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ABSTRACT

The limited lateral entry and rigid pay structure for U.S. military personnel present challenges in retaining skilled individuals who have attractive options in the civilian labor market. One tool the services use to address this challenge is the Selective Reenlistment Bonus (SRB), which offers eligible personnel with particular skills a substantial cash bonus upon reenlistment. However, the sequential nature of the bonus offer and reenlistment process limits the ability to adjust manpower quickly, raising interest in research that estimates the effect of the SRB on retention. While this literature has acknowledged challenges including potential endogeneity of bonus levels, attrition, and reenlistment eligibility, many studies do not address these concerns adequately. This paper uses a comprehensive panel data set on Air Force enlisted personnel to estimate the effect of the SRB on retention rates. We exploit variation in bonus levels within skill groups, control for civilian labor market conditions, and model reenlistment eligibility to avoid common assumptions that lead to biased impact estimates. We find substantial heterogeneity in the effect of the bonus, with the largest effects on first-term service members and those whose skills have not historically received a substantial bonus. We also find evidence that the bonus affects the timing of reenlistment decisions in addition to their frequency.

JEL Classification Codes: J450, J22, J24, J33

Keywords: Selective reenlistment bonus; Retention; Reenlistment; Timing effect; Labor supply

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I. Introduction

Compensation packages are necessary to recruit and retain workers with the skills required to perform an employer's function. Firms compete within the broader labor market not only to recruit new workers, but also to keep their own skilled labor force. To the extent that any training provided to employees develops general human capital, a firm must pay to retain the talent that it helped to create. These compensation packages may include salaries offered to individuals based on their skills, signing bonuses, and performance-based raises and bonuses.

The U.S. Armed Forces participate in the broader labor market using many of the same compensation mechanisms, but the military also faces unique constraints. Extremely limited lateral entry (Levy et al. 2004) and a rigid pay structure (Asch and Warner 1994) makes the retention of qualified personnel particularly challenging. A key solution to these constraints is a system of supplemental compensation programs designed to incentivize retention among military members with needed skill sets. However, the armed services typically announce these programs with a fixed incentive structure, and then personnel make decisions based on that structure. Accordingly, forecasting the aggregate response to these programs is essential to ensure appropriate staffing levels.

This study examines the effect of one such military compensation program, the Air Force Selective Reenlistment Bonus (SRB). The SRB is a cash bonus offered to spur reenlistment by eligible enlisted service members "in military skills with either demonstrated retention shortfalls or high training costs" (U.S. Air Force 2011, p. 20). While this and similar programs have been studied before, previous work is inadequate for identifying efficient policies. Specifically, strong assumptions about the reenlistment process do not hold true in practice, and studies frequently

identify the effect of the bonus by using variation in bonus amounts over time; such variation is likely correlated with economic conditions that also affect retention probabilities. This paper addresses these problems by modeling the reenlistment process flexibly and using a specification that controls for detailed civilian economic conditions. In particular, we use year-on-year retention as our primary outcome to avoid endogenously timed reenlistment decisions, and we identify the civilian occupations most comparable to each military career.

We find that the Air Force SRB program has relatively small but heterogeneous effects on retention. We estimate that a one-unit increase in the multiplier for first-term service members nearing the end of their contracts—which equates roughly to a $2,000 increase in compensation per enlistment contract year—increases the annual retention rate by 0.8 percentage points. The increase is smaller for service members in later enlistment terms and those who are at the beginning of their contracts and are therefore likely ineligible to reenlist. We also estimate smaller effects later in the study period (2006 and later) compared to earlier, possibly because the sharp increase in military base pay relative to the civilian market over this time diminished the need for additional incentives to retain military personnel. We find greater impacts of the bonus among career fields historically receiving low bonuses and on individuals offered a higher multiplier than in the previous year, perhaps because a bonus is more salient. Finally, patterns of early reenlistment are consistent with strategic behavior to claim bonuses when the amount offered is high. We discuss the potential implications of these findings for retention incentives in the military and in the civilian labor market.

The remainder of the paper proceeds as follows. Section II provides a background on the SRB program and previous literature. Section III describes a conceptual framework of retention and the reenlistment process. Section IV provides an overview of the rich administrative data

used to address the question, while Section V presents the estimation and results. Section VI concludes the paper with a discussion of policy implications. Appendices provide more detail about the construction of the data set and compare retention and reenlistment.

II. Background

Reenlistment bonuses have been an important military retention tool for many decades. Prior to the mid-1960s, the military provided qualified enlisted personnel with a regular reenlistment bonus (RRB) combined with proficiency pay in an effort to retain service members with specified skills.[1] In 1966, Congress approved the use of a variable reenlistment bonus (VRB) in order to improve retention in specific military specialties that were experiencing retention problems (Enns 1975). This program was in effect until June of 1974, when both the RRB and the VRB were eliminated and replaced by the SRB, which remains in effect to this day (Enns 1977).

This study focuses on the Air Force's SRB program, although the SRB programs are similar for the other services. The Air Force offers the SRB to enlisted personnel in specified career fields upon reenlistment; the cash bonus amount is equal to the product of an enlistee's monthly base pay, the length of reenlistment, and a scaling factor. The scaling factors, commonly called multipliers, vary by career field and time in service, so the military can incentivize reenlistment to achieve the required portfolio of skills and experience. Eligible service members choose whether to reenlist and the length of the enlistment term after observing the relevant

[1] An example of proficiency pay is the foreign language bonus, which is paid to enlisted Air Force personnel meeting certain criteria regarding language skills.

multiplier. As an example, a typical 30-year-old service member offered a multiplier of two would receive a bonus of $29,000 for a five-year reenlistment.[2]

Studies of the effect of reenlistment incentives predate the end of the military draft but proliferated afterwards. Enns (1977) cites 16 studies of reenlistment behavior that use data collected before July 1973. A survey by Goldberg (2001) cites 40 studies of recruitment, reenlistment, and retention of military personnel (both enlisted and officers). We provide a broad-brush overview of the methodologies commonly used in these studies and their findings.

Most studies identify the effect of the SRB on reenlistment rates using variation in multipliers over time, and many assume these variations to be exogenous conditional on various observable characteristics. A common and important set of control variables is a complete set of career-field fixed effects (e.g., Carrell [2007]; Mackin [1996]). The services are more likely to provide higher bonus multipliers to career fields that consistently have high attrition, so bonus amounts and reenlistment rates may have an inverse relationship in a cross section. Even comparing retention changes to bonus changes within career fields may not resolve this potential endogeneity, as within-career-field changes in bonus multipliers presumably reflect changes in demand for those specialties. Furthermore, these demand shifts may also be related to changes in retention rates.

Methods to address the potential endogeneity of multiplier changes have limited appeal. A common approach in the literature is to pool variation in all observed financial incentives for enlistees to separate from military service (e.g., Goldberg and Warner [1982]; Hogan et al. [2005]). These models define the annualized cost of leaving (ACOL) as the difference in expected lifetime earnings upon immediate separation from military service versus lifetime

[2] This assumes 10 years of service, a rank of E-5, and the 2010 monthly base pay of $2,906.70 (DFAS 2013). Multipliers typically range from 0 to 7, and the total bonus cannot exceed $90,000 for any one reenlistment.

earnings expected by remaining in the armed forces until a later time. Although ACOL models provide a more detailed treatment of a service member's financial incentives, they also require stronger assumptions to identify the effect of a change in bonus levels. All changes in military and civilian pay would need to be exogenous to identify the impact of the ACOL on reenlistment.[3] Identifying an instrument for the multiplier has also proven difficult. Proposed instruments such as training costs (Lakhani 1988) are likely to influence the multiplier but are also likely to affect retention decisions directly (e.g., because of the marketable skills obtained during training), thus violating the exclusion restriction.

In light of these limitations, we argue that the most plausible identification strategy that uses existing data is to include adequate controls for factors that may influence both multipliers and retention. One factor included in some studies is a measure of civilian wages potentially available to a separating service member. Barry (2001), Hansen (2000), and Saving et al. (1985) control for civilian wages linked to each career field. Carrell (2007) shows that local labor market conditions also have a significant effect on enlisted retention. Although Hogan et al. (2005) control for a wage predicted from a life-cycle earnings model, their wage does not depend on career field, so it does not capture the important variation in potential outside options that is likely to drive variation in the multipliers. For this reason, we incorporate detailed data on civilian wage opportunities by location and occupation in our models of retention decisions.

Retention is also a more appropriate outcome than reenlistment. A variety of policies and practices, including contract extensions, early reenlistment, and early separation, make the reenlistment process more complex than a set of exogenously timed, discrete decisions that are

[3] A related strategy created by Gotz and McCall (1984) models officers' retention decisions using individual-specific parameters describing taste for military service. As with the ACOL model, identification relies on assumptions about the functional form of a service member's expected income. Furthermore, in a context such as the SRB, which affects primarily first-term enlistees, short career histories are most likely insufficient to identify individual-specific tastes.

readily identified in administrative data. Most studies adopt a constrained model of the reenlistment process, such as equating certain modifications of existing enlistment contracts with new reenlistment contracts and excluding from analysis reenlistments and separations that occur too far in advance of contract end dates (e.g., Simon and Warner 2010). We provide evidence that these events excluded from the analysis are likely to differ systematically from other reenlistment decisions. Goldberg (2001) provides a similar caution and suggests that attrition has the potential to occur at any time, with greater hazard rates near the end of an enlistment contract. Although this advice appears to have gone unheeded in subsequent research, we adopt retention as an outcome to avoid these problems and provide impact estimates more directly relevant to policy. Appendix A explores this distinction in more detail.

Finally, few studies use data from the post-9/11 era (e.g., Moore and Sanders 2012). Arguably, macroeconomic conditions and other conditions of military life have differed considerably from the preceding decades. In addition to high frequencies of deployment and the worst economic recession since the Great Depression, the decade following 9/11 has also seen a sharp increase in the ratio of military to civilian pay (Hosek et al. 2012). Thus, it is unclear to what extent estimates of responsiveness of enlistees to changes in military pay and bonuses from the 1980s and 1990s are relevant to the current era. Prior studies have also found a wide range of estimates of the responsiveness of reenlistment or retention to changes in the bonus or military pay, including statistically significant effects in the opposite direction to that of economic theory (e.g., Mackin 1996). Typically, senior enlisted personnel are presumed to be relatively unresponsive to changes in pay, likely because the 20-year cliff-vested retirement system is widely believed to explain low attrition among personnel approaching this cliff (see, for

example, Asch and Warner [1994]). This study focuses primarily on enlisted Air Force personnel whose total military service makes it likely that they are in their first reenlistment term.

Given that highly skilled civilian employees can leave at any time, employee retention is also a concern outside of the military. A vast literature in human resources looks at nonpecuniary factors that can increase employee retention. Generally, though, survey data in these studies indicate that satisfaction with pay has a larger effect on retention than nonfinancial aspects of work (e.g., Brown and Yoshioka 2003). Financial benefits such as a living wage, provision of health insurance, and tuition reimbursement all improve retention (Howes 2005; Kim and Philips 2010; Manchester 2012). In the civilian sector, bonuses are used in two ways: 1) to incentivize productivity and 2) to improve retention. Many studies of bonuses in the civilian sector tend to focus on their effects on productivity. With respect to retention, Blakemore, Low, and Ormiston (1987) find that a $1,000 increase in bonus pay leads to a 2.0 to 3.5 percent reduction in the probability of quitting within a one-year period. Conversely, Clotfelter et al. (2008) find no effect of a bonus program designed to increase retention of certified teachers in low-performing and low-income schools. Thus, it appears that the evidence regarding the effectiveness of bonuses as a retention tool in the private sector is limited.

This study makes several contributions to the literature on retention incentives. First, it focuses on retention outcomes rather than reenlistment outcomes, avoiding the analytic problems with the endogeneity of reenlistment timing. Second, it uses a previously untapped series of data sources that together enable a more convincing estimation of the causal effect of the SRB on retention. Finally, it documents heterogeneity in the effects of the SRB that may help to inform bonus policies both in the military and in the private sector.

III. Framework

Enlistment decisions differ notably from other employment decisions. Individuals signing an enlistment contract are agreeing not only to serve in the military for a specified length of time, but also to be bound by the Uniform Code of Military Justice (UCMJ). Among other restrictions, the UCMJ imposes strict repercussions on a member of one of the armed services for prematurely exiting the service that would not be found in a typical employment contract. Due to these sharp constraints, many analyses of military personnel have modeled discrete decisions to reenlist or leave the service that occur at the end of the reenlistment contract.

In practice, the reenlistment process is semirigid and is more similar to the broader labor market than is often recognized. A multitude of exceptions to the standard reenlistment process allow enlisted personnel and their chains of command some of the same flexibility as civilian employees and employers have (Department of Defense 2014). Supervisors may terminate enlistments for medical or disciplinary reasons. A variety of triggers, such as a scheduled move to a new assignment location, enable enlisted personnel to reenlist outside of their regular window, or to extend their current contract without reenlisting. While the enlistment contract is unique to military service, the civilian labor market faces similar rigidities: terminating employees can be costly for employers, and employees may be contractually bound to remain in employment for a period, may have compensation that requires a vesting period, or may determine that certain times are more opportune than others to search for a new job.

This paper models *retention* of enlisted personnel rather than reenlistment. Analogous to models of the more flexible civilian labor market, we consider the factors associated with an enlisted service member remaining in the force for a calendar year. While a contractual obligation should be a strong predictor that the service member will be retained, it is not a

guarantee. By modeling retention of all service members, regardless of the timing of their enlistment contract, we incorporate deviations from the standard enlistment timing and procedures. Additionally, retention is more directly relevant to military personnel planners, who need to achieve a predetermined size of the force rather than a certain number of reenlistments. While this approach arguably reveals less about individual decisions, we contend that other approaches may misrepresent individual decisions and predict incorrect aggregate retention outcomes.

A. Model of Retention

The model relates the probability that an enlisted service member will remain in the military for a 12-month period to the SRB multiplier and other factors. Each service member *i* in career field *j* faces a decision in each year *t* whether to remain in the service or to leave. We model only year-on-year retention, although similar methods could be used to model retention over a finer time period. Each year, the service member compares the relative utility of remaining in the service to leaving at some time during the year and stays if the utility is positive. This relative utility, U_{ijt}, depends on the SRB multiplier offered, B_{jt}, military base pay, M_{ijt}, civilian wages upon leaving the service, C_{ijt}, a vector of observable characteristics, $\mathbf{X}_{ijt}$, that affect taste for military service, and unobservable characteristics about the career field, δ_j, and individual, u_{ijt}:

$$U_{ijt} = G\left(B_{jt}, M_{ijt}, C_{ijt}, \mathbf{X}_{ijt}\right) + \delta_j + u_{ijt} . \quad (1)$$

Determining the specification of the function *G* is nontrivial. ACOL models choose *G* to represent the present value of the difference in lifetime earnings between staying and leaving, but we choose to avoid the strong assumptions required for such a model for reasons discussed in

Section I. A separate issue is that unlike a model of discrete reenlistment decisions, the utility of remaining in the military is likely much higher when a service member has time remaining in his or her enlistment and would face legal repercussions for leaving prior to the expiration of that obligated service period.

We address these challenges with a simple reduced-form specification of the utility function. We relax assumptions about time preferences by allowing bonus payments, which accrue in the near future, to have a different effect than military base pay or civilian wages. We address the rigid enlistment structure by interacting financial incentives with the primary determinant of ability to leave, which is the end of the enlistment contract. A service member in the last year of his or her enlistment contract is generally free to leave by the end of that year, making that person more likely to leave and also more likely to respond to retention incentives. Service members with more than one year remaining on their contract are less likely to leave but may be able to do so at low cost under one of the exceptions to the standard enlistment timing. These exceptions are progressively less likely to apply to those with more time remaining on their contracts, although separations are still possible. Accordingly, our utility function is

$$U_{ijkt} = \beta_k B_{jt} + \mu_k M_{ijt} + \eta_k C_{ijt} + \boldsymbol{\gamma}' \mathbf{X}_{ijt} + \delta_{jk} + u_{ijkt} \ , \tag{2}$$

where k denotes the number of years remaining on the enlistment contract, rounded up to the nearest whole number.[4] The parameters β_k, μ_k, and η_k, which describe the effects of the three financial variables, are allowed to vary by contract years remaining, k. Similarly, the career field fixed effects δ_j are also interacted with k. A distributional assumption on u_{ijkt} would identify the probability that a service member with a specific set of characteristics remains in the service.

[4] We also code all service members with more than three years remaining on their contract as $k = 4$, since contracts with more than four years are somewhat less common.

While we see no theoretical reason to choose one distribution over another, we estimate a linear probability model for the sake of convenience:[5]

$$(3) \qquad Y_{ijkt} = \beta_k B_{jt} + \mu_k M_{ijt} + \eta_k C_{ijt} + \boldsymbol{\gamma}' \mathbf{X}_{ijt} + \delta_{jk} + \varepsilon_{ijkt} \ ,$$

where Y_{ijkt} is an indicator equal to one if individual *i* in career field *j* with *k* contract years remaining was retained until the end of time period *t*.

B. Identification

The process used to determine bonus levels complicates identification of the effect of the bonus. To determine the Air Force SRB amounts, analysts identify career fields deemed to have "poor health" based on a variety of measures, such as staffing levels that fall short of targets or high historical attrition. Although assisted by knowledge of historical patterns, the analysts have substantial latitude in setting bonus levels for the career field's "poor health." However, budget and other constraints (such as informal rules limiting large changes in bonus levels) introduce further variation in bonus levels conditional on expected staffing levels. While career fields with consistently high attrition are undoubtedly more likely to receive offers of higher bonuses, we do not have evidence that *changes* in bonus levels are set with substantial, reliable information about future changes in retention rates.

Our approach is to exploit within-career field variation in multipliers.[6] By using career-field fixed effects, we avoid the problem that career fields experiencing high attrition (for example, because of a strong civilian job market or distasteful aspects of the job) are also likely to receive higher bonuses. To the extent that the military adjusts multipliers based on changes in

[5] While the linear probability model in Equation (3) is not consistent with the utility in Equation (2), a logit model produces qualitatively similar results.

[6] Although various instrumental-variables have been considered in the literature, none are convincing. Factors affecting bonus levels, such as recent staffing shortfalls, are also likely to affect retention in other ways, such as through increased workload.

civilian labor market opportunities, controlling for the labor market conditions that a service member is likely to face upon separation from service will restore our ability to identify the effect of the bonus. Accordingly, the model controls for median wage of a civilian occupation similar to the service member's military career and unemployment rate in the service member's most recent location.[7] Hence, our key identifying assumption is that, conditional on other covariates, differences in multipliers over time are uncorrelated with differences in retention rates, except through the effect of the bonus.

IV. Data

The analysis draws on a rich array of Air Force administrative data, previously untapped for these purposes. Monthly snapshots of personnel records on 667,000 enlisted personnel over 14 years provide information on enlistment contracts, demographics, and military career factors. We also linked these records to other administrative data on bonus amounts offered, military base pay, and civilian employment conditions that each service member would be likely to face upon separation. We then constructed a panel data set where each observation represents a service member in a 12-month period.[8] We measure all characteristics at the beginning of the 12-month period except where noted below. Table 1 summarizes the data elements gathered and the source of each, and Appendix B contains a more complete discussion of data set construction.

Outcomes. The Air Force's Force Management Division provided monthly snapshots of each enlisted service member's personnel file, stored in the Military Personnel Data System.

[7] Although not every military career has a clear civilian counterpart, Air Force careers tend to be more similar to civilian occupations than are careers in other military services.

[8] Although the model could in principle be estimated using monthly outcomes, we opted for annual observations for ease of computation and consistency with military planning timelines. Also consistent with U.S. government accounting practices and the administration of the Air Force SRB program, we use the fiscal year as our 12-month periods, October 1 to September 30.

Records for an individual were linked by an encrypted identifier, enabling the construction of a panel data set with over 49 million monthly observations spanning from October 1997 through September 2012.[9] Among other information, monthly data include details of the current enlistment contract, enabling us to identify the timing of each separation and reenlistment. The key outcome variable, retention, is defined as the service member remaining in the Air Force until the end of the 12-month period. Similarly, the reenlistment outcome is defined as having a reenlistment event at any time in the 12-month period.

Enlistment contract time remaining. As discussed in section III, enlistment contract timing is critical to service members' separation decisions. The enlistment contract details from the personnel records also enable us to identify the length of time remaining on the enlistment contract at the start of the 12-month period. The Air Force generally permits those with one year or less remaining on their contracts to separate from military service before the end of that 12-month period, making these individuals the most similar to private sector workers with no binding employment contract. However, personnel with two years or even more remaining on their contracts may also have an opportunity to separate, and the bonus may affect them. Accordingly, we create categories of service members based on time remaining on their contract: up to one year, up to two (but more than one) years, up to three (but more than two) years, or more than three years.

Military pay and bonus amounts. Two separate administrative data sets enable us to calculate the military base pay (salary exclusive of bonuses and other supplements) and SRB offered to each service member. Historical records of base pay are publicly available by year, rank, and time in service from the Defense Finance and Accounting Service (DFAS 2013). The Force Management Division provided historical records of SRB multipliers by year, career field,

[9] Monthly personnel data are unavailable for June–August 2001 because of a change in data systems.

and time in service. Each piece of information can be linked to the personnel records at a given point in time, and the bonus amount can be calculated from base pay and the multiplier. We averaged the multipliers offered at the start of each quarter of the 12-month period.

Civilian labor market. Data on civilian labor market conditions are publicly available from the Bureau of Labor Statistics (BLS). The Occupational Employment Statistics estimates the median wage by occupation, location, and time, and the Local Area Unemployment Statistics estimates the unemployment rate by location and time (BLS 2013a,b). We matched each military career field to its most similar civilian occupation based on text descriptions of career fields (Powers 2013) and occupations (BLS 2012), enabling us to assign each service member a civilian occupation upon separation. Each monthly personnel record was then linked to a median wage and unemployment rate, using the location at which the service member was stationed at the time.

Demographics and military career factors. The same personnel records used to construct outcomes also contain detailed data on demographics and military career factors. Military career factors affect both financial incentives (including but not limited to the SRB), and potential career opportunities within and outside of the military. We also construct a measure of the degree to which a career field has the number of personnel the military indicates that it needs, using data from the Total Human Resource Managers' Information System.

Dataset overview. The overview below and the analysis in the next section divide individuals by their *enlistment terms*, first through fifth.[10] This distinction is relevant for two reasons. First, the Air Force has historically offered SRB multipliers by similar groups called

[10] In practice, we define "enlistment term" by time in service. We say that individuals with six years or less in service are in their first enlistment contract because the first reenlistment decision typically (but not always) occurs during this time. Similarly, we say that individuals with 6 to 10, 10 to 14, 14 to 17, and 17 or more years of service are in their second, third, fourth, and fifth terms, respectively.

zones, making these groups relevant to bonus policies. Furthermore, these groups are likely to respond very differently to retention incentives, both because of differences in career options and because of the 20-year cliff-vested military retirement system that provides a substantial retention incentive for individuals in their third and especially fourth enlistment terms. The analysis explores all five terms but focuses primarily on first-term enlistees, who arguably have the least attachment to their positions.

Table 2 summarizes the individual by year observations in the analytic data set. Of note, annual retention rates were high for all enlistment terms, as a minority in any term made a reenlistment decision in a given year. However, rates were substantially lower for first- and fifth-term enlisted personnel. Given the similar distributions of time remaining on contract across enlistment terms, these patterns indicate that personnel were indeed most likely to leave after their first enlistment term, or after they become eligible for retirement benefits.

A limited number of individuals were eligible for a bonus at any given point in time, but eligibility varied by time and enlistment term. Figure 1 shows that only a small percentage of individuals in the fourth and fifth enlistment terms were offered a bonus, with no offers from 1999 to 2007. Individuals in their first and second enlistment terms, and to a lesser extent the third enlistment term, were offered a bonus more frequently, and in 2003 over 90 percent of first-term personnel were in career fields that offered a bonus. However, this proportion changed substantially over time, dropping to 12 percent or less for all enlistment terms in 2007, possibly because of drawdown policies.

Bonus multipliers varied substantially across careers when an SRB was offered in 2012. Figure 2 shows that eligible service members in their second or third enlistment terms were most frequently offered low multipliers, with one as the most common multiplier. By contrast, eligible

first-term personnel were more frequently offered slightly higher bonus multipliers, most often two to four. However, enlistees in all three enlistment terms were offered a wide range of multipliers, up to seven for some career fields. The fourth and fifth enlistment terms are not shown because bonus offers were very rare, as noted above.

Retention rates varied notably by enlistment term and slightly over the years in the study period. Figure 3 shows that personnel in their first or fifth enlistment terms were least likely to be retained, while fourth-term personnel were most likely to stay. This pattern is well known and is expected because of the military retirement system's 20-year cliff vesting, which occurs just after personnel exit the fourth enlistment term. Although the term-specific rates varied over time, the patterns were similar for all years in the study period. Overall retention rates increased from 88 percent in 1999 to 91 percent in 2012, although they peaked in 2002.

Most members leave the Air Force with one year or less remaining on their enlistment contract (Figure 4). This is expected given the frequently inflexible terms of the enlistment contract, although retention was clearly less than 100 percent for groups with more than one year remaining on their contract. This further illustrates the need to track retention outcomes for all personnel, not only those who appear to be eligible for a reenlistment versus separation decision.

V. Estimation and Results

This section formalizes the analytic approach described in Section III and presents findings. We estimated Equation (3) from Section III, along with several variations of this model, using ordinary least squares with standard errors clustered by enlistee. We find small but heterogeneous effects of the bonus. Consistent with other literature and with the other incentives in military service, we find larger effects for service members in their initial enlistment contract.

Similarly, individuals nearing the end of their enlistment contracts are more likely to separate and are more sensitive to changes in the bonus. We also find previously undocumented effects: service members in career fields that have historically received higher bonuses are less responsive to changes in the bonus, and the bonus appears to have an effect on the timing of reenlistment in addition to its frequency.

Overall effect of the bonus. The overall effect of the bonus is small. Comparing across all career fields for service members in their first enlistment contract, column 1 of Table 3 shows that a one-unit increase in the multiplier was associated with a 0.6-percentage-point increase in the annual retention rate. Adding fixed effects for career field and years remaining on the enlistment contract, this figure drops to 0.1 percentage points (column 2). When interpreting this small effect, one should note that enlisted service members are generally permitted to separate only at the end of their contracts, typically after four to six years. Accordingly, the bonus should affect only a fraction of individuals in a given year.

Time remaining on contract. Service members closer to the end of their enlistment contracts were more sensitive to the bonus. Consistent with restrictions on separating before the end of an enlistment contract, the SRB had a notable impact only on enlistees who were in the last year of their contract and permitted to separate. A one-unit increase in the multiplier was associated with a 0.8-percentage-point increase in retention for enlistees in the last year of their contracts. For enlistees with more contract time remaining, there is virtually no detectable relationship between the bonus and retention (column 3 of Table 3).

Sensitivity to controls. Impact estimates of the bonus are surprisingly robust to the inclusion of additional controls. Columns 4 and 5 of Table 3 add the following controls: demographic characteristics and military and civilian pay, followed by other military career

factors and year dummies. Although increases in military and civilian pay had the expected effect on retention (positive and negative, respectively), civilian wages had a very weak relationship with retention. Furthermore, the inclusion of this host of controls had little effect of the estimated impact of the SRB. In subsequent analyses, we focus on variations of column (5), our preferred specification.

Enlistment term. Service members nearing the end of their first enlistment contract were more sensitive to the bonus than those nearing the end of a subsequent enlistment contract. Table 4 compares the estimated impacts across enlistment terms (columns 1 through 5) and by years remaining until the end of the term. Estimated impacts of the bonus were lower or statistically insignificant for the second through the fifth enlistment terms. This finding is likely a result of the military's 20-year cliff-vested retirement system: personnel nearing the end of their first or second enlistment contract may have other competitive employment opportunities, but those nearing the end of their third or fourth contracts would be abandoning an income stream with substantial present value upon separation. Those nearing the end of their fifth contract generally would have completed the 20-year eligibility period for retirement benefits, so their opportunity cost of separation would be much lower.[11] Subsequent analyses focus on enlistees serving their first contract.

Time period. The effect of the bonus varied substantially over the time period studied. Impacts were greatest early in the period, especially from October 1998 through September 2001, where a one-unit multiplier increase led to a 3.6-percentage-point increase in retention rates for service members in the last year of their contracts (column 1 of Table 5). In some time

[11] The negative coefficients for enlistees nearing the end of their second and fifth contracts raise a concern about the endogeneity of the bonus. For instance, if factors not captured by civilian wages and other controls lead to decreases in retention, and bonus levels are increased in response, the estimate of the bonus effect would be biased downward.

periods, such as 2001 through 2005, we find evidence that increased bonuses increased retention of enlistees with more than one year remaining on their enlistment contracts. This suggests that in some cases a bonus may dissuade individuals from leaving before the end of their contracts, even if they are not yet eligible to claim the bonus.

One possible explanation of these varying impacts is changes in employment-related incentives in and out of the Air Force. During the study period, military base pay increased substantially, at a faster rate than civilian wages (Hosek, Asch, and Mattock 2012). At the same time, the economic downturn led to high unemployment in the civilian labor market. One potential effect of this change is that individuals who might have otherwise been enticed by private sector jobs had less incentive to leave the relative stability and high pay of military service, and the SRB played only a small role in those decisions. This would be consistent with the smaller estimated impact of the SRB on retention in the latter part of the study period. However, we are unable to distinguish this from other possible explanations, such as changes in job satisfaction or personal and family preferences over that time.

Bonus history. Responsiveness to the bonus varied with the history of bonuses offered. Service members in career fields where individuals were offered low bonus amounts (the multiplier never exceeded one unit) and who were in the last year of their enlistment contract were three times as responsive to a change in the multiplier as their counterparts in other career fields (columns 1 and 2 of Table 6). Furthermore, service members experiencing an increase in the multiplier since the last 12-month period were more responsive to changes in the bonus than those not experiencing an increase (columns 3 and 4 of Table 6).

Ability level. The bonus does not appear to be effective in retaining service members with the highest ability, as measured by test scores. Across the first three enlistment terms,

service members with higher scores on the Armed Forces Qualifying Test (AFQT) had lower retention rates than otherwise similar peers. Individuals nearing the end of their contracts with AFQT scores one standard deviation above average were slightly *less* responsive to the bonus (columns 1–3 of Table 7). The AFQT is a broad measure of ability, and there may be more appropriate measures of ability within career fields.

Reenlistment impacts. The bonus had a positive effect on reenlistment in the first three enlistment terms, but this effect was most prominent for personnel two years from the end of their contracts. Table 8 shows no positive and statistically significant impacts of the bonus for the last year of the contract, but all (except fourth-term service members) showed a positive impact, ranging from 2.3 to 4.6 percentage points, for the next-to-last year of the contract. Taken with the results in Table 4, these suggest that a multiplier increase may have affected the timing of reenlistment but had a relatively small impact on retention. Column 4 shows a *negative* association between the multiplier and reenlistment for fourth-term service members, but these results should be interpreted with caution because of the minimal variation in bonuses offered to those individuals.

VI. Discussion

This research provides new information on the impact of a cash retention incentive for military personnel. A rich data set drawing on personnel records and other linked data sources enabled a robust estimation of the effect of the Air Force SRB on retention. A model focusing on retention avoided the strong assumptions that made similar research difficult to apply to policy. Subgroup analysis not only confirmed previously documented trends but also uncovered new

relationships that may benefit both military-personnel policy planners and civilian employers alike.

The heterogeneity in estimated impacts suggests ways of targeting bonuses for increased efficiency. With the greatest effects on first-term personnel and those who have historically received no bonuses or small bonuses, organizations may consider greater use of such incentives among those groups or their equivalent in the civilian sector. However, note that these findings highlight heterogeneity only in costs, not benefits, of retention incentives. The effect of the incentive enables the calculation of the marginal cost of retaining one additional enlistee in a given group, but employers should weigh this cost against the marginal benefit of another alternative for meeting the organization's needs.

Changes in the impact of the bonus over time suggest a need for flexible policies. While we cannot pinpoint a single reason for the differences in impacts over time, the bonus could have plausibly had a smaller effect in the latter half of the study period because of the relatively high military base pay and weak civilian labor market. To the extent that this high pay saturated the supply of labor and reduced the effect of additional incentives, policies allocating bonuses may benefit from adjustments for economic conditions.

The findings highlight a need to consider quantum versus timing effects of incentives. We found that the SRB had small effects on retention overall but notable effects on reenlistment before the standard reenlistment time period. This raises a question as to whether enlistees who would have remained in the service are altering the timing of their contract renewals in order to obtain the incentives without changing their length of service. While incentive programs such as the SRB inevitably offer payments to non-marginal individuals, a timing effect may be mistaken for a quantum effect, as we suspect is the case when using reenlistment as an outcome.

We also find suggestive evidence that expectations affect bonus responsiveness. Groups that had received no bonus or a small bonus were highly responsive to the incentive, and individuals seeing an increase in the bonus compared to the previous year were also more responsive. This suggests that bonuses should be offered with the future in mind: individuals may begin to see the bonus as an entitlement that has a smaller impact after it has been in effect for a period of time.

More research is needed on the effects of retention incentives. A more precise understanding of the heterogeneity of these incentives' effects would enable better targeting, although limited variation in specific groups makes this research a challenge. Our findings highlight a need to better understand the long-term effects of these incentives in light of their potential effect on the timing of decisions and on expectations for future incentives. An experimental validation of the findings in this line of research would likely prove cost-effective for large-scale incentive systems such as the SRB. In addition, further research is required to understand how the SRB program fits within the broader package of compensation and benefits used to attract and retain service members.

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Table 1 Data Sources

Data	Source
Outcomes: retention, reenlistment (inferred from enlistment contract details)	Personnel records (MilPDS)
Enlistment contract time remaining	Personnel records (MilPDS)
Military pay	Defense Finance and Accounting Services
Bonus amounts	Historical records of SRB multipliers (Force Management Division)
Civilian labor market: civilian wage, unemployment rate	Occupational Employment Statistics, Local Area Unemployment Statistics (BLS)
Demographics: marital status, dependents, age, gender, race/ethnicity, education, family medical issues	Personnel records (MilPDS)
Military career factors: career field, time in service, rank, obligated service beyond enlistment contract, deployment frequency, security clearance, medical restrictions, Armed Forces Qualifying Test (AFQT) scores, disciplinary actions, career field staffing shortage	Personnel records (MilPDS) and Total Human Resource Managers' Information System

NOTE: MilPDS = Military Personnel Data System; BLS = Bureau of Labor Statistics.
SOURCE: Authors' compilation.

Table 2 Summary Statistics By Enlistment Term

Variable	All	First term	Second term	Third term	Fourth term	Fifth term
Retained	0.89	0.88	0.91	0.96	0.99	0.80
	(0.31)	(0.32)	(0.29)	(0.20)	(0.12)	(0.40)
Reenlisted	0.12	0.08	0.16	0.18	0.19	0.12
	(0.33)	(0.28)	(0.37)	(0.38)	(0.39)	(0.32)
Multiplier	0.82	1.33	0.92	0.36	0.00	0.01
	(1.44)	(1.62)	(1.58)	(1.00)	(0.04)	(0.22)
1 yr. on contract	0.15	0.11	0.17	0.13	0.13	0.24
	(0.35)	(0.31)	(0.38)	(0.33)	(0.34)	(0.42)
2 yrs. on contract	0.21	0.18	0.24	0.22	0.18	0.31
	(0.41)	(0.38)	(0.42)	(0.41)	(0.39)	(0.46)
3 yrs. on contract	0.22	0.21	0.22	0.24	0.20	0.24
	(0.41)	(0.41)	(0.41)	(0.43)	(0.40)	(0.43)
> 3 yrs. on contract	0.42	0.50	0.38	0.42	0.48	0.20
	(0.49)	(0.50)	(0.48)	(0.49)	(0.50)	(0.40)
ln(military base pay)	7.74	7.47	7.79	7.92	8.02	8.19
	(0.32)	(0.16)	(0.10)	(0.11)	(0.12)	(0.20)
Median civ. wage ($/hour)	22.53	22.44	22.48	22.36	22.45	22.96
	(6.50)	(6.31)	(6.61)	(6.44)	(6.54)	(6.92)
Civ. unemp. rate (%)	5.48	5.50	5.62	5.54	5.31	5.34
	(2.20)	(2.17)	(2.33)	(2.28)	(2.13)	(2.12)
Observations	3,881,110	1,858,342	587,586	436,478	332,210	666,494

NOTE: Standard deviations are in parentheses. The summary statistics describe the analytic sample used for estimation, which includes fiscal years 1999–2012.

[a] The natural log function rescales military base pay to reduce the influence of outliers in the estimation. The overall average log base pay of 7.74 corresponds to $2,298 per month.

SOURCE: Authors' calculations using personnel records from MilPDS, historical multiplier records (Force Management Division), and Bureau of Labor Statistics.

Table 3 Bonus Impacts for First-Term Enlisted Personnel

	(1)	(2)	(3)	(4)	(5)
Fixed effects:	No	Yes	Yes	Yes	Yes
Other controls	None	None	None	Demog	Full
Multiplier	0.006***	0.001***			
	(0.000)	(0.000)			
Mult (1 yr. on contract)			0.008***	0.007***	0.008***
			(0.001)	(0.001)	(0.001)
Mult (2 yrs. on contract)			0.000	0.000	0.000
			(0.000)	(0.000)	(0.000)
Mult (3 yrs. on contract)			−0.000	−0.001	−0.000
			(0.000)	(0.000)**	(0.000)
Mult (> 3 yrs. on contract)			−0.001**	−0.002***	−0.002***
			(0.000)	(0.000)	(0.000)
ln(military base pay)				0.173***	0.905***
				(0.002)	(0.016)
ln(civilian wage)				−0.005***	−0.006***
				(0.001)	(0.001)
Civ. unemp. rate (%)				0.000	0.000
				(0.000)	(0.000)
R^2	0.00	0.22	0.22	0.23	0.24
N	1,858,342	1,858,342	1,858,342	1,858,342	1,858,342

NOTE: The dependent variable is an indicator for annual retention. Standard errors are in parentheses. * significant at the 0.10 level; ** significant at the 0.05 level; *** significant at the 0.01 level. Demographics include gender, race, marital status, number of children, and education; full controls include demographics and military rank, time in service (in years), active duty service commitments, and Armed Forces Qualifying Test scores.

SOURCE: Authors' calculations using personnel records from MilPDS, historical multiplier records (Force Management Division), and Bureau of Labor Statistics.

Table 4 Impacts by Enlistment Term

	(1)	(2)	(3)	(4)	(5)
Enlistment term:	1	2	3	4	5
Mult (1 yr. on contract)	0.008***	−0.004**	−0.002	−0.072	−0.018***
	(0.001)	(0.002)	(0.003)	(0.049)	(0.006)
Mult (2 yrs. on contract)	0.000	0.001	−0.001	−0.023	0.001
	(0.000)	(0.001)	(0.001)	(0.021)	(0.004)
Mult (3 yrs. on contract)	−0.000	−0.001	−0.001	0.006	−0.007*
	(0.000)	(0.001)	(0.001)	(0.004)	(0.004)
Mult (> 3 yrs. on contract)	−0.002***	−0.001***	−0.001	0.002	0.012***
	(0.000)	(0.000)	(0.001)	(0.008)	(0.003)
R^2	0.24	0.23	0.13	0.06	0.32
N	1,858,342	587,586	436,478	332,210	659,619

NOTE: The dependent variable is an indicator for annual retention. Standard errors are in parentheses. * significant at the 0.10 level; ** significant at the 0.05 level; *** significant at the 0.01 level. All specifications include the same controls as in Table 3, column (5).

SOURCE: Authors' calculations using personnel records from MilPDS, historical multiplier records (Force Management Division), and Bureau of Labor Statistics.

Table 5 Impacts by Time Period

	(1)	(2)	(3)	(4)	(5)	(6)
Start:	1998	2001	2005	2008	2000	2005
End:	2001	2005	2008	2012	2005	2012
Mult (1 yr. on contract)	0.036***	−0.007**	−0.004	0.006	0.040***	0.011***
	(0.005)	(0.003)	(0.006)	(0.005)	(0.002)	(0.002)
Mult (2 yrs. on contract)	−0.008***	0.009***	0.004*	0.011***	−0.001	0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Mult (3 yrs. on contract)	−0.003*	0.014***	−0.001	0.003*	0.001*	−0.001
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Mult (> 3 yrs. on contract)	−0.009***	0.005***	−0.002	0.000	−0.001**	−0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
R^2	0.32	0.18	0.30	0.20	0.24	0.24
N	375,717	578,541	395,952	508,132	954,258	904,084

NOTE: The dependent variable is an indicator for annual retention. Standard errors are in parentheses. * significant at the 0.10 level; ** significant at the 0.05 level; *** significant at the 0.01 level. All specifications include the same controls as in Table 3, column (5). Each period starts in October of the year indicated and ends in September of the year indicated.

SOURCE: Authors' calculations using personnel records from MilPDS, historical multiplier records (Force Management Division), and Bureau of Labor Statistics.

Table 6 Impacts by Multiplier History

Multiplier history:	(1) Low	(2) High	(3) Increase	(4) No increase
Mult (1 yr. on contract)	0.032***	0.009***	0.012***	−0.010***
	(0.012)	(0.001)	(0.003)	(0.001)
Mult (2 yrs. on contract)	−0.008*	0.001***	−0.013***	0.001***
	(0.005)	(0.000)	(0.002)	(0.000)
Mult (3 yrs. on contract)	−0.008*	0.001	−0.016***	0.001*
	(0.004)	(0.000)	(0.003)	(0.000)
Mult (>3 yrs. on contract)	−0.009***	−0.001***	−0.017***	−0.001***
	(0.003)	(0.000)	(0.002)	(0.000)
R^2	0.17	0.26	0.30	0.23
N	394,899	1,463,443	84,368	1,773,974

NOTE: The dependent variable is an indicator for annual retention. Standard errors are in parentheses. * significant at the 0.10 level; ** significant at the 0.05 level; *** significant at the 0.01 level. All specifications include the same controls as in Table 3, column (5).

SOURCE: Authors' calculations using personnel records from MilPDS, historical multiplier records (Force Management Division), and Bureau of Labor Statistics.

Table 7 Impacts by Ability Level

	(1)	(2)	(3)	(4)	(5)
Enlistment term:	1	2	3	4	5
Mult. (1 yr. on contract)	0.011***	−0.000	0.003	−0.061	−0.024***
	(0.001)	(0.002)	(0.003)	(0.048)	(0.006)
Mult. (2 yrs. on contract)	0.001	0.001	−0.001	−0.013	−0.000
	(0.000)	(0.001)	(0.001)	(0.023)	(0.004)
Mult. (3 yrs. on contract)	−0.000	−0.001	−0.001	0.002	−0.008**
	(0.000)	(0.001)	(0.001)	(0.003)	(0.004)
Mult. (> 3 yrs. on contract)	−0.002***	−0.002***	−0.001	−0.001	0.009**
	(0.000)	(0.000)	(0.001)	(0.010)	(0.004)
Mult. × AFQT (1 yr. on contract)	−0.010***	−0.007***	−0.011***	−0.033	0.017***
	(0.001)	(0.001)	(0.002)	(0.051)	(0.005)
Mult. × AFQT (2 yrs. on contract)	−0.000	0.000	0.001	−0.017	0.003
	(0.000)	(0.000)	(0.001)	(0.025)	(0.004)
Mult. × AFQT (3 yrs. on contract)	0.001***	0.001***	−0.001	0.006	0.005
	(0.000)	(0.000)	(0.001)	(0.006)	(0.004)
Mult. × AFQT (> 3 yrs. on contract)	0.002***	0.001***	0.001**	0.006	0.009**
	(0.000)	(0.000)	(0.000)	(0.005)	(0.003)
AFQT (standardized)	−0.002**	−0.003***	−0.003***	0.000	0.003***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Square of AFQT	−0.002***	−0.001**	−0.001*	−0.000	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.24	0.23	0.13	0.06	0.32
N	1,858,342	587,586	436,478	332,210	659,619

NOTE: The dependent variable is an indicator for annual retention. Standard errors are in parentheses. * significant at the 0.10 level; ** significant at the 0.05 level; *** significant at the 0.01 level. All specifications include the same controls as in Table 3, column (5).

SOURCE: Authors' calculations using personnel records from MilPDS, historical multiplier records (Force Management Division), and Bureau of Labor Statistics.

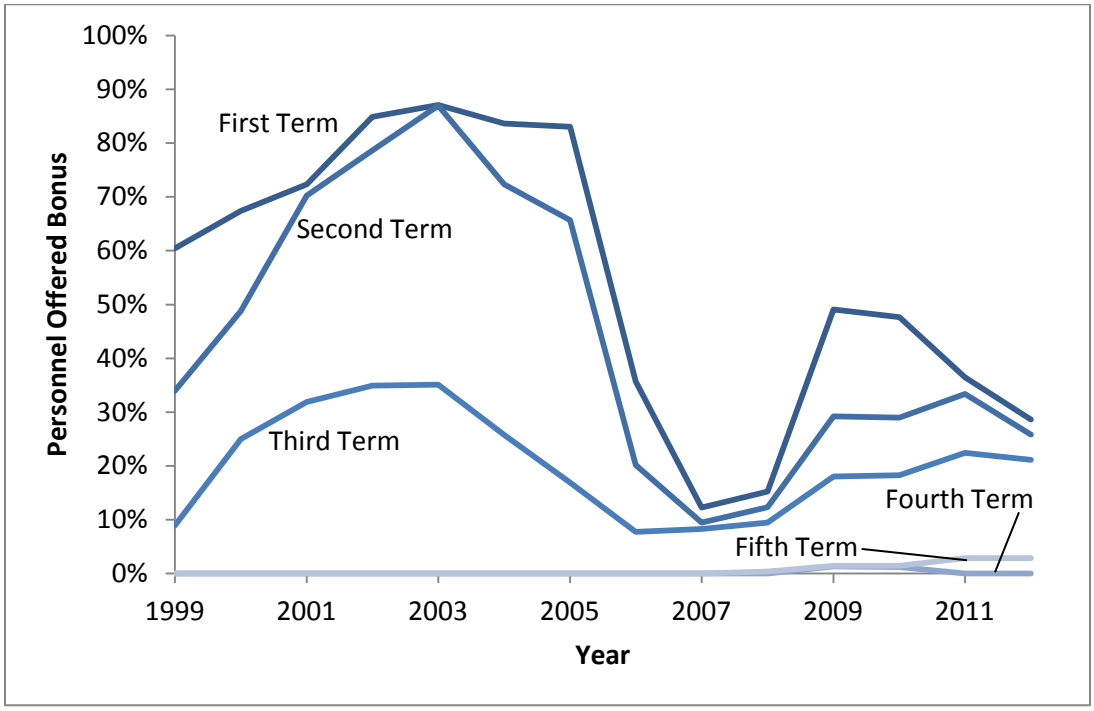
Table 8 Reenlistment Impacts

	(1)	(2)	(3)	(4)	(5)
Enlistment term:	1	2	3	4	5
Mult. (1 yrs. on contract)	0.000	−0.007***	−0.006*	−0.198***	0.000
	(0.001)	(0.002)	(0.004)	(0.069)	(0.005)
Mult. (2 yrs. on contract)	0.024***	0.046***	0.044***	−0.197***	0.023***
	(0.001)	(0.001)	(0.003)	(0.038)	(0.004)
Mult. (3 yrs. on contract)	0.006***	0.018***	0.030***	−0.072***	0.022***
	(0.000)	(0.001)	(0.002)	(0.013)	(0.004)
Mult (> 3 yrs. on contract)	0.003***	−0.001*	−0.000	−0.019***	0.007***
	(0.000)	(0.000)	(0.001)	(0.003)	(0.002)
R^2	0.22	0.26	0.37	0.49	0.14
N	1,858,342	587,586	436,478	332,210	659,619

NOTE: The dependent variable is an indicator for reenlistment in a 12-month period. Standard errors are in parentheses. * significant at the 0.10 level; ** significant at the 0.05 level; *** significant at the 0.01 level. All specifications include the same controls as in Table 3, column (5).

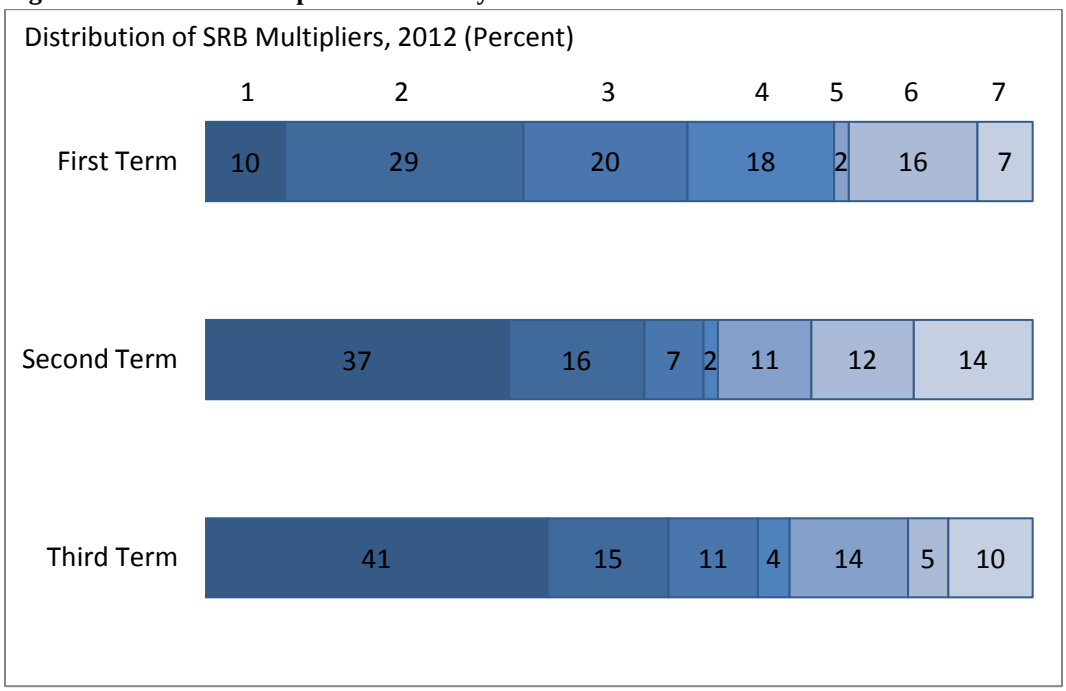
SOURCE: Authors' calculations using personnel records from MilPDS, historical multiplier records (Force Management Division), and Bureau of Labor Statistics.

Figure 1 SRB Offer by Time and Enlistment Term



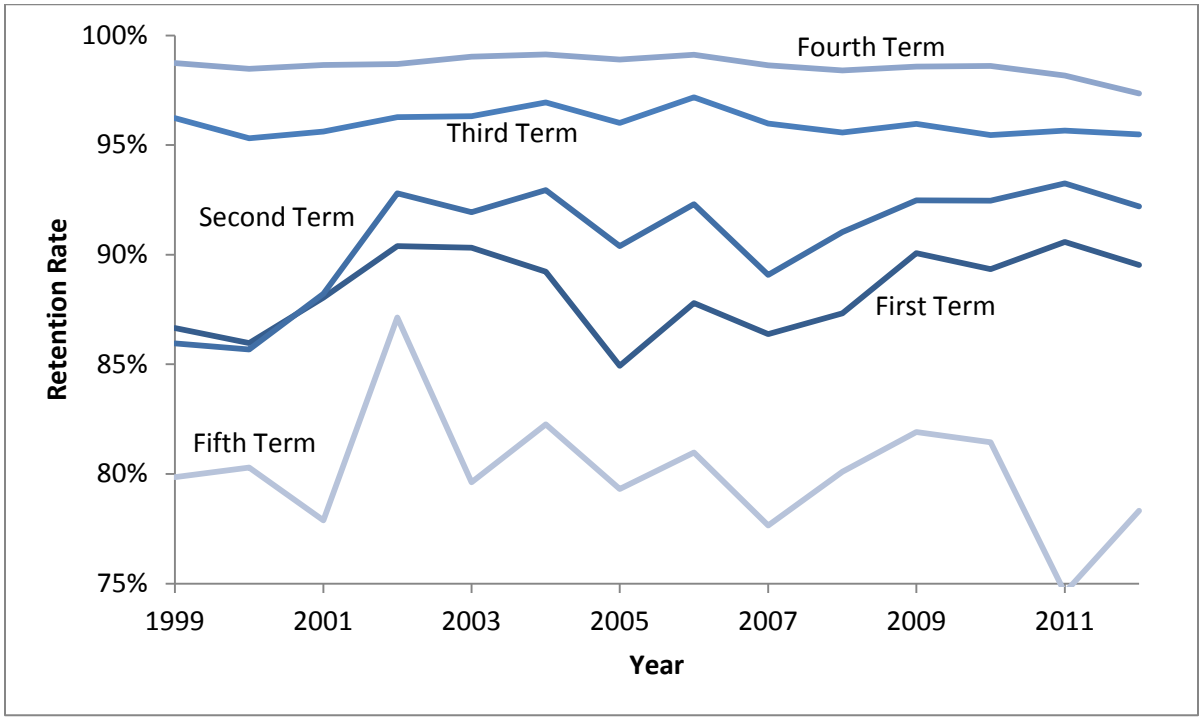
NOTE: The graph shows the percentage of enlistees in career fields offered an SRB, defined as having an average multiplier of at least 0.5.
SOURCE: Historical SRB multiplier records (Force Management Division).

Figure 2 2012 SRB Multipliers Offered by Enlistment Term



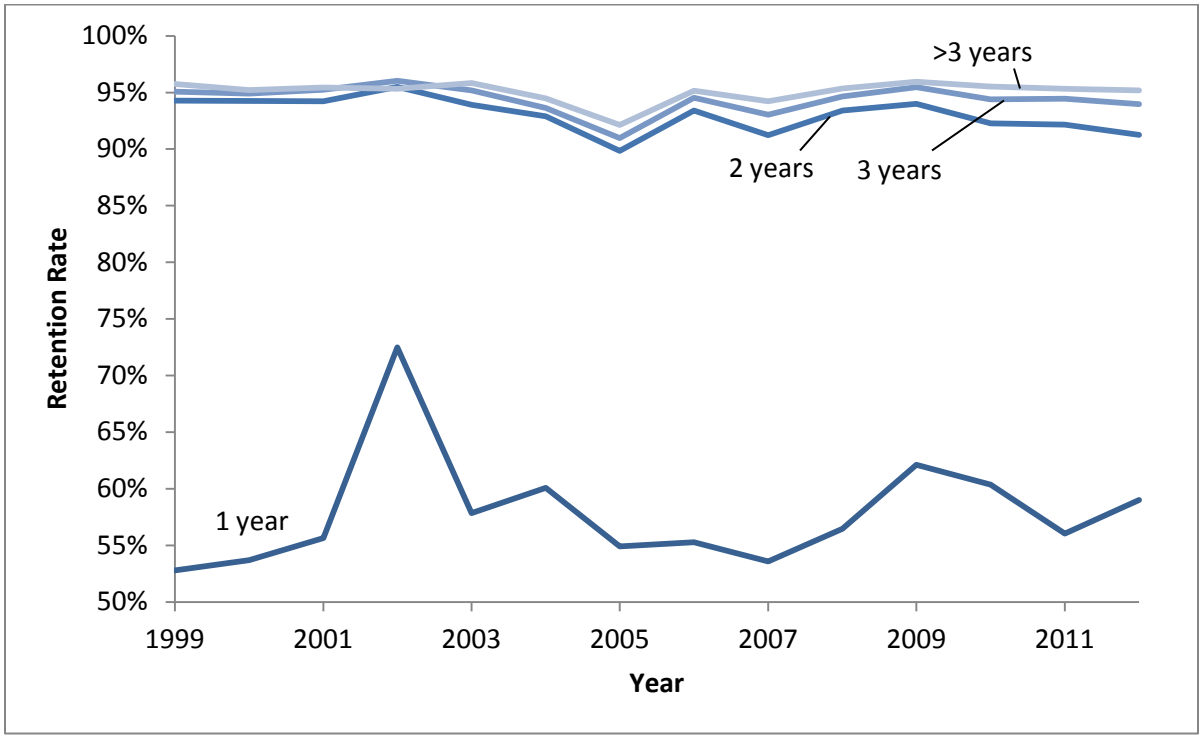
NOTE: The figure shows the frequency of multipliers offered among SRB-eligible career fields. Multipliers, measured as an average for 2012, are rounded to the nearest integer. Frequencies are weighted by the number of personnel in the career field.
SOURCE: Historical SRB multiplier records (Force Management Division).

Figure 3 Retention Rate by Time and Enlistment Term



SOURCE: Personnel records from MilPDS.

Figure 4 Retention by Contract Time Remaining



SOURCE: Personnel records from MilPDS.

Appendix A: Retention Versus Reenlistment

An alternative approach to analyzing the impact of a bonus could model the probability of reenlistment only for reenlistment-eligible service members. The same predictors (except for contract length remaining) could be used to predict reenlistment only for those service members who are reaching the end of their enlistment contract and meet all other reenlistment eligibility requirements. This restriction is common in other research, which typically defines reenlistment eligibility based on a fixed time until the end of the reenlistment contract.

Under a simple model of enlistment terms, reenlistment and year-on-year retention would have a straightforward relationship. Suppose that each year an equally sized group of service members enlist for n years, and a proportion, R, choose to reenlist when their term ends. Furthermore, assume that no extensions or early departures are possible. In each year, a fraction, $1/n$, are eligible to reenlist, of which a fraction, R, do so. In the same year, a fraction, $1 - 1/n$, are not eligible to reenlist, and hence all are retained. Among all service members, a fraction, $r = (R/n) + (1 - 1/n) = 1 - (1 - R)/n$, are retained through the end of the year. For instance, if enlistment terms are four years, a 60 percent reenlistment rate would be equivalent to a 90 percent year-on-year retention rate. Similarly, any change in the reenlistment rate, ΔR, would be identical to a scaled-down change in the retention rate, $\Delta r = \Delta R/n$. Hence, the estimated impact of the SRB multiplier (or any other factor) on reenlistment is readily convertible to the estimated impact on retention, or vice versa.

Under more realistic circumstances, this relationship does not hold. Service members may be assigned to a new duty location (in military parlance, a permanent change of station, or PCS), which also incurs a further commitment to active duty that may extend beyond the end of the enlistment term. In this case, the service member may choose to extend his or her current

enlistment period, reenlist early, or leave at the end of the current enlistment period without changing location. In contrast, airmen may leave before the end of their enlistment term under special circumstances, such as because of medical conditions or disciplinary problems. Service members' eligibility to reenlist is also endogenous, as members' decisions to separate may affect whether they are coded as eligible to reenlist. We discuss the specific effects of these complications below.

Early reenlistments generally lead reenlistment rates to overstate retention. Early reenlistments c−ause the length between reenlistments to fall below the length of the enlistment term, n, so that $r > 1 - (1 - R)/n$.[12] Some analyses have responded by excluding from reenlistment rates any reenlistments that occur more than one year before the end of the original enlistment term. Excluding these service members who in fact were retained beyond their original enlistment term would instead cause reenlistment rates to overstate retention.

Conversely, extensions lead reenlistment rates to understate retention. Extensions cause the length between reenlistments to exceed the length of the enlistment term n, so that $r < 1 - (1 - R)/n$. While some analyses count long extensions (such as those three years or longer) as reenlistments, this problem will persist because of shorter extensions.

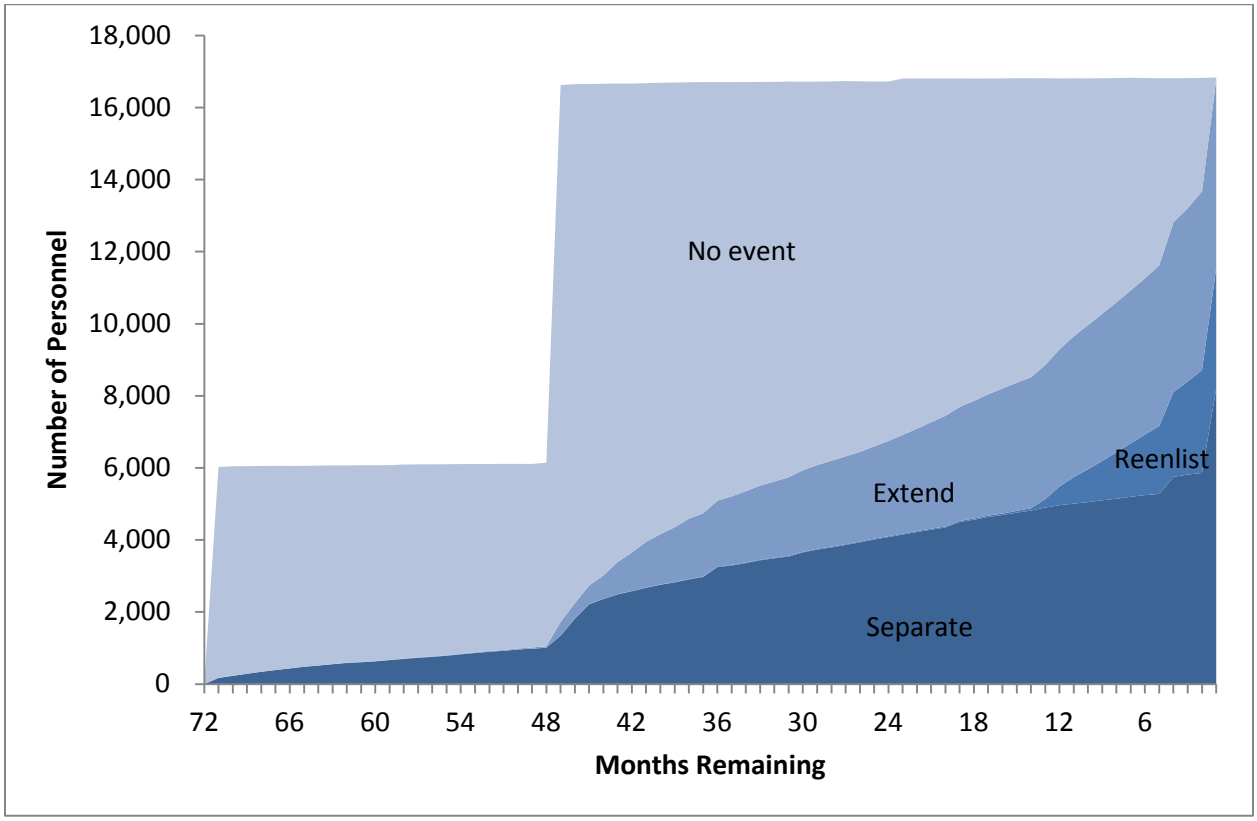
Early departures lead reenlistment rates to overstate retention. Suppose that among service members who are not eligible for reenlistment in a given year, a fraction, L, leave the service before their enlistment is up, under a special circumstance. Then the retention rate becomes $r = R/n + (1 - 1/n)(1 - L) < 1 - (1 - R)/n$. In other words, early departures reduce the retention rate but do not affect the reenlistment rate because those service members do not reach a reenlistment decision.

[12] In some situations, service members reenlisting early may be required to serve the remainder of the original enlistment term in addition to the new enlistment term. In this situation, the average time between reenlistments would still match the length of enlistment.

A related problem is that the choice to leave the service may affect the coding of reenlistment eligibility. Some service members who choose to leave at the end of their enlistment term are identified as having an "approved separation." This mark makes them ineligible for reenlistment, so including only reenlistment-eligible service members in the reenlistment rate would ignore some members who have chosen not to reenlist. The effect mirrors early departures, as these individuals would be counted as a loss in retention. They could be included in the fraction L above.

The implications of an incorrect model are potentially large. Although we do not attempt to compare differences in predictions from retention and reenlistment models, we illustrate the magnitude of the exceptions to the simple reenlistment model. Figure A.1 illustrates the first event that occurred for each service member in his or her first enlistment term: reenlist, extend, or separate. If each enlistment contract were for a fixed period, and reenlistment decisions occurred only within one year of the end of the contract, we should expect to see the cumulative number of reenlistments grow starting 12 months before the end of the contract, followed by all remaining service members separating at the end of the contract. Instead, separations are common throughout the enlistment contract, and reenlistments begin several months before the standard reenlistment window. Furthermore, extensions of contracts are very common, even early in the enlistment contract. These patterns suggest that service members should not be viewed as making discrete reenlistment versus separation decisions at predetermined times.

Figure A.1 Reenlistment Events by Contract Time Remaining



NOTE: The height of each area represents the number of enlisted personnel who experienced the indicated event during their first enlistment term. The sharp increase at 48 months is due to the fact that most first-term enlisted personnel have a four-year contract, while a smaller number have a six-year contract.

Appendix B: Analytic Data Set Construction

This appendix describes the construction of the analytic data set in more detail. The analysis relies primarily on a personnel data set containing detailed information on 602,000 airmen observed monthly. However, the personnel records were also linked to auxiliary data sources. The remainder of this appendix details the processing required for us to construct the analytic data set from the personnel data set and other data sources.

1. Personnel Data

The Air Force's Force Management Division provided monthly snapshots of personnel data on each enlisted member of the Air Force from October 1997 to September 2012.[13] Each monthly record contains contemporaneous data on contract details such as the date the enlistment contract took effect (date of enlistment) and the end of the contract (date of separation). It also contains contemporaneous data on demographics and military career information. Each record contains an encrypted individual identifier, enabling a panel data set to be constructed.

We corrected apparent inconsistencies in the panel data set's contract date variables and then used the corrected information to construct outcomes. Each of these procedures is described in more detail below.

Corrections to contract-related date variables. The key date variables describing enlistment contracts were essential for identifying retention outcomes but were frequently inconsistent over time. We focus on the date of enlistment (DOE) and date of separation (DOS), but we also used a third date related to DOS, the expiration of term of service (ETS), to draw inferences about errors in the other two. One quarter of individuals had one or more of the four

[13] Monthly personnel data are unavailable for June–August 2001 because of a change in data systems.

date inconsistencies addressed as described below. Failing to correct these errors would have nontrivial impacts, such as an erroneous change in the DOE appearing to represent a reenlistment.

- **Missing values.** If a date variable was missing a value, we attempted to fill it in based on more recent data. If an ETS or DOS was missing, we filled in the missing date with the next nonmissing date for that airman, as long as the date fell in the future. We did the same for DOE as long as it fell in the past. If only one of the two, ETS or DOS, was missing, we used the nonmissing date to fill in the missing date.
- **Backwards date changes.** For some individuals, one or more of the three dates was later changed to an earlier date. Given that all three dates should only move forward, we corrected these problematic dates by assuming that the later date was correct, again ensuring that the ETS and DOS fall in the future and the DOE falls in the past. Most likely, these errors were caused by corrections to the dates in a personnel record. For instance, if the date of enlistment changed from September 7, 2007, to September 2, 2007, most likely the former was an estimated date while the latter was the actual date.
- **Small DOE updates.** Changes in the DOE generally indicate a reenlistment, but some changes were very small (as little as one day), which is inconsistent with a reenlistment. If the DOE moved forward by less than one year, we assumed that the change was a correction rather than a reenlistment, so we filled in earlier DOE values for that individual with the later value.
- **Late DOE updates.** For some individuals, the DOE was updated in a later monthly snapshot than the month of the DOE. Given that reenlistments are identified by the

timing of a change in the DOE, we retroactively changed the DOE to the updated date for all months following the apparent reenlistment.

Construction of outcomes. The monthly data on contract details enable us to identify the timing of three key events. A separation is when a service member exits the Air Force, as evidenced by an end to monthly personnel records for that individual. A service member reenlists when he or she signs a new enlistment contract, generally extending the mandatory length of service by three to six years. Finally, an extension is an addition to the length of the current enlistment contract, generally two years or less. We identify each event at a monthly level and then summarize at the annual level. The analysis presented in the paper considers only separations and reenlistments, but Appendix A also considers extensions.

We focus on annual events for simplicity's sake: estimation using monthly data is computationally intensive, with over 49 million individual-by-month observations. Furthermore, documenting monthly differences in retention is unlikely to be of significant value if annual measures are available. For each 12-month period, we say that a service member was retained if there was no separation event during that period. Similarly, we say that a service member reenlisted during a 12-month period if there was a reenlistment event during that period.

2. Multiplier Data

SRB multiplier data were obtained from the Force Management Division's collection of SRB announcements. Each announcement is presumed to supersede the previous and contained a list of multipliers by career field and time in service for each career field that offered a bonus, along with an effective date for those multipliers (designated as "time"). In some cases, announcements had identical or similar effective dates but other disagreements. We identified a

single multiplier for each career field, time in service, and time, by first constructing a list of all multiplier effective dates. If one or more sources indicated multiplier effective dates within 60 days of one another, we assumed that they were part of the same announcement, using the earliest date as the effective date for multiplier increases and either the latest date or 30 days past the earliest date as the effective date for multiplier decreases, whichever was later. If a career field was not included for a given effective date, we assumed that the career field was not offered any SRB bonus until the next announcement date. If sources disagreed on the value of the multiplier for a given career field and time in service, we averaged the multiplier values for all available sources.

We merged the identified multiplier to the personnel records by career field, time in service, and time. For each 12-month period, we identified the career field and time in service of each service member at the start of the period. We then identified the multiplier that was in effect for that career field and time in service at the beginning of each quarter: the first day of October, January, April, and July. We then averaged these multipliers together to obtain a single multiplier for the 12-month period.

3. Military Base Pay

The Defense Finance and Accounting Service (DFAS) provides data on military base pay by rank, years of service, and time (DFAS 2013). For each service-member-by-year observation, we identified the most recent pay table effective on 1 January of the fiscal year. We then identified the base pay consistent with the individual's rank and time in service as of the time of the observation.

4. Civilian Wages

The BLS's Occupational Employment Statistics (OES) program provides data on civilian wages by occupation, location, and time (BLS 2013a). We identified the cross-industry estimated median hourly wage and interquartile range of hourly wage estimate most closely associated with each service member's career field and contemporaneous location during the period of interest. This required matching each personnel record to the OES data on these three dimensions of occupation, location, and time:

Occupation. We matched each military career field to BLS Standardized Occupational Classification (SOC) codes manually. The OES data provide civilian wage data by SOC codes, so it was necessary to identify the SOC code that most closely represents the occupation for which each airman would most likely have a comparative advantage upon entering the civilian labor market, given his or her assigned military career field. This was accomplished by comparing descriptions of each career field (Powers 2013) to descriptions of SOC codes (BLS 2012). This matching process used a related crosswalk constructed for Carrell (2007) as a basis but was updated to reflect newer military career fields and SOC codes.

Location. The BLS provides wage data by several levels of locations. The most specific location is a Metropolitan or Micropolitan Statistical Area, two kinds of populated areas defined by the U.S. Census Bureau.[14] Starting in 2006, the BLS also provided data for Nonmetropoltan Areas, which lie outside of Metropolitan and Micropolitan Statistical Areas. The BLS also provides data at the state and national levels.

We used the U.S. Postal Service zip code of each service member's contemporaneous location to determine the most precise location for which wage data were available. We matched

[14] These areas are also called Core Based Statistical Areas (CBSA). Prior to 2005, the BLS used an older version of the Census Bureau's Metropolitan Statistical Areas.

the zip code to a list of the Census Bureau's Zip Code Tabulation Areas (ZCTA), which generally contain the area covered by the corresponding zip codes.[15] We then matched each ZCTA to a Metropolitan or Micropolitan Statistical Area using crosswalks linking the two geographic designations provided by the Census Bureau (U.S. Census Bureau, 2013a, b).[16] When a ZCTA could not be matched to this level,[17] or wage data were unavailable, we matched the ZCTA to a state and county using a crosswalk provided by the Census Bureau (U.S. Census Bureau, 2013c). We then matched the state and county to a Metropolitan or Micropolitan Statistical Area or a Nonmetropolitan Area that contained that county based on crosswalks provided by the U.S. Census Bureau (2002 and 2013d).[18] If no match could be made based on the county corresponding to the ZCTA, we used wage data for the state. If no data were available at the state level, or the ZCTA did not match to any state,[19] we used national average wage data.

Time. The OES provides wage data annually in May.[20] We matched each personnel record to the wage data for May of that year. For instance, a record describing the retention decision for October 2011 through September 2012 is linked to civilian wages in May 2011.

[15] Given that zip codes are defined as routes for postal delivery and are updated based on the needs of the Postal Service, they do not correspond exactly to ZCTAs, which are updated with each decennial census.

[16] For consistency with the BLS wage data, we match observations for 2004 and earlier to the older (four-digit) Metropolitan Statistical Area codes (U.S. Census Bureau, 2013 b) and observations for 2005 and later to the newer (five-digit) CBSA codes (U.S. Census Bureau, 2013a).

[17] ZCTAs representing areas outside of Metropolitan and Micropolitan Statistical Areas would not appear in these crosswalks. Zip codes that did not correspond to any ZCTA were also handled as described here.

[18] Again for consistency with the BLS wage data, we matched observations for 2004 and earlier to the older (four-digit) Metropolitan Statistical Area codes (U.S. Census Bureau 2002) and observations for 2005 and later to the newer (five-digit) CBSA codes (U.S. Census Bureau 2013d).

[19] Many of the zip codes without a U.S. state match were Army post office (APO) codes.

[20] Data are provided more frequently for some years, but we used the May releases only, to obtain consistency across years.

5. Civilian Unemployment

The BLS's Local Area Unemployment Statistics (LAUS) program provides data on civilian unemployment rate by location and time (BLS 2013b). We identified the annual average unemployment rate most closely associated with each service member's contemporaneous location.

Location. Using the same sources as for the OES data, we matched the service member's zip code to a county, the location unit used by LAUS. If we were unable to match the zip code to a county, we used the national average unemployment rate.

Time. The LAUS provides the annual average unemployment rate for each calendar year. We matched each personnel record to the unemployment data for the same calendar year. For instance, a record describing the retention decision for October 2011 through September 2012 is linked to the 2011 annual average unemployment rate.

6. Inflation Adjustments

We deflated all dollar amounts in the independent variables to 2010 dollars. We accomplished this by doing two things: 1) dividing military base pay and civilian pay by the annual average consumer price index (CPI) for all urban U.S. consumers for the year of the observation and 2) multiplying by the average CPI for 2010 (BLS 2013c).