

The Evolution of Veteran Educational Attainment Gaps Over the Life Cycle

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SUPPLEMENTARY APPENDIX MATERIALS

Appendix A

A.1. Evidence on age of service of veterans and eligibility for educational benefits

We generated estimates of the average age of service for veterans over a period of 27 years using data from the Current Population Survey Veterans supplement that provide information on veterans' last year of service, birth year, and a categorical variable for length of service. Together, these variables can approximate years of service and age.

We know the definitive end year of service for most (82%) veterans in the sample in all years of the survey. Since service length provides a range of years, we can use the upper and lower bounds of these ranges to estimate the upper and lower bounds of starting year of service. There are 118,775 veterans in the sample with upper and lower bounds for starting years of service (survey years 1993-2018).

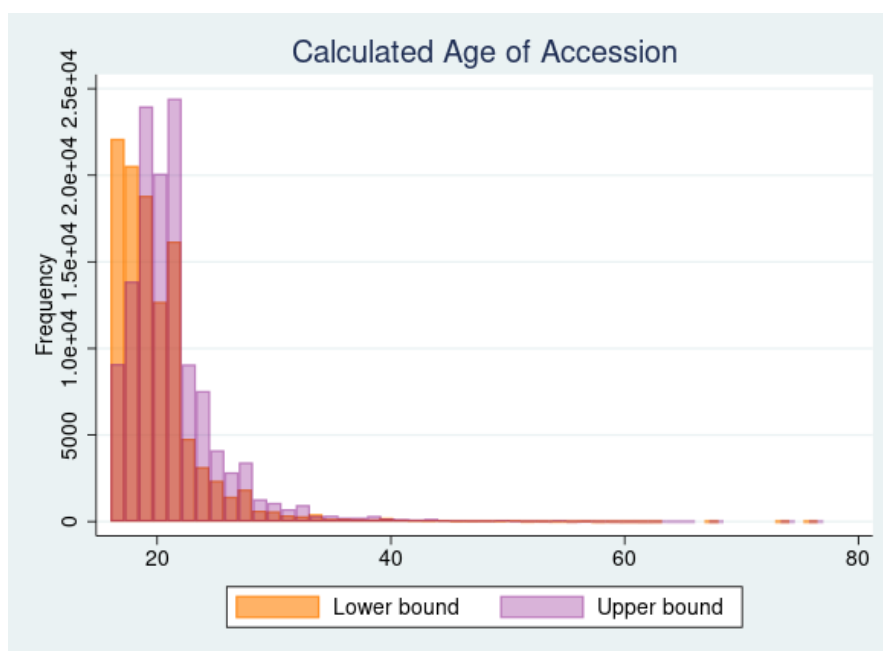
By subtracting birth year from last year of service, we have a veteran's age at the end of military service. We can do the same with the upper and lower bounds of first year of service, resulting in upper and lower bounds of age at start of service. This range is available for 107,882 veterans in the sample (survey years 1993-2018).

Table A1.1. Age of Service Summary Statistics

	mean	p50	N
Age at start of service, lower bound	20.10491	19	107,877
Age at start of service, upper bounds	21.38466	20	125,311
Age at end of service	25.27738	23	140,934

Source: Current Population Survey data from IPUMS (Flood et al. 2021) as described in text.

Figure A.1.1. Histogram of the Ages at Accession



Source: Current Population Survey data from IPUMS (Flood et al. 2021) as described in text.

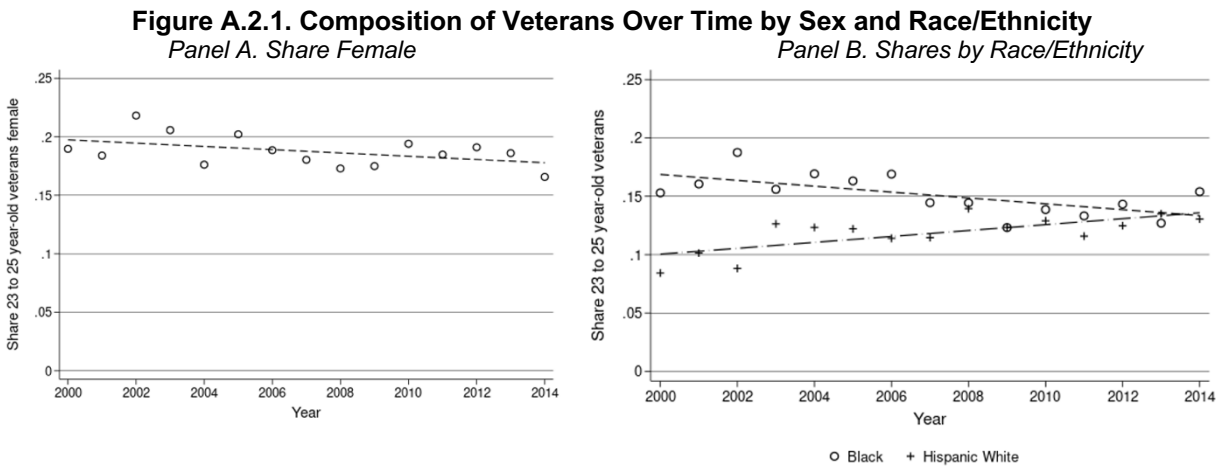
Table A.1.2. Estimated Periods of Service of Veterans in Analysis Sample

Birth Year	Service Dates			Probable Educational Benefits Coverage			
	Estimated year of service start (lower bound)	Estimated year of service start (upper bound)	Estimated year of service end	Montgomery GI Bill eligible	Retrospective eligibility for post-9/11 GI Bill	Prospective eligibility for post-9/11 GI Bill	post-9/11 GI Bill takes effect
1975	1994	1995	1999	X			
1976	1995	1996	2000	X			
1977	1996	1997	2001	X	X		
1978	1997	1998	2002	X	X		
1979	1998	1999	2003	X	X		
1980	1999	2000	2004	X	X		
1981	2000	2001	2005	X	X		
1982	2001	2002	2006	X	X		
1983	2002	2003	2007	X	X		
1984	2003	2004	2008			X	
1985	2004	2005	2009			X	X
1986	2005	2006	2010			X	X
1987	2006	2007	2011			X	X
1988	2007	2008	2012			X	X
1989	2008	2009	2013			X	X

While there were several years of veterans who are conceptually eligible for sequential use of the post-9/11 GI Bill and Montgomery GI Bill benefits, the share of veterans doing so is likely low as this dual eligibility was disputed by the Veterans Administration and was only established recently through court decisions. For more on this issue, see <https://www.militarytimes.com/education-transition/2020/01/13/court-rules-again-to-give-veterans-access-to-both-post-911-and-montgomery-gi-bill-education-benefits/>

A.2 Changes in the demographic composition of veterans over time

Due to the empirical approach we use—estimating birth cohort-specific educational attainment over the life cycle—it is important to understand how the demographic composition of veterans in these cohorts varies over time. To consider the extent to which changes in the composition of veterans by sex and race/ethnicity need to be accounted for in our empirical approach, we present calculations of the shares of veterans ages 23 to 25 by these characteristics across all years of the data that we observe our focal cohorts at these ages (2000 to 2014). This approach amounts to measuring the flow of younger veterans over time by these characteristics.



Source: Author calculations from Census and American Community Survey data from IPUMS (Ruggles et al. 2023).

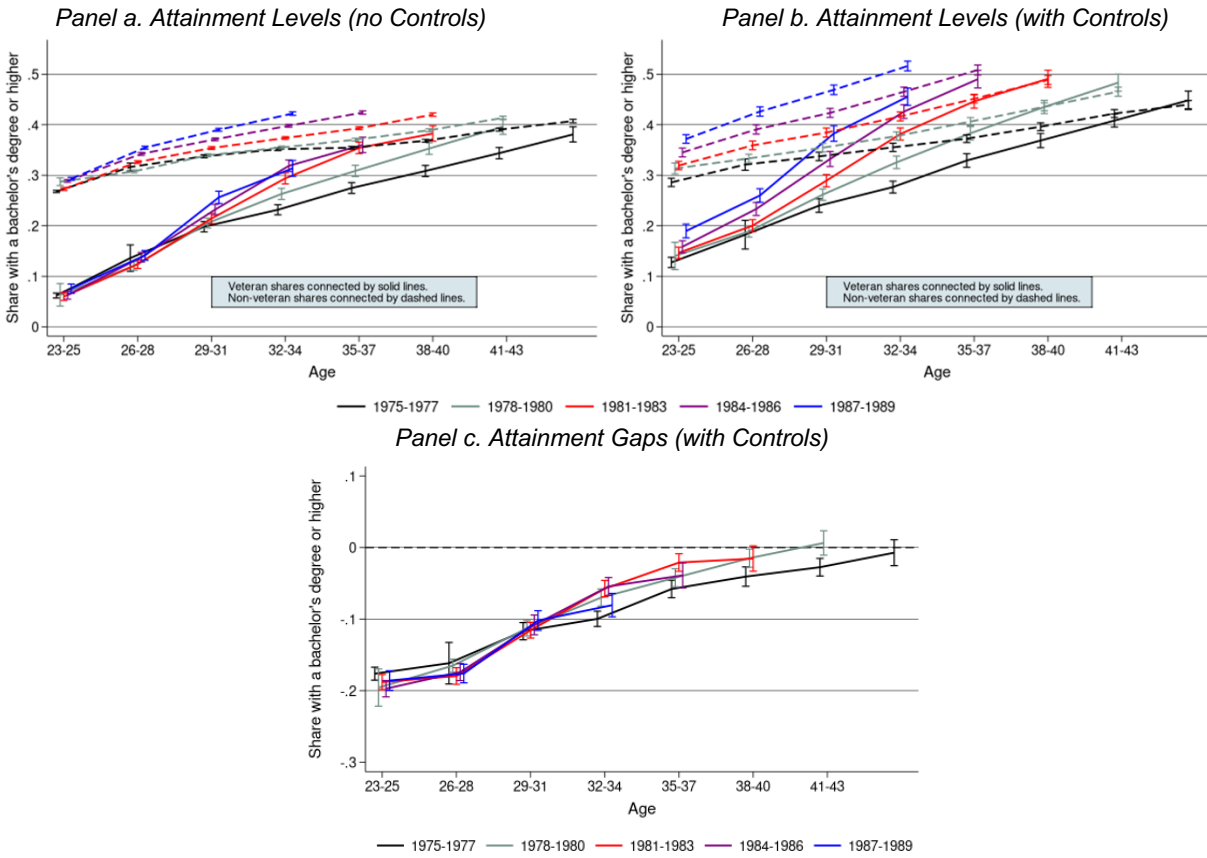
Panel A of figure A.2.1 shows that the share of female veterans declined over this time span, from an average of 19.4% between 2000 and 2004 to 18.6% from 2005-2009 to 17.8% from 2010 to 2014 (an overall decline of 10%). The share of Black veterans declined from 17.4% over 2000-2004 to 15.7% from 2005-2009 to 14.6% from 2010-2014 (16%). In contrast, the share of Hispanic veterans increased more than 20% across this same period, going from 10.7% between 2000 and 2004 to 13.4% between 2010 and 2014. For Black veterans, the overall decline was roughly mirrored by both men and women. However, for Hispanic veterans, the

increase was significantly larger for women (the share of female Hispanic veterans increased from 11% in 2000-2004 to 15.7% in 2010-2014, an increase of greater than 40%).

Appendix B. Additional Graphical Results and Numeric Tables for all Figures

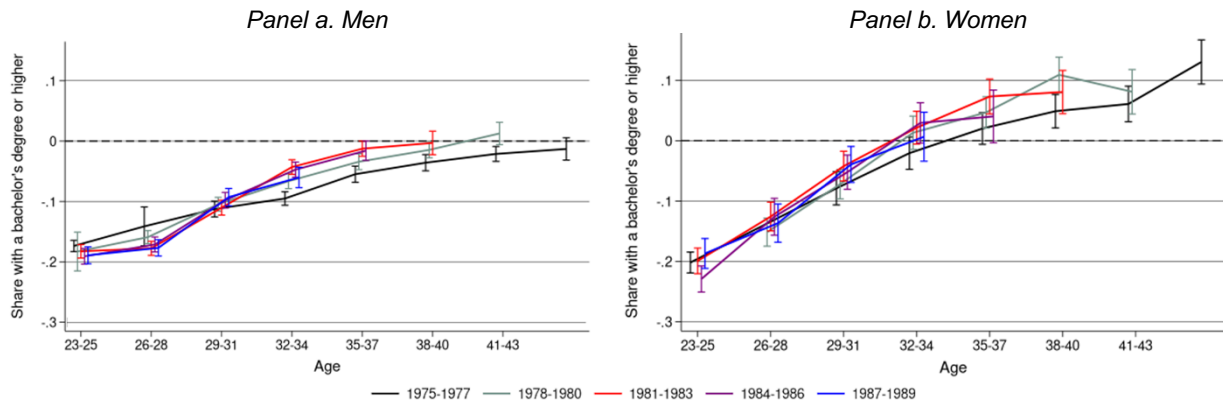
This appendix contains versions of all figures contained in the main article showing all five birth cohorts on the same figure. In the article, we exclude the second (1978-1980) and fourth (1984-1986) birth cohorts of the series of five cohorts that we include in the analysis for visual clarity. Additionally, we provide figures that reproduce the subgroup analyses of Figure 3 in the main text for our other main attainment outcome: associate's degree or higher. We also add figures showing the enrollment analysis in Figure 5 in levels rather than gaps. Finally, we present tables with the point estimates and standard errors for the main figures in the report.

Figure B.1. Veteran Attainment of a Bachelor's Degree or Higher Levels and Gaps (5 cohorts)



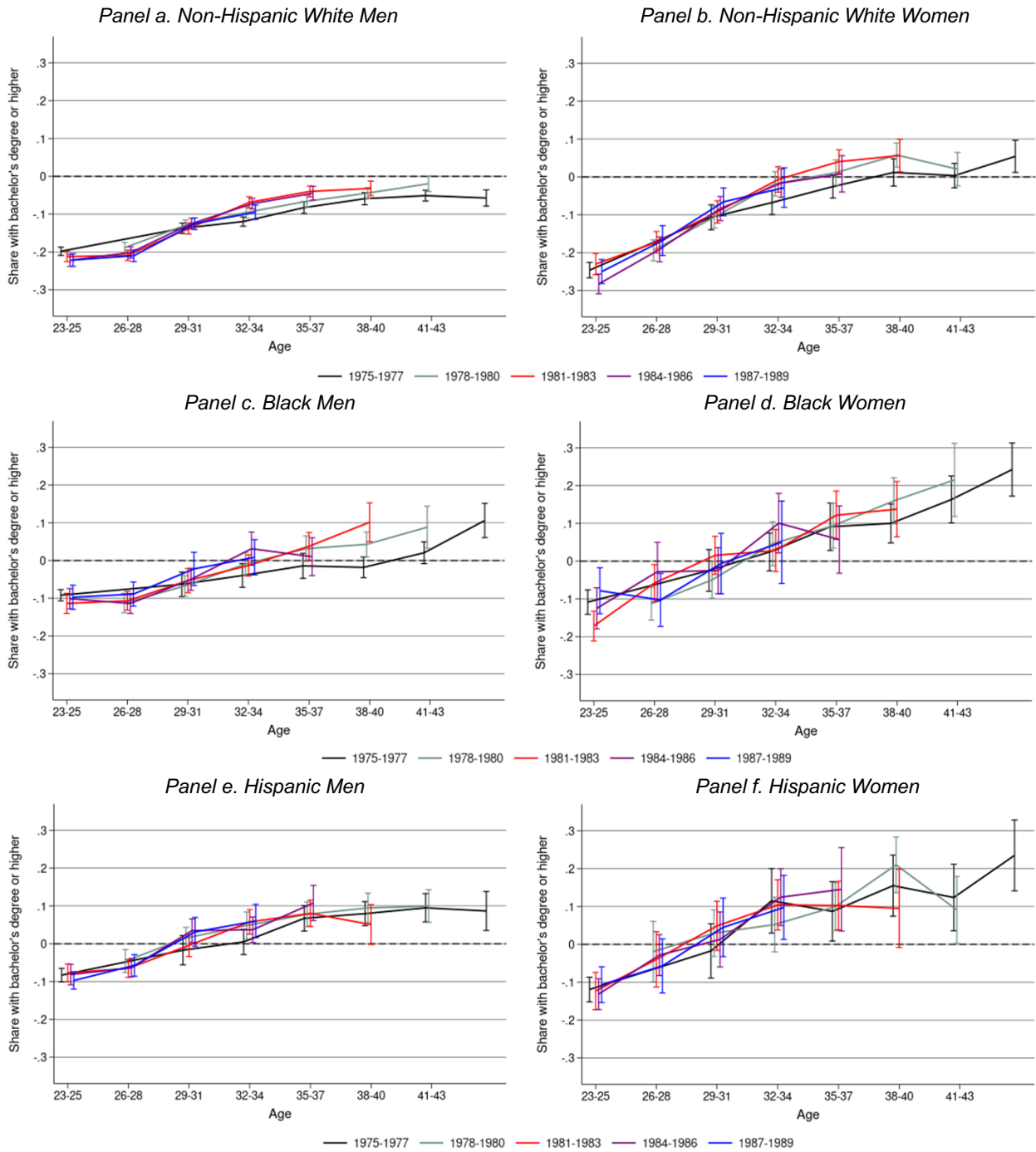
Figures depict outcomes derived from equation 1, with results from panel A controlling only for individual years of birth fixed effects while results from panels B and C include additional controls for marital status, family size, and number of children as well as PUMA fixed effects. Heteroskedasticity-robust standard errors clustered at the PUMA level are used to calculate 95% confidence intervals, which are shown as capped whiskers for each estimate. Source: American Community Survey data from IPUMS (Ruggles et al. 2023).

Figure B.2. Veteran Attainment Gaps for Bachelor's Degree or Higher by Sex (5 cohorts)



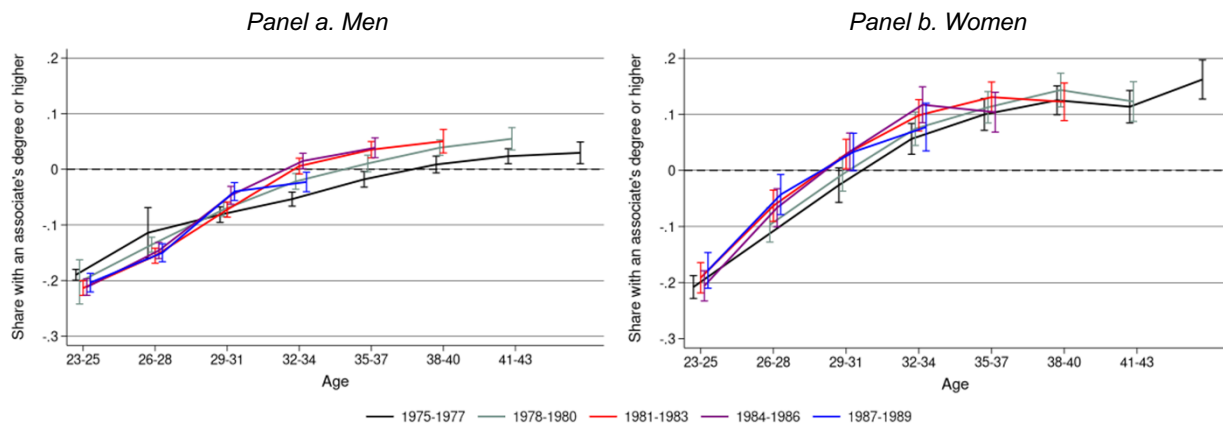
Figures depict outcomes derived from equation 1 as described in text for each indicated subsample. Heteroskedasticity-robust standard errors clustered at the PUMA level are used to calculate 95% confidence intervals, which are shown as capped whiskers for each estimate. Source: American Community Survey and Census data from IPUMS (Ruggles et al. 2023) as described in text.

Figure B.3. Veteran Attainment Gaps for Bachelor's Degree or Higher by Sex and Race/Ethnicity (5 cohorts)



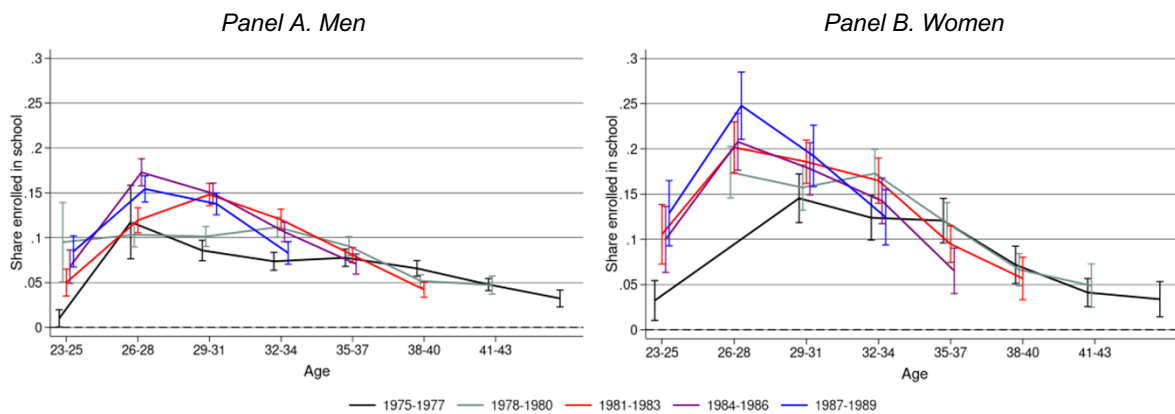
Figures depict outcomes derived from equation 1 as described in text for each indicated subsample. Heteroskedasticity-robust standard errors clustered at the PUMA level are used to calculate 95% confidence intervals, which are shown as capped whiskers for each estimate. Source: American Community Survey and Census data from IPUMS (Ruggles et al. 2023) as described in text.

Figure B.4. Veteran Attainment Gaps for Associate's Degree or Higher by Sex (5 cohorts)



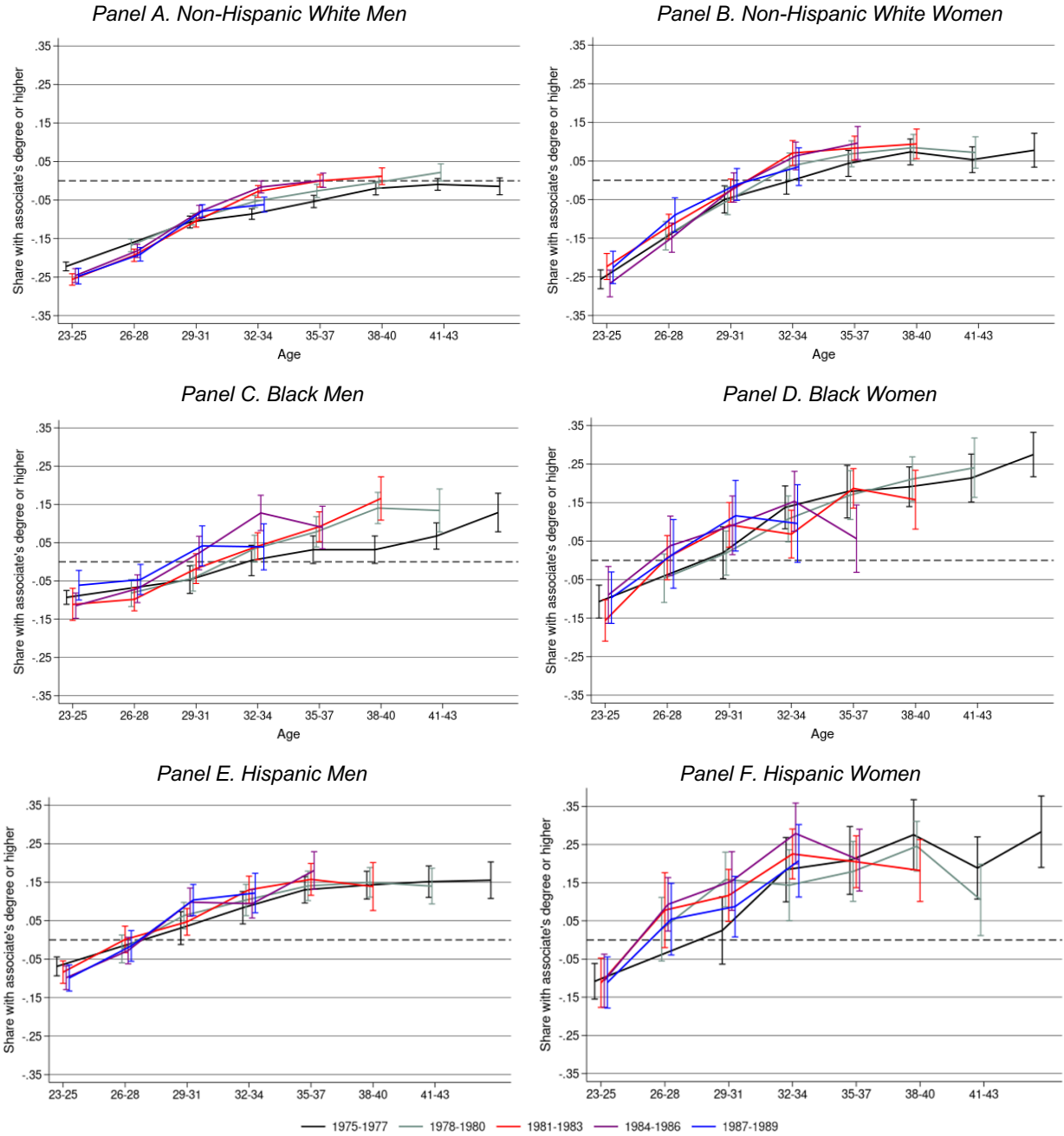
Figures depict outcomes derived from equation 1 as described in text for each indicated subsample. Heteroskedasticity-robust standard errors clustered at the PUMA level are used to calculate 95% confidence intervals, which are shown as capped whiskers for each estimate. Source: American Community Survey and Census data from IPUMS (Ruggles et al. 2023) as described in text.

Figure B.5. Veteran Enrollment Gaps by Sex (5 cohorts)



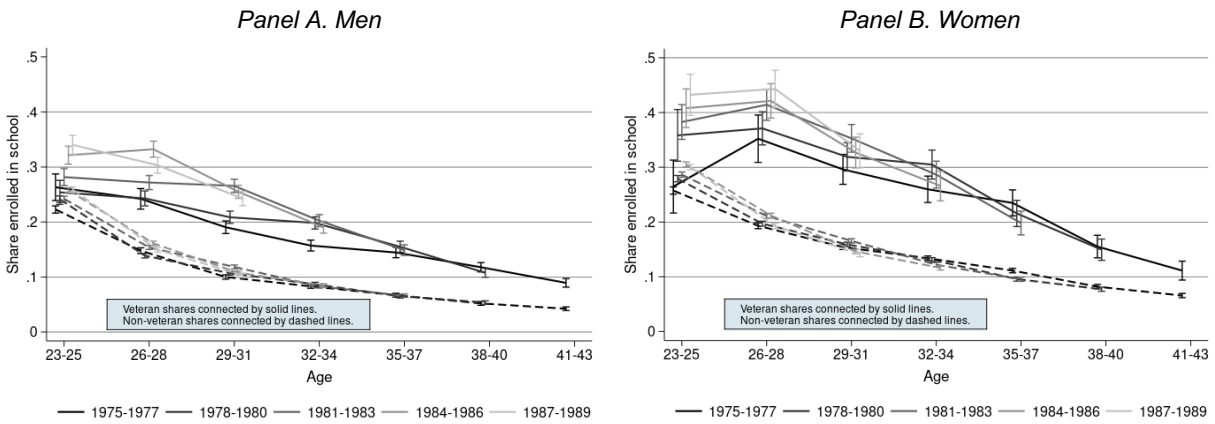
Figures depict outcomes derived from equation 1 as described in text for each indicated subsample. Heteroskedasticity-robust standard errors clustered at the PUMA level are used to calculate 95% confidence intervals, which are shown as capped whiskers for each estimate. Source: American Community Survey and Census data from IPUMS (Ruggles et al. 2023) as described in text.

Figure B.6. Veteran Attainment Gaps for Associate's Degree or Higher by Sex and Race/Ethnicity



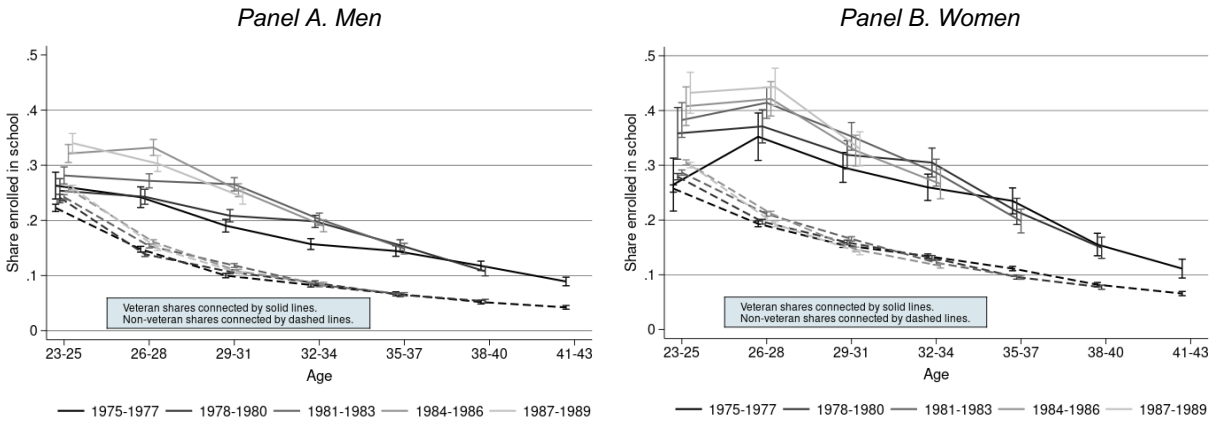
Source: American Community Survey and Census data from IPUMS (Ruggles et al. 2023) as described in text. Figures depict outcomes derived from equation 1 as described in text for each indicated subsample. Heteroskedasticity-robust standard errors clustered at the PUMA level are used to calculate 95% confidence intervals shown as capped whiskers for each estimate.

Figure B.7. Enrollment Levels Among Veterans and Nonveterans by Sex



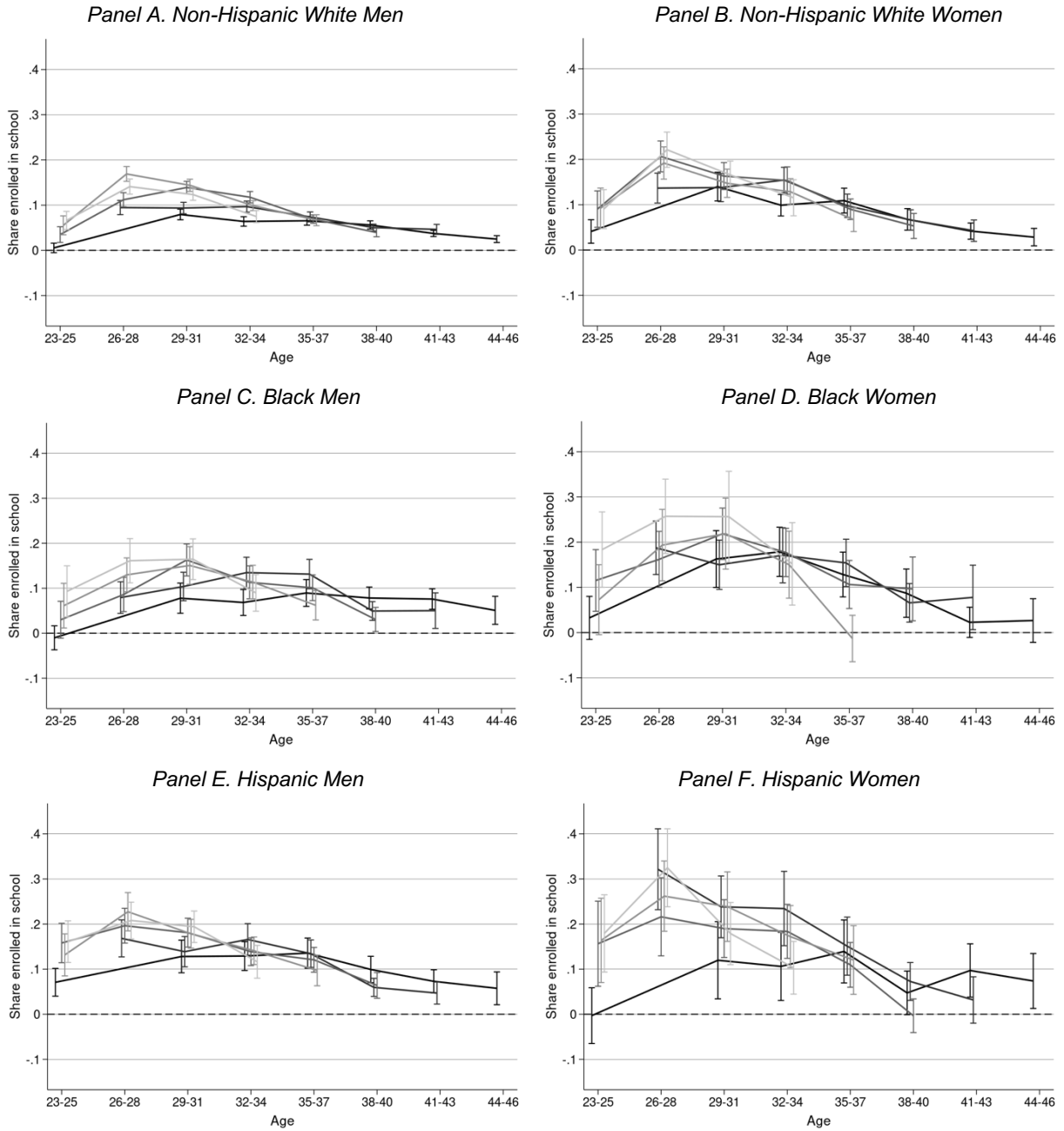
Source: American Community Survey and Census data from IPUMS (Ruggles et al. 2023) as described in text. Figures depict outcomes derived from equation 1 as described in text for each indicated subsample. Heteroskedasticity-robust standard errors clustered at the PUMA level are used to calculate 95% confidence intervals shown as capped whiskers for each estimate.

Figure B.8. Enrollment Levels Among Veterans and Nonveterans by Sex



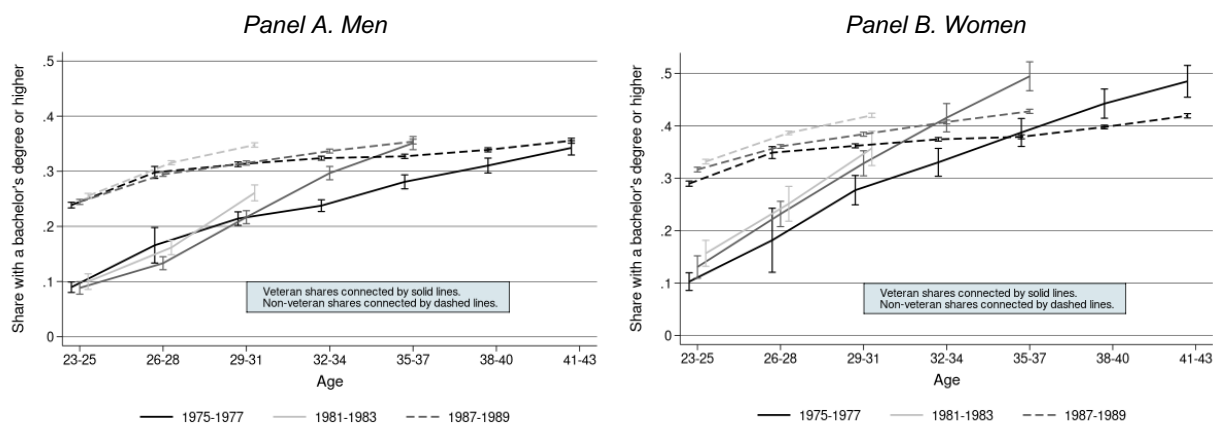
Source: American Community Survey and Census data from IPUMS (Ruggles et al. 2023) as described in text. Figures depict outcomes derived from equation 1 as described in text for each indicated subsample. Heteroskedasticity-robust standard errors clustered at the PUMA level are used to calculate 95% confidence intervals shown as capped whiskers for each estimate.

Figure B.9. Veteran Enrollment Gaps by Sex and Race/Ethnicity



Source: American Community Survey and Census data from IPUMS (Ruggles et al. 2023) as described in text. Figures depict outcomes derived from equation 1 as described in text for each indicated subsample. Heteroskedasticity-robust standard errors clustered at the PUMA level are used to calculate 95% confidence intervals shown as capped whiskers for each estimate.

**Figure B.10. Bachelor's Degree Attainment in Levels Among Veterans and Nonveterans by Sex
(three cohorts, no controls except PUMA fixed effects)**



Source: American Community Survey and Census data from IPUMS (Ruggles et al. 2023) as described in text. Figures depict outcomes derived from equation 1 as described in text for each indicated subsample. Heteroskedasticity-robust standard errors clustered at the PUMA level are used to calculate 95% confidence intervals shown as capped whiskers for each estimate.

Table B.3. Regression Results for Figure 3

Panel A. Veteran Attainment Gaps - Bachelor's Degree or Higher (Non-Hispanic White Men)

Table with columns for Birth cohort (1975-1977, 1978-1980, 1981-1983, 1984-1986, 1987-1989) and rows for Age group (23-25, 26-28, 29-31, 32-34, 35-37, 38-40, 41-43, 44-46). Each cohort has sub-columns for Gap, UB, and LB.

Panel B. Veteran Attainment Gaps - Bachelor's Degree or Higher (Non-Hispanic White Women)

Table with columns for Birth cohort (1975-1977, 1978-1980, 1981-1983, 1984-1986, 1987-1989) and rows for Age group (23-25, 26-28, 29-31, 32-34, 35-37, 38-40, 41-43, 44-46). Each cohort has sub-columns for Gap, UB, and LB.

Panel C. Veteran Attainment Gaps - Bachelor's Degree or Higher (Black Men)

Table with columns for Birth cohort (1975-1977, 1978-1980, 1981-1983, 1984-1986, 1987-1989) and rows for Age group (23-25, 26-28, 29-31, 32-34, 35-37, 38-40, 41-43, 44-46). Each cohort has sub-columns for Gap, UB, and LB.

Panel D. Veteran Attainment Gaps - Bachelor's Degree or Higher (Black Women)

Table with columns for Birth cohort (1975-1977, 1978-1980, 1981-1983, 1984-1986, 1987-1989) and rows for Age group (23-25, 26-28, 29-31, 32-34, 35-37, 38-40, 41-43, 44-46). Each cohort has sub-columns for Gap, UB, and LB.

Panel E. Veteran Attainment Gaps - Bachelor's Degree or Higher (Hispanic Men)

Table with columns for Birth cohort (1975-1977, 1978-1980, 1981-1983, 1984-1986, 1987-1989) and rows for Age group (23-25, 26-28, 29-31, 32-34, 35-37, 38-40, 41-43, 44-46). Each cohort has sub-columns for Gap, UB, and LB.

Panel F. Veteran Attainment Gaps - Bachelor's Degree or Higher (Hispanic Women)

Table with columns for Birth cohort (1975-1977, 1978-1980, 1981-1983, 1984-1986, 1987-1989) and rows for Age group (23-25, 26-28, 29-31, 32-34, 35-37, 38-40, 41-43, 44-46). Each cohort has sub-columns for Gap, UB, and LB.

Appendix C. Evidence on selection into military service over time as a driver of attainment

One potential mechanism that may be related to the changes in the speed and level of educational attainment among more recent cohorts is that the composition of individuals either selecting into military service *or* selecting into post-secondary education after military service. In Figure A1 we show the changing demographics of veteran status overtime. In our estimates we control for the observed characteristics. However, unobservable selection may be affected by the evolution of both the costs of attending college and the generosity of education benefits available for veterans. If changes in these costs lead to individuals with a greater desire to attain a college degree to enlist in the military, then this compositional change would be one of the unobservable characteristics we discussed above.

One potential indicator of a change in the type of individual entering military service is an increased propensity to exit active duty service after one term, when the minimum requirements to qualify for educational benefits will have been completed. However, we do not find support for this hypothesis in recent research on this topic. One study of reenlistment rates over the period 2000-2008 suggests that patterns of average reenlistment rates varied considerably by service over this period—for example increasing over time in the Army and declining over much of the period in the Navy—without any cross-service secular pattern (MLDC 2010). Another more recent report considers 36-month attrition rates, which are broadly correlated with exiting after a single term of service and finds that this rate declined by an average of around 20% across all four services between 2003-2007 and 2008-2013 (Marrone 2020).

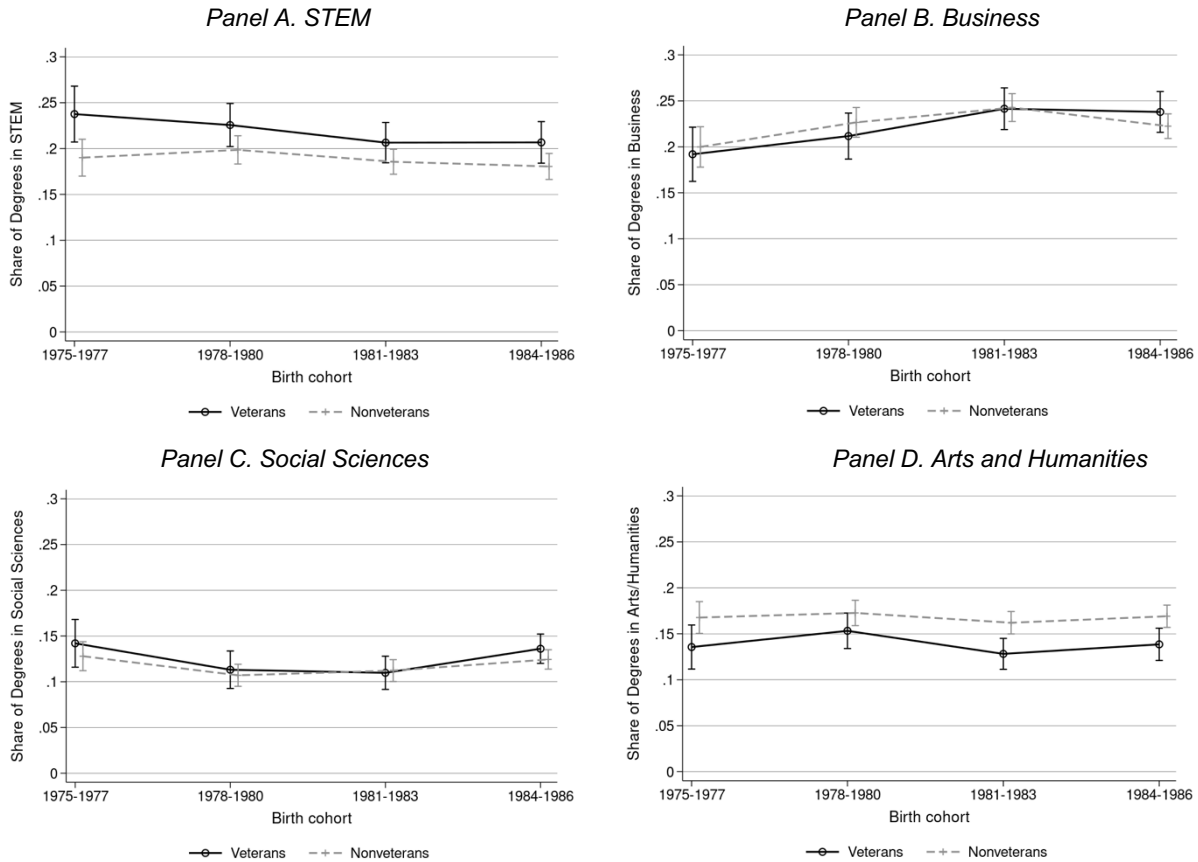
A second exercise that can shed light on the potential role of either type of selection is to consider variation in chosen fields of study across veteran cohorts affected by differential college

costs *and* differential generosity of benefits. If rising generosity of education benefits associated with military service attract a different type of individual into military service *or* induces a veteran who would otherwise have forgone post-secondary education to pursue it, it may be the case that patterns of field of study may change. In terms of academic rigor or the correlation of a field with future income, the direction of this change is unclear, a priori. If the selection was in terms of inducing more “college focused” individuals to enter military service, then the expectation might be to see a trend towards the pursuit of more academically rigorous degrees or degrees with a higher expected future return. If the selection was the result of more marginal individuals choosing to pursue college, then the direction might be towards less challenging fields of study.

Restricting our analysis sample to those who have attained a bachelor’s degree or greater among four of the five cohorts in our sample who we observe between ages 32 and 34, we test the relative share of degrees attained by veterans and nonveterans in each of four broad fields of study: business, STEM, social sciences, and arts and humanities.¹ These fields have varying degrees of difficulty (as measured by differential attrition rates and major switching rates) and pecuniary returns (Webber 2016, National Student Clearinghouse 2019, Astorne-Figari and Speer 2019).

¹ These groups comprise the following Census Bureau degree field codes (using the “degfield” variable): Arts and Humanities: Architecture (14), Area, Ethnic, and Civilization Studies (15), Linguistics and Foreign Languages (26), English Language, Literature, and Composition (33), Liberal Arts and Humanities (34), Philosophy and Religious Studies (48), Theology and Religious Vocations (49), Fine Arts (60), History (64) Business: Business (62), Social Sciences: Psychology (52), Social Sciences (55) STEM: Computer and Information Sciences (21), Engineering (25), Biological and Life Sciences (36), Mathematics and Statistics (37), Physical Sciences (50), Nuclear, Industrial Radiology, and Biological Technologies (51), Medical and Health Sciences and Services (61)

Figure C.1. Incidence of Common Fields of Study for Holders of a Bachelor’s Degree or Higher



Source: American Community Survey and Census data from IPUMS (Ruggles et al. 2023) as described in text. Figures depict outcomes derived from equation 1 as described in text for each indicated subsample from a subsample comprising individuals who have attained a bachelor’s degree or higher. Heteroskedasticity-robust standard errors clustered at the PUMA level are used to calculate 95% confidence intervals shown as capped whiskers for each estimate.

The results in figure C.1 suggest that—though there are notable share differences between veterans and nonveterans in certain fields of study (for example, STEM and Arts and Humanities)—these are fairly constant and there is no meaningful pattern of broad changes across cohorts in the shares of veterans and nonveterans completing degrees in these four broad fields. This is particularly true in the two most recent cohorts, 1981-1983 and 1984-1986, who would have been most likely to be influenced by the increased benefit generosity of the post-9/11 GI bill.

On balance, these two pieces of evidence, though not conclusive, suggest that evidence of a major change in either the type of individual entering the military or the type of student

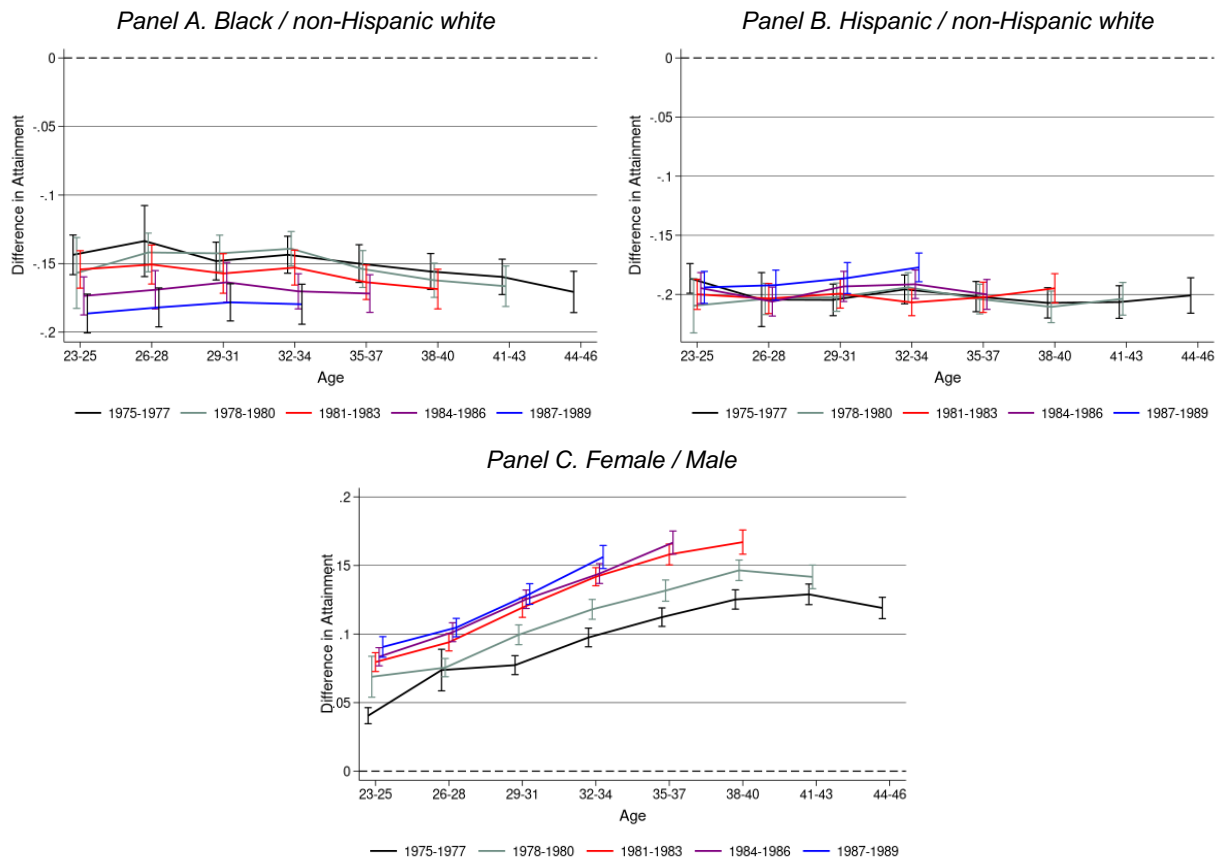
choosing college after the military is not readily apparent. This is consistent with evidence suggesting that many enter the military with only a notion, rather than a clear understanding of educational benefits available to veterans (Wenger, et al. 2017). It is also consistent with evidence suggesting that increased benefit generosity positive affects persistence, completion, and time to completion among students (Nguyen, Kramer and Evans 2019, Denning 2018).

Appendix D. Attainment trends by race/ethnicity and gender among nonveterans

In this article we focus specifically on gaps between veterans and nonveterans according to some broad, salient demographic distinctions—race/ethnicity and sex—that have been explored in prior literature on educational attainment more broadly. This research has shown that the post-secondary attainment of women has significantly outpaced that of men in recent decades (Bailey and Dynarski 2011, Reynolds and Woodham Burge 2007, Ryan and Bauman 2016). By contrast, Black/white attainment gaps among both women and men grew among birth cohorts from the 1920s to the 1970s (McDaniel, et al. 2011). Inequality in college attainment within-race has also increased over time, suggesting that factors such as parental education and means are increasingly driving divergent trends in attainment (Bailey and Dynarski 2011).

To better contextualize our results on veteran attainment gaps, we present relevant evidence on these trends from this analysis sample. Figure D.1 shows gaps in attainment of a bachelor's degree or higher among *nonveterans*. First, we present gaps for Blacks relative to non-Hispanic whites (men and women are pooled in this analysis with the same set of controls used in our veteran/nonveteran analyses). These results show that, consistent with past research, the attainment gap (shown here as a negative gap of increasing magnitude for more recent birth cohorts) is growing over time. Additionally, the gap doesn't close with age but, instead, grows modestly for cohorts we follow over a longer time period. In the case of the 1975-1978 birth cohort, this gap grows from around 11 percentage points at ages 23 through 28 to around 15 percentage points for cohorts we follow to ages 38 through 43. Panel B shows the Hispanic/non-Hispanic white gap. While not growing over time, this gap has persistently been at 15 to 16 percentage points at ages 23 to 25 and grows modestly over time with some evidence of more recent birth cohorts experiencing larger gaps.

Figure D.1. Nonveteran Attainment Gaps for Bachelor's Degree or Higher by Race/Ethnicity and Sex



Source: American Community Survey and Census data from IPUMS (Ruggles et al. 2023) as described in text. Figures depict outcomes derived from an extension of equation 1 as described in text for each indicated subsample from a subsample comprising individuals who have attained a bachelor's degree or higher. Heteroskedasticity-robust standard errors clustered at the PUMA are used to calculate 95% confidence intervals shown as capped whiskers for each estimate.

In stark contrast, Panel C presents analogous results for women. This figure shows that women have had a significant, positive attainment gap with men even at the earliest age in our analysis and that this initial gap has been growing over time, nearly doubling in magnitude for the most recent birth cohort. Moreover, this initial gap grows substantially over time, nearly tripling for the 1975-1978 birth cohort across 20 years and increasing by around 50% for the 1987-1989 cohort in just ten years.

These results help to frame the importance of the trends among veterans we examined in this study. The trends for Black nonveterans relative to non-Hispanic whites suggests that, while

Black male veterans close this attainment gap with Black male nonveterans over time, this still leaves a substantial gap relative to non-Hispanic whites. On a more positive note, the large, positive gap that emerges between Black female veterans and their nonveteran peers suggests that these women close the gap with non-Hispanic white nonveterans over a longer time span. Our results indicate that both male and female Hispanic veterans substantially narrow gaps with non-Hispanic whites later in life. The results for women in panel C of figure 8 highlight the remarkable level of educational attainment prevailing among female veterans since they are substantially outpacing the attainment of nonveteran women, who have had a large, positive attainment gap with men for decades.

Appendix Citations:

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