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Abstract

The transition to all-volunteer Armed Forces, changing nature of modern warfare, and expansion of entitlement benefits for veterans necessitate a new examination of the effects of war deployments on health, human capital, and labor market outcomes. Using linked administrative data consisting of the universe of enlisted soldiers who separated from the U.S. Army between 2001 and 2016 — and exploiting a novel natural experiment to identify the effects of conditionally randomly assigning an active duty soldier to a combat deployment — we find that post-9/11 combat deployments substantially increased take-up of Veterans Disability Compensation benefits for Post-Traumatic Stress Disorder and Traumatic Brain Injury, effects that contribute to increased post-separation unemployability and reliance on unemployment insurance. We further find that combat deployments of over 18 months reduced post-separation educational attainment by 4 to 10 percent and are exacerbated by localized combat shocks. These adverse human capital effects are concentrated among white males serving in combat branches.

Keywords: combat, disability compensation, education, military service, veterans, war

JEL Codes: H56, J45, H41

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1. Introduction

The transition from conscripted to all volunteer forces (AVFs) has been one of the most dramatic shifts in military policy over the last half century. In 1970, only 6 of 36 OECD countries were defended by all volunteer active duty forces. By 2019, this number had reached 22 nations, with an additional 5 countries allowing civilians to avoid conscription with non-military public service (Central Intelligence Agency 2019). Much of what economists know about the impact of U.S. military service in wartime on veterans' labor market outcomes is learned from studies of the draft lottery in pre-1973 wars (Angrist 1990; Angrist and Chen 2011; Angrist et al. 2011; Card and Lemieux 2001; 2002). In the main, this literature finds little evidence of adverse long-run labor market effects of conscription into military service, in part due to generous veterans' benefits programs such as the GI Bill (Angrist 1993; Angrist and Chen 2011; Angrist et al. 2011). However, the transition to an all-volunteer Armed Forces, the dramatically changing nature of modern warfare — including the waging of asymmetric warfare and counterinsurgency operations (Schoenfeld et al. 2013; Ling and Ecklund 2011; Jones et al. 2002) — and the dramatic expansion in Veterans Disability Compensation benefits (Angrist et al. 2010; Autor et al. 2016) necessitate a new examination of the economic effects of combat service for AVFs, including identification of policy relevant local average treatment effects (LATEs) that capture the economic costs of waging war for combat veterans.

While casualty rates for those deployed to Iraq and Afghanistan are 66 to 73 percent lower than in draft-era wars, injuries per fatality in modern conflicts are substantially higher (Fischer 2015; Fazal 2014; Stiglitz and Bilmes 2008; Physicians for Social Responsibility 2006).[1] Improvements in body armor, increased use of Kevlar helmets, and advances in battlefield medicine have substantially reduced fatal and non-fatal injuries (Crawford 2016; Fazal 2014; Newman et al. 2007). But explosive devices generate half of all post-9/11 casualties (Jaffee et al. 2007; Physicians for Social Responsibility 2006), a far greater share than in prior conflicts.

[1] The casualty rate (sum of total deaths and injuries divided by the number deployed to theatre) was 2.1 percent for the Iraq and Afghanistan wars combined. This compares to a casualty rate of 6.2 percent in Vietnam, 7.8 percent in Korea, 6.7 percent in World War I and 6.8 percent in World War II. Post-9/11 casualty rates were calculated using casualty data from the Department of Defense (https://dcas.dmdc.osd.mil/dcas/pages/casualties.xhtml) and estimated deployment counts from RAND (Wenger et al. 2018). Draft era casualty rates were calculated using data from the Department of Veterans Affairs (see https://www.va.gov/opa/publications/factsheets/fs_americas_wars.pdf). The number of injuries per fatality in AVF conflicts in Iraq and Afghanistan were 7.4 and 8.6 respectively, compared to 2.6 in Vietnam, 2.8 in Korea, 1.8 in World War I, and 1.6 in World War II. Calculations for injuries per fatality were obtained using: http://siadapp.dior.whs.mil/personnel/CASUALTY/catastrop.htm.

The mortality rate from improvised explosive devices (IEDs), mines, and roadside bombs has fallen substantially relative to prior conflicts (Okie 2005; Stiglitz and Bilmes 2008, p. 255), resulting in traumatic brain injury (TBI) emerging as the distinctive injury of post-9/11 wars (Polimanti et al. 2017; Ling and Ecklund 2011). TBI rates in the wars in Iraq and Afghanistan are nearly twice those from Vietnam (Summerall 2016). Between 2000 and mid-2011, 220,430 service members had sustained TBI; over 51,000 of these cases could be classified as moderate to severe cases (Kelly et al. 2012). The impacts of TBI on cognitive, social, and communication processes are significant (Lash 2015), and may have long-lasting and severe effects on veterans (National Research Council 2008; Zoroya 2007) and their families (Summerall 2016).[2]

In addition to rising rates of TBI, over 25 percent of U.S. servicemembers deployed to Afghanistan and Iraq suffered from depression, drug and alcohol dependency, or suicide ideation, and nearly one-fifth had symptoms of Post-Traumatic Stress Disorder (PTSD) (Tanielian and Jaycox 2008). Post-9/11 military service has also been linked to suicidal behaviors (Brignone et al. 2017; Ursano et al. 2018; Naifeh et al. 2018; Bryan et al. 2015), opioid dependency (Cesur and Sabia 2019), and reduced attention, verbal learning, and visual-spatial memory (Vasterling et al. 2006; Hoge et al. 2006).

The modern political and policy environments have changed significantly as well. The Veterans Disability Compensation (VDC) program constitutes a major entitlement program akin to Social Security and Medicare (Stiglitz and Bilmes 2008) and may affect labor market outcomes of post-9/11 veterans. Over $65 billion was spent on the VDC program in Fiscal Year 2016, representing a nearly threefold increase relative to the pre-9/11 period. This rapid increase has been attributed to (i) the rise of TBI (Polimanti et al. 2017; Ling and Ecklund 2011) and PTSD (Tanielian and Jaycox 2008), (ii) greater willingness of recent veteran cohorts to seek help for health ailments (Stiglitz and Bilmes 2008, p. 83-84), (iii) advances in medical technology that permit improved screening of health conditions (Defense Health Agency 2019; Health and Human Services 2016; Sayer et al. 2011; Schwab et al. 2007), and (iv) liberalized eligibility standards that provide benefits to veterans who not only served in a theater of war (Autor et al. 2016), but also to those who served in proximity to war theater, but were not physically or psychologically wounded in battle (Angrist et al. 2011). Expansions in disability entitlement benefits have generated sharp increases in federal

[2] In practice, disentangling the cognitive effects of TBI and PTSD can be difficult, because both are often present, "feeding and reinforcing" each other (Lash 2015; Bryant 2011).

transfer income (Angrist et al. 2010) and strong work disincentives for veterans (Angrist et al. 2010; Autor et al. 2010).

The adverse health effects of modern warfare waged with AVFs, coupled with the expansion of entitlement benefits for veterans, may translate to larger adverse labor market effects than were seen in prior conflicts. Disability and unemployment rates for veterans of Operation Iraqi Freedom (OIF, 2003-2011) and Operation Enduring Freedom (OEF, 2001-2014) exceed disability and unemployment rates for all veterans (U.S. Bureau of Labor Statistics 2018), and the unemployment rate for veterans under age 25 is 39 percent higher than for non-veterans with similar demographic characteristics (U.S. Bureau of Labor Statistics 2016). Nearly half of active duty soldiers who served following September 11 applied for unemployment insurance benefits following their separation (Carter and Miller 2015).

Most prior attempts by economists to estimate the effect of post-9/11 military service on veterans' economic wellbeing have been hampered by (1) a lack of administrative data linking servicemembers' military records to data on their post-separation economic transitions, (2) the absence of a draft lottery, which has hobbled attempts at identification, and (3) an inability to measure localized combat shocks, such as unit-level combat injuries and deaths, which capture dangerous aspects of military service that may generate the largest adverse economic consequences. The current study makes important contributions on each of these three fronts.

First, we leverage a newly available administrative panel dataset consisting of the universe of enlisted soldiers who separated from the U.S. Army between fiscal years 2001 and 2016 (see Sabia and Skimmyhorn 2018).[3] These unique data link military records compiled by the U.S. Army with administrative data on veterans' post-separation benefits use, unemployment insurance, and educational attainment from the Department of Veterans Affairs, Federal and state Departments of Labor, and the National Student Clearinghouse, respectively. Together, these data describe one million recent enlisted soldiers' war histories and post-separation transitions.

Second, we identify a novel natural experiment to isolate the causal impact of post-9/11 combat service on veterans' economic transitions. This experiment exploits the administrative procedures by which active duty enlisted soldiers receive their deployment assignments, which mimic the conditions of (conditional) random assignment. The Army Human Resources Command (HRC) treats enlisted soldiers of identical rank and primary military occupation specialty (MOS) as

[3] Following Sabia and Skimmyhorn (2018), additional research (notably Bruhn et al. (2022)) analyzes the effects of combat deployments on health, labor market and financial outcomes.

perfect substitutes for the purposes of unit deployment assignments. Individual soldiers are rarely selected for deployment; rather, units receive deployment orders. Senior Army commanders have very limited authority to take into account personal preferences, family circumstances, or future economic potential in making unit deployment assignments (Engel et al. 2010; Lyle 2006). Using these procedures, we are able to isolate variation in combat assignment that is exogenous of other potential determinants of post-separation economic wellbeing.

The LATE identified from this novel experiment may differ in important ways from LATEs generated by draft lotteries. Our LATE will not capture the economic effects of military service per se nor will it capture the effects of peacetime service. Rather, our experiment isolates the effects of modern war deployments for all-volunteer active duty personnel. While potentially quite different than the effect of a civilian being drafted into military service, our experiment will (i) uncover an important policy relevant parameter in the context of modern warfare waged by all-volunteer forces, and (ii) shed light on the full social costs of war.

Third, the new data permit better measurement of exogenous exposure to localized combat shocks, measured by unit-level injury and death rates. This important innovation allows us, for the first time, to investigate the economic consequences of the most dangerous aspects of military service, including battlefield violence.

Our results provide strong evidence that post-9/11 combat deployments impeded civilian employment transitions and reduced educational attainment among active duty Army personnel. We find that combat assignment increased post-separation take-up of Veterans Disability Compensation (VDC) benefits for Post-Traumatic Stress Disorder (PTSD) and Traumatic Brain Injury (TBI) by 20 and 5 percentage-points, respectively, generating approximately $60 billion in additional healthcare costs to the Department of Veterans Affairs.

We find that adverse health effects of post-9/11 combat and, perhaps, disincentives for employment and human capital acquisition generated by disability benefits receipt, translate into worse labor market outcomes for recent veterans. Each additional year of post-9/11 combat deployment increased the likelihood that a veteran received an "unemployable" combined disability rating by 6 percentage-points and increased take-up of the Unemployment Insurance for Ex-Servicemembers (UCX) program by 2 percentage-points. Importantly, our findings are robust to restricting the sample to those servicemembers who served only one term in the Armed Forces and then separated, ameliorating concerns about sample selection bias over time as individuals make retention decisions.

Finally, our results show that post-9/11 combat assignments generated adverse schooling effects for Army veterans. Each additional year of combat assignment reduced the probability of post-secondary school attainment during enlistment by 20 percent and the post-separation probability of attaining a Bachelor's degree by 4 to 10 percent. These adverse human capital effects were exacerbated by exposure to localized combat shocks, as measured by injuries to members of a soldier's unit. We conclude that combat deployments in the Global War on Terror generated a number of important adverse economic consequences for veterans.

2. Background and Literature

2.1 Modern Conflict with All-Volunteer Armed Forces

Modern conflicts have differed from those of previous eras in their duration, nature, and demands on military servicemembers. Following the September 11, 2001 terrorist attacks on the U.S., President George W. Bush declared a Global War on Terror (GWOT), culminating in U.S.-led military invasions of Afghanistan (Operation Enduring Freedom) and Iraq (Operation Iraqi Freedom), followed by occupation, nation building, and counterinsurgency operations. Together, OEF and OIF constituted,

> "…the two longest wars in the history of the American republic, and, although not the bloodiest conflicts in American history — a position still held by the Civil War — … had resulted in thousands of Americans dead and tens of thousands wounded, and they had cost trillions of dollars in treasure." (Jenkins, RAND Corporation, 2014)[4]

The GWOT was, in many ways, also a new kind of war (Army War College 2002), "bear[ing] more resemblance to a protracted hunt than it does to what most people understandably call a war" (Gray 2003, p. 5). This type of conflict has broadly been categorized as "asymmetric warfare," in which smaller powers (nation states or other groups) seek to avoid conventional conflict with

[4] The Watson Institute at Brown University estimates the budgetary costs of wars in Afghanistan, Iraq, Syria and Pakistan to be over $5.6 trillion, including $1.0 trillion in future obligations in medical and disability benefits to veterans (Watson Institute 2018); Stiglitz and Bilmes (2008) estimate the Iraq war alone has cost over $3 trillion. The Congressional Research Service places OEF and IEF conflicts as the second most costly war in the history of the United States, only behind World War II (Daggett 2010).

technologically superior forces like the U.S. and its allies, and instead apply their strengths against the powerful opponents' weaknesses (Plant 2008; Ewans 2005). As a result, soldiers have increasingly faced threats from explosive devices (remote or suicide detonated) and up to 70 percent of injuries arise from explosive blasts (Schoenfeld et al. 2013).

While modern technological advances, particularly in body armor and medicine, resulted in post-9/11 servicemembers surviving combat at much higher rates than before (Crawford 2016; Marx et al. 2009; Newman et al. 2007), injuries per fatality were much higher than in prior conflicts (Fischer 2015; Fazal 2014; Stiglitz and Bilmes 2008; Physicians for Social Responsibility 2006). Increases in nonfatal injuries per fatality raises a plethora of new health issues and costs associated with addressing these injuries among veterans (Fazal 2014). For instance, TBI has become the signature injury of recent conflicts owing to the increased use of improvised explosive devices, technological advances in body but not head armor, advances in battlefield medicine, and an increased awareness and ability to separately diagnose TBI and PTSD (Ling and Ecklund 2011).[5]

Post-9/11 combat deployments generated a substantial number of psychologically wounded veterans (Tanielian and Jaycox 2008; Cesur et al. 2013).[6] Unsurprisingly, the mental health problems of post-9/11 veterans have been called "the U.S. Army's third front" (Thompson 2010). However, while some service members may not seek treatment, those in the AVFs appear to be more likely to seek help for mental health distress than their draft-era counterparts (Stiglitz and Bilmes 2008, p. 83-84).

During GWOT-era military operations, U.S. active duty service members were deployed more frequently and for substantially longer durations than in prior wars (Marx et al. 2009). Nearly 40 percent of those deployed to Iraq and Afghanistan were deployed on multiple occasions (Litz and Schlenger 2009), and the average duration of a combat tour was 28 percent higher than in recent prior conflicts (Baiocchi 2013).

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[5] Stiglitz and Bilmes (2008) note that estimates of combat-related injuries may be understated given the Department of Defense's discretion in classifying injuries as combat-related for incidents like vehicle and helicopter crashes, disease, or physical illness. We acknowledge this concern but use existing VA and DOD casualty and injury data in the estimates provided throughout the paper.

[6] The source of war-related psychological trauma has been studied extensively by both military health researchers (McFarlane 2010) and health economists (Cesur et al. 2013). Combat experiences such as (i) witnessing deaths of unit members, coalition members, or civilians, (ii) engaging the enemy in firefight (including rocket or mortar fire), (iii) killing another human being, and (iv) witnessing injuries to those with whom a servicemember has a personal relationship, are associated with substantially increased levels of trauma (Litz and Schlenger 2009; Steenkamp et al. 2011), often manifest in the form of PTSD (Fontana and Rosenheck 2004; Litz and Schlenger 2009; Cesur et al. 2013; Gubkin 2014; Smith et al. 2008). In addition, even if such traumatic events do not materialize, there is evidence that the fear and guilt associated with potentially enduring these events may generate symptoms of PTSD (Steenkamp et al. 2011; Cesur et al. 2013).

In addition to the changing nature of warfare, the transition from a conscripted force to an all-volunteer force (AVF) has resulted in important changes to the population of enlisted service members. In particular, there is evidence that the sociodemographic characteristics of all-volunteer forces deployed in OEF and OIF differ from conscripted forces who fought in prior U.S. wars (Laich and Wilkerson 2017; Elder et al. 2010; Carter et al. 2017). If those who select into voluntary military service were drawn from more economically disadvantaged, less socially connected populations (Elder et al. 2010; Laich and Wilkerson 2017), these characteristics may interact with modern warfare to exacerbate adverse labor market effects of combat. On the other hand, if combat soldiers in OEF and OIF were drawn from white, higher income neighborhoods (Carter et al. 2017), such socioeconomic factors could be protective for the marginal enlistee relative to marginal conscriptee.

Finally, as discussed extensively below, there have been large increases in post-9/11 veterans benefits, particularly disability and education programs, each of which could impact labor market outcomes (Angrist et al. 2010; Autor et al. 2016; Barr 2015; Barr et al. 2019). Funding veterans' needs comprises an important new entitlement program alongside the Medicare and Social Security programs (Stiglitz and Bilmes 2008, p. 89).

2.2 Drawdown and Economic Transitions to Civilian Life

Following major combat operations in Iraq and Afghanistan, the Obama Administration began the largest drawdown of the Army since the end of the Cold War. Between 2012 and 2017, the size of the Army's active duty force declined by nearly 20 percent, with over 120,000 soldiers returning to civilian life (U.S. Department of Defense 2018). The transitions of these soldiers to civilian life have garnered the attention of national policymakers and could prove important in planning and administering future force drawdowns.

The Veterans Opportunity to Work and Hire Heroes Act was passed in 2011 (and retroactively expanded in 2015) to provide tax credits to firms who hired recent veterans, with larger credits offered for the hiring of veterans who had experienced longer unemployment spells or whose households were characterized by socioeconomic disadvantage. In January 2018, President Trump signed Executive Order 13822, which mandated the Secretaries of Defense, Homeland Security, and Veterans Affairs produce a plan to aid in the "transitioning uniformed service members in the year following discharge, separation, or retirement" (Executive Order 13822, 2018).

Since 2012, the Department of Defense has coordinated branch (i.e., Army, Navy, Air Force, Marines and Coast Guard)-specific Transition Assistance Programs (TAP) that consolidate the provision of information about post-separation services. The previous TAP was a shorter, less resourced program with lower emphasis on attendance that consisted of pre-separation counseling, an employment workshop, an optional briefing on veteran benefits, and a special TAP for the disabled (U.S. Government Accountability Office 2014). The Veterans Opportunity to Work and Hire Heroes Act now requires all separating veterans to attend their branch's revised TAP, and to initiate the process earlier (i.e., with more time until their separation, up to a year in advance) in order to facilitate their transitions.

The largest component of the current TAP is the employment workshop, administered by the Department of Labor at military installations around the world (U.S. Department of Labor 2016).[7] Transitioning service members are required to meet Career Readiness Standards (CRS), which includes satisfying several transition-related tasks.[8] The TAP is typically conducted in a classroom/computer laboratory setting with content provided on slides, through guided computer searches, and significant interaction via question and answer sessions with instructors and transition counselors. In addition to employment-related assistance and benefit eligibility and enrollment, the TAP affords service members the opportunity to attend one or more of the following multi-day training seminars based on personal goals: enhancing employment prospects (i.e., the Career Technical Training), enrolling in educational institutions (i.e., the Accessing Higher Education Track), opening new businesses (i.e., the Boots to Business Program).

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[7] Employment documents can also be obtained and completed via the Joint Knowledge Online (JKO) program. See: https://www.dol.gov/vets/programs/tap/DOLEW-Participant-Guide-January-2015.pdf

[8] CRS requires servicemembers to meet several tasks: (1) documenting personal goals (e.g., for personal employment, higher education, career technical training, and/or entrepreneurship), (2) developing a post-separation one-year budget (e.g., that identifies goals, current compensation and benefits, planned expenses during separation, estimated future compensation, and estimated expenses after separation), (3) registering on the VA eBenefits website (e.g., to apply and track the status of education, health, and/or disability benefits), (4) completing continuum of service opportunity counseling (e.g., for those transitioning from Active Duty service to Reserve Component service), (5) evaluating the transferability of military skills to the civilian workforce (e.g., use Department of Labor Occupation Net resources to find civilian occupations comparable to the service member's current military occupational specialty, and to identify gaps between goals and current skills), (6) identifying requirements/eligibility for certification or licensing in career field of interest (e.g., identifying licenses required to work in a specific occupation), (7) completing an individual assessment to help match personal interests to career plans (e.g., complete assessments like the O*Net Interest profiler (https://www.onetcenter.org/IP.html?p=2) or the Kuder education and career planning tool (https://www.kuder.com/about/success-stories/dantes/)), and (8) receipt of a DOL *Gold Card for American Job Centers*, which allows priority employment counseling services for separating servicemembers. Requirements and components can be tailored to the service member based on their career goals. So for example, an individual with the goal of pursuing higher education might identify appropriate colleges/universities with programs of interest for item (6) and then complete the appropriate applications.

The TAP engages unit commanders to mentor and monitor service members' progress, resources TAP specialists at the installation to counsel and support service members through the process, and mandates that service members complete all CRS and complete a "capstone" event no later than 90 days prior to their transition.[9] Prominently included among the programs discussed in TAP, many of which are provided by the Department of Veterans Affairs, are disability compensation, unemployment compensation, and education benefits.

2.3 Prominent Veterans Benefits Programs for Post-9/11 Veterans

2.3.1 Veterans Disability Compensation. Veterans who incur injuries, disease, or psychological trauma (or have their injuries or diseases aggravated) during active duty service or training may qualify for veterans disability compensation (VDC). According to the Department of Veterans Affairs, "a disability can apply to physical conditions, such as a chronic knee condition, as well as a mental health condition, such as post-traumatic stress disorder" (U.S. Department of Veterans Affairs 2018)

All post-9/11 servicemembers complete a medical evaluation from their military service prior to transition. The TAP includes additional information on how to connect with the VA for disability claims, and how to file a claim. Service members are not required to complete any screenings or evaluations with the VA, but disability is a salient topic among transitioning service members and a VA representative completes the TAP session on VA benefits. The VA process is handled separately from any military (e.g., Army) disability ratings, though the VA may rely in part on military health records (e.g., TBI or PTSD diagnoses) in its disability rating process. While the disability application process will be unique to each individual, the VA outlines its eight step disability compensation process on its website, and service members can connect with a VA representative during the TAP to learn more and/or initiate their claim(s).[10]

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[9] Anecdotal evidence suggests that while capstone completion 90 days prior to transition is less than universal, the revised TAP has significantly increased the number of service members participating in TAP and helped them to participate earlier.

[10] The eight steps are: (1) Service members/veterans file a claim, (2) a Veteran Service Representative (VSR) reviews the claim, (3) the VSR gathers evidence from required sources (e.g., the service member, a VA medical professional, or another medical professional), (4) the VBR reviews the evidence, (5) the VSR prepares for a decision by preparing a recommendation and if required, gathering additional information, (6) The VA reviews the recommended decision and makes a final decision, (7) the notification packet is prepared, and (8) the VA sends the decision packet. Claims can be tracked on the VA eBenefits website and service members / veterans can appeal the decisions. For more information see: https://www.benefits.va.gov/compensation/process.asp.

Despite a 17 percent decline in the share of the U.S. population who were veterans between 2000 and 2013, Federal expenditures on the VDC program grew from $20 billion to $54 billion, with projections of over $65 billion by Fiscal Year 2016 (U.S. Congressional Budget Office 2014). The large increases in total expenditures are due to an 83 percent increase in the share of veterans who receive VDC benefits (9 percent in 2000 versus 17 percent in 2013), and a 60 percent increase in the per-veteran VDC payment (U.S. Congressional Budget Office 2014). Among the explanations for these trends include the intense physical and psychological consequences of combat operations in Iraq and Afghanistan (including increased diagnoses of PTSD and TBI), liberalization of eligibility requirements, and slack labor markets for separating veterans (U.S. Congressional Budget Office 2014). The recognition of war syndromes as pensionable by the federal government and the difficulty in treating these syndromes may result in persistent and significant future public expenditures.

There is evidence that the generosity of VDC benefits affects labor market outcomes. Using changes to program eligibility requirements or in the generosity of benefits as policy experiments, studies find that VDC benefits are negatively related to civilian labor force participation (Angrist et al. 2010; Autor and Duggan 2007; Autor et al. 2011, 2016; Coile 2015).

2.3.2 Unemployment Compensation for Ex-Servicemembers. While VDC eligibility requires diagnosis of some physical or mental health condition, many more veterans are eligible for the Unemployment Compensation for Ex-Servicemembers (UCX) program, a program similar to the Unemployment Insurance program for civilians. Service-related UCX eligibility requirements are determined by the Department of Defense (DOD) and include (i) receipt of an honorable or general discharge, (ii) separation for inaptitude or a personality disorder with at least one year of continuous service, or (iii) separation for medical conditions (Carter and Miller 2015). UCX is available to service members who voluntarily left the military, though traditional unemployment insurance (UI) are not. Moreover, receipt of full UCX benefits does not diminish receipt of disability compensation benefits via the VDC program.

States determine the maximum duration of UCX benefit receipt, per week benefit amounts, and work search or education requirements, generally following rules established under the Unemployment Insurance (UI) program for civilians. Most separating veterans are eligible for benefits for up to 26 weeks, with some states allowing maximum benefit duration of 52 weeks.[11]

[11] The American Recovery and Reinvestment Act, enacted in the midst of the Great Recession of 2009, permitted some to receive benefits for up to 99 weeks.

Veteran participation in the UCX program is common, with approximately half of all transitioning enlisted soldiers applying for benefits (Carter and Miller 2015). DOD spending on the UCX program reached over $600 million in FY2015, though spending on the program has declined in recent years due to the economic recovery.

A handful of descriptive studies have examined demographic characteristics associated with UCX participation. Desrosiers et al. (2014) find that individuals who are less able, less educated, non-white, single, younger, female, and who worked in military service/supply occupations are more likely to receive UCX. Carter and Miller (2015) find a similar pattern for Army veterans in Texas, Illinois, and North Carolina. They also find that those with poor military performance and family related needs are more likely to receive UCX. To date, no study has linked combat experiences (average or heterogeneous) to participation in this program or tracked its use over time.

2.3.3 Veterans Administration Education Benefits. Education benefits comprise one of the most important components of transition assistance for many veterans. The original 1944 GI Bill ("The Servicemen's Readjustment Act") provided post-separation schooling benefits to servicemembers following World War II, benefits that were renewed for veterans serving in subsequent military conflicts, including the Korean War, the Vietnam War, and the first Gulf War. Under the Montgomery GI Bill (MGIB), enacted in 1984 to augment a variety of smaller prior GI Bills, veterans are required to contribute $100 per month for at least one year and serve for at least three years to be eligible for benefits. [12] The MGIB provided benefits directly to veterans for use at public or private colleges or universities, with highest benefit take-up within the first three years of separation (Barr 2015; Martorell and Bergman 2013). For veterans who separated in 2000, the average benefit received was $20,994, with total government spending on the program of $384 million (Martorell and Bergman 2013).

Recently revised and expanded, the "Post-9/11 GI Bill," (PGIB), enacted in 2008 (and later amended), provides educational benefits to servicemembers who recorded at least 90 days on active duty service following September 10, 2001. Benefits include payments for tuition and fees, monthly housing, and books and supplies (up to $1000). In 2016, the maximum benefit covers up to (i) 100%

[12]The MGIB's benefit package is primarily a monthly stipend. The exact monthly rate is adjusted every year to account for raising costs of tuition. For 2017, the maximum monthly rate for the MGIB was $1,928 (less for non-fulltime students). Additional funds can be earned if veterans opt in to a "$600 buy-up" in which a one-time payment of $600 can increase monthly rates by $150. The MGIB benefits last for a total of 36 months. While the MGIB is commonly used for universities, the funds can also be used for apprenticeships and on the job training at a maximum per month rates of $1,446 for the first 6 months, decreasing over time (Department of Veterans Affairs 2016).

tuition and fees paid to in-state public educational institutions, or (ii) up to $17,500 per year to private institutions. Benefits are available for a maximum of 36 months and for up to 15 years following completion of active duty service. GI benefits can be used not only for universities and colleges, but also for technical training, flight school and on-the-job training programs (U.S. Department of Veterans Affairs 2016). In Fiscal Year 2013, 754,229 veterans had received post-9/11 GI benefits, representing a 36 percent increase from two years prior (U.S. Department of Veterans Affairs 2014), and total expenditures on the PGIB exceed $11 billion annually (Cate et al. 2017).

Studies of the schooling and labor market effects of GI Bill benefit receipt following the Second World War (Lemieux and Card 2001), the Vietnam War (Angrist 1993), the Korean War (Stanley 2003), and Post-9/11 Iraq and Afghanistan Wars (Barr 2015) find that GI Bill benefits were associated with substantial gains in educational attainment, translating into important labor market benefits. However, Stanley (2003) finds that these earlier benefits have mainly counteracted the adverse schooling effects of war rather than increased schooling beyond that which would have occurred in the absence of war. There is evidence that GI Bill participation and the probability of separation in the post-draft era increase with the generosity of benefits (Simon et al. 2010). Moreover, Castleman et al. (2019) find that servicemembers of higher socioeconomic status (e.g., those with more tenure, higher education, and who are officers as compared to enlisted) are more likely to transfer their benefits to eligible dependents. However, we know very little about the effects of combat experiences on subsequent educational attainment.

2.4 Mechanisms

While post-9/11 combat veterans entering the civilian labor market possess many cognitive, non-cognitive, and job-related skills that make them attractive to employers, they also face many challenges. The adverse physical and mental health effects of combat deployments (Cesur et al. 2013; 2016; Lyk-Jensen et al. 2016; Tanielian and Jaycox 2008; Vasterling et al. 2006; Hoge et al. 2006) may impede economic transitions not only directly via health channels, but also by affecting the behavior of firms. Surveys of human resource professionals suggest that nearly half of civilian employers report that mental health problems are "a potential barrier to hiring employees with military experience" (Society for Human Resource Management 2015). The Vice Chairman of the Joint Chiefs of Staff warned that prospective employers are "scared off" by concerns that veterans suffer from PTSD (Winnefeld 2015). Given that PTSD can be difficult to observe, this could result in statistical discrimination against all veterans.

Time spent in post-9/11 war deployments may replace civilian labor market experience, lead to greater skill mismatch, and induce depreciation of human capital needed for successful civilian job transitions (MacLean 2016). This is especially true for service members in combat occupations. While skill mismatch may lead to an increase in the demand for education, time spent in the military may also reduce the lifetime returns to such investments.

Combat deployments may also increase reliance on Veterans Disabilities Compensation (VDC) and unemployment insurance benefits, which could generate disincentives for job search, labor market attachment, and investments in human capital (Bound and Waidmann 1992; Autor et al. 2011; 2016; Angrist and Chen 2011). On the other hand, greater access to generous GI Bill benefits could increase educational attainment and improve longer-run labor market outcomes (Lemieux and Card 2001; Angrist 1993; Stanley 2003; Barr 2015). Finally, combat service may also erode social capital or noncognitive skills needed for networking in the civilian labor market.

2.4 Prior Literature on the Labor Market Effects of Military Service

Prior studies examining the economic effects of military service have most frequently used draft lotteries to isolate the causal effect of military service. The literature on the impact of draft lottery-induced military service on educational attainment (Angrist 1993; Keller et al. 2009; Angrist and Chen 2011; Hubers and Webbink 2015) and employment or earnings (Siminski 2013; Autor et al. 2016; Angrist et al. 2010; Angrist and Chen 2011) suggests heterogeneity in effects of military service across nations, conflicts, and cohorts of veterans.

Studies of American men generally find that military service is associated with an increase in educational attainment, largely due to veterans' eligibility for public education benefits via the GI Bill (Angrist 1993; Angrist and Chen 2011). There is also evidence that draft avoidance behaviors increase educational attainment via college deferments (Card and Lemieux 2001; 2002). In contrast, in OECD nations and in Australia, there is stronger evidence that conscripted service is negatively related to educational attainment, perhaps due to less generous educational benefits earmarked for veterans (Keller et al. 2009; Hubers and Webbink 2015).

With regard to employment effects, most evidence suggests that U.S. World War II veterans have higher employment rates than comparable nonveterans, while the reverse is true for Vietnam veterans (Angrist and Krueger 1994). However, using conscription as a natural experiment, there is little evidence that U.S. military service in either war causally affected overall employment rates

(Angrist and Chen 2011).[13] There is stronger evidence for negative employment effects of draft-induced military service in other nations, such as Australia, which offers generous pension benefits that may deter work (Hubers and Webbink 2015).

Findings on the earnings effects of military service are also mixed, with evidence suggesting that any negative effects may dissipate over time. Angrist (1990) finds that draft-induced Vietnam War service is associated with a 15 percent decline in earnings among U.S. men in the 1980s. However, evidence from more recent Censuses suggests that earnings penalties associated with Vietnam era-conscription disappeared by the early 1990s (Angrist et al. 2011). As with schooling and labor market effects, Keller et al. (2009) document stronger adverse effects of military service across OECD nations, particularly when conscription is for longer durations. In contrast, findings from Israel suggest that conscription led to increased earnings, perhaps due to increased networking opportunities (Asali 2019).

Isolating the economic impacts of U.S. military service in the post-draft/all volunteer forces era (post-1973) poses new empirical challenges given non-random selection into military service. Most of these studies compare U.S. military applicants, some of whom enlisted and others who did not (Martorell et al. 2013; Loughran et al. 2011; Angrist 1998). Loughran et al. (2011) find that enlistment is associated with a reduction in the probability of obtaining a four-year college degree, but a small increase in the probability of completing a two-year associate's degree.

With respect to earnings, Martorell et al. (2013) find that post-9/11 veterans earn a premium relative to nonveterans prior to separation, driven by those who re-enlist, but the premium narrows at the time of separation. Moreover, those in military occupations with more easily transferable skills, such as healthcare, intelligence, or communications (Martorell et al. 2013) see larger post-separation earnings gains than those serving in combat occupations. While descriptively important, the reports by Loughran et al. (2011) and Martorell et al. (2013) are limited because the identification strategy employed in each study relies on the assumption that the probability of acceptance (and the decision to enlist), conditional on completing a service application, is orthogonal to labor market outcomes.

[13] The PGIB also includes a provision for service members to transfer all or a portion of their earned benefits to their military dependents. Castleman, Murphy and Skimmyhorn (2019) document that transfer correlates negatively with measures of SES and therefore the provision may have limited effects on intergenerational mobility, and suggestive evidence of adverse effects on earnings, both of which increase in magnitude as children age.

Perhaps more convincingly, Angrist (1998) exploits an error in the scoring of exams that screened military applicants as a natural experiment and finds that military service in the early 1980s increased the post-separation probability of employment. He also finds evidence of heterogeneous earnings effects of service by race, with white veterans experiencing a post-separation earnings decline and non-whites seeing a small long-term earnings gain.

A final set of studies examine health and family wellbeing effects of deployments in the post-draft era. The LATEs identified from these studies may be quite different from the draft because they identify the effects of deployments among military personnel rather than military service per se. Angrist and Johnson (2000) finds that Gulf War deployments of husbands have no effect on divorce risk, but increases the likelihood of wives' employment. In contrast, deployment of wives increases divorce risk, but has no effect on husbands' employment. Lyle (2006) and Engel et al. (2010) find that parental deployments are associated with (relatively small) declines in academic performance of children.

Focusing on the post-9/11 era and using survey data on health outcomes, other studies find that deployments are associated with increased reports of Post-Traumatic Stress Disorder (U.S. Veteran Affairs 2017; Cesur et al. 2013; Hourani et al. 2015; Smith et al. 2009; Tanielian and Jaycox 2008), divorce (Negrusa and Negrusa 2014; Negrusa et al. 2014), substance abuse (Cesur et al. 2016; Cucciare et al. 2015; Jacobson et al. 2008), domestic violence (Cesur and Sabia 2016), and decreased human capital in attention, verbal learning, and visual-spatial memory (Vasterling et al. 2006; Hoge et al. 2006).[14] Each may be important an important channel through which post-9/11 war deployments could affect post-separation economic wellbeing.

3. Identification

Prior studies of the draft lottery identify the labor market effects of a civilian being "randomly" drawn into military service. The current study estimates a different LATE, one that identifies the effect of (conditionally) randomly assigning an active duty enlisted volunteer being to a post-9/11 combat deployment. This policy parameter is important in assessing the full costs of waging modern war on voluntarily enlisted soldiers' labor market outcomes. However, it is

[14] The most commonly used survey datasets in this literature include the Department of Defense Health and Related Behaviors Survey Among Active Duty Personnel, the Millennium Cohort Study, and the National Longitudinal Study of Adolescent and Adult Health.

important to note that it may not be comparable to prior draft lottery studies, particularly those that have explored the effects of peacetime military service or that have emphasized the role of entitlement benefits programs available to veterans, but not civilians. That is, our estimates will not capture the effects of military service per se, but rather the effects of waging war for military personnel. While national policymakers retain the ability to wage war, they do not, as yet, have the authority to reinstitute the draft. Thus, while our LATE is different, we believe the policy parameter we seek to identify remains very important for policymakers.

To identify the causal impact of combat deployments on economic transitions of separating soldiers, we exploit the administrative procedures by which U.S. Army Human Resources Command (HRC) assigns active duty enlisted service members to their units and the processes by which the Department of Defense and U.S. Army Forces Command (FORSCOM) assigns those units to deployments, including combat deployments. These procedures generate the conditions for a natural experiment through which we can identify the causal effect of post-9/11 combat deployments.[15]

Senior Army commanders rarely deploy individual soldiers, but rather deploy units after assigning, and often re-assigning, servicemembers to units. For the purposes of assignment of active duty servicemembers to their units and the assignment of those units to overseas deployment duties, the U.S. Army regards servicemembers of identical military rank and occupation specialty as essentially perfect substitutes in the assignment of their duties. As a rule, senior commanders do not consider personal preferences, family background, or future civilian labor market prospects in making unit and deployment assignments (Lyle 2006; Engel et al. 2010; Carter and Skimmyhorn 2017; Kawano et al. 2017). Assignment decisions are based on (1) the needs of the Army, driven by world events, and (2) the availability of units, defined broadly by equipment availability, unit training

[15] In practice HRC may assign individuals to many different types of units including specific higher echelon organizations (e.g., an Army, Corps or Divisional Headquarters, a Special Forces Group, or other unique strategic units), to brigade level organizations at an installation (where they may be subsequently assigned by brigade human resources personnel), or directly to sub brigade-sized organizations (e.g., specialized battalion or company level units) that do not report directly to a brigade. Of note, the Army is a large, complex, dynamic organization with a constantly evolving force structure (Moran 2006). More importantly, regardless of the unit level, soldiers are assigned to units based on the "needs of the Army," as opposed to individual preferences, thus minimizing the chance of selection into any particular unit. For additional details on how Army assignments prioritize job skills and Army requirements over soldier preferences, see Department of Defense (DoD) directive 1315.07, "Military Personnel Assignments" and U.S. Army Regulation 600-14, "Enlisted Assignments and Utilization Management." In addition to the quasi-experimental variation inherent in individual assignments, units are selected for deployment without regard to the preferences of the individual unit members. For additional details on how the Department of Defense and the U.S. Army Forces Command assign units to deployments based on national interests, operational requirements, and unit capabilities, see CJCSI3100.01E "Joint Strategic Planning System," the Global Force Management Allocation Plan, and Army Regulation 525-29 "Military Operations: Force Generation – Sustainable Readiness."

and certifications, and the occupational skill set of unit members (Army Regulation 220-1). These regulations provide a strong prior for plausibly exogenous deployment assignments.

Active duty soldiers may affect their probability of combat deployments as well as their lifetime combat exposure in a number of ways, including (i) branch of service selected, (ii) military occupation chosen, and (iii) length of service in the Army, depending on their ability to forecast the appropriate expected combat exposure. However, conditional on rank, primary occupation specialty, and timing of service (i.e. year of enlistment), unit-level combat deployment assignments at a given point in time are assumed to be orthogonal to other determinants of transition benefit receipt and labor market outcomes.[16]

We pursue three efforts to document the credibility of our identification strategy. First, we estimate the effect of combat deployment on our outcomes under study with and without a rich set of individual characteristics at the time of enlistment. These characteristics include a rich set of demographic characteristics (i.e., age, gender, race/ethnicity, number of children, and marital status) and data on human capital (i.e., educational attainment and Armed Forces Qualifying Test Scores (AFQT), all measured at the time of enlistment. We find that the estimated treatment effect is statistically unchanged when we include these controls, ameliorating concerns about individual selection into combat service or other omitted variables. Second, we regress an indicator of combat deployment (or a continuous measure of combat deployment length) on the observable characteristics that determine deployment assignment (rank, military occupation specialty, and timing/length of enlistment). Then we explore how the variation in the dependent variable explained by these covariates change when we add a set of background characteristics that should not influence combat assignment are included on the right-hand side of the regression. We find that the observable characteristics described above explain very little of the variation in combat deployments, further strengthening our case that combat deployments are quasi-randomly assigned, conditional on an individual's rank, military occupation specialty and enlistment term).[17] Finally, as discussed below, we exploit an additional instrumental variables (IV) strategy in which we use unit-level deployment assignment as an instrument for individual deployments. The similarity of the IV and main ordinary least squares results provides further evidence that our identification strategy

[16] Carter and Skimmyhorn (2017) provide evidence for this assumption for Army assignments within the United State.
[17] In untabulated results, available upon request, we find that our observable characteristics explain less than two percent of the variation in combat exposure. This result follow from the first check, wherein adding our controls has minimal effect on our main coefficients.

leverages variation in combat deployments that appears unrelated to other potential determinants of the outcomes.

There are two other potential threats to identification. The first is *stay-back selection*. This is the possibility that not all unit members are deployed, perhaps because some are non-randomly classified as "stay-back personnel" who remain back at their home base for administrative duties. Stay-back personnel might be service members who are non-deployable for some period of time, often due to health reasons. In the main, the risks of this type of selection is small given (i) the limited ability of personnel to affect their deployment assignments, and (ii) the share of units who serve as stay-back personnel (approximately 5 percent). However, to address this type of selection, we follow the approach of Lyle (2006) and use unit-level (i.e., battalion) deployment orders as an instrument for individual deployment in a two-stage least squares (2SLS) framework.

The second type of selection is *Army exit selection*. While enlistment terms are exogenously set by the Army prior to an individual's reenlistment, it may be that those assigned to combat service are more or less likely to reenlist. This may be due to increased taste for combat and loyalty to comrades, dissolution with war, or increased likelihood of injury and death. This second type of selection is more challenging to empirically address and speaks to the generalizability of our results.

We take a number of steps to address Army exit selection. First, because we have administrative data, we can ensure no sample attrition from the sample and are able to control for rank (tenure) and total years of service (enlistment length) to ensure that combat assignment effects are not contaminated by decisions to reenlist. Second, we separately estimate the effects of combat deployments for those with different enlistment term lengths (e.g., 1-6 years), including those who serve one term and do not re-enlist. Focusing separately on so-called one-termers versus those who remain on active-duty service longer will (1) ameliorate some concerns about endogeneous attrition (not from the sample, as we have the full sample of servicemembers, including following separation, but from the Army), (2) allow us to explore heterogeneous treatment effects by length of time served. Finally, we will estimate the effects among those who remain in the Army — including educational attainment — to get a sense of the magnitude and direction of sample selection effects.

4. Data, Measures and Methods

4.1 Data and Measures

We construct an individual-level longitudinal dataset consisting of the universe of active duty enlisted soldiers (i.e., omitting warrant officers and officers) separating from the U.S. Army between

2001 and 2016. These confidential data consist of four merged datasets: (1) administrative military records from the U.S. Army, including personal characteristics as well as individual- and unit-level deployment and casualty records, (2) administrative data on disabilities benefits and Post-9/11 GI benefit receipt from the U.S. Veterans Administration, (3) administrative data on UCX receipt from the U.S. Department of Labor and State Departments of Labor, and (4) administrative data on educational attainment from the National Student Clearinghouse (NSC).

Army administrative data include information on the soldier's enlistment and separation date, highest military rank achieved, primary military occupation specialty (PMOS), educational attainment at separation, Armed Forces Qualifying Test (AFQT) score, unit, as well as individual- and unit-specific casualty and death rates. These data also contain demographic characteristics, including race/ethnicity, marital status, number of dependents, and state to which the separating veteran will relocate. Veterans' Administration data include information on VDC benefits (along with codes for PTSD, TBI and the veteran's continuing disability rating, or CDR) and Post-9/11 GI Bill use. VDC administrative data are available for fiscal years 1999 through 2017 and Post-9/11 GI Bill use for fiscal years 2015 and 2016. UCX data, available for fiscal years 2010 to 2015, are obtained from U.S. Department of Labor and state Departments of Labor, merged via the Military State Data Exchange System.[18] National School Clearinghouse data on educational attainment are available for the 2001 through 2017 period.

Our primary analysis sample consists of approximately one million soldiers (1) who separated from the U.S. Army between fiscal years 2001 and 2016, (2) had military records that included information on duration of hostile fire pay receipt, length of military service, rank (E1-E9), military occupation, year of separation, demographic characteristics at enlistment (age, gender, race/ethnicity, marital status, and educational attainment); and (3) for whom administrative data on program participation and educational attainment were available in the fiscal year following separation.[19]

Descriptive Statistics. Our main analysis sample of all-volunteer active duty enlisted soldiers who separated from the Army between 2001 and 2016 is described in Table 1. The average age of an

[18] While UCX data on applications, eligibility, and enrollment are available for all states, data on receipt is available from 26 states and can be merged to administrative Army records.

[19] Our second analysis sample consists of all active duty servicemembers who enlisted after September 11, 2001, independent of whether they had ever separated from the Army. We also condition the sample on those who had non-missing information on the above military characteristics and demographic characteristics at enlistment. This sample will be used to estimate outcomes that can be measured during their last year of active duty service or post-separation, including employment-related outcomes (unemployment insurance receipt) and educational attainment.

enlisted service member at the time of separation was 27.5 years, having served for 5.6 years. The vast majority of the sample (68.2 percent) attained the highest rank of a junior enlisted service member (E01 to E04; private, private first class, and specialist/corporal), with 23.0 attaining the rank of junior non-commissioned officer (E05-E06) and 8.8 percent attaining the rank of senior non-commissioned officer (E07-E09). Approximately 29 percent had chosen combat branches (Infantry, Armor, Field Artillery, and Special Forces). We find that 82.9 percent were males, two-thirds (64.7 percent) were non-Hispanic whites, and 31.7 percent were Black (20.6 percent) or Hispanic (11.1 percent). Nearly all of the sample had attained a high school degree (high school diploma or GED) at the time of separation.

Combat deployments are measured using administrative pay records to document time spent deployed in combat zones via the number of years the soldier received hostile fire pay (HFP) (*Combat Years)*. Hostile fire pay accrues to service members deployed to combat zones, defined by appropriate commanders as regions where military personnel are subject to hostile fire or explosion of a hostile mine or are in close proximity thereto. Over our sample period, this largely is categorized as deployments to Iraq and Afghanistan. However, it can also include operations in Qatar, Kuwait, Saudi Arabia, Yemen, Sudan, Tunisia, Egypt, Syria, and Guantanamo Bay, Cuba. Over the sample period under study, 57 percent had been deployed to combat at some point during their enlistment (*Any Combat*). The unconditional average deployment length was approximately 9 months, and 18.7 percent of our sample reported cumulative combat deployments of over 18 months.

We measure unit-level combat exposure by using administrative casualty data and identifiers from the soldier's company during his/her active duty enlistment period. Approximately 10 percent of servicemembers experienced a death to a member of their unit. For each servicemember, we also construct a measure of unit-level injury exposure, generated as the length of time the servicemember had been exposed to an enlisted member of his unit being injured (excluding him or herself). Thus, if an injury occurred to one or more members of a soldier's unit during 6 months of his/her combat deployments, the value of this variable (in years) would be 0.5. The average service member was exposed to unit-level injuries for 0.12 years.

Our first set of dependent variables measure mental and physical health using government administrative data. First, using data from the Department of Veteran Affairs, we generate indicators for whether the soldier had enrolled in a VDC benefits program for Post-Traumatic Stress Disorder (*PTSD*) and traumatic brain injury (*TBI*). In our analysis sample, 21.0 percent of separating soldiers enrolled in VDC benefits related to a *PTSD* diagnosis at some point during their post-separation life.

Approximately eight percent (8.4 percent) enrolled in VDC benefits for *TBI*. We also measure whether the veteran was wounded in combat (*Wounded*) using DOD casualty data and find that approximately 2 percent of the sample had been wounded.

Next, we measure disability that may be indicative of unemployability using the soldier's combined disability rating (CDR). Specifically, we examine whether a separating veteran has a CDR of 70 percent or greater, a rating which suggests multiple disabilities, generous VDC benefits, and high probabilities of non-employment for extended periods (*Unemployable Risk*). This category of disability captures cases where service members are classified as "Priority 1" for health care services delivery by the VA as mandated by the Veterans' Health Care Eligibility Reform Act of 1996. A 70 percent cumulative rating constitutes an important cutoff for VA definitions of unemployability; a veteran can be deemed unemployable if he has a combined rating of 70 percent or more along with two or more service-connected disabilities (with individual disability ratings of at least 40 percent) (U.S. Department of Veteran Affairs 2019).[20] We find that 23.7 percent of our sample had an overall CDR that exceeded 70 percent.

As a second, more direct measure of unemployment, we use administrative data on state UCX applications (*UCX-Application*) and state determination of eligibility (*UCX-Eligible*), which are available for fiscal years 2010 through 2015. During this period, we find that 44.1 percent of separating service members applied for UCX benefits; a full 93 percent of those who applied were deemed eligible for these benefits.

Turning to schooling, we first measure educational attainment while serving. Among those with a high school degree or GED at enlistment, we find that 11.1 percent attend college prior to separation and 3.9 percent attain a degree. With regard to post-separation schooling, we measure whether the soldier had applied for and enrolled in the Post-9/11 GI Bill (*GI Bill)*, which retroactively applied to servicemembers serving following September 11, 2001. In FY 2015-2016, 41.3 of separating veterans had applied and were eligible for the Post-9/11 GI Bill.

Finally, we generate a set of post-separation school enrollment and educational attainment measures. We measure educational attainment as whether the respondent had attained a four-year college degree (*Bachelor*) or a two-year associate's degree (*Associate*). Among those without an advanced degree at separation, 11.2 percent attained a four-year college degree following separation.

[20]In addition, the Department of Veterans Affairs (2019) requires:

> "You must be unable to maintain substantially gainful employment as a result of service-connected disabilities (marginal employment, such as odd jobs, is not considered substantial gainful employment for VA purposes)."

Among those with only a high school degree (or GED) at separation, 10.3 percent attained a four-year college degree and 10.0 percent attained an associate's degree (but not a bachelor's degree) following separation. In addition, we measure the number of days that a separating veteran had attended college or some job training program following separation. Among those without an advanced degree at separation, 58.2 percent attended some post-secondary schooling following separation, and 38.0 percent enrolled for a full semester at a four-year college.

In Table 2, we provide observable characteristics of separating soldiers, stratified by selected outcomes. [21] We find that those who receive disabilities compensation benefits for PTSD are likely to have longer combat deployments than their counterparts who did not receive such benefits (1.35 years versus 0.60 years). There is some evidence that average combat deployment lengths are slightly longer for those who enrolled in UCX benefits than those who did not (1.12 years versus 0.922 years). Interestingly, for educational attainment, we find some evidence that those with a college degree have slightly longer combat deployment lengths than those without such degrees (0.96 versus 0.83 years).

4.2 Methods

To identify the causal effect of combat, we rely on the conditional random assignment of soldiers to deployments. That is, *conditional on military rank, occupation, and time spent in military service,* deployment assignments are exogenous to our outcomes. We first estimate:

[21] Appendix Figures 1 through 5 show post-separation VDC and UCX participation rates and schooling rates for various cohorts of separating veterans. Figures 1 through 5 show unconditional trends in transition benefit use and educational attainment among separating veterans. We show separate graphs by year of separation in order to impose more balanced panels to ensure that post-separation trends are not affected by compositional changes. Figures 1 and 2 show that rates of VDC compensation for PTSD and TBI diagnoses continue to rise following separation; more recent cohorts of separating veterans see larger initial jumps in participation, reflective of, perhaps, improved medical screening techniques and more public awareness of these ailments. Rates of PTSD- and TBI-related benefit use are consistently higher for those who saw combat relative to those that did not. In Figure 3, we show that rates of UCX participation are substantial in the period following separation; given state rules that limit duration of benefit receipt to under two years (as in the UI program), participation rates fall to near zero two or more years following separation. As with the VDC program, participation rates are higher for those assigned to combat deployment relative to those that did not. Figures 4 through 6 show post-separation schooling-related outcomes. We find that attendance rises in the four to five years following separation and then levels off or slightly declines (Figure 4). The probability of a four-year college degree rises immediately following separation and peaks four to five years following separation before trailing off (Figure 4); a similar pattern results for attaining an associate's degree, though the peak occurs at 2 to 3 years following separation . Interestingly, school attainment and college graduation rates are slightly higher for those assigned to combat than those not assigned to combat (Figure 5), but these trends, as in prior figures, do not condition on rank or occupation. These differences are consistent with the results of Carter et al. (2017), who find that those who select into combat operations tend to be drawn from white, higher income populations.

$$Y_i = \beta_0 + \beta_1 Any\ Combat_i + \beta_2 \mathbf{M}_i + \varepsilon_i \quad (1)$$

where Y_i is an indicator for post-separation benefit receipt, school attendance, or educational attainment for individual *i* following separation (or at separation, for educational attainment during enlistment), $\mathbf{M}_i$ is a vector of individual-level military controls including fully interacted indicators of military rank (E1-E9), primary military occupation specialty (PMOS), years of enlisted military service, separation year fixed effects, and gender. Our key right hand side variable, $Any\ Combat_i$, is an indicator for whether servicemember *i* had ever received hostile fire pay. In alternate specifications, $Any\ Combat_i$ is replaced by *Combat Years*, a continuous measure of the total number of years of deployment. We also allow for non-linear effects of deployment length.

If soldiers of identical rank (tenure) and occupation face the same probability of combat deployment in a given calendar year, then β_1 should be an unbiased estimate of the effect of combat on the outcomes described above. We explore the exogeneity of deployments by adding a vector of personal characteristics $\mathbf{P}_i$ (including age, race/ethnicity, marital status, educational attainment at separation, AFQT score, number of dependents, and post-separation state of residence) to equation (1):

$$Y_i = \beta_0 + \beta_1 Combat_i + \beta_2' \mathbf{M}_i + \beta_3' \mathbf{P}_i + \varepsilon_i \quad (2)$$

If combat assignment is exogenous, our estimate of β_1 should remain unchanged.

Our second identification strategy is designed to ensure that our estimates are not contaminated by stay back selection. Following Lyle (2006), we instrument for individual-level combat deployment length using battalion-level deployment orders, *Orders*. The first-stage regression equation is given by:

$$Combat_{iu} = \alpha_0 + \alpha_1\ Order_{u-i} + \alpha_2' \mathbf{M}_i + \alpha_3' \mathbf{P}_i + \nu_{iu} \quad (3)$$

where $Order_{u-i}$ is our instrument measuring the total number of years (or share of years) for which other members of the soldier's unit *u* received deployment orders. Note that we exclude soldier *i*'s deployment orders from the calculation of unit level orders.

Following Lyle (2006), we assume that a deployment order has been issued if at least one-third of the members of the soldier's unit (i.e., battalion) has been deployed.[22] Our identifying assumption for this IV approach requires that deployment orders are unrelated to any unmeasured determinants of benefit receipt or schooling (conditional on military observables). That is, we assume that senior commanders' issuance of unit-level deployment orders is unrelated to anything other than world events and national security policy, the readiness and availability of units (e.g., supplies and training), or the rank-occupation composition of the unit to meet operational needs.

Next, we exploit a somewhat different natural experiment to estimate the impact of combat exposure on veterans' economic transitions. We measure combat exposure in two ways: *Injury Exposures*, the total number of years that other members of the soldier's unit experienced a war injury, and *Death Exposure*, an indicator for whether another member of the soldier's unit died in war. This natural experiment treats combat exposures among soldiers of identical rank, occupation, enlistment tenure, separation year, *and combat deployment length* as orthogonal to economic transitions. Specifically, we estimate:

$$Y_{iu} = \beta_0 + \beta_1 Injury\ Exposure_{u-i} + \beta_2 Combat_i + \beta_4' \mathbf{M}_i + \beta_5' \mathbf{P}_i + \varepsilon_{iu} \quad (4a)$$

$$Y_{iu} = \beta_0 + \beta_1 Death\ Exposure_{u-i} + \beta_2 Combat_i + \beta_4 \mathbf{M}_i + \beta_5' \mathbf{P}_i + \varepsilon_{iu} \quad (4b)$$

Finally, we explore heterogeneity in the impacts of combat assignment and combat exposure estimating equations (1), (3), and (4a/4b) across military characteristics (rank, branch, enlistment tenure, separation year) and demographic traits (race/ethnicity, gender, marital status). These analyses will inform how the effects of combat deployments differ by pre-treatment characteristics of enlisted servicemembers that could mitigate or exacerbate adverse health, human capital, and labor market effects of combat deployments, and whether "one-termers" are differentially affected by combat deployments relative to those who serve additional time in the military.

5. Results

[22] This approach is justified by the fact that the battalion to which a soldier is assigned generally consists of three companies (Alpha, Bravo, and Charlie) and if at least one third of a soldier's battalion is deployed, this is generally indicative of a company receiving deployment orders. In addition, we experimented with alternative fractional cutoffs, including one-half and two-thirds, with a similar pattern of findings as those reported below.

We present our main findings in Tables 3 through 10 below. We estimate ordinary least squares regressions and cluster our standard errors at the entry term unit-level.[23]

5.1 Health, Disability Benefits, and the Labor Market

Table 3 presents estimates of equation (1) for VDC benefits for PTSD. Conditional on military observables, assignment to a combat zone (*Any Combat*) is associated with an 18.5 percentage-point increase in a VA diagnosis of PTSD (Panel I. column 1). This effect is large relative to the mean (21.0) and is consistent with large psychological costs of war deployments as well as increased availability of VDC benefits to those who were exposed to war theatre. In Panel II, we replace *Any Combat* with *Combat Years* and find that each additional year of combat deployment is associated with an 8.9 percentage-point increase in VDC benefits for PTSD. The results in Panel III suggest that the effects of combat deployments increase with deployment length, suggestive of a dose-response relationship. This result could lend a clue to the mechanism at work. To the extent that VA claims personnel simply screen for *any exposure* to combat theatre and award benefits, we might not expect a dose response relationship. Thus, these findings provide support to actual psychological harm rather than simply loosening of eligibility requirements, though they are not definitive.

The magnitudes of our PTSD effects are substantial and coupled with lifetime per-servicemember cost of treating produced by the CBO (2014), suggest additional health care costs of almost $40 billion to the Department of Veterans Affairs. This is, of course, a lower-bound estimate of the total economic cost to servicemembers suffering from PTSD.

In column (2), we add controls for age at separation, age-squared, race/ethnicity, Armed Forces Qualifying Test (AFQT) score, marital status, educational attainment at separation, number of dependents at separation, and intended state of separation. A comparison of estimates in columns (1) and (2) suggests very small differences, consistent with the hypothesis that deployment assignment is orthogonal to VDC benefit receipt.

In the next two columns of Table 3, we explore the effect of combat assignment on *TBI*. We find that assignment to a combat zone is associated with a 4.7 to 4.8 percentage-point increase in the probability of VDC benefits for TBI (Panel I). As with PTSD, the effects of combat increase with deployment length. Combat deployments greater than 18 months are associated with a 6 to 8

[23] Estimated marginal effects using probit models produce a quantitatively similar pattern of results.

percentage-point increase in TBI. This finding is consistent with longer deployment lengths associated with greater risk of exposure to intense combat activities including firefights, vehicle collisions, and head-related injuries that may be manifested in the form of TBI. Again, estimated effects are not sensitive to the inclusion of demographic controls.

Given the relatively objective screening procedures required for a TBI diagnosis, we interpret these findings as additional evidence for physical harm of post-9/11 combat deployments rather than simply reflecting benefit expansions to those in proximity to combat. Screening for TBI involves VA clinicians (or, if in-theatre, skilled military medical personnel) assessing brain injuries from an external force, which includes evaluating loss of consciousness (LOC), alteration of consciousness (AOC), and post-traumatic amnesia (PTA) (Defense and Veterans Brain Injury Center 2019).[24] While screening is imperfect, particularly for cases of mild TBI (Hoge et al. 2008; Bryant 2011), the link of TBI disability benefits to documented combat exposure, head trauma, and neurological injuries makes the likelihood of benefit receipt to non-injured veterans less likely than for PTSD disability benefits, where screening procedures lack some of these more objective measures.[25] Coupled with estimates of the direct health care costs of treating TBI from the Congressional Budget Office (2014), the magnitudes of our estimated effects imply combat-induced TBI costs for the Department of Veterans Affairs of nearly $20 billion.

In the final two columns of Table 3 (columns 5 and 6), we explore the impact of combat assignment on the probability of sustaining a service-connected physical injury. Because this measure comes from DOD casualty data and not from VDC benefit receipt data, it provides more compelling evidence on whether the combat deployment effects we observe reflect true greater risks of injuries or solely expansions in disability benefits generosity. We find that combat assignment is

[24] For example, during deployments, the initial screening following a possible concussion is the Military Acute Concussion Evaluation (MACE). As part of this screening, service members must detail the event that led to the injury in question, document whether there were witnesses to the event, and report whether his "head [were] hit by any objects," he "felt a blast wave," was "lying motionless on the ground," and was "slow to get up after a direct or indirect blow to the head." Consciousness and cognition are also assessed (Defense and Veterans Brain Injury Center 2019).
[25] In contrast to the focus on a specific physical trauma for TBI screenings (NIH 2019, 2016), a common initial screening for PTSD by the VA includes the Primary Care PTSD Screen for DSM-5 (PC-PTSD-5) (U.S. Department of Veterans Affairs 2019). Respondents are asked, "sometimes things happen to people that are unusually or especially frightening, horrible, or traumatic. For example, a serious accident or fire, a physical or sexual assault or abuse, an earthquake or flood, a war, seeing someone be killed or seriously injured, or having a loved one die through homicide or suicide. Have you ever experienced this kind of event?" If they answer yes, veterans are asked if they had "nightmares about the event(s) or thought about the event(s) when you did not want to," "tried hard not to think about the event(s) or went out of your way to avoid situations that reminded you of the event(s)," had "been constantly on guard, watchful, or easily startled," "felt numb or detached from people, activities, or your surroundings, and "felt guilty or unable to stop blaming yourself or others for the event(s) or any problems the event(s) may have caused."

associated with a 1.8 percentage-point increase in the probability of being wounded in war (Panel I); the effects are larger, as expected for longer deployment lengths. Each additional year of combat deployment raises the likelihood of wounding by 1.5 percentage-points. These war injuries generate substantial costs, as estimates place the costs of treating each additional wounded soldier at $2 million, an estimate that incorporates not only health care costs, but also veterans' disability benefits for physical injuries (Bilmes and Stiglitz 2006).

Together, the findings in Table 3 suggests substantial adverse physical and mental health effects of post-9/11 combat, as well as substantial increases in disability benefits take-up. These effects may spill over to the labor market following separation. The first column of Table 4 shows that combat assignment is associated with a 5 to 6 percentage-point increase in the likelihood of a high unemployability risk, that is, having a CDR greater than 70 percent. This represents an approximately 25 percent increase relative to the mean. However, we fail to detect strong evidence of a dose-response effect of combat, as we find the largest impacts of combat assignment for those deployed less than 18 months (Panel III).

In the remaining columns of Table 4, we examine the impact of combat assignment on take-up of unemployment insurance benefits. We find that combat assignment is associated with a 1.0 to 1.5 percentage-point increase in the likelihood of applying and being deemed eligible for the UCX program, representing about a 2.5 percent increase in applications relative to the mean. The most economically important effects are found for those deployed for at least one year, where we find deployment effects closer to 5 percent. These findings suggest that combat deployments may impede short-run attachment to the labor market, a result that could be explained by both the health costs of post-9/11 conflicts as well as increased reliance on disability benefits (Angrist et al. 2010; Autor et al. 2016).[26]

One concern with these estimates is that combat assignment may impact the probability of re-enlistment, perhaps among soldiers of heterogeneous types. While we control for years of enlisted service in all regressions, this may not fully control for compositional changes. In the first row of Appendix Table 1, we restrict the sample to single-term enlistments where the soldier chose not to re-enlist. While this is a select sample of individuals (whose re-enlistment decisions could have been affected by first-term deployment assignments), one can be sure that exposure to deployment assignment is unrelated to re-enlistment decisions. For this sample, the results continue to show

[26] These findings are also consistent with work in the civilian labor market, which has found that adverse psychological wellbeing is negatively related to labor market outcomes (Chatterji et al. 2008; Fletcher 2008; 2013).

that combat deployment length is positively related to use of the VDC program and unemployability risk. However, the positive effects on unemployment insurance receipt appear to be driven by those who served at least four (4) years (third row), which we discuss further in the below section on heterogeneous treatment effects (see Section 5.4).

5.2 Schooling

In the first two columns of Table 5, we explore the impact of combat assignment on educational attainment during enlistment. We restrict our sample to those who had attained a high school degree or GED at the time of Army enlistment. We find that each month of combat deployment (Panel II) is associated with a 1.8 percentage-point (15.9 percent) decline in the probability of post-secondary college attendance by separation and a 1.1 percentage-point (28.2 percent) decline in the probability of earning an associate's or bachelor's degree by separation. There is strong evidence of a dose-response relationship, with the largest adverse education effects for those deployed for at least 18 months. While online programs have expanded (e.g. Liberty University, Southern New Hampshire University) and the Department of Defense has made efforts to increase "brick and mortar" offerings while soldiers are deployed overseas (e.g. University of Maryland University College, Central Texas College), the findings in Table 5 are consistent with time substitution or the psychological and physical effects of war.

Could the declines in educational attainment described above impact use of post-separation education benefits? In column (3), we find that among those without a bachelor's degree at separation, combat assignment is associated with a 0.9 percentage-point increase in the probability of enrolling in post-9/11 GI benefits. This finding could be explained by combat-induced declines in schooling during enlistment, combat-specific peer effects (see Murphy 2017, who finds that young Army Soldiers' educational benefit enrollment decisions may be influenced by their colleagues), or a "gateway effect" whereby veterans learn about schooling benefits from the VA and other organizations when they learn about needed medical and disabilities benefits. The inclusion of housing benefits in the PGIB may be particularly important to disabled veterans. Emerging evidence, in fact, suggests that PGIB benefits fail to increase earnings for recipients (Barr et al. 2019)

Consistent with increased participation in the GI Bill program, there is evidence of increases in college attendance, as measured by positive number of days attending a two- or four-year college (column 4). However, we find no evidence that combat assignment is associated with an increase in the probability of semester enrollment in a four-year college. In fact, we find that each additional

year of combat assignment is associated with a 0.7 percentage-point decline in the probability of semester college enrollment, driven by a 1.6 percentage-point decline for those deployed to combat for two years or more (column 5). These findings persist when we restrict the sample period to the years for which we have post-9/11 GI Bill data (columns 6 and 7). Our results could suggest that those assigned to combat may sign up for post-9/11 GI Bill benefits for benefits other than four-year schooling or that they enroll in such programs, but do not graduate.

In Table 6, we examine the impact of combat assignment on post-separation educational attainment. We find some weak evidence that combat is associated with an increase in the probability of obtaining an associate's degree following separation (column 1), consistent with Loughran et al. (2011). However, the effects are small in magnitude and are concentrated among those deployed between 12 and 17 months.

There is much stronger evidence that combat deployments are negatively related to the probability of obtaining a four-year college degree following separation. This is true among those who were high school graduates at separation (column 2), those without four-year college degrees at separation (column 3), and when we restrict the sample to allow at least four years of post-separation data (column 4). Our results suggest that combat deployments of 18 months or more generate a 4 to 10 percent decline in the probability of obtaining a four-year college degree following separation. Our results provide consistent evidence of adverse human capital effects of post-9/11 combat for all volunteer soldiers.

5.3 2SLS Estimates

One concern with our prior estimates is that they could be contaminated by stay back selection. For example, if those who are chosen to be remain at the domestic base or who are deemed non-deployable are soldiers with the highest unobserved propensity for health ailments that may impede economic transitions. Along the same lines it may be that those who take action to deploy are those who can most mitigate the adverse health and labor market effects of combat deployments. If either scenario is trye, then OLS estimates will be biased downward (negatively). Alternatively, if the savviest soldiers most concerned about future transitions find a way to avoid combat, then OLS estimates could be biased upward (positively). Our 2SLS estimates should address any concerns about endogenous selection into combat deployments and their similarity to our OLS results suggests minimal bias from this type of selection.

First-stage results in row (3) of Table 7 show that unit-level deployment orders are a very strong predictor of the probability of individual deployment. We find that a one-year increase in the number of occasions that a soldier's unit has at least one-third of its members deployed is associated with a 0.9-year increase in individual combat deployment length. Estimated t-statistics range from 200 to 350, suggesting that deployments are highly likely when a servicemembers unit receives deployment orders. Row (2) of Table 7 shows 2SLS (IV) estimates along with OLS estimates (row 1) for comparison. Our results provide no evidence that stay back selection is an important source of bias. We find consistent evidence that post-9/11 combat assignment causes increased disability conditions (columns 1-3), decreased attachment to the labor market (columns 4-6), and diminished educational attainment (columns 7 and 10-12).

5.4 *Army Exit Selection*

One concern with the above estimates is that combat assignment may impact the probability of re-enlistment, perhaps among soldiers of heterogeneous types. While we control for years of enlisted service in all regressions, this, of course, cannot fully control for compositional changes. To partially address this issue, we take two approaches. In the first row of Appendix Table 1, we restrict the sample to single-term enlistments where the soldier chose not to re-enlist. For this sample, the results continue to show that combat deployment length is positively related to use of the VDC program and with diminished educational attainment during enlistment. However, for this select sample, we find little evidence of diminished educational attainment following separation. This is not surprising given that the results in Table 6 suggest that adverse post-separation education effects are driven by combat deployments of 18 months or more, which are far less prevalent in single-term enlistments, which last, on average, four years.

In the remaining rows of Appendix Table 1, we more generally examine the impacts of combat deployments across all years of enlisted service, including those who re-enlist. The effects of combat assignment on VDC benefits receipt exist across all enlistment periods, with the largest estimated marginal effects for those serving fewer total years of service. Combat-induced increases in PGIB use exist only for those enlisted for shorter periods (column 7), where we also observe increases in the probability of receiving an associate's degree in the post-separation period (column 11). However, the adverse educational attainment effects during enlistment (column 6) and in the post-separation period for four-year college degree receipt (column 10) are largest for those who re-enlist and serve for at least seven years.

5.5 Combat Exposure

Table 8 presents findings from an alternate natural experiment, where we estimate the effect of specific combat exposure measures (i.e., injuries and death in a unit), conditional on combat deployment length. In Panel I we find that a one year increase in duration of exposure (e.g. an injury, on average, in every month of the year) to unit-level injuries is associated with a 19.6 percentage-point increase in the probability of VDC benefit use for PTSD, a 16.4 percentage-point increase in the likelihood of benefit use for TBI, and a 13.2 percentage-point increase in a CDR of greater than 70 percent. We also find that each additional year of injury exposure is associated with a 15.1 percentage-point increase in the probability of own wounding. This suggests that unit-level injuries may capture intense combat experiences of servicemembers that lead to substantial increases in reliance on VDC benefits.

While we find no evidence that unit-level injury exposure is associated with economically important changes in the probability of UCX receipt, we do find that injury exposure is associated with a small reduction in the probability of post-9/11 GI Bill receipt. This is in contrast to our prior evidence on combat assignment, which suggests that intense physical injuries and mental health ailments deters benefit take-up. One explanation for these results may be that veterans exposed to intense combat exposure may be more likely to substitute these benefits for the Vocational Rehabilitation and Employment program.

Our results show that unit-level injury exposure is associated with important reductions in educational attainment during enlistment as well as following separation. We find that each additional year of unit injury exposure is associated with a 0.8 percentage-point (20.5 percent) reduction in the probability of an advanced degree (associate's or bachelor's degree, column 8) between enlistment and separation, and a 0.6 percentage-point (6 percent) reduction in the probability of a four-year college degree following separation (column 11).

With regard to death exposure, deaths were sufficiently infrequent during GWOT operations (~3,000) such that a very small percentage of soldiers are exposed to the death of a member of his unit in multiple months of deployment (less than 4 percent). Thus, we present estimates of the effect of any exposure to death in the unit. While less precisely estimated, we find that exposure to a unit-level death is associated with a 1 to 2 percentage-point increase in the probability of VDC

benefit receipt (columns 1 through 2). Moreover, we find that unit-level death exposure is associated with declines in post-9/11 GI Bill receipt (column 6).[27]

5.6 Heterogeneous Impacts of Post-9/11 Combat Deployments

Finally, we explore whether there are heterogeneous impacts of combat, focusing on injury exposure estimates from equation (3). First, in Table 9, we explore whether the effects of combat differ by military rank or combat heavy occupations in the Infantry, Armor, Field Artillery and Special Forces. The results on rank are consistent with above findings on age. Junior enlisted personnel are more likely to participate in the VDC, UCX and GI Bill programs than senior NCOs, while senior enlisted veterans are more likely to suffer adverse educational effects of combat. Findings by Army occupational fields (Panel I) suggest little evidence of heterogeneous effects by combat-heavy occupations. This result may lend credence to the hypothesis that traditional combat occupation distinctions are somewhat less important determinants of combat exposure in modern warfare.

Next, we examine whether the impact of injury exposure differs by years of enlisted service (Appendix Table 2). We show that the magnitudes of estimated VDC benefits effects are largest for those who serve under 10 years, generally reaching a maximum around 4 to 6 years, the first enlistment term for many servicemembers. With regard to education, we find the largest effects for post-separation four-year college attainment for those with over four years of enlisted service. An examination of combat exposure effects by separation year (Appendix Table 3) suggests somewhat larger VDC effects for those serving during major combat operations in Iraq and Afghanistan relative to the post-2010 period, when these operations were relatively less intensive. However, education effects appear larger in more recent separating cohorts.

In Table 10, we examine the impact of injury exposure by gender and race. While women were prohibited from entering some combat positions during a substantial share of the period under study, women increasingly participated in combat roles. By 2013, the Pentagon had lifted the ban on women in these roles, and women have long been serving in combat zones in supportive roles. Moreover, the non-linear nature of modern battlefields and non-traditional threats (e.g., improvised explosive devices) has made the traditional combat role distinction less important. The results

[27]When we adjust deaths and injuries to the same scale (using time exposed to deaths and injuries or exposure to any death or injury), we find that the impacts of deaths are approximately three times larger than that of injuries, suggesting mechanisms related to both psychological trauma and heavy and intense combat operations.

suggest that combat assignment has generally similar effects for VDC benefit use, enrollment in the GI Bill, and educational attainment for women as men.

Turning to race, we find little difference in VDC or educational benefit receipt effects of combat for whites (row 1) versus non-whites (row 2). The largest difference emerges when examining educational attainment, were we find that the negative impacts of combat are far larger for whites than non-whites, in percentage-point and percentage terms.[28] This is consistent with the findings of Carter et al. (2017) who find that the AVF induced more deployments and combat injuries for white and Hispanic soldiers relative to black soldiers.

6. Conclusions

The global shift to all-volunteer forces, most prominently in the U.S., and the changing nature of modern warfare in the Global War on Terrorism has necessitated a new examination of the impact of wartime service on health, human capital, and labor market outcomes. In addition, the rapid expansion of new veterans' entitlement benefits, most notably via the Veterans Disability Compensation program in the post-9/11 era, coupled with liberalizing eligibility standards, may have important impacts on the labor market outcome of post-9/11 veterans.

Next to nothing is known about how GWOT-era war deployments or unit-specific combat exposure affects the economic transitions of separating veterans. This study seeks to fill this important gap in knowledge by linking Army administrative data on enlisted veterans to data from the Department of Veteran Affairs, the National School Clearinghouse, and Federal and state Departments of Labor. We use these newly available administrative panel data, and novel natural experiments in overseas deployment assignment and combat exposure, to estimate the impact of combat service on a host of individual post-service economic outcomes.

Our findings show that combat deployment assignments are associated with substantially increased risks of diagnoses of, and eligibility for, VDC benefits for PTSD and TBI. We also find that combat assignment is associated with small increases in UCX applications, consistent with combat-induced challenges of integrating into the civilian labor market as well as disincentives to transition given the generosity of modern benefits. These estimates suggest over $60 billion in direct

[28] In results available upon request, we explore whether the impacts of combat differ by marital status. We find that married veterans are much more likely to receive VDC, UCX, and schooling benefits then their non-married counterparts, and to suffer from the adverse post-separation schooling effects.

health care costs to the VA and unemployment insurance benefits. Coupled with the costs to physically wounded warriors, these costs would exceed $160 billion.

In addition, we find that combat assignment is associated with a significant reduction in educational attainment during enlistment, which may, in part, explain modest increases in enrollment in the post-9/11 GI Bill. However, we find very little evidence that these benefits translate to increases in post-separation human capital acquisition. Our estimates show that longer combat deployments are associated with substantial declines in the probability of receiving a college degree. Deployments of over 18 months are associated with a 4 to 10 percent decline in the probability of four-year college graduation. These adverse effects are concentrated among white men who attained the rank of junior or senior NCO, suggesting heterogeneous treatment effects on human capital acquisition for those who serve longer in the Army. Finally, our results show that unit-level combat exposure, measured by deaths and injuries to comrades, is associated with substantially increased reliance on transition benefits and diminished human capital acquisition.

Given that disabilities claims are multi-faceted — the average disability claim now cites five separate conditions and 25 percent of claims cite more than eight conditions (U.S. House Committee on Veterans Affairs 2007; Barnes et al. 2007) — disentangling benefits effects from injury-related channels is quite difficult. Our assessment of the current evidence is that both pathways are likely at work. While our estimates cannot rule out either channel entirely, we provide suggestive evidence that war-related injuries are important. Specifically, our results showing (i) combat-induced increases in TBI disability benefits and war injuries (the latter measured from DOD casualty data), (ii) a dose-response relationship between combat deployment length and receipt of PTSD/TBI disability benefits, and (iii) increased intensity of combat effects from unit-level casualty exposure, suggest that post-9/11 conflict itself played an important role in the adverse labor market effects we document. Disentangling and quantifying the effects of modern war from those of modern veterans' benefits warrants further attention and research.

Our findings add to a growing new literature examining the impact of post-9/11 military service on servicemembers, veterans and their families (Greenberg et al 2022; Bruhn et al. 2022; Carter and Wozniak 2021; Kawano et al. 2017). They also underline the need for further study of heterogeneity in combat service effects, both across different types of service members (i.e., those in combat versus not combat branches, Black versus White servicemembers) and across different

military experiences (both varying levels of combat intensity and non-combat experiences such as training and relocation).[29]

Our findings have a number of important policy implications. First, our findings can improve the Federal interagency Transition Assistance Program, known in the Army as the *Soldier for Life* program. The findings can also inform pilot programs and experimental research that will use combat exposure to predict veterans' benefit receipt. The results might enable specialized training (e.g., additional psychological support services, special interview preparation, more tailored resume writing) for those exposed to combat and better tailored services for injured soldiers in Warrior Transition Units.

We also acknowledge that the precise channels at work are important for assessing the efficacy of particular policy prescriptions. To the extent that our findings reflect true post-9/11 combat costs, the provision of additional services and remediation efforts while individuals are still in service may be warranted. They may also provide a rationale for additional compensation for combat veterans serving in all volunteer forces. On the other hand, to the extent that adverse labor market effects we find are reflective of disincentives for human capital acquisition and labor force attachment generated by expanded disability benefits, our results suggest caution in expanding veterans' entitlement benefits. These competing goals make additional research into separately identifying and quantifying these effects especially important.

[29] For instance, Greenberg et al. (2022) exploit a natural experiment generated by eligibility thresholds in AFQT scores that affect enlistment probabilities and find that military service increases the earnings of Black, but not White servicemembers. Bruhn et al. (2022) also find that combat service increased both death and disability payments, with important heterogeneity by race/ethnicity and intensity of combat exposure. Their analyses differs from Skimmyhorn and Sabia (2018) in its sample composition, time period, and identification strategy. With regard to human capital effects, our findings in panel I of Appendix Table 1 are most comparable to theirs.

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Table 1. Descriptive Statistics

	Mean	N
Dependent Variables		
Post-Traumatic Stress Disorder-Related VDC Benefits (PTSD)[a]	.210	976,963
Traumatic Brain Injury-Related VDC Benefits (TBI)[a]	.084	976,963
Combat-Related Injury (Wounded)[a]	.020	977,744
Unemployable Risk with CDR ≥ 70 (*URisk*)[a]	.237	976,963
Applied for UCX Program (*UCX-A*)[b]	.440	409,627
Eligible for UCX Program (*UCX-E*)[b]	.413	409,627
Attend College During Enlistment (*Attend Enlist*)[c]	.111	861,612
Graduate from College During Enlistment (*Grad Enlist*)[c]	.039	861,612
Applied for Post-9/11 GI Bill (*PGIB*)[d]	.428	131,606
Enroll in Post-Secondary College for Days > 0 (*Post Attend*)[e]	.582	928,837
Enroll for Semester at Four-Year College or University (*Post Semester*)[e]	.380	928,837
Attain Bachelor's Degree or Higher (*Bachelor*)[e]	.112	928,837
Attain Associate's Degree (*Associate*)[f]	.097	928,837
Combat Measures		
Any Combat Deployment	.573	976,963
Years Combat Deployed	.755	976,963
Combat Deployment < One Year	.204	976,963
Combat Deployment of 12 to 17 Months	.183	976,963
Combat Deployment of 18 to 23 Months	.072	976,963
Combat Deployment of Two Years+	.115	976,963
Unit-Level Years of Injury Exposure	.116	976,963
Unit-Level Any Death Exposure	.116	976,963
Years of Combat Deployment of Other Unit Members (IV)	.752 (.913)	976,963
Selected Controls		
Years of Enlisted Service	5.61 (6.26)	976,963
Junior Enlisted (E01-E04)	.682	976,963
Junior NCOs (E05-E06)	.230	976,963
Senior NCOs (E07-E09)	.088	976,963
Combat Branches (Infantry, Armor, Field Artillery and Special Forces)	.291	976,963
Non-Combat Branches	.709	976,963
Age	27.5 (7.34)	976,963
Male	.829	976,963
White	.647	976,963
Black	.206	976,963
Hispanic	.111	976,963
Other	.036	976,963
AFQT-Cat 1	.045	976,963
AFQT-Cat 2	.320	976,963
AFQT-Cat 3A	.272	976,963
AFQT-Cat 3B	.334	976,963
AFQT-Cat 4	.028	976,963

	Mean	N
AFQT-Cat 5	.001	976,963
Single at Separation	.475	976,963
Divorced at Separation	.051	976,963
Married at Separation	.474	976,963
Zero Dependents at Separation	.497	976,963
One Dependent at Separation	.193	976,963
Two Dependents at Separation	.141	976,963
Three Dependents at Separation	.112	976,963
Four Dependents at Separation	.055	976,963
Five+ Dependents at Separation	.002	976,963
High School Graduate at Separation	.709	976,963
GED at Separation	.116	976,963
Associates Degree at Separation	.037	976,963
Some College at Separation	.081	976,963
College Degree or higher at Separation	.050	976,963

[a]VDC benefit and wounding data are collected from FY2001 to FY2017.
[b] UCX benefit data are available from FY2010 to FY2015.
[c] Data on school attainment during enlistment is available from FY2001 to FY2017. Means are conditional on those for whom a high school degree or GED was the highest degree attained at enlistment.
[d]Post-9/11 GI Bill data are available in FY2015 and FY2016.
[e]Data on post-separation college attendance and four-year degree completion are available from FY2001 to FY2017. Means are conditional on those for whom an associate's degree or some college was the highest level of education attained at enlistment.
[f]Data on post-separation associate's degree receipt are collected from FY2001 to FY2017. Mean is conditional on those for whom a high school degree or GED is highest degree attained at enlistment.

Table 2. Means of Combat Measures and Selected Controls, by Post-Separation VDC, UCX, & Post-9/11 GI Bill Program Participation and Four-Year College Degree Receipt

	PTSD=0	*PTSD=1*	*UCX-A=0*	*UCX-A=1*	*PGIB=0*	*PGIB=1*	*Bachelor=0*	*Bachelor=1*
Combat Measures								
Any Combat Deployment	.483	.908	.602	.770	.495	.667	.560	.647
Years Combat Deployment	.596	1.35	.922	1.12	.829	.970	.743	.802
Combat Deployment < One Year	.193	.242	.179	.217	.169	.265	.198	.238
Combat Deployment of 12-17 Mos	.152	.300	.174	.257	.090	.140	.179	.215
Combat Deployment of 18-23 Mos	.056	.132	.080	.109	.070	.097	.071	.082
Combat Deployment of 2 Years+	.082	.234	.168	.188	.167	.166	.112	.111
Unit Years of Injury Exposure	.083	.237	.146	.183	.133	.161	.117	.107
Unit Any Month Death Exposure	.082	.157	.103	.102	.080	.084	.095	.112
Selected Controls								
Years of Enlisted Service	5.04 (6.06)	7.75 (6.53)	6.05(6.92)	6.00(4.81)	6.05(6.74)	6.64(5.24)	5.12(5.78)	7.09(6.87)
Junior Enlisted (E01-E04)	.721	.538	.680	.675	.688	.618	.728	.483
Junior NCOs (E05-E06)	.201	.337	.211	.284	.220	.322	.207	.367
Senior NCOs (E07-E09)	.078	.125	.109	.041	.092	.060	.065	.150
Combat Branches	.274	.353	.324	.277	.220	.305	.305	.235
Non-Combat Branches	.726	.647	.676	.723	.092	.695	.695	.765
Age	26.9 (7.16)	29.9 (7.53)	27.9(8.03)	28.6(6.41)	27.9(8.12)	28.5(6.41)	26.9(6.93)	28.6(7.42)
Male	.816	.877	.689	.830	.872	.851	.845	.733
White	.658	.607	.688	.620	.638	.598	.667	.610
Black	.200	.231	.177	.215	.205	.229	.197	.240
Hispanic	.108	.122	.102	.130	.122	.139	.111	.113
Other	.034	.040	.033	.035	.035	.034	.025	.037
AFQT-Cat 1	.051	.025	.052	.034	.034	.045	.031	.085
AFQT-Cat 2	.334	.271	.328	.297	.293	.324	.300	.430
AFQT-Cat 3A	.271	.278	.263	.266	.267	.257	.282	.246
AFQT-Cat 3B	.321	.382	.336	.371	.388	.354	.358	.216
AFQT-Cat 4	.023	.044	.021	.032	.018	.020	.029	.023

	PTSD=0	*PTSD=1*	*UCX-A=0*	*UCX-A=1*	*PGIB=0*	*PGIB=1*	*Bachelor=0*	*Bachelor=1*
AFQT-Cat 5	.000	.000	.000	.000	.000	.000	.000	.000
Single at Separation	.515	.322	.471	.341	.451	.348	.490	.445
Divorced at Separation	.045	.070	.052	.071	.049	.072	.047	.064
Married at Separation	.439	.606	.477	.588	.500	.580	.463	.491
Zero Dependents at Separation	.512	.320	.481	.357	.461	.374	.480	.466
One Dependent at Separation	.190	.207	.183	.219	.174	.217	.190	.204
Two Dependents at Separation	.131	.177	.138	.174	.141	.165	.140	.134
Three Dependents at Separation	.100	.159	.111	.134	.121	.129	.108	.112
Four Dependents at Separation	.045	.085	.056	.071	.063	.070	.052	.054
Five+ Dependents at Separation	.022	.052	.031	.045	.040	.045	.030	.030
High School Graduate at Separation	.716	.680	.712	.706	.786	.676	.760	.696
GED at Separation	.114	.123	.095	.130	.074	.069	.132	.042
Associates Degree at Separation	.035	.043	.039	.031	.043	.046	.031	.107
Some College at Separation	.077	.098	.091	.084	.094	.109	.077	.155
College Degree+ at Separation	.050	.047	.056	.042	.000	.000	.000	.000

Table 3. Estimates of the Impact of Combat Assignment on VDC Eligibility for PTSD and TBI, and Wounding

	PTSD		*TBI*		*Wounded*	
	(1)	(2)	(3)	(4)	(5)	(6)
			Panel I: Any Combat Deployment			
Any Combat	.185***	.190***	.047***	.048***	.018***	.018***
	(.005)	(.005)	(.004)	(.004)	(.003)	(.003)
			Panel II: Linear Deployment Length			
Years Combat	.089***	.094***	.028***	.029***	.015***	.015***
	(.005)	(.005)	(.003)	(.003)	(.002)	(.003)
			Panel III: Non-Linear Deployment Length			
1 to 11 Months	.164***	.167***	.040***	.041***	.016***	.016**
	(.006)	(.006)	(.004)	(.004)	(.003)	(.003)
12 to 17 Months	.212***	.212***	.055***	.056***	.018***	.018***
	(.006)	(.006)	(.004)	(.004)	(.003)	(.003)
18 to 23 Months	.225***	.225***	.062***	.065***	.032***	.032***
	(.006)	(.006)	(.006)	(.006)	(.006)	(.006)
2 Years +	.238***	.238***	.072***	.076***	.039***	.039***
	(.006)	(.006)	(.006)	(.006)	(.005)	(.005)
Mean of DV	.210	.210	.084	.084	.020	.020
N	976,963	976,963	976,963	977,744	977,744	976,963
Military Controls	Yes	Yes	Yes	Yes	Yes	Yes
Personal Controls	No	Yes	No	Yes	No	Yes

***Significant at 1% level **at 5% level *at 1% level

Notes: Estimates obtained using Army administrative data merged with administrative panel data from the Veterans' Administration. Military controls include fully interacted indicators for rank, primary military occupation specialty, years of enlisted service, year of separation, and gender. Personal controls include age at separation, age-squared, indicators for race/ethnicity, Armed Forces Qualifying Test (AFQT) scores, marital status, number of dependents, and educational attainment at the time of separation.

Table 4. Estimates of the Impact of Combat Assignment on Unemployable Risk, and UCX Applications and Eligibility

	URisk	*UCX-A*	*UCX-E*
	(1)	(2)	(3)
	Panel I: Any Combat Deployment		
Any Combat	.062***	.015***	.010***
	(.005)	(.003)	(.003)
	Panel II: Linear Deployment Length		
Years Combat	.012***	.006***	.005***
	(.003)	(.002)	(.002)
	Panel III: Non-Linear Deployment Length		
1 to 11 Months	.063***	.011***	.007**
	(.005)	(.003)	(.003)
12 to 17 Months	.065***	.019***	.013***
	(.005)	(.004)	(.003)
18 to 23 Months	.052***	.019***	.015***
	(.006)	(.005)	(.005)
2 Years +	.036***	.021***	.018***
	(.007)	(.005)	(.004)
Mean of DV	.237	.440	.412
N	976,963	409,627	409,627

***Significant at 1% level **at 5% level *at 1% level

Notes: Estimates obtained using Army administrative data merged with administrative panel data from the Veterans' Administration. Military controls include fully interacted indicators for rank, primary military occupation specialty, years of enlisted service, year of separation, and gender. Personal controls include age at separation, age-squared, indicators for race/ethnicity, Armed Forces Qualifying Test (AFQT) scores, marital status, number of dependents, and educational attainment at the time of separation. Data for *URisk* available FY2001 through FY2017 while data on *UCX-A* and *UCX-A* available FY2010-FY2015.

Table 5. Estimates of the Impact of Combat Assignment on Educational Attainment at Separation, GI Bill Receipt and College Attendance, FY2001-FY2017

	Attend Enlist	*Grad Enlist*	*PGIB*	*Post Attend*	*Post Semester*	*Post Attend*	*Post Semester*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Panel I: Any Combat Deployment			
Any Combat	-.0085***	-.0046***	.0094**	.0102***	-.0006	-.0041	-.0027
	(.0014)	(.0008)	(.0046)	(.0020)	(.0021)	(.0030)	(.0059)
				Panel II: Linear Deployment Length			
Years Combat	-.0178***	-.0105***	.0044	-.0003	-.0074***	.0064	-.0108***
	(.0017)	(.002)	(.0027)	(.0014)	(.0015)	(.0050)	(.0033)
				Panel III: Non-Linear Deployment Length			
1 to 11 Months	-.0046***	-.0023**	.0075	.0108***	.0015	.0071	-0014
	(.0010)	(.0007)	(.0046)	(.0020)	(.0020)	(.0047)	(.0053)
12 to 17 Months	-.0092***	-.0050***	.0177**	.0104***	-.0018	.0094	-.0019
	(.0015)	(.0010)	(.0075)	(.003)	(.0026)	(.0080)	(.0094)
18 to 23 Months	-.0221***	-.0117***	.0143	.0092***	-.0056	-0043	-.0013
	(.0030)	(.0018)	(.0087)	(.0033)	(.004)	(.0088)	(.0011))
2 Years +	-.0402***	.018***	.0137	.0012	-.0160***	-.0128	-.0292***
	(.0041)	(.004)	(.0092)	(.0036)	(.0036)	(.0101)	(.0109)
Mean of DV	.112	.039	.413	.582	.380	.432	.249
N	861,612	861,612	131,606	928,837	928,837	131,606	131,606
Sample	*HS Grads at Enlistment*	*HS Grads at Enlistment*	*No College at Separation*	*No College at Separation*	*No College at Separation*	*No College at Separation*	*No College at Separation*
Years	FY2001-2017	FY2001-2017	FY2015-16	FY2001-17	FY2001-17	FY2015-16	FY2015-16

***Significant at 1% level **at 5% level *at 1% level

Notes: Estimates obtained using U.S. Army administrative data merged with administrative panel data from the Veterans' Administration. Military controls include fully interacted indicators for rank, primary military occupation specialty, years of enlisted service, year of separation, and gender. Personal controls include age at separation, age-squared, indicators for race/ethnicity, Armed Forces Qualifying Test (AFQT) scores, marital status, and number of dependents. All regressions condition the sample on those with a high school diploma or GED at enlistment.

Table 6. Estimates of the Impact of Combat Assignment on Associates Degree and Four-Year College Degree Receipt

	Associate	*Bachelor*		
	(1)	(2)	(3)	(4)
		Panel I: Deployment to Combat		
Any Combat	.0008	-.0015	-.0028**	-.0036*
	(.0012)	(.0015)	(.0014)	(.0017)
		Panel II: Linear Deployment Length		
Years Combat	.0014	-.0029***	-.0051***	-.0060**
	(.0009)	(.0010)	(.0014)	(.0012)
		Panel III: Non-Linear Deployment Length		
1 to 11 Months	-.0012	-.0003	-.0016	-0020
	(.0014)	(.0014)	(.0014)	(.0018)
12 to 17 Months	.0041***	-.0031	-.0033**	-.0043**
	(.0015)	(.0019)	(.0016)	(.0019)
18 to 23 Months	.0029	-.0044*	-.0073***	-.0081***
	(.0025)	(.0026)	(.0029)	(.0029)
2 Years +	.0041	-.0050*	-.0109***	-.0129***
	(.0025)	(.0028)	(.0025)	(.0030)
Mean of DV	.100	.103	.112	.137
N	692,991	692,991	928,837	727,336
Sample	*HS Grads at Separation*	*HS Grads at Separation*	*No College at Separation*	*No College at Separation YOS<FY13*

***Significant at 1% level **at 5% level *at 1% level

Notes: Estimates obtained using U.S. Army administrative data merged with administrative panel data from the Veterans' Administration. All models include military controls and personal controls. Military controls include fully interacted indicators for rank, primary military occupation specialty, years of enlisted service, year of separation, and gender. Personal controls include age at separation, age-squared, indicators for race/ethnicity, Armed Forces Qualifying Test (AFQT) scores, marital status, and number of dependents. Samples are conditional on educational attainment at enlistment as indicated.

Table 7. 2SLS Estimates of the Effects of Combat Deployment Length on Transition Benefit Receipt and Educational Attainment

	PTSD	*TBI*	*Wounded*	*URisk*	*UCX-A*	*UCX-E*	*Grad Enlist*	*PGIB*	*Post Attend*	*Post Semester*	*Associate*	*Bachelor*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2SLS	.098***	.027***	.011***	.008**	.006***	.005***	-.0114***	.007***	.002	-.006***	.003***	-.005***
	(.004)	(.002)	(.001)	(.003)	(.002)	(.002)	(.0012)	(.003)	(.002)	(.002)	(.001)	(.001)
OLS	.094***	.029***	.018***	.012***	.012***	.011***	-.0104***	.005*	.001	-.005***	.002	-.004***
	(.005)	(.003)	(.003)	(.003)	(.002)	(.002)	(.0011)	(.003)	(.002)	(.002)	(.001)	(.001)
First Stage	.899***	.899***	.899***	.899***	.894***	.894***	.897***	.884***	.897***	.897***	.897***	.899***
	(.004)	(.004)	(.004)	(.004)	(.004)	(.004)	(.003)	(.005)	(.003)	(.003)	(.003)	(.004)
Mean DV	.210	.085	.020	.231	.440	.412	.034	.433	.582	.359	.097	.108
N	914,465	914,465	914,572	914,465	385,599	385,599	803,324	123,741	760,577	760,577	760,777	869,241

***Significant at 1% level **at 5% level *at 1% level

Notes: Estimates obtained using U.S. Army administrative data merged with administrative panel data from the Veterans' Administration. All models include the full set of military and personal controls. Military controls include fully interacted indicators for rank, primary military occupation specialty, years of enlisted service, gender, and year of separation. Personal controls include age at separation, age-squared, indicators for race/ethnicity, Armed Forces Qualifying Test (AFQT) scores, marital status, and educational attainment at the time of separation.

Table 8. OLS Estimates of the Impacts of Unit-Level Injury Exposure and Death Exposure on Transition Benefit Receipt and Educational Attainment

	PTSD	*TBI*	*Wounded*	*URisk*	*UCX-A*	*PGIB*	*Attend Enlist*	*Grad Enlist*	*Post Attend*	*Post Semester*	*Bachelor*	*Associate*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
						Panel I: Duration of Unit-Level Injury Exposure						
Injury	.196***	.164***	.151***	.132**	-.0087*	-.036***	-.015***	-.0080***	-.005	-.013***	-.006***	.002
Exposure	(.010)	(.010)	(.014)	(.001)	(.0049)	(.0080)	(.0036)	(.0026)	(.004)	(.004)	(.003)	(.003)
N	976,963	976,963	977,744	976,963	409,627	131,606	861,612	861,612	928,837	928,837	928,837	839,026
						Panel II: Any Unit-Level Death Exposure						
Death	.0196***	.0200***	.0140***	.0149***	-.0020	.0196***	-.0020	-.0016	-.0016	-.0039*	-.0020	-.0019
Exposure	(.0027)	(.0033)	(.0024)	(.003)	(.0028)	(.0027)	(.0028)	(.0021)	(.0021)	(.0020)	(.0014)	(.0019)
N	976,963	976,963	977,744	976,963	409,627	131,606	861,612	861,612	928,837	928,837	928,837	839,026

***Significant at 1% level **at 5% level *at 1% level

Notes: Estimates obtained using U.S. Army administrative data merged with administrative panel data from the Veterans' Administration. All models include the full set of military and personal controls. Military controls include fully interacted indicators for rank, primary military occupation specialty, years of enlisted service, gender, and year of separation. Personal controls include age at separation, age-squared, indicators for race/ethnicity, Armed Forces Qualifying Test (AFQT) scores, and marital status. Columns (1) through (5) control for level of education attained at separation and columns (6) through 12) condition the sample on educational attainment at separation or enlistment as noted in Table 1.

Table 9. Heterogeneity in Estimated Impact of Duration of Injury Exposures, by Military Rank and Combat Branch

	PTSD	*TBI*	*Wounded*	*URisk*	*UCX-A*	*UCX-E*	*Grad Enlist*	*PGIB*	*Post Attend*	*Post Semester*	*Bachelor*	*Associate*
	(1)	(2)	(4)	(3)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
						Panel I: Military Rank						
Junior Enlisted	.237***	.184***	.1579***	.177***	-.0102	-.0101	-.0014*	-.054***	-.0015	-.033	.002	.006*
(E01-E04)	(.010)	(.0014)	(.0228)	(.011)	(.0082)	(.0077)	(.0008)	(.005)	(.0074)	(.004)	(.003)	(.004)
N	666,157	666,157	666,577	666,157	277,825	277,825	603,343	603,343	650,482	650,482	650,482	640,517
Junior NCOs	.166***	.158***	.1557***	.109***	-.0104	-.0101	-.0084*	-.022*	-.0053	-.015**	-.012***	-.005
(E05-E06)	(.012)	(.011)	(.0178)	(.014)	(.0074)	(.0075)	(.0046)	(.012)	(.0058)	(.006)	(.004)	(.004)
N	224,765	224,765	224,997	224,765	98,692	98,692	189,374	189,374	208,984	208,984	208,984	198,409
Senior NCOs	.050***	.096***	.1043***	.024*	-.0024	-.0027	-.0345***	-.041*	-.0213*	-.038***	-.016	-.003
(E07-E09)	(.004)	(.012)	(.0188)	(.014)	(.0116)	(.0116)	(.0119)	(.021)	(.0123)	(.013)	(.010)	(.009)
N	86,041	86,041	86,170	86,041	33,110	33,110	68,895	68,895	69,371	69,371	69,371	53,389
						Panel II: Combat vs Non-Combat Occupational Fields						
Combat Branch	.208***	.191***	.2068***	.153***	-.0071	-.007	-.0100**	-.043***	-.012**	-.011*	-.008***	.0004
	(.016)	(.011)	(.0100)	(.016)	(.0061)	(.006)	(.0042)	(.007)	(.005)	(.006)	(.003)	(.004)
N	284,219	284,219	284,428	284,219	124,646	124,646	257,688	40,949	276,113	276,113	276,113	269,590
Other Branch	.182***	.136***	.0996***	.108***	-.0122	-.012	-.0075**	-.029*	-.0008	-.014***	-.004	.0003
	(.008)	(.009)	(.0091)	(.007)	(.008)	(.008)	(.0029)	(013)	(.0056)	(.005)	(.004)	(.0004)
N	692,744	692,744	693,316	692,744	284,981	284,981	603.924	90,657	652,724	652,724	652,724	622,725

***Significant at 1% level **at 5% level *at 1% level

Notes: Estimates obtained using U.S. Army administrative data merged with administrative panel data from the Veterans' Administration. All models include the full set of military and personal controls. Military controls include fully interacted indicators for rank, primary military occupation specialty, years of enlisted service, gender, and year of separation. Personal controls include age at separation, age-squared, indicators for race/ethnicity, Armed Forces Qualifying Test (AFQT) scores, marital status, and educational attainment at the time of separation.

Table 10. Heterogeneity in Estimated Impact of Injury Exposures, by Gender and Race

	PTSD	*TBI*	*Wounded*	*URisk*	*UCX-A*	*UCX-E*	*Grad Enlist*	*PGIB*	*Post Attend*	*Post Semester*	*Bachelor*	*Associate*
	(1)	(2)	(4)	(3)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
						Panel I: Gender						
Men	.196***	.167***	.155***	.132***	-.010*	-.009*	-.0079***	-.034**	-.007*	-.012***	-.006***	.0004
	(.010)	(.009)	(.014)	(.011)	(.005)	(.005)	(.0026)	(.009)	(.004)	(.004)	(.002)	(.003)
N	809,989	809,989	810,669	809,989	349,318	349,318	719,208	113,610	773,328	773,328	773,328	744,743
Women	.170***	.079***	.055***	.124**	.005	.006	-.0127	-.047	.033**	-.010	-.0002	.008
	(.023)	(.003)	(.013)	(.020)	(.004)	(.004)	(.0090)	(.049)	(.014)	(.017)	(.013)	(.017)
N	166,974	166,974	167,075	166,974	60,309	60,309	142,404	17,996	155,509	155,509	155,509	147,572
						Panel II: Race						
White	.2041***	.1772***	.1685***	.1434***	-.0076	-.0080	-.0058**	-.0392***	-.0081	-.0126***	-.0083**	.0003
	(.0114)	(.0092)	(.0138)	(.0108)	(.0063)	(.0062)	(.0024)	(.0096)	(.0056)	(.0049)	(.0035)	(.0032)
N	631,866	631,866	632,306	631,866	270,069	270,068	558,861	81,636	604,516	604,516	604,516	584,823
Non-White	.1837***	.1368***	.1174***	.1103***	-.0097	-.0074	-.0114**	-.0235	-.0003	-.0165**	-.0021	.0003
	(.0115)	(.0127)	(.0158)	(.0136)	(.0103)	(.0105)	(.0048)	(.0169)	(.0073)	(.0076)	(.0054)	(.0053)
N	345,097	345,097	345,483	345,097	139,558	139,558	302,751	49,970	324,321	324,321	324,321	307,492

***Significant at 1% level **at 5% level *at 1% level

Notes: Estimates obtained using U.S. Army administrative data merged with administrative panel data from the Veterans' Administration. All models include the full set of military and personal controls. Military controls include fully interacted indicators for rank, primary military occupation specialty, years of enlisted service, gender, and year of separation. Personal controls include age at separation, age-squared, indicators for race/ethnicity, Armed Forces Qualifying Test (AFQT) scores, marital status, and educational attainment at the time of separation.

Appendix Table 1. Heterogeneity in Effects of Combat, by Years of Service

	PTSD	*TBI*	*Wounded*	*URisk*	*UCX-A*	*Grad Enlist*	*PGIB*	*Post Attend*	*Post Semester*	*Bachelor*	*Associate*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
One-Termers	.147***	.042***	.021***	.040**	-.0007	-.0019***	.0178**	.0045**	-.0006	.0012	.0020
	(.006)	(.004)	(.004)	(.004)	(.0029)	(.0003)	(.0071)	(.0019)	(.0022)	(.0013)	(.0032)
N	585,045	585,045	585,272	585,045	229,204	518,597	69,978	562,904	562,904	562,904	527,875
0-3 YOS	.202***	.0590***	.0232***	.0749****	.0070	-.0020***	.0206***	.0124***	.0040*	.0017	.0037**
	(.0063)	(.0049)	(.0052)	(.0055)	(.0047)	(.0003)	(.0077)	(.0025)	(.0024)	(.0015)	(.0013)
N	509,854	598,854	510,067	509,854	188,687	457,984	60,867	494,002	494,002	494,002	486,404
4-6 YOS	.099***	.0297***	.0181***	.0115***	.0072**	-.0031***	.0039	.0023	-.0043	-.00004	.0028**
	(.0041)	(.0024)	(.0027)	(.0029)	(.0032)	(.0006)	(.0075)	(.0027)	(.0028)	(.0017)	(.0014)
N	219,024	219,024	219,229	219,024	100,751	191,034	26,760	209,798	209,798	209,798	204,881
7-9 YOS	.0700***	.0250***	.0158***	-.0013	.0128***	-.0056***	.0067	-.0045	-.0126***	-.0085***	-.0011
	(.0035)	(.0031)	(.0024)	(.0032)	(.0037)	(.0010)	(.0074)	(.0030)	(.0033)	(.0017)	(.0020)
N	87,812	87,812	87,911	160,273	46,748	77,747	16,025	84,668	84,668	84,668	81,979
10+ YOS	.0514***	.0175***	.0096***	-.0096***	.0009	-.0202***	.0003	-.0073***	-.0132***	-.0103***	-.0019
	(.0027)	(.0020)	(.0016)	(.0020)	(.0024)	(.0020)	(.0040)	(.0021)	(.021)	(.0013)	(.0011)
N	160,273	160,273	160,537	160,273	73,441	134,847	27,954	140,369	140,369	140,369	119,051

***Significant at 1% level **at 5% level *at 1% level

Notes: Estimates obtained using U.S. Army administrative data merged with administrative panel data from the Veterans' Administration. All models include the full set of military and personal controls. Military controls include fully interacted indicators for rank, primary military occupation specialty, years of enlisted service, gender, and year of separation. Personal controls include age at separation, age-squared, indicators for race/ethnicity, Armed Forces Qualifying Test (AFQT) scores, marital status, and educational attainment at the time of separation.

Appendix Table 2. Heterogeneity in Estimated Impact of Injury Exposure, by Years of Enlisted Service

	PTSD	*TBI*	*Wounded*	*URisk*	*UCX-A*	*UCX-E*	*Grad Enlist*	*PGIB*	*Post Attend*	*Post Semester*	*Bachelor*	*Associate*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0-3 YOS	.288***	.208***	.1790***	.211***	-.017	-.017	.0003	-.016	.0069	-.002	.007	.007
	(.014)	(.019)	(.0241)	(.013)	(.012)	(.012)	(.0008)	(.032)	(.0090)	(.007)	(.005)	(.005)
N	509,854	509,854	510,067	509,854	188,687	188,687	457,984	60,867	494,002	494,002	494,002	486,404
4-6 YOS	.204***	.168***	.1614***	.145***	-.012	-.013	-.0031*	-.041*	-.0039	-.010	-.008**	-.001
	(.007)	(.008)	(.0143)	(.007)	(.008)	(.008)	(.0019)	(.024)	(.0079)	(.009)	(.004)	(.006)
N	219,024	219,024	219,229	219,024	100,751	100,751	191,034	26,760	209,798	209,798	209,798	204,881
7-9 YOS	.158***	.176***	.1597***	.119***	-.009	-.010	-.0047*	-.042**	-.0186**	-.011	-.011**	.005
	(.013)	(.011)	(.0160)	(.010)	(.012)	(.012)	(.0028)	(.020)	(.0095)	(.009)	(.005)	(.006)
N	87,812	87,812	87,911	87,812	46,748	46,748	77,747	16,025	84,668	84,668	84,668	81,979
10+ YOS	.126***	.109***	.1070***	.050***	-.002	-.002	-.0207***	-.033**	-.0096	-.025***	-.009	-.005
	(.010)	(.007)	(.0105)	(.010)	(.008)	(.008)	(.0068)	(.014)	(.0082)	(.008)	(.006)	(.005)
N	160,273	160,273	160,537	160,273	73,441	73,441	134,847	27,954	140,369	140,369	140,369	119,051

***Significant at 1% level **at 5% level *at 1% level

Notes: Estimates obtained using U.S. Army administrative data merged with administrative panel data from the Veterans' Administration. All models include the full set of military and personal controls. Military controls include fully interacted indicators for rank, primary military occupation specialty, years of enlisted service, gender, and year of separation. Personal controls include age at separation, age-squared, indicators for race/ethnicity, Armed Forces Qualifying Test (AFQT) scores, and marital status. Columns (1) through (6) control for level of education attained at separation and columns (7) through 12) condition the sample on educational attainment at separation or enlistment as noted in Table 1.

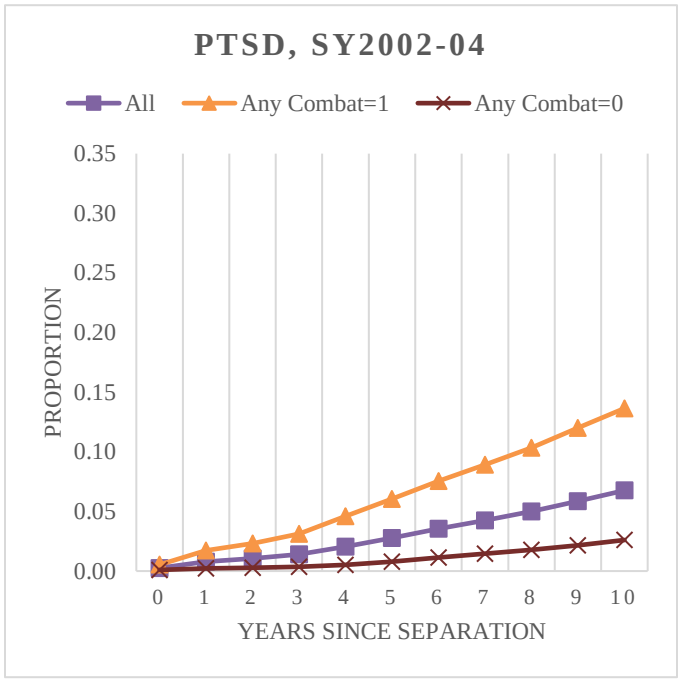
Appendix Table 3. Estimates of the Impact of Duration of Injury Exposures, by Year of Separation

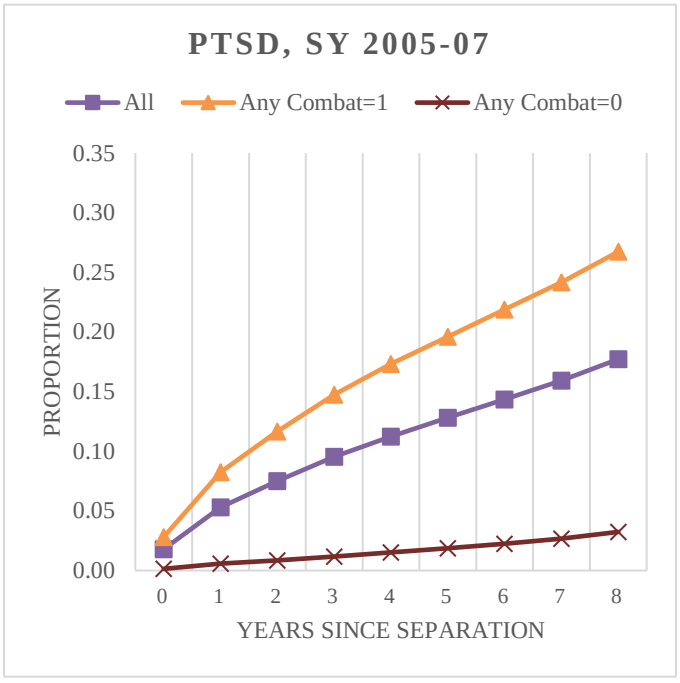
	PTSD	*TBI*	*URisk*	*Post Semester*	*Bachelor*	*Associate*
	(1)	(2)	(3)	(4)	(5)	(6)
Pre-2002	.5093*	-.0579	.2592	-.1085	-.0629	-.1848*
	(.2990)	(.1222)	(.2377)	(.2571)	(.2440)	(.1006)
N	485,926	485,296	485,296	470,666	470,666	456,173
2002-2005	.3006*	.1266***	.2034***	-.0355**	.0075	-.0018
	(.0171)	(.0102)	(.0171)	(.0155)	(.0026)	(.0115)
N	240,913	240,913	240,913	230,393	230,393	221,692
2006-2009	.2234***	.1690***	.1695***	-.0066	-.0039	.0077
	(.0100)	(.0114)	(.0097)	(.0087)	(.0074)	(.0065)
N	223,770	223,770	223,770	211,823	211,823	202,672
2010-2016	.1713***	.1614***	.1124***	-.0114***	-.0055***	-.0010
	(.0130)	(.0106)	(.0127)	(.0044)	(.0019)	(.0028)
N	487,004	487,004	487,004	461,328	461,328	443,439

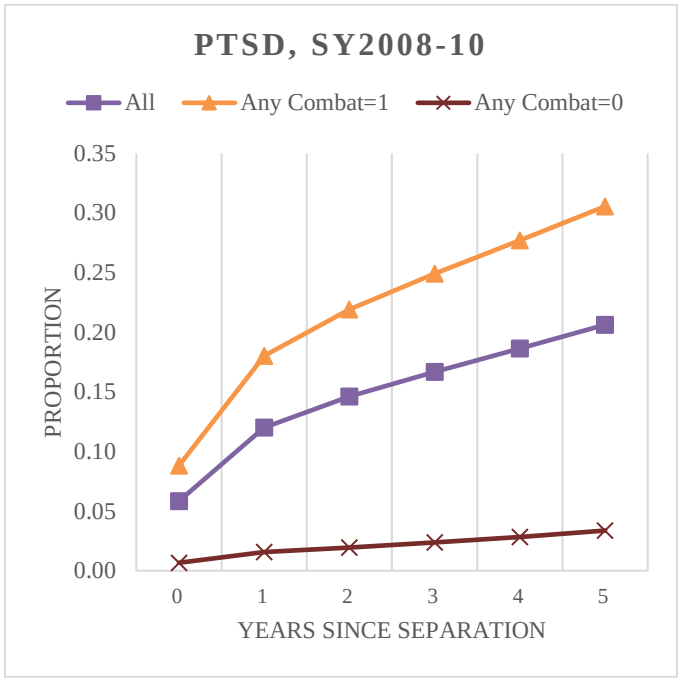
***Significant at 1% level **at 5% level *at 1% level

Notes: Estimates obtained using U.S. Army administrative data merged with administrative panel data from the Veterans' Administration. All models include the full set of military and personal controls. Military controls include fully interacted indicators for rank, primary military occupation specialty, years of enlisted service, gender, and year of separation. Personal controls include age at separation, age-squared, indicators for race/ethnicity, Armed Forces Qualifying Test (AFQT) scores, marital status, and educational attainment at separation.

Figure 1. Post-Separation VDC Benefits for PTSD Diagnosis, by Separation Year







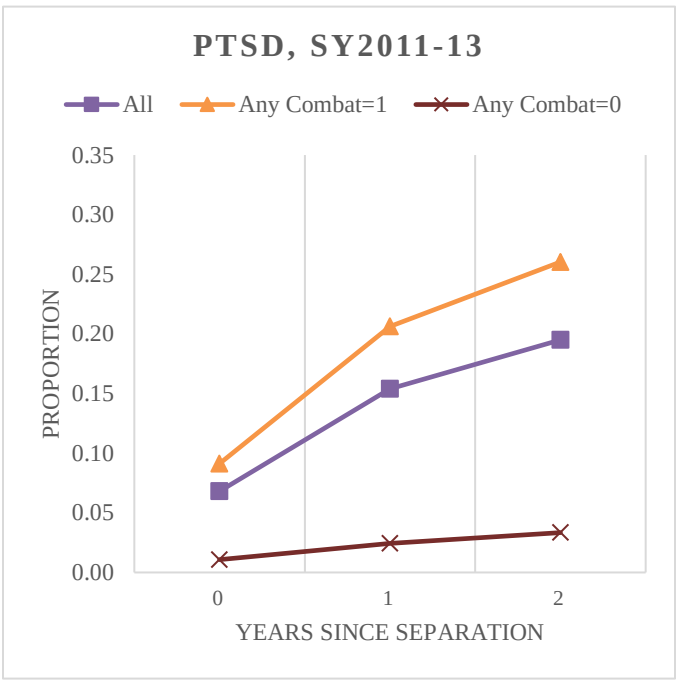


Figure 2. Post-Separation VDC Benefits for TBI Diagnosis, by Separation Year (SY)

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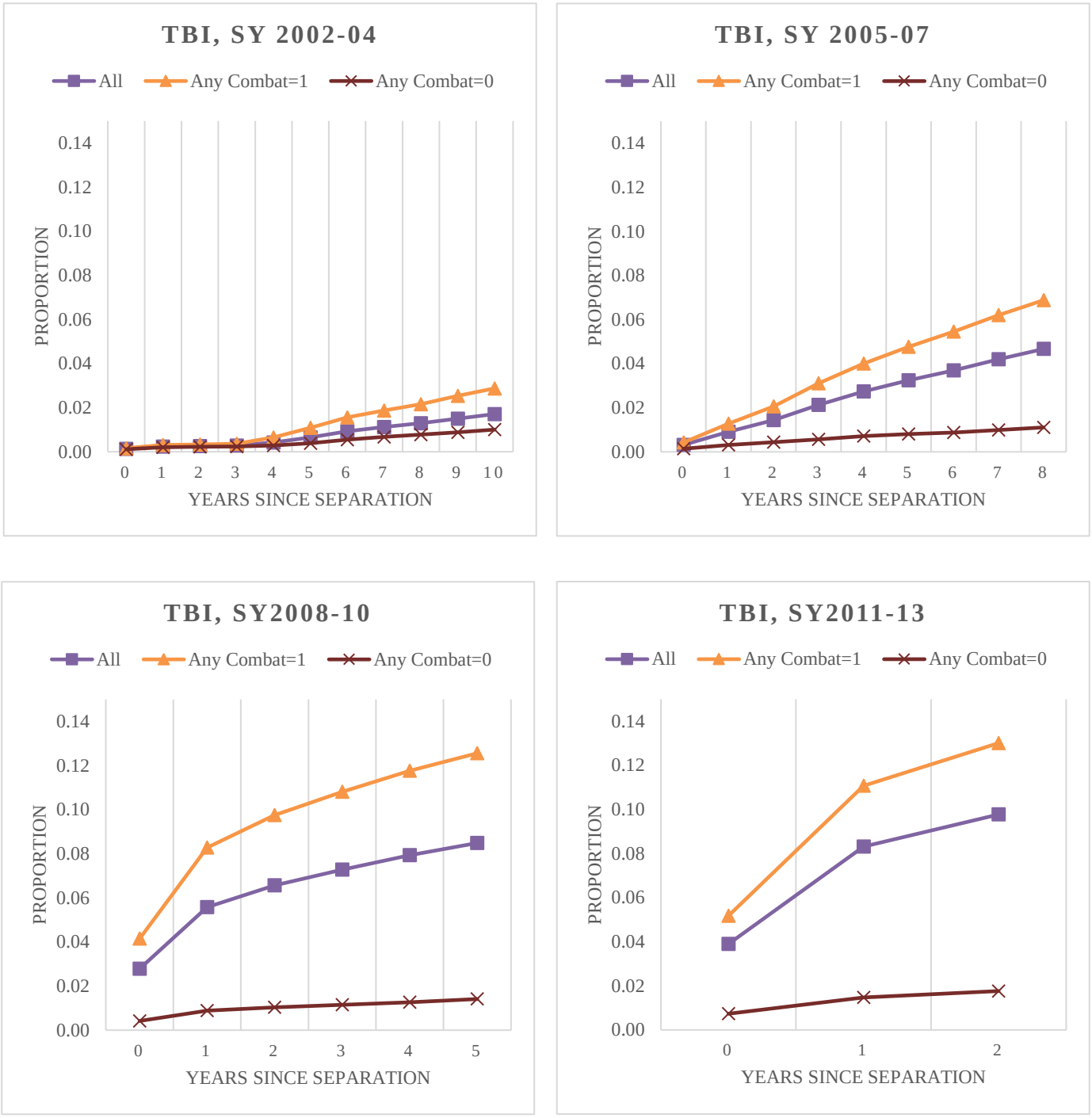


Figure 3. Post-Separation VDC Benefits for CDR ≥ 70%, by Separation Year

Figure 4. UCX Participation for those that Separate in FY 2010-2011

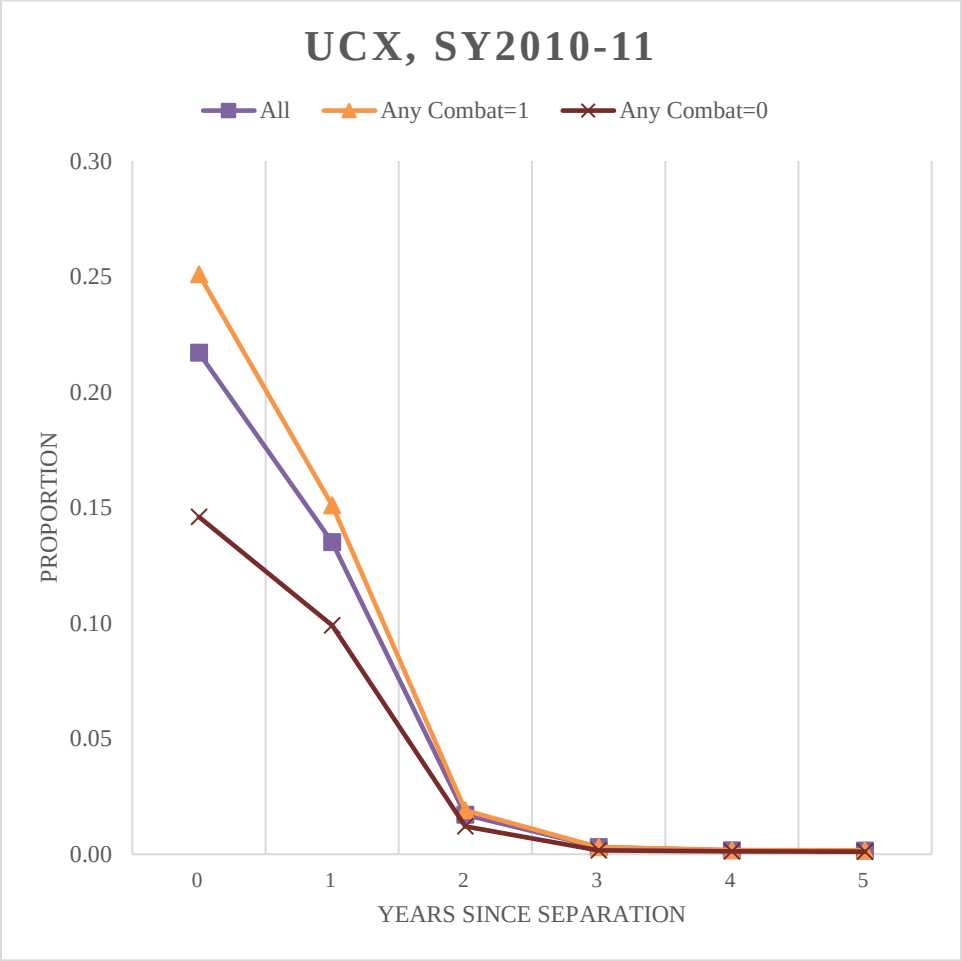
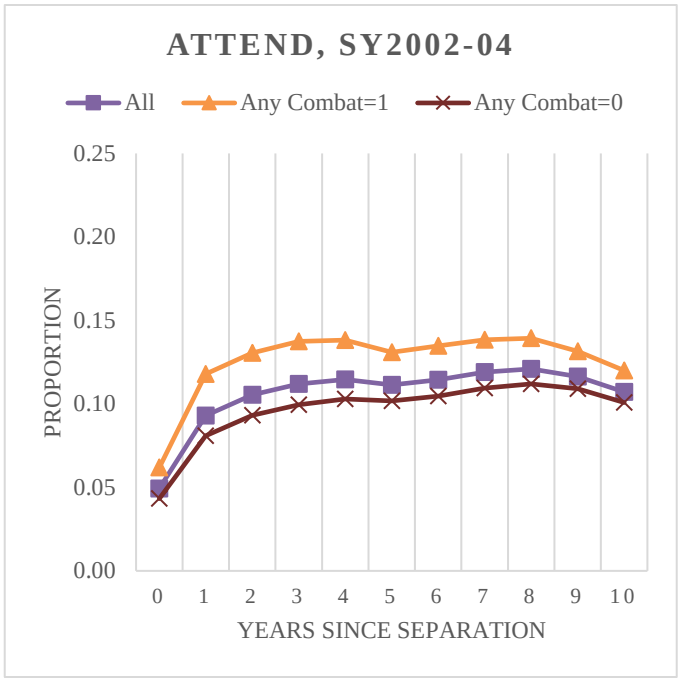
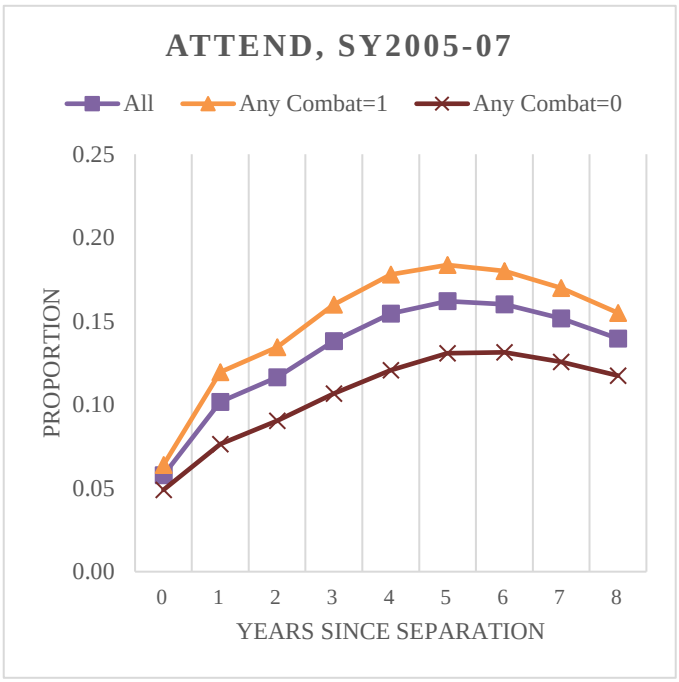
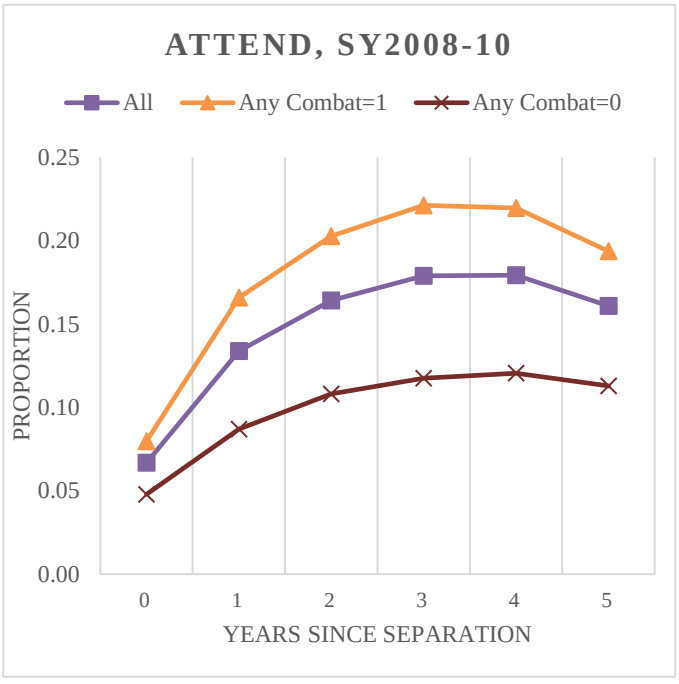


Figure 5. Post-Separation Post-Secondary Attendance, by Separation Year







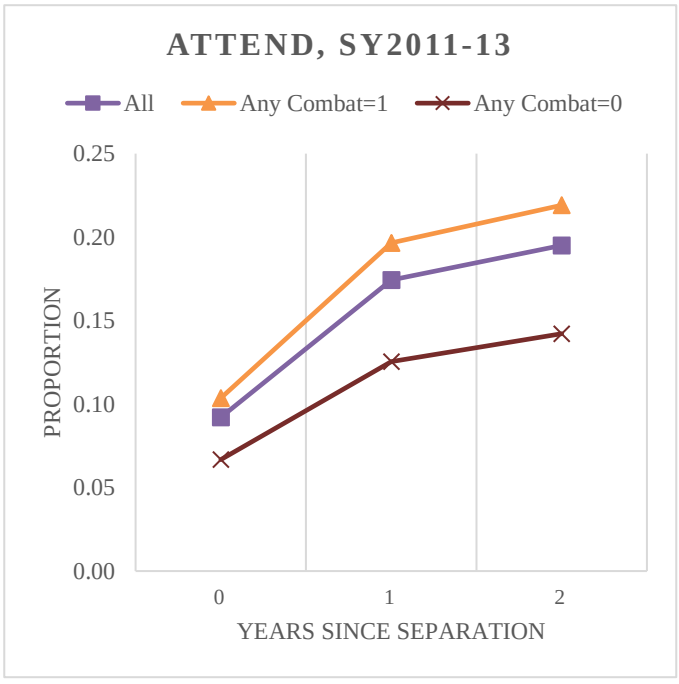


Figure 6. Post-Separation Four-Year College Degree Receipt Among those without Degree at Separation, by Separation Year

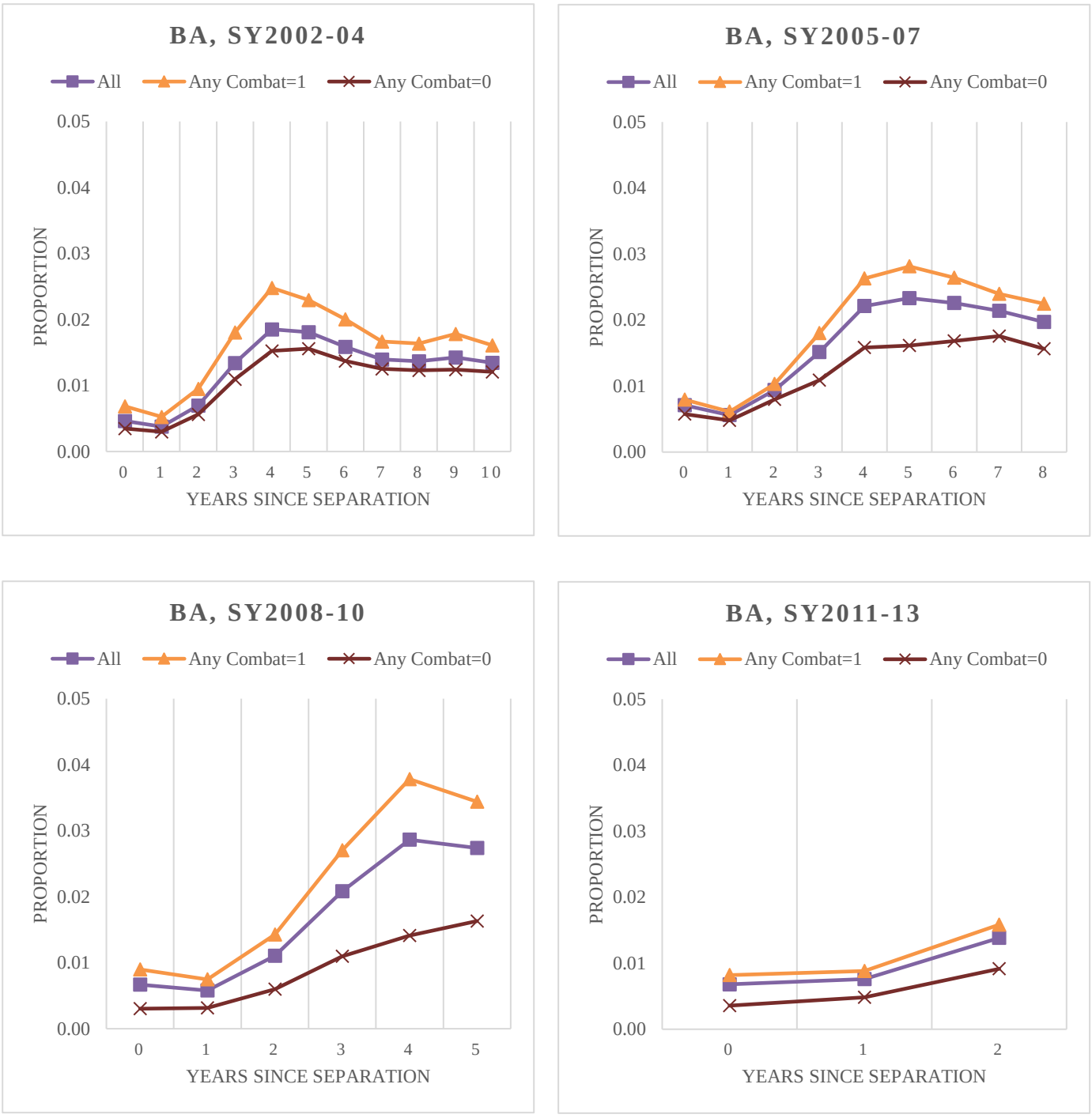


Figure 7. Post-Separation Associate Degree Receipt Among those without Degree at Separation, by Separation Year