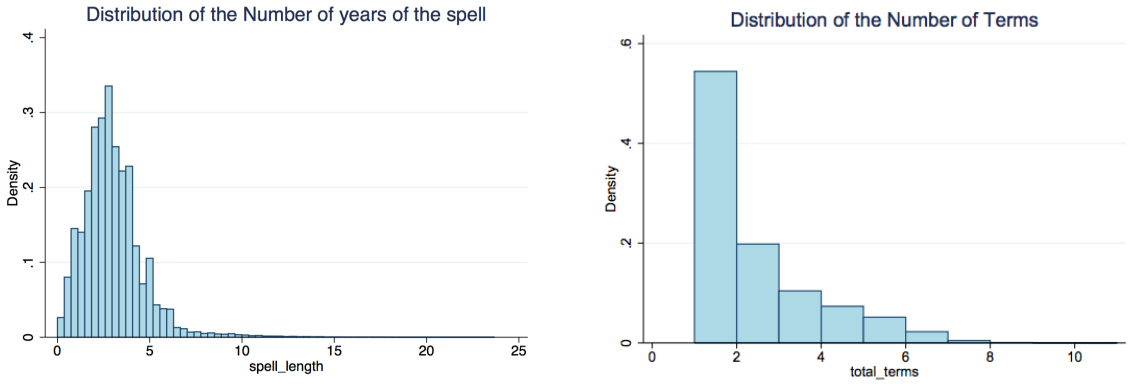
B.1.3 Data Appendix Tables and Figures

Figure B1: Average AFQT Score Percentile by Tenure with the Army



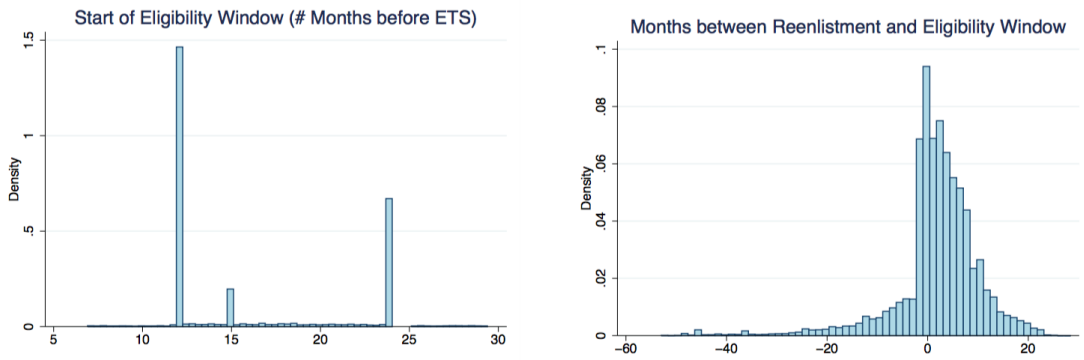
Notes: The figure plots the average AFQT Score Percentile of enlisted soldiers in the Army from 1992-2016, excluding soldiers who are currently serving. Years of service is defined as a soldier's total tenure with any branch of the military. Years of service is measured at the time of separation, or, for soldiers still serving, in the current period.

Figure B2: Distribution of the Number of Terms amoung Enlisted Soldiers (1992-2017)



Notes: Sample includes all enlisted soldiers from 1992-2016 and excludes soldiers currently serving in the Army.

Figure B3: The Timing of Reenlistment Decisions and the Eligibility Window



Notes: Sample includes all enlisted soldiers from 1992-2016 and excludes soldiers currently serving in the Army. The left panel plots the distribution of the time between the beginning of the reenlistment window and the end of the soldier's term The right panel plots the distribution of the difference between the start of the reenlistment window and the date that the soldier actually reenlists.

Table B1: Correlations of Armed Forces Qualifications Test (AFQT) and Job-Specific Hands-On Performance Measure

Specialty	AFQT w/ Performance
Administrative specialist	0.35
Air traffic control operator	0.10
Rifleman	0.40
Machinegunner	0.49
Mortarman	0.33
Motor transport operator	0.24
Radio operator	0.22
Median Correlation	0.26

Source: Wigdor and Green (1991), Table 8-10.

Table B2: Correlation of Promotion Speeds Across Ranks

	(1)						
Time to:	E-2	E-3	E-4	E-5	E-6	E-7	E-8
E-2	1						
E-3	0.758	1					
E-4	0.598	0.686	1				
E-5	0.0764	0.128	0.298	1			
E-6	0.0526	0.0876	0.213	0.620	1		
E-7	0.0812	0.112	0.241	0.565	0.803	1	
E-8	0.112	0.144	0.256	0.505	0.653	0.774	1

Notes: Sample includes all enlisted soldiers from 1992-2016. Correlations are pairwise.

Figure B4: The Correlation of AFQT scores and speed of promotion

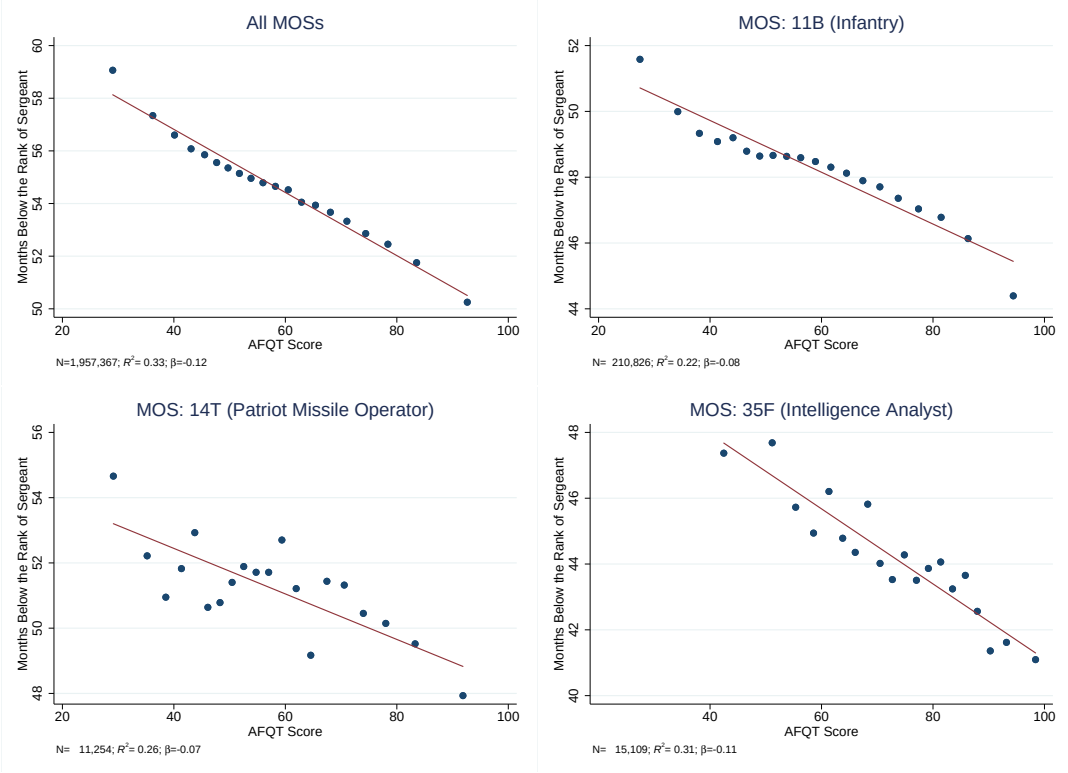
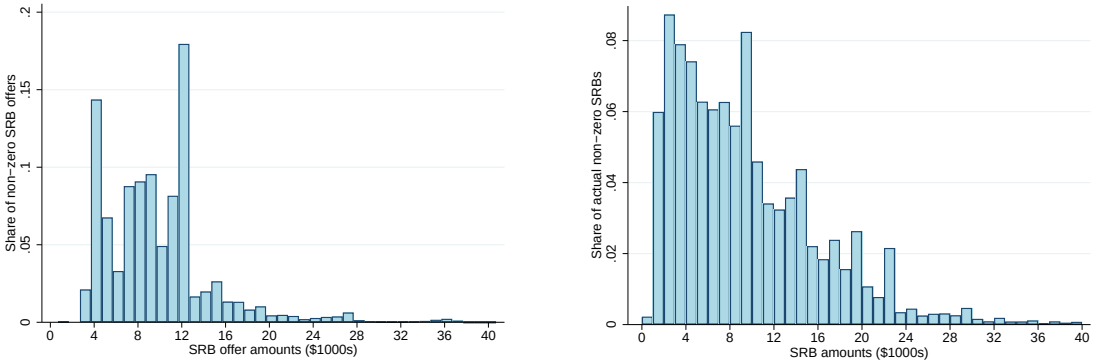


Figure B5: Distribution of SRB Offers and Actual SRB Bonuses, 1997–2015



(a) SRB Offers

(b) Actual bonuses received

Table B3: Correlation of SRB offers Across Chosen Reenlistment Term

	(1)
	4 Year Term
2 Year Term	0.593
3 Year Term	0.986
5 Year Term	0.988
6 Year Term	0.964

Notes: Sample includes all SRB offers from 1997-2016. Correlations are pairwise.

Table B4: Correlations of Unconditional and Conditional (Location-Specific) SRB Offers (4-year terms)

	(1) Regular Offer
Continental US 1	0.372
Continental US 2	0.510
Continental US 3	0.585
Continental US 4	0.698
Continental US 5	0.722
Continental US 6	0.846
Continental US 7	0.831
Non-continental 1	0.586
Non-continental 2	0.608

Notes: Sample includes all SRB offers from 1997-2016. Correlations are pairwise.

Figure B6: Continuation Profiles by AFQT Score

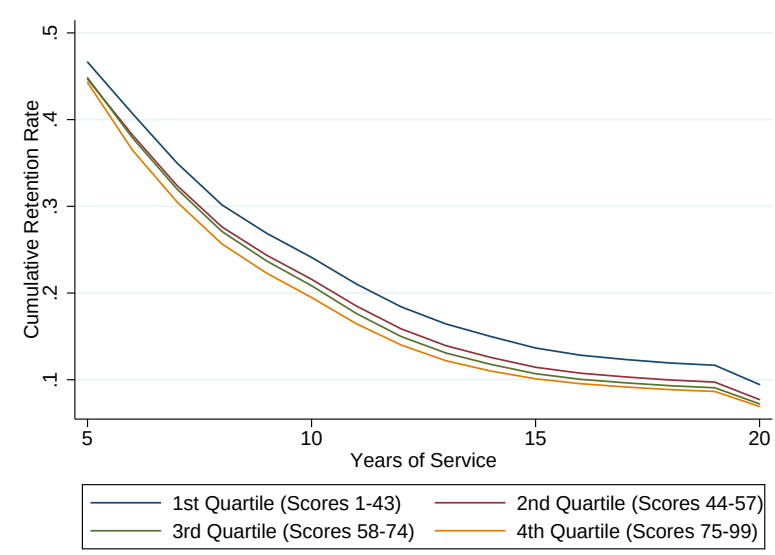


Table B5: Eligibility for Early Retirement Programs

	Panel A: TERA Program		
	All Soldiers	15+ Years of Service	Within 1 year of cutoff
Total Soldiers	259,998.00	25,441.00	3,114.00
Eligible Soldiers	1,731.00	1,731.00	1,731.00
Fraction Eligible for TERA	0.67	6.80	55.59
	Panel B: VSI/SSB Program		
	All Soldiers	6+ YOS	–
Total Soldiers	194,017.00	62,420.00	–
Eligible Soldiers	7,326.00	7,326.00	
Fraction Eligible for VSI	3.78	11.74	

Notes: In Panel A, Column 1 includes sample is all enlisted solders serving in the military on August 31, 1994, the start date for the TERA program. In Panel A Column 2, the sample is restricted to those with at least 15 years of service. In Column 3, the sample is restricted to those in eligible occupations and ranks with service that puts them within 1 year of eligibility. In Panel B, Column 1 includes all enlisted soldiers serving in August 1, 1993, the start date of the VSI program. Column 2 further restricts the sample to those soldiers with at least 6 years of service.

Table B6: Pairwise Correlations Between Ability Measures (AFQT and Months Below Sergeant) and Credit Score, MGIB Participation, and TSP Participation

	AFQT	Months Below Sergeant
Credit Score	0.21	-0.14
MGIB Enrollment	-0.06	0.01
MGIB Buy-up	0.07	-0.04
Any TSP Contribution	0.09	-0.03
% TSP Contribution	0.12	-0.04

B.2 Case Studies: Time Series Variation in SRBs

Department of Defense guidance establishes that SRB amounts are to be determined by a combination of "inside" factors—i.e., the military's operational and strategic requirements—and "outside factors"—namely, labor market conditions and other economic trends affecting civilian labor market opportunities. Specifically, DoD guidance requires the Army and other branches to consider (1) the potential impact of a "critical personnel shortage" on the mission of the branch, (2) the degree to which current or historic retention in a particular military skill falls short of "established retention objectives," (3) the length and cost of training associated with a particular military skill, (4) any overall Army-wide personnel shortage and shortages within particular ranks, (5) the "relatively arduous or otherwise demanding nature of the military skill, as compared to other military or civilian alternatives," and, finally, (6) the degree of demand for the military skill in the civilian labor market.[34] In fact, our conversations with U.S. Army officials revealed that inside factors—those reflecting the "needs of the Army"—predominate, and outside factors are incorporated only indirectly. Rather than directly adjusting SRB offers based on civilian labor market conditions or other economic indicators, the Army typically only adjusts SRBs according to its own manning levels. Thus, to the extent that soldiers are more likely to exit the Army when the civilian labor market is strong (Borgschulte and Martorell, 2018), SRB offers will indirectly reflect outside economic conditions by way of their effect on aggregate retention rates (either at the MOS, grade, or Army-wide level).

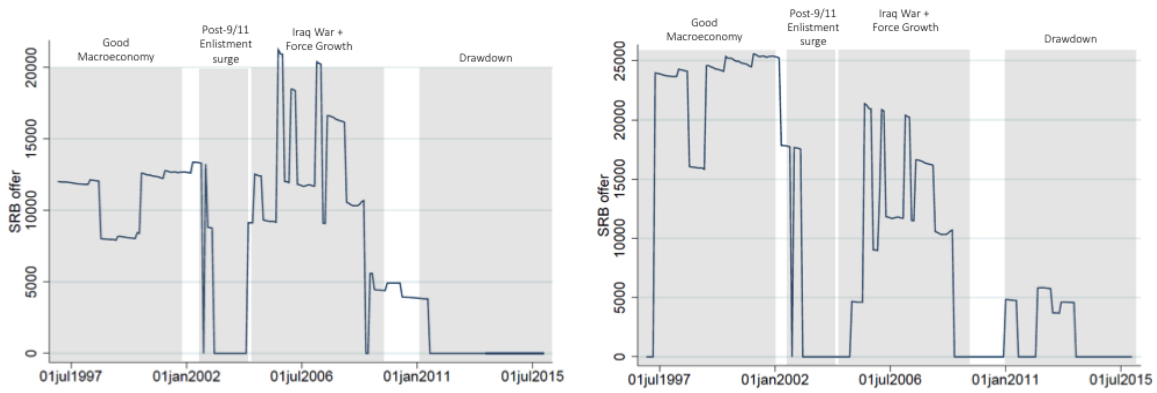
Here we briefly consider how these factors may have driven time-series variation in SRB offers for two separate MOSs. Specifically, in Figure B7, we plot the time series of SRB offers for infantrymen on the left and Patriot missile operators (responsible for operating a type of surface-to-air missile system that gained notoriety during the 1991 Gulf War) on the right. The Infantry MOS is not only the largest in the Army (11% of our sample) but also the most representative of the Army as a whole. Infantry SRBs remained moderately high throughout the period preceding the September 11, 2001 attacks. Although operational requirements were relatively minimal during this period, pre-war SRBs might reflect positive macroeconomic conditions, which forced the military to compete with civilian employers for qualified workers. Relatively high pre-war SRBs for infantry personnel may also reflect lower average retention rates relative to other MOSs as well as the perceived "arduousness" of the specialty relative to other civilian jobs. Still, infantry SRBs dipped dramatically in early 2002 and remained low throughout much of the 2002-2004 period. This may reflect higher accessions and retention during a period of surging enlistment, which many attribute

[34] See Department of Defense Instruction (DoDI) 1304.31, "Enlisted Bonus Program; DoDI 1304.29, "Administration of Enlistment Bonuses, Accession Bonuses for New Officers in Critical Skills, Selective Reenlistment Bonuses, and Critical Skills Retention Bonuses for Active Members."

to heightened patriotism in the aftermath of the 9/11 attacks. Infantry SRBs increased again in 2004, and despite considerable volatility, they remained high through approximately 2008, most likely reflecting the military's growing operational requirements in Iraq and Afghanistan. Though we might be concerned that this period also had higher casualties than other periods (a negative job amenity that is likely to affect reenlistment outside of its effect on SRBs), we control for month fixed effects in all regressions and occupation-by-month fixed effects in others. Infantry SRBs have remained low since approximately 2011, likely reflecting the military's gradual exit from Iraq and its overall drawdown of personnel.

In contrast to infantry SRBs, SRB offers for Patriot missile operators, plotted in the right panel of Figure B7, appear to be largely driven by operational requirements and large-scale changes to the Army's overall force structure. SRB offers to Patriot missile operators were highest between 1997 and 2002, which was precisely the period during which the Army was expanding its number of Patriot missile battalions from 13 to 15. The Army's focus on Patriot missiles was likely influenced by a period of perceived threat by Iraqi Scud missiles, against which Patriot missiles were intended to defend. The Patriot missile operator SRBs illustrate how exogenous changes in Army force structure—due to the standing-up of a new unit or perhaps the introduction of new military technology—can be an important driver of variation in SRBs over time.

Figure B7: Selective Reenlistment Bonus (SRB) Case Studies
SRB offers by MOS (E-4), 1997-2015

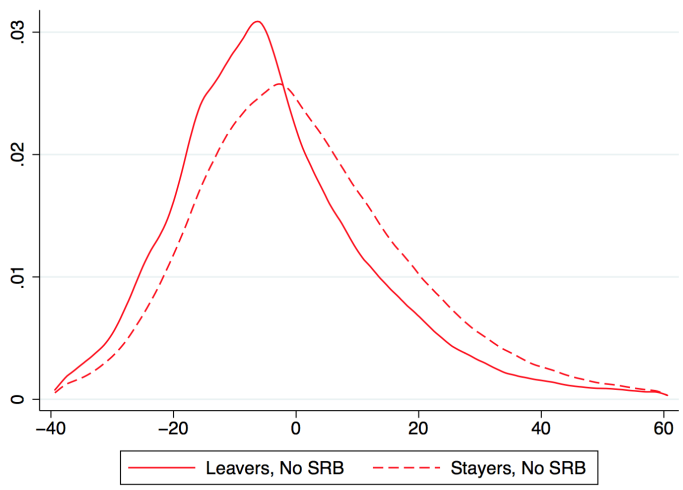


(a) MOS: 11B (Infantry)

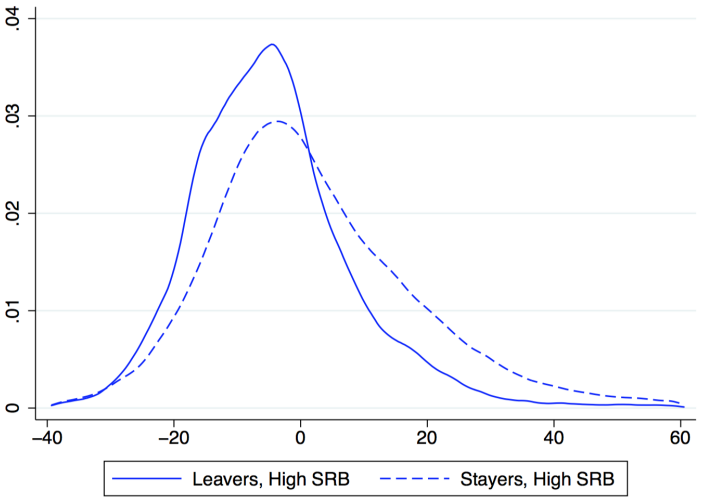
(b) MOS: 14T (Patriot Missile Operator)

C Robustnes of Empirical Results

Figure C1: The Distribution of First Term Promotion Speeds, Split by Reenlistment Decisions and SRB Offers



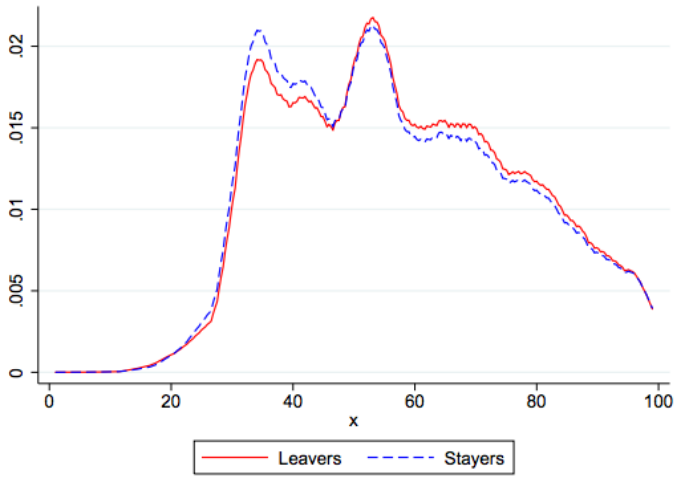
(a) Soldiers without an SRB offer



(b) Soldiers offered an SRB of at least $8,000

Notes: The figure plots the residuals of a regression of the number of months the soldier spent below sergent (rank E4 of below) on MOS*rank*YOS dummies as well as date dummies. The sample includes those soldiers who have a choice to reenlist. The left panel plots the distributions for the set of soldiers who do not have a SRB available at the start of their reenlistment window. The right panel shows the distributions for the set of soldiers who have an offered SRB of at least $8,000. The left figure includes 1.7 million observations (75% of the sample) while the right panel includes 300,000 observations (13% of the sample). Each distribution is truncated at the top and bottom 1%

Figure C2: The raw distribution of AFQT scores for soldiers, split by reenlistment decisions.



Notes: The figure plots the raw AFQT score distribution for soldiers by their reenlistment decision. The sample includes those soldiers who have a choice to reenlist.

Table C1: Soldiers' Reenlistment Probabilities by AFQT and SRB Bonus Offers: Alternative Specifications

	(1) Baseline	(2) SRB in logs	(3) Constant sample	(4) Main MOS only	(5) High-Corr. MOS only	(6) No Surge Years	(7) Positive SRB Offer
SRB	0.615		0.313	0.465	0.600	0.527	0.216
	(0.078)		(0.069)	(0.207)	(0.221)	(0.076)	(0.109)
SRB*AFQT	-0.710		-0.260	-0.646	-0.574	-0.648	-0.224
	(0.116)		(0.105)	(0.335)	(0.366)	(0.113)	(0.117)
AFQT	-9.347	-9.098	-15.158	-11.889	-10.195	-9.201	-17.428
	(0.868)	(0.934)	(0.657)	(1.950)	(2.765)	(0.938)	(1.669)
log(SRB)		0.752					
		(0.098)					
log(SRB)*AFQT		-0.850					
		(0.184)					
R^2	0.157	0.157	0.135	0.127	0.142	0.155	0.114
Year * Month FE	Y	Y	Y	Y	Y	Y	Y
MOS*Rank*YOS FE	Y	Y	Y	Y	Y	Y	Y
Demographic Controls	Y	Y	Y	Y	Y	Y	Y
Avg. Reenlistment Rate	65.10	65.10	66.72	65.87	63.25	63.92	66.35
Avg. SRB	2.89	2.66	3.26	2.96	3.5	2.72	9.86
Observations	1,761,615	1,761,615	1,422,783	627,775	382,301	1,457,868	516,754

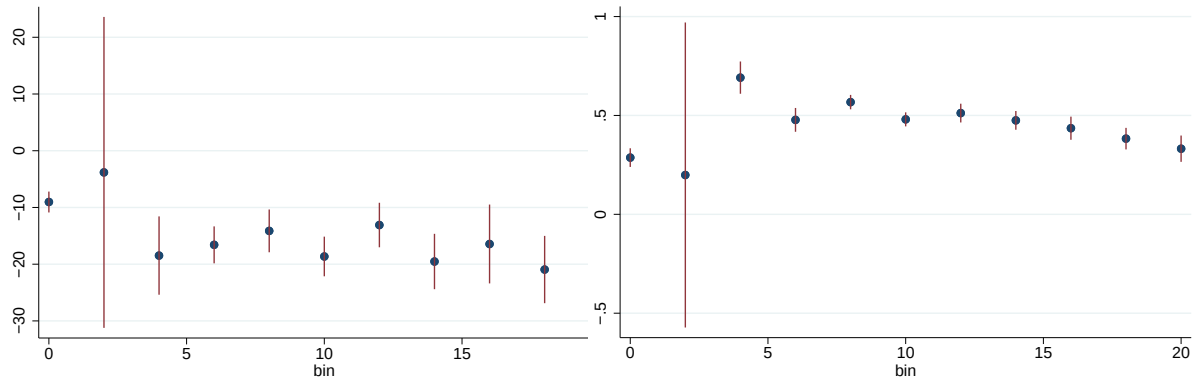
Standard errors are reported in parentheses. They are twoway clustered at the MOS*Rank*YOS and individual level. All samples are restricted to the soldiers who are eligible to reenlist in spells ending between 1997-2015. Demographic controls include gender, age, marital status, race, and special skill dummies. SRBs are in $1000s of 2015 dollars, and AFQT is on a scale from 0-1. The "Constant sample" column is restricted to a sample with non-missing Year*Month*CZ fixed effects; the "Main MOS" column is restricted to the 10 largest occupations in our sample; the "High-Corr. MOS" sample is restricted to MOSs identified by Wigdor and Green (1991) as exhibiting a high correlation between AFQT score and hands-on job performance; the "No Surge Years" column excludes soldiers entering their reenlistment window during the Iraq surge years (2007-2009); and, the "Positive SRB offer" column includes only solders who were offered a positive SRB.

Table C2: Soldiers' Reenlistment Probabilities by Months E-4 or Below and SRB Bonus Offers: Alternative Specifications

	(1) Baseline	(2) Constant sample	(3) Main MOS only	(4) High-Corr. MOS only	(5) No Surge Years	(6) Positive SRB Offer
SRB	-0.607	-0.281	-0.877	-0.952	-0.672	0.461
	(0.108)	(0.098)	(0.295)	(0.326)	(0.116)	(0.111)
SRB*Months E4 or Below	0.015	0.008	0.019	0.024	0.016	-0.009
	(0.002)	(0.002)	(0.005)	(0.005)	(0.002)	(0.002)
Months E4 or Below	0.309	0.416	0.334	0.273	0.288	0.599
	(0.024)	(0.019)	(0.054)	(0.067)	(0.024)	(0.030)
R^2	0.171	0.164	0.150	0.158	0.167	0.150
Year * Month FE	Y	Y	Y	Y	Y	Y
MOS*Rank*YOS FE	Y	Y	Y	Y	Y	Y
Demographic Controls	Y	Y	Y	Y	Y	Y
Avg. Reenlistment Rate	66.3	66.73	66.51	63.92	65.24	66.40
Avg. SRB	3.02	3.27	3.04	3.59	2.86	9.86
Observations	1,708,425	1,433,249	619,066	376,659	1,403,790	522,354

Standard errors are reported in parentheses. They are twoway clustered at the MOS*Rank*YOS and individual level. All samples are restricted to the soldiers who are eligible to reenlist in spells ending between 1997-2015. Demographic controls include gender, age, marital status, race, and special skill dummies. SRBs are in $1000s of 2015 dollars. The "Constant sample" column is restricted to a sample with non-missing Year*Month*CZ fixed effects; the "Main MOS" column is restricted to the 10 largest occupations in our sample; the "High-Corr. MOS" sample is restricted to MOSs identified by Wigdor and Green (1991) as exhibiting a high correlation between AFQT score and hands-on job performance; the "No Surge Years" column excludes soldiers entering their reenlistment window during the Iraq surge years (2007-2009); and, the "Positive SRB offer" column includes only solders who were offered a positive SRB.

Figure C3: Effect of Soldier Ability on Probability of Reenlistment, by SRB Offer Bins

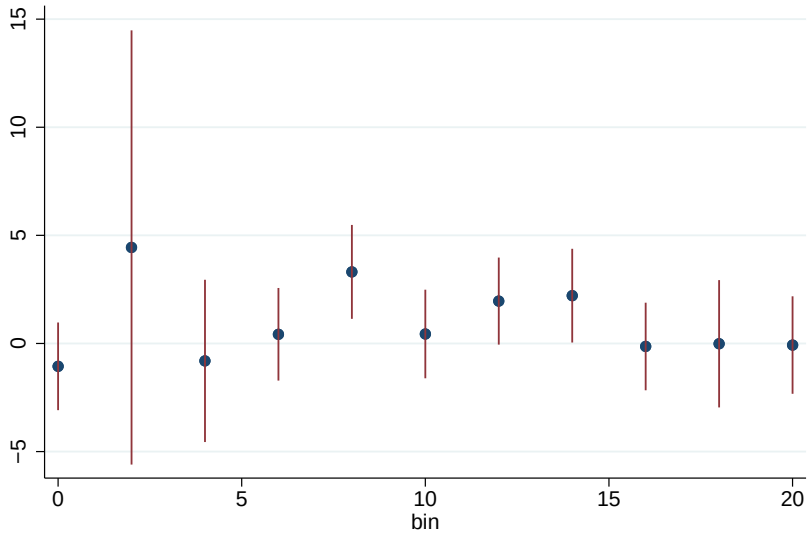


(a) Effect of AFQT, by SRB Bins

(b) Effect of Speed of Promotion, by SRB Bins

Notes: The left panel of this figure plots the coefficient estimates on the interaction of AFQT scores and a dummy for $2,000 SRB offer bins, up to $20,000. Zero-dollar offers are plotted as their own bin, and x-axis labels represent the upper bound of the $2,000-bin. For example, offers of more than $0 but less-than-or-equal-to $2,000 are plotted above $2,000 on the x-axis. The right panel plots similar regression coefficients for the interaction between soldier's promotion speeds and $2,000 SRB offer bins. The promotion speed is measured by the number of months the soldier spend at a rank below a sergeant. In both panels, the red bars show 95 percent confidence intervals, clustering the standard errors at the MOS*rank*yos level. Reenlistment probabilities (the y-axis) are scaled by 100 and SRB values are in terms of thousands of U.S. dollars.

Figure C4: Effect of SRB Offers on Probability of Reenlistment: Nonlinear Specification



Notes: This figure plots the coefficient estimates from a regression of soldiers' reenlistment choices on dummies for $2,000 SRB offer bins, up to $20,000. Zero-dollar offers are plotted as their own bin, and x-axis labels represent the upper bound of the $2,000-bin. For example, offers of more than $0 but less-than-or-equal-to $2,000 are plotted above $2,000 on the x-axis. The red bars show 95 percent confidence intervals, clustering the standard errors at the MOS*rank*yos level. Reenlistment probabilities (the y-axis) are scaled by 100 and SRB values are in terms of thousands of U.S. dollars.

Table C3: Selective Reenlistment Bonuses (SRBs) and Average AFQT: Alternative Specifications

Dependent Variable: AFQT Score Percentile									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
					Subsamples				IV Spec
	Baseline	CZ Trends	MOS Trends	SRB in Logs	Main MOS only	High-Corr. MOS only	No Surge Years	Positive SRB Offers	Actual SRBs
SRB*Stay	-0.048***	-0.056***	-0.018		-0.166***	-0.059	-0.042**	-0.020	-0.038
	(0.015)	(0.016)	(0.012)		(0.035)	(0.056)	(0.019)	(0.020)	(0.065)
SRB*Leave	0.066***	-0.000	0.108***		-0.047	0.074	0.061**	0.024	
	(0.022)	(0.023)	(0.016)		(0.063)	(0.071)	(0.024)	(0.020)	
log(SRB)*Stay				-0.064***					
				(0.016)					
log(SRB)*Leave				0.087***					
				(0.028)					
Stay	-1.216***	-1.817***	-1.183***	-1.132***	-1.544***	-1.250***	-1.173***	-2.195***	
	(0.118)	(0.089)	(0.121)	(0.124)	(0.248)	(0.381)	(0.126)	(0.279)	
R-squared	0.304	0.351	0.326	0.304	0.251	0.226	0.302	0.313	0.290
Observations	1,761,615	1,422,783	1,757,584	1,761,615	627,775	382,301	1,457,868	516,754	913,070
Year * Month FE	x			x	x	x	x	x	x
Year * Month * CZ FE		x							
Year * Month * MOS FE			x						x
MOSxRankxYOS FE	x	x	x	x	x	x	x	x	x
Demographic Controls	x	x	x	x	x	x	x	x	x
Mean Dep. Var	58.26	59.08	58.25	58.26	54.83	59.83	58.17	61.17	56.61
Mean SRB	2.89	3.26	2.9	2.66	2.96	3.5	2.72	9.86	3.36

Note: Standard errors are reported in parentheses. They are twoway clustered at the MOS*Rank*YOS and individual level. Sample is restricted to the soldiers who are eligible to reenlist in spells ending between 1997-2015. SRBs are in $1000 of 2015 dollars. Demographic controls include gender, age, marital status, race, and special skill dummies. The dependent variable is a soldier's AFQT score. AFQT is on a scale from 0-100. The ``main MOS only" column restricts to the 10 largest occupations. The ``high corr. mos" column restricts to MOSs identified by Wigdor and Green (1991) as exhibiting a high correlation between AFQT score and hands-on job performance. The ``no surge years" specification excludes soldiers entering their reenlistment window during the Iraq surge years (2007-2009). The ``positive SRB offer" column incldues only soldiers who were offered a positive SRB. The ``IV Specification" restricts to only those who chose to reenlist and uses the offered SRB as an instrument for the actual SRB offer that the soldier receives. The first stage F-statistic for the IV regression is 460.

Table C4: Selective Reenlistment Bonuses (SRBs) and Average Months Below Sergeant: Alternative Specifications

Dependent Variable: Months E4 or Below								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Subsamples				IV Spec
	Baseline	CZ Trends	MOS Trends	Main MOS only	High-Corr. MOS only	No Surge Years	Positive SRB Offers	Actual SRBs
SRB*Stay	0.022	-0.007	0.051*	0.073	0.054	0.021	0.013	0.076
	(0.030)	(0.031)	(0.030)	(0.091)	(0.106)	(0.032)	(0.029)	(0.082)
SRB*Leave	-0.076***	0.037	-0.055	-0.079	-0.134	-0.116***	0.428***	
	(0.027)	(0.023)	(0.043)	(0.061)	(0.086)	(0.028)	(0.052)	
log(SRB)*Stay								
log(SRB)*Leave								
Stay	6.693***	8.416***	6.652***	7.115***	5.396***	5.974***	13.041***	
	(0.505)	(0.451)	(0.529)	(1.074)	(1.132)	(0.492)	(0.962)	
R-squared	0.342	0.391	0.361	0.305	0.316	0.336	0.327	0.343
Observations	1708425	1433249	1704497	619066	376659	1403790	522354	897384
Year * Month FE	x			x	x	x	x	x
Year * Month * CZ FE		x						
Year * Month * MOS FE			x					x
MOSxRankxYOS FE	x	x	x	x	x	x	x	x
Demographic Controls	x	x	x	x	x	x	x	x
Mean Dep. Var	54.4	53.1	54.4	53.57	52.16	54.41	51.93	58.77
Mean SRB	3.02	3.27	3.02	3.04	3.59	2.86	9.86	3.46

Note: Standard errors are reported in parentheses. They are twoway clustered at the MOS*Rank*YOS and individual level. Sample is restricted to the soldiers who are eligible to reenlist in spells ending between 1997-2015. SRBs are in $1000 of 2015 dollars. Demographic controls include gender, age, marital status, race, and special skill dummies. The dependent variable ``Months E4 or Below" is defined as the number of months spent in a rank below Sergeant during the soldier's first enlistment. The ``main MOS only" column restricts to the 10 largest occupations. The ``high corr. mos" column restricts to MOSs identified by Wigdor and Green (1991) as exhibiting a high correlation between AFQT score and hands-on job performance. The ``no surge years" specification excludes soldiers entering their reenlistment window during the Iraq surge years (2007-2009). The ``positive SRB offer" column incldues only soldiers who were offered a positive SRB. The ``IV Specification" restricts to only those who chose to reenlist and uses the offered SRB as an instrument for the actual SRB offer that the soldier receives. The first stage F-statistic for the IV regression is 460.

Table C5: Selective Reenlistment Bonuses (SRBs) and Average AFQT: Alternative SRB Offer Windows

Dependent Variable: AFQT Score Percentile						
	(1)	(2)	(3)	(4)	(5)	(6)
		Alternative SRB Offer Windows				
	Baseline	6-mo. Avg. SRB	12-mo. Avg. SRB	6-mo. Max. SRB	12-mo. Max. SRB	Final SRB Offer
SRB*Stay	-0.048***	-0.061***	-0.072***	-0.055***	-0.059***	-0.063***
	(0.015)	(0.017)	(0.018)	(0.014)	(0.014)	(0.011)
SRB*Leave	0.066***	0.055**	0.044*	0.055***	0.050**	-0.001
	(0.022)	(0.024)	(0.025)	(0.021)	(0.021)	(0.015)
Stay	-1.216***	-1.227***	-1.247***	-1.189***	-1.163***	-1.530***
	(0.118)	(0.118)	(0.118)	(0.119)	(0.119)	(0.117)
R-squared	0.304	0.304	0.304	0.304	0.304	0.304
Observations	1761615	1761615	1761615	1761615	1761615	1761615
Year * Month FE	x	x	x	x	x	x
MOS*Rank*YOS FE	x	x	x	x	x	x
Demographic Controls	x	x	x	x	x	x
Average Dep. Var	58.26	58.26	58.26	58.26	58.26	58.26
Average SRB	2.89	2.71	2.53	3.21	3.45	.4

Note: Standard errors are reported in parentheses. They are twoway clustered at the MOS*Rank*YOS and individual level. Sample is restricted to the soldiers who are eligible to reenlist in spells ending between 1997-2015.Demographic controls include gender, age, marital status, race, and special skill dummies. SRBs are in $1000s of 2015 dollars and AFQT is on a scale from 0-100. The ``Baseline'' column uses soldiers' highest SRB offer on the first day of their reenlistment eligibility window. The ``6-mo. Avg.'' column uses the average of the high SRB offer on the first day of the first six months of a soldier's reenlistment eligibility window. The ``12-mo. Avg.'' column averages the high SRB offers across the first 12 months of the soldier's reenlistment eligibility window. The ``6-mo. Max.'' column uses the highest SRB offer from the first six months of the reenlistment eligibility window. The ``12-mo. Max.'' column uses the highest SRB offer from the first 12 months of the reenlistment eligibility window. The ``Final SRB Offer'' uses the highest SRB offer available on the last day of a soldier's reenlistment eligibility window, which is generally 90 days prior to the end of the soldier's current enlistment.

Table C6: Selective Reenlistment Bonuses (SRBs) and Average Months Below Sergeant: Alternative SRB Offer Windows

Dependent Variable: AFQT Score Percentile						
	(1)	(2)	(3)	(4)	(5)	(6)
		Alternative SRB Offer Windows				
	Baseline	6-mo. Avg. SRB	12-mo. Avg. SRB	6-mo. Max. SRB	12-mo. Max. SRB	Final SRB Offer
SRB*Stay	0.022	0.012	0.003	0.019	0.017	0.010
	(0.030)	(0.031)	(0.031)	(0.028)	(0.026)	(0.016)
SRB*Leave	-0.076***	-0.083***	-0.089***	-0.077***	-0.080***	-0.016
	(0.027)	(0.030)	(0.033)	(0.027)	(0.027)	(0.022)
Stay	6.693***	6.718***	6.742***	6.668***	6.637***	6.987***
	(0.505)	(0.506)	(0.507)	(0.508)	(0.512)	(0.475)
R-squared	0.342	0.342	0.342	0.342	0.342	0.342
Observations	1708425	1708425	1708425	1708425	1708425	1708425
Year * Month FE	x	x	x	x	x	x
MOS*Rank*YOS FE	x	x	x	x	x	x
Demographic Controls	x	x	x	x	x	x
Average Dep. Var	54.4	54.4	54.4	54.4	54.4	54.4
Average SRB	3.02	2.83	2.64	3.35	3.6	.42

Note: Standard errors are reported in parentheses. They are twoway clustered at the MOS*Rank*YOS and individual level. Sample is restricted to the soldiers who are eligible to reenlist in spells ending between 1997-2015.Demographic controls include gender, age, marital status, race, and special skill dummies. SRBs are in $1000s of 2015 dollars, and the dependent variable ``Months E4 or Below'' is defined as the number of months spent in a rank below Sergeant during the soldier's first enlistment. The ``Baseline'' column uses soldiers' highest SRB offer on the first day of their reenlistment eligibility window. The ``6-mo. Avg.'' column uses the average of the high SRB offer on the first day of the first six months of a soldier's reenlistment eligibility window. The ``12-mo. Avg.'' column averages the high SRB offers across the first 12 months of the soldier's reenlistment eligibility window. The ``6-mo. Max.'' column uses the highest SRB offer from the first six months of the reenlistment eligibility window. The ``12-mo. Max.'' column uses the highest SRB offer from the first 12 months of the reenlistment eligibility window. The ``Final SRB Offer'' uses the highest SRB offer available on the last day of a soldier's reenlistment eligibility window, which is generally 90 days prior to the end of the soldier's current enlistment.

Table C7: Soldier's Survival Probabilities by Soldier Quality and VSI Program Eligibility

Dependent Variable: Indicator for Remaining in Military through VSI Period								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Quality Measure:	AFQT Score Percentile				Months below Sergent in first term			
	All Soldiers		6+ Years of Service		All Soldiers		6+ Years of Service	
VSI/SSB Eligibility	-0.099***	-0.196***	-0.097***	-0.151***	-0.198***	0.411***	-0.174***	0.047*
	(0.014)	(0.032)	(0.016)	(0.032)	(0.014)	(0.031)	(0.012)	(0.026)
VSI/SSB*Quality		0.193***		0.106***		-0.006***		-0.002***
		(0.030)		(0.029)		(0.000)		(0.000)
Quality	-0.099***	-0.107***	-0.022***	-0.034***	0.005***	0.005***	-0.001***	-0.000
	(0.011)	(0.011)	(0.008)	(0.008)	(0.000)	(0.000)	(0.000)	(0.000)
R-squared	0.154	0.155	0.168	0.168	0.230	0.240	0.176	0.182
Observations	189243	189243	60678	60678	161364	161364	32356	32356
Average Dep. Var	0.83	0.83	0.84	0.84	.84	.84	.85	.85
Fraction Eligible	.04	.04	.12	.12	.03	.03	.17	.17

Note: Standard errors are reported in parentheses. They are clustered at the MOS*Rank*YOS. Sample in column 1, 2, 5 and 6 is restricted to all soldiers serving on August 1, 1993 (the first day of the VSI/SSB program and the start of the sample period). Sample in Column 3, 4,79 and 8 is further restricted to those soldiers with between 6 an 20 years of service as of August 1, 1993. All regressions include occupation and rank fixed effects, a control for the years of service as of August 1, 1993, as well as controls for gender, age, marital status, and race. ``Ability'' is defined as AFQT score for columns (1)-(4) and months below Sergeant for columns (5)-(8). AFQT is on a scale from 0-1.

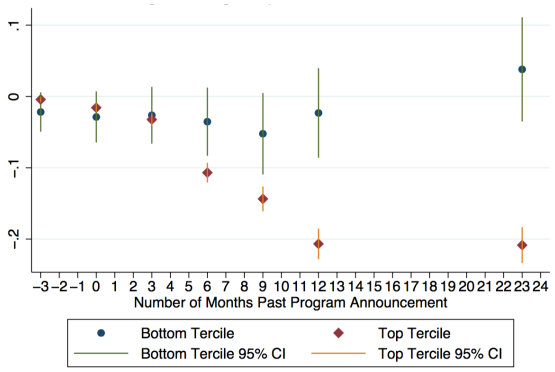
Table C8: Soldier's Survival Probabilities by Soldier Quality and TERA Program Eligibility

Dependent Variable: Indicator for Remaining in Military through TERA Period								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Quality Measure:	AFQT Score Percentile						Months below Sergent in first term	
	All Soldiers		15+ Years of Service		Around Cutoff		All Soldiers	
TERA Eligibility	-0.046***	-0.088***	-0.021	-0.053	-0.024	-0.089**	-0.145***	0.264*
	(0.014)	(0.032)	(0.016)	(0.032)	(0.021)	(0.040)	(0.032)	(0.152)
TERA*Ability		0.078		0.061		0.122*		-0.003***
		(0.056)		(0.057)		(0.067)		(0.001)
Ability	-0.060***	-0.060***	-0.022*	-0.026**	-0.023	-0.066*	0.003***	0.003***
	(0.008)	(0.008)	(0.012)	(0.012)	(0.035)	(0.037)	(0.000)	(0.000)
R-squared	0.107	0.107	0.115	0.115	0.078	0.079	0.148	0.148
Observations	254274	254274	24589	24589	4387	4387	219156	219156
Average Dep. Var	.91	.91	.87	.87	.84	.84	.92	.92
Fraction Eligible	.01	.01	.07	.07	.33	.33	<.01	<.01

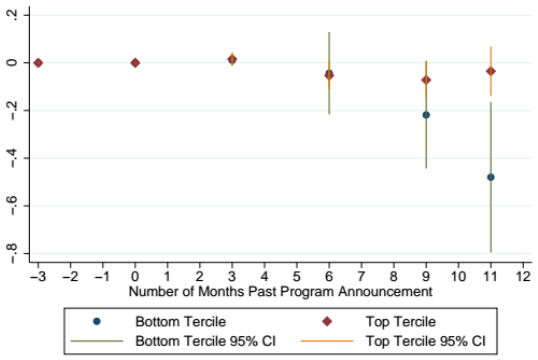
Note: Standard errors are reported in parentheses. They are clustered at the MOS*Rank*YOS. Sample in column 1, 2, 7 and 8 is restricted to all soldiers serving on August 31, 1994 (the first day of the TERA program and the start of the sample period). Sample in Column 3 and 4 is further restricted to those soldiers with between 15 an 20 years of service as of August 31, 1994. Columns 5 and 6 restrict the sample to those soldiers in an eligible occupation/rank but within 2 years (above or below) the mininmum years of service for program eligibility. All regressions include occupation and rank fixed effects, a control for the years of service as of August 31, 1994, as well as controls for gender, age, marital status, and race. ``Ability'' is defined as AFQT score for columns (1)-(6) and months below Sergeant for columns (7) and (8). AFQT is on a scale from 0-1.

Figure C5: The Effect of Early Retirement Programs on Retention by Soldier Promotion Speeds

(a) The probability of surviving by VSI/SSB Eligibility



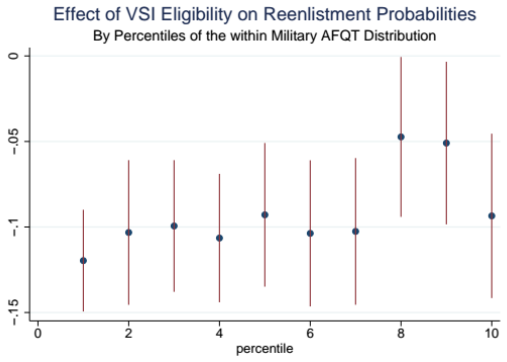
(b) The probability of surviving by TERA Eligibility



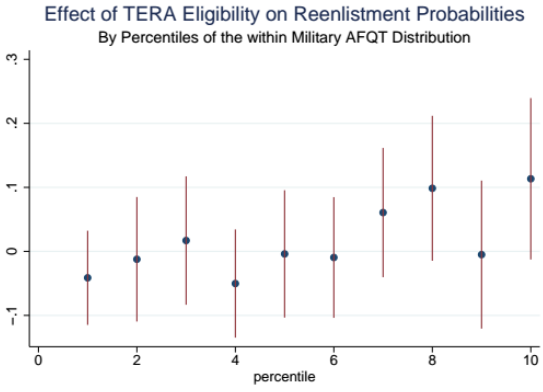
Notes: The left panel shows the probability of remaining in the Army for each month relative to August 1, 1993, the start of the VSI/SSB program, split by the soldier's promotion speed in his first term. We split soldiers into terciles of the months spent below sergeant in their first term. In each time period, we run a regression of program eligibility interacted with the soldier's promotion tercile on the probability of remaining in the military in period t. Each regression also includes occupation and rank fixed effects, a control for the soldier's tenure as of the program start date, dummies for the soldier's promotion speed tercile, and demographic controls (age, marital status, gender and race). Blue circle plot the coefficient on program eligibility interacted with the top tercile, and red triangles plot plot the coefficient on program eligibility interacted with the bottom tercile. The middle tercile was also included in the regression but is not plotted here. Lines show the 95% confidence intervals, with standard errors clustered at the occupation*rank*year of service bin. The sample includes the set of soldiers in the military on February 1, 1993, 6 months prior to the VSI program. The right panel shows similar specifications, but defines the sample and the time period relative to August 31, 1994, the day the TERA program was introduced. The right panel further restricts the sample to include only soldiers in the affected ranks and occupations, who are within 1 year of being eligible.

Figure C6: The Effect of Early Retirement Programs on Soldier Retention by Soldier Quality: Nonlinear Specifications

(a) The probability of remaining in the military by VSI/SSB Eligibility



(b) The probability of remaining in the military by TERA Eligibility



Notes: Each blue dot shows the estimate of program eligibility interacted with the soldier's AFQT score percentile from a regression where the dependent variable is an indicator for the solider still being in the military at the end of the program period. The regression also includes occupation and rank fixed effects, a control for the year of service, dummies for the soldier's AFQT score percentile, and demographic controls (age, marital status, gender and race). Standard errors are clustered at the occupation*rank*year of service bin. The left panel includes the sample of soldiers who were serving on August 1, 1993, the start of the VSI/SSB period, and the right panel includes the set of soldiers who were serving on August 31, 1994, the start of the TERA program. Additioally, the left panel also restricts the sample to those soldiers with at least 6 years of experience. The right panel restricts the sample to include only soldiers in the affected ranks and occupations, who have tenures that put them within 1 year of being eligible.

Table C9: Relationship Between Soldier Ability and Take-Up of SSB vs. VSI

	(1)	(2)	(3)	(4)	(5)	(6)
	Ind. Var.: AFQT			Ind. Var.: Months E-4 or Below		
AFQT	-0.154	-0.094	-0.065			
	(0.021)	(0.023)	(0.026)			
Months E-4 or below				0.082	0.028	0.042
				(0.016)	(0.017)	(0.019)
R^2	0.012	0.085	0.096	0.006	0.087	0.101
MOS FE	N	Y	Y	N	Y	Y
Rank FE	N	Y	Y	N	Y	Y
Demographic Controls	N	N	Y	N	N	Y
Dep. mean	.91	.91	.91	.92	.92	.92
Ind. Mean	53.81	53.78	53.94	88.23	88.35	87.57
Observations	5,620	5,573	5,323	4,970	4,928	4,753

Standard errors are reported in parentheses. Sample is restricted to the soldiers who were eligible for the second wave of the VSI/SSB programs and who chose to separate under one of the two programs. Demographic controls include gender, age, marital status, race, and special skill dummies. AFQT is on a scale from 0-1.

Table C10: The Effect of SRBs on Soldier Retention, by AFQT
Robustness Specifications Including Credit Score, Montgomery GI Bill, and Thrift Saving Program Interactions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Prime Credit Score			GI Bill Enrollment			Any TSP Contribution		
SRB	0.477	0.481	0.631	0.282	0.292	0.562	0.365	0.360	0.346
	(0.145)	(0.145)	(0.152)	(0.115)	(0.115)	(0.112)	(0.093)	(0.094)	(0.094)
SRB * AFQT	-0.847	-0.851	-0.756	-0.567	-0.573	-0.608	-0.708	-0.695	-0.699
	(0.188)	(0.187)	(0.181)	(0.126)	(0.126)	(0.125)	(0.132)	(0.132)	(0.135)
AFQT	-9.652	-8.903	-7.309	-17.463	-17.598	-24.432	-10.171	-10.999	-11.306
	(0.955)	(0.912)	(1.050)	(0.849)	(0.847)	(1.678)	(0.907)	(0.906)	(0.903)
Mechanism Var.		-3.443	-1.401		-3.628	-7.483		4.870	3.943
		(0.290)	(0.624)		(0.456)	(1.066)		(0.181)	(0.369)
SRB * Mechanism Var.			-0.291			-0.267			0.080
			(0.039)			(0.057)			(0.040)
AFQT * Mechanism Var.			-2.610			7.558			1.231
			(0.882)			(1.414)			(0.564)
R^2	0.207	0.209	0.209	0.222	0.222	0.223	0.232	0.233	0.233
Year * Month FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
MOS * Rank * YOS FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year * Month * MOS FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Demographic Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Avg. Reenlistment Rate	68.28	68.42	68.42	52.38	52.38	52.38	64.62	64.62	64.62
Avg. SRB	2.06	2.06	2.06	3.29	3.29	3.29	2.70	2.70	2.70
Observations	606,350	600,688	600,688	1,078,808	1,078,808	1,078,808	1,168,621	1,168,621	1,168,621

Standard errors are reported in parentheses. They are two-way clustered at the MOS*Rank*YOS and individual level. Sample is restricted to the soldiers who are eligible to reenlist in spells ending between 1997-2015. Samples for columns (1)-(3) are further restricted to soldiers with non-missing credit scores. Samples for columns (4)-(6) are restricted to soldiers with non-missing GI Bill participation data. Samples for columns (7)-(9) are restricted to soldiers with non-missing TSP contribution data. Prime credit score is a dummy variable for whether the soldier has a credit score of 680 or greater. GI Bill Enrollment is defined as a dummy variable for whether the soldier enrolls in the GI Bill at all. SRBs are in $1000s of 2015 dollars. Demographic controls include gender, age, marital status, race, and special skill dummies. AFQT is on a scale from 0-1.

D Selection and Average Ability Levels

In this section, we present empirical specifications and results demonstrating how the offer of either reenlistment bonuses or early retirement benefits affects the average quality of soldiers who are retained. The results in Section 4 showed that soldiers of higher ability are both less likely to reenlist in the military on average and are less responsive to both SRB offers and a pair of early early-retirement programs. Appendix Section A further demonstrates that the effect this has on the average quality of retained soldiers is ambiguous and depends on the magnitude of the selection on ability. In this section, we show that our individual-level effects are large enough to generate changes in average soldiers ability-levels. This second analysis also enables us to characterize the quality of the marginal soldiers, i.e. the soldiers who were induced to reenlist when offered higher compensation.

Starting with the Army's SRBs, we estimate the change in the *average* quality of the "stayers" and the "leavers" using the following specification:

$$\text{AFQT}_i = \alpha_0 + \alpha_1 \text{SRB}_{it} * \text{Stay}_{it} + \alpha_2 \text{SRB}_{it} * \text{Leave}_{it} + \alpha_3 \text{Stay}_{it} + \gamma_{MOS,rank,yos} + \mu_t + \delta \mathbf{X}_{it} + \epsilon_{it}, \quad \text{(D1)}$$

The coefficients of interest are α_1 and α_2, which estimate the effect of higher reenlistment bonus offers on the average ability of stayers or leavers, respectively. A positive value on α_1 would indicate that higher bonus offers tend to retain soldiers of higher average ability. As discussed in Section A, our basic conceptual framework offers ambiguous predictions regarding the effect of a change in relative military compensation on the average ability of either stayers or leavers. As in Equation 1, we include MOS×rank×years-of-service fixed effects.

Table D1 shows estimates from Equation D1, showing how the average ability of soldiers who chose to stay varies with the offered bonus. The identifying assumption underlying this analysis is that SRB offers are not systematically offered to cohorts of soldiers that are of higher quality. If this were the case, then we would observe that higher SRB offers are associated with higher quality reenlisted soldiers, but it would not reflect soldier selection.[35] The first column shows that this assumption is indeed satisfied – once we control for the set of fixed effects that determine the SRB offer, there is no correlation between the average ability of the soldiers eligible for reenlistment and their SRB offer. Columns 2 and Column 3 then split the sample by the soldier's

[35]Note that on average, in the raw data, soldiers of higher ability are offered higher bonus offers. This reflects the fact that soldiers of higher ability tend to be in higher skill occupations with more outside options. However, once we control for the soldiers occupation, tenure and rank, this positive correlation goes away.

reenlistment decision. Column 2 shows that when the SRB offer is $10,000 dollars, the average ability of those soldiers who endogenously chose to stay in the military is 0.2 percentage points lower, although the estimate is noisy. As with the results in Table 2 and Figure 2, this shows that lower ability soldiers are more responsive to SRB offers, and enough so that they bring down average soldier quality. Column 3 shows, conversely, that when the SRB is higher, the average ability of those who leave the military is higher, although the estimate is also noisy. Column 4 pools the two samples and jointly estimates how the quality of the two groups endogenously changes as the bonus offer changes. The only difference between this specification and the split-sample specification in columns 2 and 3 is that the fixed effects are restricted to be the same, which gives us more power. When we do this, the results are qualitatively similar but even stronger – when an SRB of $10,000 i is offered, the average AFQT score of the soldiers who reenlist is 0.48 percentage points lower and the average AFQT score of those who exit the military is 0.66 percentage points higher.

While at first glance these magnitudes look small, these are in fact quantitatively large effects. The average difference in quality between the stayers and the leavers is 1.2 percentage points. A $10,000 increase in the average SRB bonus offer increases the difference between these two groups by an additional 1.1 $(0.48 + 0.66)$ percentage points, a 92 percent increase.

The last two columns of Table D1 repeat the analysis using our within-military measures of soldier quality. Recall that smaller numbers reflect higher ability, since faster promotions result in fewer months spent below the rank of Sergeant in a soldier's first term. We see results here that are largely consistent with the AFQT results, in that higher SRBs tend to increase the average quality of leavers while reducing the average quality of stayers. In particular, when the average SRB offer is increased by $10,000, we find that soldiers exiting the Army have spent 0.76 fewer months below the rank of Sergeant. While stayers tend to be lower ability even in the absence of additional bonus offers, we find that a $10,000 increase in the average SRB offer increases the speed-of-promotion gap between stayers and leavers by approximately 15 percent $((0.22 + 0.76)/6.693)$. Appendix Tables C3 and C4 show that these patterns are largely robust to alternative specifications and sample restrictions, including when we instrument for *actual* reenlistment bonuses with SRB offers.[36]

Combining estimates from Table D1 with the previous results from Table 2, we can also benchmark the effect of SRBs on the quality of the *marginal* soldier—the sol-

[36]Because the actual SRB offer is only observed for the set of people who reenlist, we restrict the sample to the stayers only. The actual SRB and the offered SRB can vary for several reasons—for example, the soldier may decide to reenlist for a term that is longer or shorter than 4 years, she may wait to reenlist until later in her enlistment window when the initial SRB offer is no longer available, or she may choose to switch occupations, thereby becoming eligible for an alternative SRB offer. Even so, the SRB offer available at the beginning of a soldier's reenlistment window is highly predictive of the actual SRB offer received. The IV estimates are noisier but similar in magnitude to the OLS regressions.

dier who would not have reenlisted but for the bonus offer. Specifically, for any increase in average SRB offers, we can express the average ability of all retained soldiers ($\tilde{A}$) as a convex combination of the average AFQT score of inframarginal soldiers (i.e. those who would have reenlisted regardless of the heightened bonus offers) and that of marginally-retained soldiers (those who are specifically induced to reenlist by the additional cash bonuses):

$$\tilde{A} = \frac{r}{r + r'} * \bar{A} + \frac{r'}{r + r'} * \bar{A}', \tag{D2}$$

where $\bar{A}$ is the average AFQT score of inframarginal soldiers, r is the quantity of inframarginal soldiers, $\bar{A}'$ is the average AFQT score of marginally-retained soldiers, and r' is the quantity of such soldiers. By solving for $\bar{A}'$, we will can describe how the average quality of marginally-retained soldiers would respond to a counterfactual \$10,000 in the average SRB offer.

On average, approximately 94,000 enlisted soldiers are eligible to reenlist in each year of our sample, of whom approximately 61,200 (65.1%) actually do. Column 1 of Table 2 shows that a \$10,000 increase in the average SRB offer makes soldiers approximately 1.6 percentage points more likely to reenlist. Therefore, were the Army to counterfactually increase the average SRB offer by \$10,000, it would retain approximately 1,410 additional soldiers in an average year. These marginally-retained soldiers would account for approximately 2.25% of all retained soldiers, whereas the remaining 97.75% would have reenlisted absent the additional bonus offers. Column 2 of Table D1 shows that, given average SRB offers, retained soldiers have an average AFQT score of 57.5. Finally, from Column 4, we saw that a \$10,000 increase in SRBs would lower the average AFQT score of retained soldiers by 0.48 points, resulting in a new average AFQT score of 57.02. Plugging these quantities ($r = 61,200$; $r' = 1,410$; $\bar{A} = 57.5$; and $\tilde{A} = 57.02$) into Equation (D2) and solving for $\bar{A}'$, we find that, given a \$10,000 increase in the average SRB offer, the group of marginally-retained soldiers would have an average AFQT percentile score of just 36—more than a full standard deviation below retained soldiers' usual AFQT average of 57.5, and just a few points above the Army's current minimum score of 31 for first-time enlistments. Moreover, our results from Figure 2 (in which we allow the effect of SRBs on reenlistment to vary by decile of the AFQT distribution) suggest that almost four-fifths of the marginally-retained group would come from below the median of the Army's AFQT score distribution.[37]

As before, we also examine the effect of these programs on average quality of retained soldiers by running the regression described in Equation D1.

[37] We arrive at this estimate by taking a Riemann sum of the regression coefficients for the bottom five deciles in Figure 2, then dividing that number by a separate Riemann sum of all ten deciles.

Table D1: Selective Reenlistment Bonuses (SRBs) and Average Soldier Ability

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	AFQT Score Percentile				Months below Sergent in first term	
	Full Sample	*Stayers Only*	*Leavers Only*	*Full Sample*		
SRB	-0.015				0.004	
	(0.015)				(0.020)	
SRB*Stay		-0.021		-0.048***		0.022
		(0.015)		(0.015)		(0.030)
SRB*Leave			0.014	0.066***		-0.076***
			(0.019)	(0.022)		(0.027)
Stay				-1.216***		6.693***
				(0.118)		(0.505)
R-squared	0.302	0.313	0.293	0.304	0.326	0.342
Observations	1761615	1146584	614559	1761615	1708425	1708425
Year * Month FE	x	x	x	x	x	x
MOSxRankxYOS FE	x	x	x	x	x	x
Demographic Controls	x	x	x	x	x	x
Mean Dep. Var	58.26	57.5	59.67	58.26	54.4	54.4
Mean SRB	2.89	2.98	2.73	2.89	3.02	3.02

Note: Standard errors are reported in parentheses. They are twoway clustered at the MOS*Rank*YOS and individual level. The full sample is restricted to the soldiers who are eligible to reenlist in spells ending between 1997-2015. Column 2 restricts to the spells in which the soldier decides to renlist in the Army Column 3 restricts to the enlistment spells where the soldier decides to leave the Army. SRBs are in $1000 of 2015 dollars. Demographic controls include gender, age, marital status, race, and special skill dummies. The dependent variable is defined as AFQT score for columns (1)-(4) and months below Sergeant for columns (5)-(6).AFQT is on a scale from 0-100.

$$\text{AFQT}_i = \alpha_0 + \alpha_1 \text{ELIG}_i * stay_{i,t_T} + \alpha_2 * \text{ELIG}_i * leave_{i,t_T} + \alpha_3 stay_{i,t_T} + \gamma_{MOS,rank} + \delta \mathbf{X}_i + \epsilon_i, \quad \text{(D3)}$$

The coefficients of interest from Equation D3 are α_1 and α_2, which estimate the effect of drawdown program eligibility on the average ability among either stayers or leavers, respectively. Stayers are those who remain in the military at the end of the program eligibility window (t_T), and leavers are those who separate from the military at any point during the program eligibility window.

Table D2 presents estimates from Equation D3, showing how the average ability of those who chose to stay in the Army at the end of the program and those who chose to leave the Army varies with eligibility for the program. The first column shows that even after controlling for soldier rank, occupation, tenure and demographics, the average AFQT score of VSI/SSB-eligible soldiers is lower than that of ineligible soldiers. This is not a problem for identification, but it means that the coefficients in Column 2, which show the relative ability of the stayers and the leavers by the end of the VSI sample period, must be interpreted in relation to the coefficient on VSI/SSB eligibility

in Column 1, rather than relative to 0 as in the earlier analysis.

Column 2 shows that by the end of the VSI period, the average AFQT score of the eligible stayers is about 0.71 percentage points higher ($1.704 - 0.998$) and the average AFQT score of the eligible leavers is almost 2.1 percentage points lower ($1.704 - 3.784$) than the average for the eligible population, shown in Column 1. Columns 3 and 4 show similar results on a more restricted sample of soldiers (namely, those with enough tenure to be among the general group of soldiers targeted by the early retirement program). Finally, Columns 5 through 8 show that the patterns are similar when considering the soldier's speed of promotion—by the end of the VSI period, the average ability of the soldiers still in the Army increased with program eligibility and the average ability of those outside the Army decreased with eligibility, growing. Table D3 shows comparable results for the TERA program, which are qualitatively similar but statistically weaker.

Finally, as we did with SRBs, we can perform a back-of-the-envelope calculation to benchmark how early retirement offers affect the average quality of the marginal soldier. Here, the question is not which soldiers were induced to reenlist at the end of their contract, but rather, which soldiers were induced to separate from the Army by the end of the program eligibility window. From Table B5 we know that more than 194,000 enlisted soldiers were exposed to the VSI/SSB program (in the sense that they were actively serving on August 1, 1993, when the program was first offered). Of these, only 7,326 soldiers (4%) met the eligibility criteria based on tenure, rank, and MOS. A relevant counterfactual, then, is how the average ability of marginal soldiers would respond to a relaxation of program eligibility rules.

We consider a counterfactual scenario in which VSI/SSB offers are extended to an additional 10,000 soldiers, either by relaxing the tenure criteria or by extending early retirement offers to additional MOSs and ranks. We can benchmark the effect of VSI/SSB offers on the quality of the marginal soldier by constructing another weighted average similar to Equation (D2). From Table C7 we know that, of the soldiers serving on August 1, 1993, just 17% would separate from the Army by the end of June 1995, when the VSI/SSB program expired. The same table shows that eligibility for VSI/SSB increased the separation rate by 9.9 percentage points (58%). Therefore, were the Army to counterfactually extend VSI/SSB-style early retirement incentives to an additional 10,000 soldiers, we can anticipate that an additional 990 soldiers would exit the military by June 1995, on top of the 1,700 soldiers who would separate regardless of the early retirement incentives. Under actual program eligibility criteria, soldiers who separated from the Army by the conclusion of the VSI/SSB period had an average AFQT percentile score of 60.2, two points above the average score of those who remained in the Army over the same period. However, Column 2 of Table D2 shows that VSI/SSB eligibility reduced the average AFQT score of leavers by close to

2.1 points, resulting in a new average AFQT score of 58.1. Plugging these quantities ($r = 1,700$; $r' = 990$; $\bar{A} = 60.2$; and $\tilde{A} = 58.1$) into Equation (D2), we find that, were the Army to extend VSI/SSB offers to an additional 10,000 soldiers, almost 1,000 additional soldiers would be induced to leave, and their average AFQT score would be approximately 54.5—close to a third of a standard deviation below the usual average of 60.2 for soldiers exiting the Army during this time period. Our results from Figure C6 make a similar point, suggesting that, given an expansion in VSI/SSB eligibility, more than 70% of marginal leavers would come from below the median AFQT score.[38]

Table D2: Average Soldier Ability and VSI/SSB Eligibility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable:	AFQT Score Percentile				Months below Sergent in first term			
	All Soldiers		6+ Years of Service		All Soldiers		6+ Years of Service	
VSI/SSB Eligibility	-1.705***		-1.760***		4.390***		-3.903***	
	(0.343)		(0.365)		(0.816)		(0.528)	
VSI/SSB Eligibility*Stay		-0.529		-0.616		-9.812***		-10.653***
		(0.444)		(0.438)		(0.833)		(0.730)
VSI/SSB Eligibility*Leave		-3.346***		-3.134***		23.914***		3.768***
		(0.445)		(0.462)		(0.927)		(0.628)
Stay		-2.433***		-0.901***		20.752***		0.854**
		(0.248)		(0.224)		(0.584)		(0.361)
R-squared	0.281	0.283	0.320	0.321	0.370	0.439	0.641	0.650
Observations	189243	189243	60678	60678	161364	161364	32356	32356
Mean Dep. Var	58.57	58.57	54.74	54.74	59.24	59.24	81.06	81.06
Fraction Eligible	.04	.04	.12	.12	.03	.03	.17	.17

Notes: Sample in Column 1, 2, 5 and 6 is restricted to all soldiers serving on August 31, 1994 (the start of the sample period). Sample in Column 3, 4, 7 and 8 is further restricted to those soldiers with between 6 and 20 years of service as of August 31, 1994. All regressions include occupation and rank fixed effects, a control for the years of service as of August 31, 1994, as well as controls for gender, age, marital status, and race. Stay is defined as being in the Army at the end of the VSI/SSB period. The dependent variable is defined as AFQT score for columns (1)-(4) and months below Sergeant for columns (5)-(8). AFQT is on a scale from 0-100.

[38] As with SRBs, we arrive at this estimate by taking a Riemann sum of the regression coefficients for the bottom five deciles in Figure C6, then dividing that number by a separate Riemann sum of all ten deciles.

Table D3: Average Soldier Quality and TERA Eligibility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable:	AFQT Score Percentile						Months below Sergent in first term	
	All Soldiers		15+ Years of Service		Around Cutoff		All Soldiers	
TERA Eligibility	1.450***		-0.211		0.529		31.700***	
	(0.528)		(0.559)		(1.127)		(1.945)	
TERA Eligibility*Stay		2.518***		1.436		0.153		14.569***
		(0.885)		(0.879)		(1.441)		(3.802)
TERA Eligibility*Leave		0.834		-0.922		0.310		44.929***
		(0.611)		(0.622)		(1.110)		(1.645)
Stay		-2.296***		-0.681**		0.440		18.480***
		(0.271)		(0.334)		(0.816)		(0.639)
R-squared	0.277	0.278	0.347	0.347	0.336	0.361	0.334	0.367
Observations	254274	254274	24589	24589	4387	4377	219156	219156
Mean Dep. Var	58.62	58.62	53.75	53.75	52.15	52.13	59.15	59.15
Fraction Eligible	.01	.01	.07	.07	.33	.33	<.01	<.01

Notes: Sample in Column 1, 2, 7 and 8 is restricted to all soldiers serving on August 31, 1994 (the start of the sample period). Sample in Column 3 and 4 is further restricted to those soldiers with between 15 an 20 years of service as of August 31, 1994. Columns 5 and 6 restrict the sample to those soldiers in an eligible occupation/rank but within 2 years (above or below) the mininmum years of service for program eligibility. All regressions include occupation and rank fixed effects, a control for the years of service as of August 31, 1994, as well as controls for gender, age, marital status, and race. Stay is defined as being in the Army at the end of the VSI/SSB period. The dependent variable is defined as AFQT score for columns (1)-(6) and months below Sergeant for columns (7) and (8). AFQT is on a scale from 0-100.