Title: G.I. Jane Goes to College? Female Educational Attainment, Earnings, and the Servicemen's Readjustment Act of 1944

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Abstract

The 1944 Servicemen's Readjustment Act (the "G.I. Bill") provided returning World War II veterans with educational benefits sufficient to cover tuition, fees, and living expenses at almost any U.S. university or college. While several studies examine subsequent educational attainment and earnings for male veterans, little is known about how the G.I. Bill affected the 330,000 American females who served in World War II. Using data from the 1980 5 percent Census Public-use Microdata Sample, I find that female World War II veteran status is associated with a 19 percentage point increase in the proportion who report any college attendance, a 7.8 percentage point increase in college completion, and earnings that are 19.8 percent greater relative to comparable females who are not veterans. Because service was entirely voluntary for females, I use service eligibility requirements, enlistment records, 1940 Census data, and the G.I. Bill's retroactive nature to establish a causal relationship between veteran status, educational attainment via the G.I. Bill, and increased earnings. To help separate the effect of the G.I. Bill from the effect of military service itself, and because benefits increased with longer service, I instrument for female veterans' educational attainment using age at the time of the G.I. Bill's announcement. My IV estimates imply that female veterans' earnings increase by $1,350 (11.6 percent) per year of G.I. Bill-induced education, explaining 73 percent of the overall difference between veteran and non-veteran females' earnings in 1980.

Introduction

The Serviceman's Readjustment Act of 1944 (the "G.I. Bill") provided a range of benefits - including unemployment assistance, favorable loans to start a business, and low-interest mortgages - to returning World War II (WWII) veterans. The G.I. Bill, however, is perhaps best known for providing generous educational and training benefits. Veterans who pursued a college degree could receive up to $500 per year for tuition, fees, and books, along with a $50 monthly living expense allowance, for up to four years, with benefits varying depending on length of service. For context, average tuition was just over $400 at private universities in 1948 and from 1945 to 1950 the federal minimum wage was 40 cents per hour.[1] Given the generosity of benefits, it is not surprising that more than 2.2 million WWII veterans pursued a college education in the years following the war.[2]

Studying the effect of the G.I. Bill, Bound and Turner (2002) find a 16 percent increase in the number of years of college and a 23 percent increase in college completion when estimating the effect of cohort veteran share on cohort level educational attainment for men.[3] Stanley (2003) finds that Korean War and WWII G.I. benefits increased years of college completed by between 15 and 20 percent for men in eligible birth year cohorts. Little is known, however, about the effect of the G.I. Bill for the 330,000 females who served in WWII, despite the fact that records show that 19.5 percent of veteran females elected to use their G.I. benefits to pursue a college education, compared to only 15 percent of male veterans.[4,5]

To determine whether greater educational attainment and earnings among female veterans can be attributed to the G.I. Bill, I examine differences in college attendance, completion, and annual earnings among veteran and non-veteran females. My estimates rely on data from the 1980 5 percent Census Public-use Microdata Sample (PUMS), which is the first year the long-form census asked females about military service. Among female high school graduates born between 1919 and 1925, descriptive estimates suggest that WWII veterans are 19 percentage points (56.7 percent) more likely to report attending college, 7.8 percentage points (57.8 percent) more likely to report having completed their degree, and complete about one semester more college (52.6 percent) relative to comparable non-veterans. Looking at earnings in 1980,

[1] See p. 676 in Stanley (2003) for more on tuition costs. See https://www.dol.gov/agencies/whd/minimum-wage/history/chart for historical federal minimum wage information (last accessed 8/5/2020).

[2] Data from the Department of Veteran's Affairs - https://www.benefits.va.gov/gibill/history (last accessed 9/5/2020).

[3] Put differently, for a 10 percentage point increase in veteran share at the cohort level, Bound and Turner's estimates imply a 1.6 percent increase in the number of years of college and a 2.3 percent increase in college completion among the cohort.

[4] To be precise, 64,728 servicewomen attended college under the program out of a total of 332,178 eligible female veterans. See https://beta.womensmemorial.org/history-highlight (last accessed 2/15/2020) for further discussion and background information. See Appendix B for more on enlistment requirements for females.

[5] Note that the text of the 1944 G.I. Bill makes no distinction between men and women when describing eligibility and benefits. See https://www.loc.gov/law/help/statutes-at-large/78th-congress/session-2/c78s2ch268.pdf (last accessed 5/12/2021).

I find that WWII veterans earn $1,887 more per year, a 19.8 percent boost relative to non-veteran females. My estimates focus on those born between 1919 and 1925 because, in addition to being a high school graduate, female enlistees generally had to be 21 or older, meaning that a female born in 1926 could not be a WWII veteran.[6] I exclude those born before 1919 to avoid bias from endogenous retirement decisions - those born in 1918 or earlier would be eligible for Social Security benefits in 1980. I examine the robustness of my findings to different sample restrictions in later sections.

While my findings are consistent with the idea that the G.I. Bill increased educational attainment and subsequent earnings for female veterans, there are at least three reasons why my estimates may not have a causal interpretation. The first is that female veterans who volunteered for service may have already had greater educational attainment at the time of enlistment. Focusing, however, on females who completed high school and were born between 1919 and 1925, summary statistics from my 1980 Census sample suggest that 33.5 percent of non-veterans and 53.8 percent of female WWII veterans attended at least some college, a 20.3 percentage point difference. As I mentioned earlier, administrative records suggest that 19.5 percent of female veterans used their G.I. benefits to attend college. It is possible, therefore, that the additional educational attainment of veteran females is entirely related to college attendance after their period of service. To provide direct evidence on this issue, I turn to the complete-count 1940 Census and Women's Army Corps enlistment records to further illustrate that differences in education in 1980 are not related to differences in education at the time of enlistment.

A second threat to identification is that female veterans may have been especially likely to attend college after (or because of) their service, even if there were no G.I. benefits. However, the number of females who were high school graduates, aged 21 or older, who had not already attended college and were intending to later do so is likely to be negligible, particularly in the 1940s. Indeed, any individuals who were planning to soon attend college would likely have chosen not to enlist in the military, which would have delayed their intended path, unless they suspected that service would lead to generous educational benefits.[7] The G.I. Bill's benefits, however, could not have been easily anticipated - even as late as mid-1944 - because the G.I. Bill passed the U.S. Senate by just a single vote.[8] Further, if many females enlisted only to obtain benefits, one would expect to see greater educational attainment among those veterans eligible to enlist only after the G.I. Bill was instituted. Instead, when I examine outcomes for females who were too young to enlist until

[6] See https://armyhistory.org/skirted-soldiers-the-womens-army-corps-and-gender-integration-of-the-u-s-army-during-worldwar-ii/ for more on the requirements for female enlistees. Last accessed 10/13/2020. See Appendix B for more on the variations in requirements for females across each branch of the military.

[7] Negative selection would work against finding any effects on education and earnings.

[8] The Department of Veteran's Affairs explains that Rep. John Gibson had to be "rushed" to the Capitol to cast the tie-breaking vote. See https://www.benefits.va.gov/gibill/history.asp.

after the G.I. Bill was passed, I find that they were slightly less likely to attend college compared to older veterans.

While I revisit issues of selection when discussing my findings, the enlistment requirements for females, the difference in educational attainment among those who enlisted at different times, along with the retroactive and unexpected nature of the G.I. Bill's benefits suggest that relatively few female veterans would have subsequently attended college absent the G.I. Bill's educational benefits. Together with the fact that enlistment records show enlistees had similar educational attainment to other female high school graduates in the same birth cohorts at the time of enlistment, and even though my data only allows me to identify female veteran status, this means that my estimates are consistent with the G.I. Bill being responsible for the additional educational attainment and associated higher earnings of female veterans. More generally, my estimates of the G.I. Bill's effect on educational attainment for female veterans are causal under an identifying assumption that there were no idiosyncratic shocks to educational attainment that were also correlated with the decision to enlist during WWII.

When examining later-life earnings, leaving aside issues of selection, a third threat to identification is that service in the military may itself help to develop valuable skills that increase future earnings, absent any additional education. To separate the effect of G.I. Bill-related education from military service, I use age at the time of the G.I. Bill's announcement as an instrument to provide a causal estimate of the effect of education on earnings for female veterans. My instrument is potentially valid because G.I. benefits varied by length of service, ensuring that those who could enlist earlier in the war effort would receive more post-service support, at least on average. When I instrument for educational attainment, my two-stage least squares estimates suggest that female veterans' earnings are larger by $1,350 (11.6 percent) per year of additional education. Because age in 1944 is not likely to be correlated with unobserved ability, at least among female veterans born between 1919 and 1925, my instrumental variables (IV) estimates ease any concerns that veterans who attend college because of the G.I. Bill would have higher earnings even absent that additional education.

My findings make three contributions to the literature. First, while several studies examine the impact of WWII on educational attainment, labor market outcomes, and family formation for *non-veteran* females (Kossoudji and Dresser, 1992; Acemoglu et al., 2004; Jaworski, 2014; Bellou and Cardia, 2016; Rose, 2018), I document that WWII service and associated G.I. Bill benefits worked to improve educational attainment for female veterans, not only male veterans. Second, I show that the G.I. Bill led to significant later-life gains in earnings for female veterans, largely via increases in education rather than via the skills developed during service. Examining how the G.I. Bill increased earnings for females via additional educational attainment is important because American economic history features persistent gender-based differences in both labor market participation and outcomes (Altonji and Blank, 1999; Blau and Kahn, 2000; Mulligan and

Rubinstein, 2008; Goldin, 2014). Since the 1950s, however, female labor force participation has increased substantially (Acemoglu et al., 2004) and the gap in earnings for females, per dollar of male earnings, has decreased from about 40 cents per dollar to closer to 20 cents per dollar (Blau and Kahn, 2017). Female educational attainment has also increased over the same time period. For example, Blau and Kahn (2017) show that, by 2011, women had higher average levels of education (by 0.2 years, on average) and were 2.8 percentage points more likely to have an advanced degree than men. My findings suggest a causal relationship between increased education and earnings for females over this time period. Finally, my IV approach provides a new estimate of the long-term return to college for females during a uniquely interesting period in U.S. economic history.

G.I. Bill Background and Existing Work

Military records show that more than 330,000 females served in the U.S. military during WWII, often within dedicated female-only branches of service including the Women's Army Corps (WAC), the Women Airforce Service Pilots (WASP), and the Women Accepted for Volunteer Military Services (WAVES).[9] While 60,000 females served in the Army Nurse Corps, a majority of servicewomen held clerical positions: typists, clerks, mail sorters, and so on.[10] Such roles were essential to the war effort as having women fill these jobs freed up more men to engage in armed conflict. In June of 1944, to help veterans readjust to civilian life, Congress passed the first G.I. Bill ("Servicemen's Readjustment Act"), providing generous educational benefits to "all individuals who had served in the U.S. armed forces during the World War II period [...] for a minimum of one year of training plus one additional month for each month of active duty, up to a maximum of 48 months" (Stanley, 2003).

Despite the number of females who joined the war effort, the economics literature on the WWII G.I. Bill focuses entirely on males. For example, Bound and Turner (2002) use data from the 3 percent 1970 Census sample to examine the collegiate attainment of white male WWII veterans. Comparing veterans to non-veterans in the most-affected birth cohorts, they find that serving in WWII was associated with more than a 100 percent difference in college completion rates along with similar effects on the number of years of college completed.[11] However, because many male veterans would have attended college had they not been conscripted, and because men who failed mental and physical fitness tests were excused from WWII

[9] To a lesser degree, women also served in the Marines and the Coast Guard. See https://libguides.mnhs.org/wwii women.

[10] The Nurse Corps were the only branch to serve both in the U.S. and overseas. For more, see https://e-anca.org/History/ANCEras/1940-1950. Note that I present estimates where I exclude females who report being either doctors or nurses as an appendix item. My findings are very similar.

[11] My synopsis of Bound and Turner's findings relies on the estimate for the 1923 to 1928 cohorts in their Table 3.

service, Bound and Turner note that direct comparisons between veterans and non-veterans (what Bound and Turner refer to as a "within-cohort" approach) cannot be considered a valid estimate of the effect of WWII service and the G.I. Bill on educational attainment.

To get a better sense of the net effect of service and the G.I. Bill, Bound and Turner proceed to examine outcomes at the birth year-quarter level, regressing cohort educational attainment on the cohort veteran share, first using OLS and then using eligibility for service prior to V-J Day ("Victory over Japan") as an instrument for the share of a cohort that are veterans (a "between-cohort" approach). The idea with this strategy is that a larger share of veterans in a cohort increases later educational attainment among that cohort via G.I. Bill-induced education. When focusing on cohorts born between 1923 and 1928, Bound and Turner's between-cohort estimates imply a 16 percent increase in the number of years of college completed and a 23 percent increase in college completion rates if the share of veterans in a cohort were to increase from 0 percent to 100 percent. The effects are similar using either OLS or an IV approach.

On the other hand, because later-born cohorts (for example, those born in 1927 or 1928) had relatively fewer WWII veterans, Bound and Turner suggest that their cohort level estimates might represent only a lower bound on the true effects. Their argument is that men who were too young to serve in WWII had a high probability of serving in the Korean War and Korean War veterans later obtained educational benefits from the Veterans' Readjustment Assistance Act of 1952 (known as the "Korean War G.I. Bill"). Further complicating identification, those who served in WWII were generally exempt from Korean War-related conscription.

Instead of positioning the Korean War as an obstacle to identification, Stanley (2003) directly studies the effect of the Korean War G.I. Bill on educational outcomes, relying on a sharp cutoff in Korean War G.I. benefit eligibility for identification. Although his focus is on Korean War veterans, Stanley then uses his estimates to bound similar effects for WWII veterans. Using data from the 1973 Survey of Occupational Change in a Generation, the identification provided by the sharp benefit eligibility cutoff allows Stanley to report that the Korean War and WWII G.I. Bills "probably increased total post-secondary attainment among all men born between 1921 and 1933 by about 15 to 20 percent."

Regardless of the approach taken, it is clear that estimating how WWII and the 1944 G.I. Bill affected educational outcomes for male veterans is challenging because the majority of men born between 1920 and 1935 served in either WWII or the Korean War, and sometimes both. Among those who served, many would have attended college shortly after turning 18 had the U.S. not been involved in WWII and young men who did not serve were generally deemed to be either physically or mentally unfit, ensuring that they are a poor comparison group. In contrast, to the extent that relatively few females served, that their service was voluntary, that they had to be 21 and a high school graduate, and that their choice to serve did not require them to be available for armed conflict, similarly aged non-veteran females who were also high school

graduates are likely to be a valid comparison group (meaning that a version of Bound and Turner's "within-cohort" approach is more likely to produce reasonable estimates of the effects of interest). Because relatively few females served in the Korean War, those born just too late (1926 or later) to serve in WWII are potentially also a reasonable comparison group.[12]

Because the challenges for identification are different when looking at the effect of the G.I. Bill on male versus female veterans, I focus mainly on providing evidence to show that female veterans were not positively selected in terms of pre-service (or intended future) educational attainment. Because of that focus, I present estimates looking at outcomes at the birth year-quarter cohort level only as an appendix item. While I discuss those cohort-level estimates in greater detail when discussing my findings (and again in the online appendix), it is worth noting here that cohort-level estimates may be confounded by other effects of the war effort on women's labor force participation.

For example, Acemoglu et al. (2004) show that between 1940 and 1945 the share of U.S. women over the age of 15 in the labor force increased by 21.5 percent. If some fraction of these new labor force participants would otherwise have attended college, then WWII could have reduced overall female educational attainment even while considerably increasing attainment among female veterans. Further, Jaworski (2014), using 1960 Census data, finds that greater military mobilization among males in an area resulted in lower educational attainment among high school-age females. Jaworski's estimates imply a 0.163 reduction in years of school completed at the median level of WWII mobilization, providing further evidence that instead of completing high school and going to college, young women were entering the labor force.[13] These findings suggest that Bound and Turner's between-cohort instrumental variables approach would fail the exclusion restriction when focusing on outcomes for females.

Notably, the war's impact on females was not limited to one generation; Fernandez et al.´ (2004) show that men whose mothers worked because of WWII are themselves 24 to 32 percentage points more likely to have a spouse who works. Additionally, the war effort affected post-war labor force participation and labor supply decisions (Kossoudji and Dresser, 1992; Rose, 2018), labor demand (Shatnawi and Fishback, 2018), marriage and fertility decisions (Larsen et al., 2015; Doepke et al., 2015), and later occupational choices (Bellou and Cardia, 2016).

Other work on later-life outcomes for veterans, not limited to WWII veterans, also tends to focus on males. As examples, Angrist (1993), Angrist and Krueger (1994), and Card and Lemieux (2001) consider

[12] My 1980 Census data indicates Korean War Veteran status. In the data, I have responses from 6,069 female Korean War Veterans but only 1,779 (0.48 percent of all females in those cohorts) of them were born between 1926 and 1930. Among all Korean war veterans, 20.23 percent are also WWII Veterans.

[13] It is worth noting, however, that Jaworski (2014) finds that the effects, although still negative, are not statistically significantly different from zero by 1970. Looking at Jaworski's estimates, it's difficult to determine whether the changes between 1960 and 1970 are coming from improved high school or college completion rates.

the issue of male veterans' earnings. Angrist (1993), using data on men from a 1987 survey of (mostly) Vietnam veterans, finds that a "post-service grade increment of one year translates to an increase in earnings of about 4.3 percent, so that use of veterans' benefits raises annual earnings by around 6 percent (1.4 years times 4.3 percent)." Angrist notes that this premium "appears to accrue primarily to the 77 percent of benefit users who attended college or graduate school" but not other types of eligible training.[14] Angrist and Krueger (1994) focus on male WWII veterans and find that nonrandom selection into the military explains why male veterans earn more than similar non-veterans in their cohort. Their approach can leverage veterans' quarter of birth as instruments because from 1942 men were drafted in chronological order of birth date. Note, however, that Angrist and Krueger (1994) do not examine whether the 1944 G.I. Bill had a unique and separate impact on male WWII veterans. Indeed, identifying the causal effect of just the G.I. Bill on male veterans' earnings is likely infeasible because, as Stanley (2003) explains, enlistment and conscription patterns ensured that "over 80 percent [of male veterans] qualified for the four years of support necessary to earn a bachelor's degree." In contrast, females were not conscripted and were not required to serve for any particular period of time, almost surely generating greater variation in the quantity of G.I. benefits females could obtain.[15]

Veterans in other countries also experienced increased earnings from readjustment benefits. Card and Lemieux (2001), for example, focus on Canadian veterans and analyze patterns of education and earnings for men from Ontario, using French-speaking men from Quebec, who were significantly less likely to enlist, as a comparison group. Card and Lemieux position their work as avoiding the challenges facing analyses using American veterans noting that "the absence of a credible control group" ensures that "the education and earnings outcomes of later cohorts cannot be used to form simple inferences about the effect of the G.I. Bill on [American] WWII-eligible cohorts" (p. 314). Their estimates imply that veterans experienced a 7 to 15 percent return on their benefit-induced education. Further, several authors have studied how veteran status affects other long-term outcomes, including physical and mental health (Bedard and Deschenes, 2006; Grimard and Parent, 2007; Cesur et al., 2013). My work does not consider such outcomes but contributes by examining how the 1944 G.I. Bill affected female veterans' educational attainment and labor market outcomes. My approach to examining how the G.I. Bill increased female veterans' earnings is particularly informative because my estimates, relative to those that examine outcomes for male veterans, are in many ways less clouded by enlistment requirements, conscription patterns, and selection issues.

My work also helps to explain part of what Goldin (2014) refers to as the "grand convergence" between male and female earnings. When examining how the gender earnings gap has evolved over the course of

[14] Berger and Hirsch (1983), Angrist (1989), and Angrist (1990) also examine earnings of male Vietnam veterans.

[15] Indeed, females were only granted full military recognition, rather than being merely federal employees, in 1943. See https://www.nationalww2museum.org/war/articles/its-your-war-too-women-wwii for more information (last accessed 9/10/2020).

the 20th century, Goldin highlights how the "explained" portion of that gap has declined because differences "in years of education, in the content of college, and in accumulated labor market experience narrowed." Because differences in education and experience are now less-pronounced, explanations for remaining unexplained differences such as differences in bargaining (Babcock and Laschever, 2003) or tastes for competition (Niederle and Vesterlund, 2007; Manning and Saidi, 2010) have received more attention in the literature. Goldin notes, however, that Waldfogel (1998) finds a significant "child earnings penalty" and that these alternate explanations "do not explain why women without children generally have higher earnings than women with children and why the former's earnings are almost equal to those of comparable men." Moreover, such alternative explanations do not help us understand why the gender gap in earnings differs so much by age. Goldin then argues, convincingly, that the residual gap in earnings among men and women occurs because of idiosyncratic temporal demands across occupations, where (mostly male) workers are disproportionately rewarded for long hours or for working unusual hours. However, to get to the point where the remaining differences are so "idiosyncratic," females had to begin accumulating more human capital and that human capital had to pay dividends in the form of higher earnings. My work provides evidence that the G.I. Bill caused many veteran females to obtain more education and that the increase in education led to greater earnings.

Estimation Strategy and Data

To estimate the effect of the G.I. Bill on female labor market outcomes, I primarily examine differences between veteran females and comparable non-veterans. The general econometric specification is as follows;

$$Y_i = \alpha + \tau D_i + X_i \Pi + \epsilon_i.$$

In the estimating equation, Y_i represents some educational or labor market outcome of interest for female *i* (in 1980). Following Stanley (2003), I assume G.I. Bill eligibility is equal to WWII veteran status (although females are perhaps less likely to obtain the maximum amount of benefits). Therefore, the binary indicator D_i equals one for those who report being a World War II veteran and zero otherwise. The ϵ_i term is an idiosyncratic shock while X_i represents demographic controls and fixed effects. In this framework, τ represents the treatment effect of the G.I. Bill (technically, WWII veteran status) on the outcome of interest under an identifying assumption that there are no idiosyncratic shocks to educational attainment or earnings that are correlated with the decision to enlist during WWII.

I estimate the G.I. Bill's effect on female veterans using data from the 1980 5 percent Census sample. While any females who were eligible to serve in WWII were in their late fifties or older in 1980, I must rely on the 1980 5 percent sample because it is the first to ask about veteran status for females. My estimates leverage variation in WWII service eligibility across birth-year cohorts by restricting my main estimation sample to veterans and non-veterans who turned 21 between 1940 and 1946 (born between 1919 and 1925). Because females who were eligible for WWII service had to be at least a high school graduate, I also eliminate those who do not report having at least a high school diploma from my sample. Naturally, when examining earnings, I focus only on those who report that they are currently working (in 1980, the oldest individual in the main estimation sample would be 61). As an appendix item, however, I examine how differences in employment status affect my earnings estimates using a Heckman selection approach.[16] Note that in my summary statistics and estimates, all dollar figures are in 1980 dollars.

I do not include those who turn 21 before 1940 (meaning those born in 1918 or earlier) in my sample because these individuals would be at least 62 years old in 1980 and my census data shows that WWII veterans born between 1915 and 1918 had much lower labor force participation rates (in 1980) relative to those born between 1919 and 1925. Specifically, among WWII female veteran high school graduates, 68 percent of those born in 1915, 66 percent of those born in 1916, 57 percent of those born in 1917, and 51 percent of those born in 1918 were not in the labor force. Among those born in 1919 and 1920, 49.4 percent and 46 percent were not in the labor force. Of those born in 1925, only 35 percent were not in the labor force in 1980. These patterns suggest that I should exclude females closer to retirement from my main sample to avoid any bias. On the other hand, it is unclear exactly where to draw the line. I choose 1919 for three main reasons. The first is that those born in 1918 are the first cohort where a majority of female veterans were not in the labor force. Notably, the 1918 birth cohort would become eligible for early Social Security benefits in 1980. The second reason is that those born prior to 1918 may have been increasingly likely to already be married, have children, and so on, by the time the U.S. entered WWII, leading to another potential selection issue in my sample.

The third reason I limit the sample to those born after 1918 is so that I can examine differences in educational attainment and labor market outcomes for female veterans relative to females who were too young to enlist (those born after 1925).[17] The motivation for this approach is that serving in WWII delayed veterans' entry into adult civilian life by a number of years. Moreover, as I discuss earlier, Jaworski (2014) suggests that many younger females in states and birth cohorts most affected by war mobilization joined the labor force rather than pursuing further education. For that reason, the appropriate comparison group might

[16] See Table A5. Those estimates are similar to my main estimates.

[17] Note that the Army considered the WWII service period, at least for the purpose of obtaining G.I. Benefits to be from September 1940 to July 1947, which would allow those who enlisted as late as 1946 to obtain at least some G.I. Benefits.

be those who were born just too late to serve in or to have their education disrupted by WWII. Including those born before 1919 could make the two groups increasingly dissimilar. That being said, I present estimates that also include earlier-born females (1915 to 1918) as an appendix item and those estimates are reassuringly similar to the estimates when restricting the sample to females born between 1919 and 1925.

In Table 1, I present relevant summary statistics for female veterans and non-veterans born between 1919 and 1925 who were high school graduates. I also provide the same information for female high school graduates who turned 21 between 1947 and 1951 (females born between 1926 and 1930). The summary statistics demonstrate that, in 1980, WWII veterans had higher earnings, more education, were more likely to be white, and were less likely to be married. The marital status patterns are noteworthy, with veterans being less likely to be married, and particularly so if they had more than a high school education. I suspect this pattern emerges because married females were less likely to enlist and, conditional on marrying during their period of service, were then less likely to pursue further education after their service. Such selection effects would ensure that college-educated female veterans were less likely to be married.[18] Note that the summary statistics also demonstrate female patterns of enrollment in the military, with 3.26 percent (966 out of a total of 30,596) of females born in 1919 reporting that they were WWII veterans. That proportion rises to 4.54 percent of those born in 1922 before declining markedly for those eligible to enlist after 1944. Such a pattern helps to ease concerns that many females entered the army *in response* to the benefits provided by the G.I. Bill.

Along with the information on cohort sizes by year of birth, I provide the percent of each cohort that attended any college. Notice that females who were born earlier, and therefore eligible to enlist in the war effort sooner, were significantly more likely to report having attended college when surveyed in 1980. The same pattern is not evident among non-veterans. The difference in female veterans' educational attainment across birth cohorts suggests that the G.I. Bill might have affected females differently based upon age in 1944. I later exploit this variation to instrument for the G.I. Bill's impact on educational achievement.

Main Findings

I present my findings in four related subsections. First, I provide descriptive estimates of the association between veteran status, labor market outcomes, and educational attainment in 1980. To help support a causal

[18] Note that the proportion of veterans who were "never married" is just under 7 percent, with the remaining individuals in the sample being a mix of divorced and widowed females.

interpretation for those estimates, I then use the available information on the take-up of G.I. Bill benefits, differences in education in 1980, WAC enlistment records, and education levels in the 1940 complete-count Census to establish that the educational attainment of veteran females is related to education that occurs after, rather than before, their WWII service. Next, I show that veteran females would not likely have attended college after their service without the G.I. Bill by appealing to the variation provided by the G.I. Bill's announcement. My final empirical exercise uses that same variation in an instrumental variables framework to show that the additional education of female veterans explains a large majority of the overall difference between female veterans' and non-veterans' earnings in 1980. In a fifth subsection, I contrast my approach with Bound and Turner (2002) and explain why their birth year-quarter cohort level strategy is less applicable in my setting.

Descriptive Estimates

In this section, I examine the impact of WWII veteran status on indicators for any college, having completed four or more years of college, labor force status, and employment status (employed/unemployed, conditional on being in the labor force). I also consider years of college completed and annual earnings from employment. As I mentioned earlier, because females had to be high school graduates to be eligible for WWII service, both my treatment (WWII veterans) and comparison (non-veterans) groups include only those with a high school diploma. Specifically, in the estimates in Panel A of Table 2, non-veterans are female high-school graduates born between 1919 and 1925 who do not enlist in the armed forces during the WWII period. I include state fixed effects and controls for marital status, age (measured in quarters), and race in each specification.

Using an OLS-based Linear Probability Model, I find that female veterans (in 1980) were 19 percentage points more likely to have at least some college, 7.8 percentage points more likely to have completed four years of college, and were 3.2 percentage points more likely to be in the labor force relative to non-veteran female high school graduates. Female veterans, however, were not statistically more or less likely to be employed (conditional on being in the labor force). Further, using a Poisson model, I find that female veterans completed 49.8 percent more years of college than non-veteran females, conditional on having a high school diploma.[19]

The educational attainment of veterans suggests that veterans and non-veterans differed in ways that could affect earnings from employment later in life. Confirming this suspicion, OLS estimates in column

[19] In estimates not reported here, I find that veterans complete 6.4 percent more years of college than non-veteran females, conditional on attending at least some college. This suggests that most of the effect is coming from extensive margin changes in college attendance.

six suggest that WWII veterans earned $1,887 more per year compared to non-veterans in 1980. Given annual earnings of $9,518 for non-veterans, my findings imply that being a veteran is associated with a 19.8 percent boost in earnings relative to similar non-veterans. As an online appendix item, I show that accounting for selection into the labor force (using a Heckman selection approach with "other household income" as the selection variable) leads to very similar estimates of the greater earnings of female veterans.

Note that I intentionally do not control for education when examining earnings because education is highly correlated with veteran status (see Table 1) and would bias estimates of veterans' additional earnings downward. Put differently, I am interested in the gross effect of veteran status, whereas controlling for education would provide a net effect. I also purposely do not control for occupation when looking at earnings because veteran status may predict selection into occupations or industries with higher wages. However, I present estimates where I control for education and occupation as an appendix item. In those estimates, while the additional earnings of veterans are still large and statistically significant, including education and occupation controls attenuates the effect of veteran status on earnings. Such a pattern suggests that the additional earnings of veterans come, at least in part, from the subsequent occupational choices of veterans enabled by greater educational attainment. Note that I also provide estimates where I exclude nurses and doctors from my sample as an appendix item. Those estimates are reassuringly similar to the estimates in Table 2 and highlight that my main findings are not driven solely by the enlistment of medical professionals.

To the extent that military service delayed entry into civilian life (including career choices, marriage timing, fertility, and so on) for veteran females, females from the same age cohort (those born 1919 to 1925) are perhaps not the right comparison group. Also, and as I describe earlier, educational attainment among non-veteran was somewhat negatively affected by WWII. In Panel B of Table 2, therefore, I designate non-veterans to be female high-school graduates born between 1926 and 1930. These females were just too young to serve in WWII. The estimates in Panel B confirm that WWII veterans experience large and statistically significant increases in educational attainment and annual earnings, regardless of the comparison group.

At issue is whether the additional earnings of veterans are causally related to the education benefits provided by the G.I. Bill. The problem is that being a veteran could have affected earnings in at least two other ways. First, female veterans selected into service, and may have had greater (unobserved) productivity than non-veterans, whether due to innate differences or veterans becoming more productive *because* of their service (by acquiring skills and/or experience). Second, veterans, as a group, may have greater educational attainment than otherwise comparable females even before they enlist. The effect of WWII veteran status on annual earnings in the final column of Panel A of Table 2 simply estimates the size of the veterans' earning premium and makes no attempt to disentangle such competing explanations.

For my estimates to be causal, the additional educational attainment of veterans must be explained by the benefits provided by the G.I. Bill. Moreover, it must also be the case that such educational attainment causes at least some of the veterans' earnings premium. In the next two subsections, to help establish a causal relationship, I show that the additional educational attainment of veterans is almost entirely explained by veterans attending college after their service who otherwise would not have attended college. I also show that there is no evidence that attending college affected veterans' earnings differently relative to non-veterans. Then, I attempt to separate the effect of veterans' experience and innate characteristics from the effect of education by using age at the time of the G.I. Bill's announcement to instrument for veterans' later educational attainment.

Selection on Pre-Service Educational Attainment

One threat to a causal interpretation for my findings is that female WWII enlistees might have been more likely to have attended college *before* their service, relative to high school graduates who did not enlist. To see that this is not likely, first note that the Department of Veteran's Affairs reports that 19.5 percent of eligible females used their benefits to attend college and the estimates in column one of Table 2 highlight that WWII veterans are 19 percentage points more likely to report having attended at least some college when responding to the 1980 long form Census.[20] The alignment between these measures suggests veterans were not especially more likely to have attended college prior to their service, relative to other female high school graduates.[21] If my 1980 census sample is representative, it therefore appears that differences in educational attainment between female veterans and non-veterans are explained by those veterans who attend college *after* serving in WWII.

To further support such a claim, I turn to the publicly available Women's Army Corps (WAC) Enlistment Records.[22] The enlistment records refer to females in just one particular branch of the military, but provide educational attainment and other background information including age, race, marital status, birthplace, 1940 residence information, and army enlistment date for almost 37,000 female veterans aged between 21 and 26 at the time of enlistment.[23] Using the WAC enlistment records, I compare educational

[20] It is possible that some veteran females did not use their G.I. Bill benefits to attend college (lack of sufficient eligibility, attending outside of 1947-1956 benefit time period, and so on). Unfortunately, my data does not allow me to determine eligibility for benefits or when females attended.

[21] To be clear, the alignment I refer to is the fact that 19.5% of veterans used their benefits to attend college. If the levels of college attendance among veterans and non-veterans was otherwise the same, and if each of those veterans would not have attended college absent the G.I. Bill's benefits, then we would expect a 19.5 percentage point difference among veteran and non-veterans' college attendance. In my data, the difference between college attendance for these groups is not 19.5 percentage points, but it is 19 percentage points.

[22] I "scraped" these records from https://aad.archives.gov/aad/series-list.jsp?cat=WR26.

[23] Note that the records specifically refer to WAC enlistees and not females in other military branches. It is possible, therefore, that these records underestimate the educational attainment of female WWII enlistees.

attainment (by age) at the time of enlistment to educational attainment for female high-school graduates (at the same ages) in the 1940 complete count census (Ruggles et al., 2020). Table 3 presents a summary of educational attainment for female WAC enlistees age 21 to 26 at the time of their enlistment compared to females age 21 to 26 in the 1940 census. The summary statistics in Table 3 illustrate that WAC enlistees were a little more likely to have some college but somewhat less likely to have completed college. This may represent enlistees interrupting their education to join the military, especially when we consider that enlistees were much more likely to be 21 or 22, relative to the age distribution in the 1940 Census. The key takeaway, however, is that enlistees when I combine those who have some and those who have completed college - were not especially more likely to have a college education prior to service relative to high school graduates in the population.

Selection on Post-Service Educational Attainment

While it appears that females were not significantly more likely to have attended college *before* enlisting, it is possible that veterans would attend college after their service absent any G.I. Bill benefits. For example, those who enlist might also be those who were planning to attend college in the future. For this to be a significant source of bias, there would have to be a large number of female enlistees who were high school graduates, and were planning to go to college, and yet (because females had to be 21 to enlist) did not attend college between the ages of 18 and 21. It is perhaps more likely that selection would work in the opposing direction. That is, the overall probability of attending college for females (or, indeed, males) age 21 or older, conditional on not attending college between age 18 and 21 is likely small. Furthermore, among those choosing to enlist (because few could have anticipated any educational benefits at the time they enlisted) the *ex-ante* probability of subsequent college attendance, absent G.I. benefits, could be lower relative to those who choose not to enlist.

The mid-1944 announcement of the G.I. Bill additionally limits the value of selecting into service primarily to obtain educational benefits. Given WWII G.I. benefits were awarded to those who served between September 1940 and July 1947 (see Stanley, 2003, p. 674), only those who were already enlisted at the time of the announcement would have enough time to obtain the quantity of G.I. Bill benefits sufficient to complete a college degree (each month of active duty provided an additional month of G.I. Bill benefits).[24]It is possible that some delayed their exit from service to maximize their G.I. Bill benefits. Such behavior clouds identification only if there is a correlation between that delay (thereby increasing the quantity of G.I. benefits) and the individual's pre-enlistment likelihood of attending college after their period

[24] The July 1947 cut-off ensures that any who turn 21 in 1947 essentially could not obtain any significant quantity of benefits, which is why I limit my main sample to those born no later than 1925 (and turn 21 in 1946).

of service. In such a case, the causation would be reversed, college attendance would, at least to some degree, "predict" G.I. Bill benefits. Given that the available evidence suggests few female veterans were likely to attend college without G.I. benefits, and the fact that enlistment was concentrated prior to the announcement of G.I. benefits, it seems unlikely that such behavior could be a significant source of bias.

At the same time, because I do not observe the quantity of benefits available nor individual army enlistment dates in my 1980 Census data, I cannot completely rule it out. Instead, to try to directly address this potential source of bias, I present estimates where I interact WWII veteran status with an indicator for those who turned 21 after June 1944 in Table 4. These later-born individuals could have been aware of the available G.I. benefits prior to being old enough to enlist and could be driving the increased educational attainment of veterans purely via selection effects once the benefits became known. On the other hand, summary statistics in Table 1 illustrate that those who were old enough to enlist in 1943 or earlier (rather than after 1943) were significantly more likely to attend college. The estimates in Table 4 reinforce that pattern. Looking at the interaction term only, female veterans who served in WWII but who were only eligible to serve after 1943 were somewhat less likely to attend college, complete their degree, and had fewer years of college compared to those who could enlist before the G.I. Bill was announced. They also had earnings that are lower, but the estimate is not statistically significant. The lack of precision perhaps arises because (1) the estimates are limited to only those who are employed and (2) only a relatively small proportion of the estimation sample consists of female veterans born after 1923. In any case, these estimates suggest that females selecting into service upon learning of the G.I. Bill's potential benefits are not driving my estimates.

Note that the estimates in Table 4 also suggest that the experience of serving in the military is not driving my findings. That is, while the mechanism would be far from clear, the experience of being in the army could have caused veterans to attend college even absent any financial assistance to do so. If that were true, however, we would not expect differences in subsequent college attendance among those who were eligible to enlist earlier relative to those who could enlist later. The estimates in Table 4 also ease concerns that those who were planning to attend college in the future (for whatever reason) were significantly more likely to enlist across the WWII period. For example, if veterans were generally more likely to attend college after service, theory would suggest that the G.I. Bill's announcement should further increase that proportion, at least at the margin. In turn, then those who turn 21 after 1943 should be especially likely to attend college relative to enlistees in prior years, but they are not.

To further ease concerns that those who took up the offer of G.I. Bill benefits were positively selected, I present estimates that interact veteran status with indicators for educational attainment in Table 5. There, I find suggestive evidence of mild negative selection, in the sense that veterans experienced a smaller boost in earnings from education relative to non-veterans. It is possible therefore, that instrumental variable (IV)

estimates will be larger than OLS estimates of the impact of education on earnings when focusing on veterans. Essentially, a valid IV may estimate a larger local average treatment effect because the instrument changes the behavior of veterans only for whom the positive effects of more education might be larger than average. Such a pattern would be consistent with the higher average earnings of veterans relative to non-veterans among those who did not attend any college (see Table 1).

IV Estimates

Before turning to an IV approach, I briefly summarize my findings. In Table 2, I show that female WWII veterans' educational attainment and annual earnings from employment were significantly greater than comparable non-veterans. Combining administrative data along with enlistment patterns and requirements, I then show that female veterans' additional educational attainment must be due to veterans obtaining education after their service, that veterans were not especially likely to attend college even if they did not obtain G.I. benefits (Table 4 and related discussion), and that veterans were not likely to benefit disproportionately from education (Table 5 and related discussion).

My final empirical exercise demonstrates that those induced to attend college by the G.I. Bill's generous benefits are driving most of the overall earnings premium experienced by female veterans, further limiting concerns that service itself or innate differences in productivity are driving the earnings gap among veterans and non-veterans. Specifically, to try to isolate how increased education, caused by the G.I. Bill, affected veterans' earnings, I use age at the time of the G.I. Bill's announcement to instrument for increased educational attainment among veterans;

$$Educ_i = \alpha + \tau Age_{i,1944} + X_i\Pi + \epsilon_i.$$

The idea with this approach is that army enlistment patterns, the 1944 announcement of the G.I. Bill, and the fact that longer periods of service granted more G.I. benefits, mean that female veterans born in 1919, and therefore old enough to enlist several years prior to the G.I. Bill's announcement, could take greater advantage of the G.I. Bill's unexpected benefits. My data are at least consistent with such a claim; in Table 1, I show that female veterans born earlier were much more likely to attend college compared to later-born veterans. Further validating my instrument, enlistment records (see Table 3) do not suggest that older enlistees were more likely to have a college education at the time of enlistment (relative to younger enlistees and relative to the general population). Using predicted education values, I then estimate how additional education affects veterans' earnings;

$$Annual\ Earnings_i = \theta + \phi\widehat{Educ_i} + X_i\Pi + \mu_i.$$

In practice, I use an indicator for being born after the second quarter of 1923 (identifying those turning 21 after the G.I. Bill is announced in June 1944) to instrument for three different measures of educational attainment for veterans: any college, four or more years of college (equivalent to a Bachelor's degree or more), and total years of college.[25] I present two-stage least squares estimates, alongside OLS estimates, in Table 6. All specifications include state fixed effects while controlling for marital status and race. I do not control for year-quarter of birth in these estimates because I use age as an instrument. The OLS estimates show that attending any college increases veteran's earnings by $2,424, completing at least four years of college increases earnings by $3,597, and that each additional year of college corresponds to a $925 increase in earnings relative to veterans with only a high-school education.[26] Each estimate is significant at the 1 percent level. Because veterans obtained more education, and because more education appears to increase earnings, my OLS estimates suggest it is possible that the G.I. Bill (via increased education) explains most or all of the $1,887 earnings premium for female veterans in 1980.

On the other hand, the OLS estimates combine veterans who already attended college (or would have attended absent any G.I. benefits) with those who attended only because of the G.I. Bill. When using an IV approach, I find evidence that OLS likely underestimates the effect of G.I. Bill-induced education on earnings for female veterans. Specifically, the IV estimates suggest that female veterans induced to attend at least some college by the G.I. Bill have $6,495 greater annual earnings, those who complete four or more years of college experience $8,214 greater annual earnings, and that each additional year of college corresponds to a $1,350 increase in annual earnings (an 11.6 percent annual return). The effects on earnings are significant at the 5 percent level for two of the three outcomes (falling just short of the 5 percent level when looking at "Any College") and the first stage F-statistics indicate that the instrument is not weak.

Note again that using age in 1944 as an instrument is conceptually valid because age in 1944 is clearly correlated with educational attainment (see Table 1) and is unlikely to be directly correlated with differences in earnings in 1980, other than through its effect on education. Furthermore, the difference between the OLS and IV estimates is aligned with the literature on the returns to education described by Card (2001).[27] While an 11.6 percent return to an additional year of education seems large, Card (1999) finds that IV estimates range between 6 percent (Angrist and Krueger, 1991) and 15.3 percent (Harmon and Walker, 1995) in

[25] Note that these are three re-scalings of the same underlying information. I include all three to highlight that my estimates follow what we would expect when re-scaling in this fashion with the returns to a year of college being relatively small, the returns to attending college for the average period of time larger, and the returns to completing college larger again.

[26] Note that the OLS estimates in Table 6 refer only to veterans and are therefore not directly comparable to the estimates in Table 5.

[27] Card explains that "instrumental variables estimates of the return to schooling typically exceed the corresponding OLS estimates-often by 20 percent or more." Examples of such findings using U.S. data include Angrist and Krueger (1991), Kane and Rouse (1995), and Staiger and Stock (1997).

studies that use data from the 1970s, 1980s, and 1990s. Moreover, Dougherty (2005) highlights that females benefit more from college education.[28]

My two-stage least squares estimates suggest that 72.5 percent of the overall earnings boost for female veterans can be explained by the additional earnings of those who used their G.I. benefits to attend college. This back-of-the-envelope calculation relies on my earlier OLS estimates of the increase in any college (19 percentage points) and college completion (41 percent of those who complete any college) along with my IV estimates of the returns to education for those induced to attend ($6,495 per year) or complete college ($8,214 per year). Using those values, $6,495×.19×.59 + $8,214×.19×.41 = $1,368, which is 72.5 percent of the $1,887 overall difference between veteran and non-veteran females in 1980.

My IV estimates further limit concerns regarding positive selection into service by females with greater future earnings potential. Given the pattern of estimates, we would not expect veterans to be significantly more productive absent their additional education, as might be the case if IV estimates were smaller than OLS estimates. Moreover, because the estimates in Table 6 are restricted to veterans, they ease concerns that military service itself, by providing experience or on-the-job training, explain all of the veterans' earnings premium.

Cohort Level Analyses

As I mentioned earlier, if we are concerned that comparisons between veterans and non-veterans are invalid, one alternative approach would be to perform a cohort-level analysis, following Bound and Turner (2002). Specifically, Bound and Turner use birth year-quarter cohort aggregates to develop estimates of the relationship between the share of veterans in a cohort and overall educational outcomes. Their OLS estimates suggest that the share of male veterans in a cohort is positively related to greater male educational attainment. They also present complementary IV estimates where they use an indicator variable for being born prior to the fourth quarter of 1927 (thus turning 18 prior to Victory over Japan Day, August 15, 1945) as an IV to predict the share of a cohort that are veterans. V-J Day works as an IV because Japan's surrender marked the end of the war. Bound and Turner show that the share of WWII veterans by cohort declines swiftly for cohorts born after early 1927. Highlighting that V-J Day was important, their IV estimates closely match their OLS estimates.

For Bound and Turner, the primary motivation for their cohort level analyses is that many veterans would have attended college (instead of serving) and non-veteran males in the same cohorts are those who failed physical and/or mental fitness, limiting their value as a comparison group. Put differently, when

[28] Hubbard (2011) documents, however, that the additional premium for female college attendance has dissipated in recent years.

looking at male veterans, the main empirical issue is that the within-cohort non-veteran comparison group is small and severely negatively selected, requiring an alternative approach. As I explained when discussing Bound and Turners findings earlier, such concerns are less of an issue when focusing on females. When studying female veterans, the small share of female veterans in any given birth cohort (no more than 4.54 percent in my data) means that the within-cohort non-veteran comparison group is both large and unlikely to be severely negatively selected. For that reason, the primary concern when looking at the effect of the WWII G.I. Bill on female veterans is positive selection into service, either from having greater education prior to service or from innate ability/productivity differences that lead to greater future earnings even absent further educational attainment. To the extent that female WWII enlistees (1) did not have greater educational attainment than comparable non-veterans prior to enlisting and (2) were not likely to attend college after serving, as I demonstrate earlier, then comparisons between veteran and non-veteran females will provide reasonable estimates of the effects of interest.

That being said, I present estimates in Appendix C that mirror Bound and Turner's cohort level analyses, using both OLS and the same "eligible for service prior to V-J Day" instrument.[29] However, regardless of my approach to estimation (OLS or IV), I find mostly null effects on cohort level labor force participation, employment, and earnings. Counter-intuitively, the share of a female birth year-quarter cohort that is a WWII veteran is associated with reduced educational attainment at the cohort level, even when focusing only on WWII-eligible cohorts. Specifically, the coefficients in Table C1 refer to the effect on the outcome of interest for a one percentage point increase in the female veteran share in the cohort. Looking at females born between 1919 to 1925, my between-cohort OLS estimates show that if around 3 percent of the sample are WWII veterans, then WWII was associated with a 1.5 percentage point reduction in college completion and about a 0.05 reduction in the number of years of college completed at the cohort level.

As I mentioned earlier, however, negative cohort-level effects on education would be consistent with Acemoglu et al. (2004) and Jaworski (2014), who find that the war effort caused many non-veteran females to join the labor force rather than continuing their education. As a result, despite the boost provided by some veterans in eligible cohorts gaining additional education via the G.I. Bill, those cohorts obtained less education overall. In turn, cohort level IV estimates have the "wrong" sign because the correlation between the instrument (being born early enough to turn 21 before V-J Day, regardless of veteran status) and educational outcomes in relevant cohorts is negative.

Any war-related decline in educational attainment among non-veteran females means that comparisons between veterans and non-veterans in the same birth cohorts will tend to overestimate the effect of the G.I. Bill on female veterans' outcomes. Helpfully, the effects on educational attainment are relatively small at

[29] For females, this means born prior to the fourth quarter of 1924, because of the different age requirements for female enlistees.

the cohort level. Moreover, Table 1 shows that the effect of the war effort on college attendance for females seems to have mostly dissipated when we look at those born between 1926 and 1930. The estimates in Panel B of Table 2, because they compare outcomes for female WWII veterans to those of females born from 1926 to 1930, therefore help to bound the size of any overestimate. As one example, the difference between the estimates in Panel A and Panel B of Table 2, in terms of years of education, amounts to 0.169 years in 1980. Looking at years of education completed in 1960, Jaworski (2014) finds a war-related 0.163 decline in years of education for females at the median level of mobilization. If only non-veteran females experienced a decline in years of education because of WWII, then any comparison of veterans to non-veterans would likely overestimate the effect of veteran status on years of education by 0.163, right in line with the difference in estimates I report in Table 2. However, to the extent that the war effort also disrupted education among some females who served, it is perhaps best to view the estimates in Panel B of Table 2 as representing a lower bound on the true effect, with the estimates in Panel A representing an upper bound. Either way, it remains clear that female veterans experienced significant G.I. Bill-related increases in educational attainment and earnings.

Conclusion

By providing generous benefits to veterans, the 1944 Servicemen's Readjustment Act (the "G.I. Bill") improved access to higher education for millions of Americans. Several studies examine how the G.I. Bill affected male veterans, but little is known about how the G.I. Bill affected female veterans. While the vast majority of veterans were men, persistent differences in wages by gender mean that it is particularly important to study whether policies that provide greater access to education can lead to better outcomes for females. For that reason, I examine the long-term effects of the G.I. Bill on female World War II veterans who appear in the 1980 Census 5 percent Public-use Microdata Sample, focusing on differences in educational attainment and labor market outcomes.

I find that, in 1980, female veterans are 19 percentage points more likely to report having attended at least some college and 7.8 percentage points more likely to report completing four years of college or more relative to non-veteran female high school graduates of similar age. Further, I find that female veterans complete about one more semester of college relative to non-veteran females, conditional on having a high school diploma. Given differences in educational attainment, it is not surprising that I find female veterans earn $1,887 more per year compared to non-veterans. One caveat to my findings is that I rely on an indicator for WWII veteran status rather than G.I. Benefit generosity specifically. Given, however, that some veterans may have obtained little or no G.I. benefits, my estimates therefore potentially understate the G.I. Bill's true effects.

I support my findings by ruling out three plausible alternate explanations for the increase in educational attainment and subsequent earnings among female veterans. The first is selection on existing or planned educational attainment. The second is selection on ability or productivity. The third is that WWII service exerts its own impact, absent any G.I. benefits or selection effects. To limit such concerns, I rely on administrative reports, 1940 census data, and enlistment records to establish that attendance after service explains virtually all of the additional educational attainment among female veterans. I also show that female veterans who obtain a college education do not experience a larger overall "return" to education relative to non-veterans, which suggests that veterans are not especially likely to be those who would benefit from college. Mild differences in the overall returns to education also suggest that service itself does not exert an important independent impact on future labor market outcomes. Indeed, those estimates, combined with IV estimates that use age in 1944 as an instrument, suggest that veterans who used their G.I. benefits to attend college may have been somewhat negatively selected.

My IV estimates imply that 72.5 percent of the overall earnings boost for female veterans can be explained by the additional earnings of those who used their G.I. benefits to attend college. Further, my IV estimates suggest that those induced to attend college by the G.I. Bill experience a $6,495 increase in annual earnings, which amounts to 69.4 percent of the overall earnings gap among males and females at the time (the overall gender wage gap was $9,496 in 1980 among male and female high school graduates who work full-time and were born between 1919 and 1925). The fact that greater educational attainment does not close the entire gender gap in earnings is consistent with studies that examine the returns to higher education for females (see Black et al., 2008, for example).

A final caveat is that WWII led to reductions in educational attainment among non-veteran females. For that reason, my empirical approach, comparing veterans to similar non-veterans, could overestimate the effects of interest. However, the available evidence suggests that any overestimate is likely to be small. Overall, it is clear that the G.I. Bill caused significant additional educational attainment and led to substantial increases in earnings among female veterans.

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Table 1: Summary Statistics - 1980 Census 5 Percent Public Use Micro Sample

		WWII Veterans b. 1919-1925		Non-Veterans b. 1919-1925		All Females b. 1926-1930	
		Summary Statistic	SD	Summary Statistic	SD	Summary Statistic	SD
% in Labor Force		57.5		52.8		62.3	
% Employed (if in Labor Force)		96.22		96.59		96.4	
Annual Earnings (All)		$11,597	8,592	$9,518	7,116	$9,420	7,151
Annual Earnings (HS Only)		$10,140	7,406	$8,517	6,190	$8,319	6,164
Annual Earnings (≤3 years of College)		$11,316	8,097	$9,615	7,182	$9,457	7,104
Annual Earnings (≥4 years of College)		$14,604	10,310	$13,339	8,916	$13,029	8,856
% Any College		53.8		33.5		36.2	
% Completed College		21.7		13.5		15.7	
Years of College Completed	0	4,160		164,443		126,050	
	1	863		20,397		15,943	
	2	1,151		20,944		16,969	
	3	876		8,253		7,662	
	4	1,029		19,222		17,490	
	5+	926		14,036		13,423	
# Born in (% attended any college)	1919	966 (60.8)		29,630 (33.7)			
	1920	1,371 (60.8)		33,915 (33.6)			
	1921	1,615 (56.4)		35,027 (33.9)			
	1922	1,686 (53.3)		35,434 (33.5)			
	1923	1,641 (49.9)		36,328 (32.8)			
	1924	1,227 (46.5)		38,317 (33.1)			
	1925	499 (45.7)		38,644 (34.0)			
	1926					38,351 (38.6)	
	1927					39,493 (40.0)	
	1928					39,132 (39.0)	
	1929					39,156 (39.2)	
	1930					41,405 (39.7)	
% Married		69.3		73.7		77.5	
% Married (High School Only)		71.5		74.2		78.4	
% Married (Any College)		65.7		70.7		74.1	
% Married to a Male Veteran		51.6		40.1		42.8	
Race	% White	97.4		93.1		91.2	
	% Black	1.9		5.4		6.8	
	% Other	0.7		1.5		2	
Observations		9,005		247,295		197,537	

Source: 1980 PUMS 5 Percent Census Sample restricted to females who completed high school.

Table 2: Estimates for WWII Veteran Status on Female Earnings and Education

	Panel A: Non-Veterans = Non-Veteran Female HS Graduates born 1919-1925					
	(1)	(2)	(3)	(4)	(5)	(6)
	Any College	Completed Degree	Years of College	In Labor Force	Employed	Annual Earnings
	(OLS)	(OLS)	(Poisson)	(OLS)	(OLS)	(OLS)
WWII Veteran	0.190***	0.078***	0.498***	0.032***	-0.004	1,887.05***
	(0.005)	(0.004)	(0.012)	(0.005)	(0.003)	(121.77)
Mean of Dep. Var. for Veteran	0.538	0.217	1.615	0.575	0.962	11,597
Mean of Dep. Var. for Non-Veteran	0.335	0.135	0.947	0.528	0.966	9,517
Observations	256,326	256,326	256,326	256,326	135,818	131,163
R-squared	0.032	0.020	-	0.070	0.003	0.030

	Panel B: Non-Veterans = All Female HS Graduates born 1926-1930					
	(1)	(2)	(3)	(4)	(5)	(6)
	Any College	Completed Degree	Years of College	In Labor Force	Employed	Annual Earnings
	(OLS)	(OLS)	(Poisson)	(OLS)	(OLS)	(OLS)
WWII Veteran	0.141***	0.043***	0.319***	0.022***	-0.003	1,730.46***
	(0.007)	(0.005)	(0.017)	(0.006)	(0.003)	(148.55)
Mean of Dep. Var. for Veteran	0.538	0.217	1.572	0.575	0.962	11,597
Mean of Dep. Var. for Non-Veteran	0.362	0.157	1.062	0.623	0.964	9,420
Observations	206,543	206,543	206,543	206,543	128,328	123,671
R-squared	0.030	0.019	-	0.047	0.003	0.031

Source: 1980 PUMS 5 Percent Census Sample. Note: Standard errors, corrected for heteroskedasticity, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dollar values are $1980. In Panel A, I restrict the sample to female, high-school graduates, who turned 21 between 1940 and 1946. Non-veterans are, therefore, female high-school graduates born between 1919 and 1925 who do not enlist in the armed forces during the WWII period. In Panel B, I restrict the sample to female, high-school graduates, who turned 21 between 1940 and 1951, but then exclude non-veterans born between 1919 and 1925. In those estimates, therefore, non-veterans are female high-school graduates born between 1926 and 1930 who do not enlist in the armed forces during the WWII period. All specifications include state fixed effects and control for marital status and race. In Panel A, I also control for age using quarter of birth indicators. In Panel B, I cannot control similarly for age because veteran status does not vary for individuals born prior to 1926 due to the sample restriction. To capture the effect of age, I instead add a linear birth year-quarter trend. Estimates without including this linear trend are very similar.

Table 3: Educational Attainment in 1940 Census and Enlistment Records

Panel A: Educational Attainment for Females in 1940 Census

Age	High School Grad		Some College		College Grad		Total	
	N	%	N	%	N	%	N	%
21	423,449	74.6%	116,111	20.5%	27,791	4.9%	567,351	100.0%
22	401,888	74.2%	93,917	17.3%	45,790	8.5%	541,595	100.0%
23	384,635	74.0%	83,499	16.1%	51,503	9.9%	519,637	100.0%
24	370,145	73.3%	81,620	16.2%	52,944	10.5%	504,709	100.0%
25	358,626	71.9%	84,342	16.9%	55,861	11.2%	498,829	100.0%
26	326,461	70.1%	84,645	18.2%	54,799	11.8%	465,905	100.0%
Observations	2,265,204	73.1%	544,134	17.6%	288,688	9.3%	3,098,026	100.0%

Panel B: Educational Attainment for Females in WAC Enlistment Records

Age at Enlistment	High School Grad		Some College		College Grad		Total	
	N	%	N	%	N	%	N	%
21	7,808	78.0%	1,899	19.0%	309	3.1%	10,016	100.0%
22	8,751	73.7%	2,420	20.4%	703	5.9%	11,874	100.0%
23	5,797	70.8%	1,634	20.0%	757	9.2%	8,188	100.0%
24	3,388	68.9%	996	20.3%	532	10.8%	4,916	100.0%
25	1,008	71.6%	286	20.3%	113	8.0%	1,407	100.0%
26	287	72.8%	80	20.3%	27	6.9%	394	100.0%
Observations	27,039	73.5%	7,315	19.9%	2,441	6.6%	36,795	100.0%

Sources: The data in Panel A refer to the 1940 Complete Census restricted to female high-school graduates age 21 to 26 in 1940. Panel B contains data from Women's Army Corps Enlistment Records.

Table 4: Selection After G.I. Bill Announced

	(1)	(2)	(3)	(4)	(5)	(6)
	Any College	Completed Degree	Years of College	In Labor Force	Employed	Annual Earnings
	(OLS)	(OLS)	(Poisson)	(OLS)	(OLS)	(OLS)
WWII Vet × (b. 1923 or later)	-0.090***	-0.064***	-0.271***	0.010	-0.004	-116.09
	(0.012)	(0.009)	(0.030)	(0.011)	(0.006)	(265.37)
Observations	256,326	256,326	256,326	256,326	135,818	131,163
R-squared	0.032	0.020		0.062	0.003	0.030

Source: 1980 PUMS 5 Percent Census Sample. Note: In all specifications, non-veterans are female high-school graduates born between 1919 and 1925 who do not enlist in the armed forces during the WWII period.

Table 5: Education Interaction Estimates

	(1)	(2)	(3)
	Annual Earnings	Annual Earnings	Annual Earnings
Any College?	2,592.44***		
	(43.59)		
WWII Veteran × Any College?	-172.63		
	(236.64)		
Years of College		1,002.59***	
		(13.63)	
WWII Veteran × Years of College		-72.39	
		(69.50)	
Degree (= 4 or more Years of College)			4,327.96***
			(64.89)
WWII Veteran × Degree			-669.09**
			(323.89)
Observations	131,163	131,163	131,163
R-squared	0.07	0.10	0.09

Source: 1980 PUMS 5 Percent Census Sample. Note: Standard errors, corrected for heteroskedasticity, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dollar values are $1980. All estimates include controls for age, race, marital status, and state.

Table 6: Two-Stage Least Squares Estimates

	OLS Estimates			IV Estimates (IV = Age at time of G.I. Bill Announcement)		
	(1)	(2)	(3)	(4)	(5)	(6)
	Annual Earnings	Annual Earnings	Annual Earnings	Annual Earnings	Annual Earnings	Annual Earnings
Any College	2,423.53***			6,495.00*		
	(234.35)			(3,330.26)		
Bachelor's Degree (or more)		3,597.04***			8,214.15**	
		(317.72)			(4,178.71)	
Years of College			924.68***			1,350.18**
			(68.01)			(671.67)
F-Stat First Stage				32.79	27.09	54.07
Observations	4,984	4,984	4,984	4,984	4,984	4,984
R-squared	0.07	0.08	0.09	0.02	0.03	0.08

Source: 1980 PUMS 5 Percent Census Sample restricted to female veterans born 1919 to 1925. Note: Standard errors, corrected for heteroskedasticity, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dollar values are $1980. All specifications include state fixed effects and control for marital status and race. I do not control for year-quarter of birth in the OLS or IV estimates because I use age as an instrument. "Age at time of G.I. Bill Announcement" refers to an indicator for being born before versus after the second quarter of 1923, making a female 21, and thus eligible to serve, before versus after the announcement of the G.I. Bill.

Online Appendix Material

Appendix 1 - Additional Estimates

High School Completion Status

The National Museum for the U.S. Army states that female enlistees had to be "high school graduates between 21 and 45 years of age."[1] Despite the stated requirements, my data has a small number of females who report being a WWII veteran and who do not report having a high school diploma. As a robustness check, I present estimates that expand my sample to all females, regardless of high-school completion status, in Table A1. Unsurprisingly, because including those without a high school diploma tends to reduce the overall sample means for educational attainment and earnings, expanding the sample in this manner tends to increase the effect of WWII service on the various outcomes.

Medical Professions

Because one source of problematic selection could be that those in medical occupations may have been more educated prior to enlistment, I present estimates in Table A2 where I again exclude those who do not report having a high school diploma but also exclude any who report being a nurse or doctor in 1980. Reassuringly, when my sample excludes such females, my findings are only very mildly attenuated.

Wider Sample of Birth Years

Another source of problematic selection is that, by 1980, anyone born in 1915 would be 65 years old. For females, as I mention in the main text, those age 62 (= b. 1918) are the first birth year cohort for whom a majority (51 percent) are retired (technically, "not in the labor force"). That means that the oldest birth year cohort for whom a majority are not retired in 1980 are those who were born in 1919, and who therefore turn 21 in 1940. Because those born prior to 1919 are more likely to be retired, and because they would have been 23 or older when the U.S. entered WWII (they may have already married, had kids, and so on), I exclude them from my main estimates. One further reason to restrict the sample this way is to ensure it is more comparable to those born between 1926 and 1930, my alternative comparison group. To formally illustrate, however, that I am not cherry-picking my sample, I present estimates in Table A3 where I once again exclude those who do not report having a high school diploma but expand the sample to include

[1] See https://armyhistory.org/skirted-soldiers-the-womens-army-corps-and-gender-integration-of-the-u-s-army-during-worldwar-ii/. Last accessed 10/13/2020.

females born as early as 1915. Reassuringly, when my sample includes such females, my findings are essentially the same as when I restrict the sample to those born in 1919 or later.

IV Placebo Estimates

In Table A4 I examine what happens if I use age at the time of the G.I. Bill to instrument for non-veterans' educational attainment. The IV estimates are seriously inflated (but statistically insignificant) because the instrument is extremely weak (I present first-stage F-statistics in the table), explaining little of the variation in non-veterans' educational attainment. Such a pattern is consistent with Bound et al. (1995) who examine the bias associated with weak instruments.

Heckman Two Step Earnings Estimates

Because there are differences in the proportion of female and non-female veterans who are employed in 1980, I present estimates of the effect on veteran status on annual earnings for females using a Heckman Selection model in Table A5. In the table, for comparison purposes, the first column reports estimates using OLS where the sample includes all females born between 1919 and 1925, regardless of labor force status and asserts annual earnings of $0 for those who report not working. In the second column, this estimate is restricted only to those who are working (that estimate is the same as the main estimate in Table 2). In the third column, I present estimates using a Heckman Selection approach. In the selection equation, I use other household income as the "additional" variable. For most respondents, this is spouse/partner income, which is a common approach in this literature. The estimates when using a Heckman selection model are negligibly different relative to the OLS estimates. However, I present these estimates only as an appendix item because I cannot easily refute the claim that spousal or other household income is correlated with veteran status.

Estimates Including Education and Occupation as Controls

In Table A6, I progressively add education and occupation controls to the specification in column six of Table 2 in the body of the paper. As I mention in the paper, veterans' earnings are likely to be greater than non-veterans' because of increased education and associated occupation choices. The effect of veteran status on earnings is somewhat smaller with these additional controls but remains large and statistically significant.

Testing Conditional Independence Assumption

Table 1 suggests that veterans and non-veterans differ in terms of their observable characteristics. For that reason, in Table A7, I present estimates where I examine the sensitivity of my main estimates (Table 2, Panel A) to sequentially adding controls and fixed effects. This serves as a test of the conditional independence assumptions that underpin my cohort-based approach. In the table, I first present estimates similar to Table 2, Panel A but with no controls. Then, I add race, marital status, state, and year-quarter of birth as controls and fixed effects. Adding controls tends to mildly reduce the effect of veteran status on the outcomes of interest. Note, I do not attempt to control for parental education in my main estimates because, in my 1980 census data, parents' educational attainment is only available in the data when that parent is living with the respondent.

Table A1: Estimates Including All Females b. 1919-1925

	Non-Veterans = All Non-Veteran Females born 1919-1925					
	(1)	(2)	(3)	(4)	(5)	(6)
	Any College	Completed Degree	Years of College	In Labor Force	Employed	Annual Earnings
	(OLS)	(OLS)	(Poisson)	(OLS)	(OLS)	(OLS)
WWII Veteran	0.236***	0.096***	0.795***	0.039***	0.001	2,372.37***
	(0.005)	(0.004)	(0.013)	(0.005)	(0.003)	(111.24)
Observations	426,163	426,163	426,163	426,163	203,649	194,883
R-squared	0.032	0.015	-	0.073	0.003	0.04

Source: 1980 PUMS 5 Percent Census Sample. Note: Standard errors, corrected for heteroskedasticity, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dollar values are $1980. Here, I restrict the sample to females who turned 21 between 1940 and 1946, regardless of whether they report having a high school diploma or not. Non-veterans are, therefore, all females born between 1919 and 1925 who do not enlist in the armed forces during the WWII period. All specifications include state fixed effects and control for marital status, age (measured in quarters), and race.

Table A2: Estimates Excluding Nurses and Doctors

	Non-Veterans = Non-Veteran Female HS Graduates born 1919-1925					
	(1)	(2)	(3)	(4)	(5)	(6)
	Any College	Completed Degree	Years of College	In Labor Force	Employed	Annual Earnings
	(OLS)	(OLS)	(Poisson)	(OLS)	(OLS)	(OLS)
WWII Veteran	0.166***	0.071***	0.451***	0.017***	-0.006**	1,610.11***
	(0.006)	(0.005)	(0.014)	(0.005)	(0.003)	(133.30)
Observations	249,677	249,677	249,677	249,677	130,470	125,890
R-squared	0.031	0.019	-	0.070	0.003	0.05

Source: 1980 PUMS 5 Percent Census Sample. Note: Standard errors, corrected for heteroskedasticity, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dollar values are $1980. Here, I restrict the sample to females who turned 21 between 1940 and 1946, who have a high school diploma, and do not report being either a nurse or a doctor. Non-veterans are, therefore, all females with a high-school diploma born between 1919 and 1925 who do not enlist in the armed forces during the WWII period and are not nurses or doctors in 1980. All specifications include state fixed effects and control for marital status, age (measured in quarters), and race.

Table A3: Estimates for Female High-School Graduates b. 1915-1925

	Non-Veterans = Non-Veteran Female HS Graduates born 1915-1925					
	(1)	(2)	(3)	(4)	(5)	(6)
	Any College	Completed Degree	Years of College	In Labor Force	Employed	Annual Earnings
	(OLS)	(OLS)	(Poisson)	(OLS)	(OLS)	(OLS)
WWII Veteran	0.201***	0.091***	0.526***	0.029***	-0.003	1,846.68***
	(0.005)	(0.004)	(0.010)	(0.005)	(0.002)	(110.59)
Observations	369,905	369,905	369,905	369,905	175,652	169,616
R-squared	0.032	0.021	-	0.095	0.003	0.04

Source: 1980 PUMS 5 Percent Census Sample. Note: Standard errors, corrected for heteroskedasticity, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dollar values are $1980. Here, I restrict the sample to females who turned 21 between 1936 and 1946, who have a high school diploma. Non-veterans are, therefore, all females with a high-school diploma born between 1915 and 1925 who do not enlist in the armed forces during the WWII period. All specifications include state fixed effects and control for marital status, age (measured in quarters), and race.

Table A4: Two-Stage Least Squares Estimates, Placebo Using Non-Veterans

	OLS Estimates			IV Estimates (IV = Age at time of G.I. Bill Announcement)		
	(1) Annual Earnings	(2) Annual Earnings	(3) Annual Earnings	(4) Annual Earnings	(5) Annual Earnings	(6) Annual Earnings
Any College	2,594.94***			57,039.50		
	(43.61)			(77,039.50)		
Bachelor's Degree (or more)		4,333.27***			48,281.92	
		(64.89)			(42,830.94)	
Years of College			1,003.62***			6,992.74
			(13.63)			(4,292.56)
F-Stat First Stage				0.29	0.43	1.09
Observations	126,179	126,179	126,179	126,179	126,179	126,179
R-squared	0.07	0.09	0.1			

Source: 1980 PUMS 5 Percent Census Sample restricted to female non-veterans born 1919 to 1925. Note: Standard errors, corrected for heteroskedasticity, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dollar values are $1980. All specifications include state fixed effects and control for marital status and race. My OLS estimates also control for year-quarter of birth. My IV estimates do not control for year-quarter of birth because I use age as an instrument. "Age at time of G.I. Bill Announcement" refers to an indicator for being born before versus after the second quarter of 1923, making a female 21, and thus eligible to serve, before versus after the announcement of the G.I. Bill.

Table A5: Heckman Selection Model

	OLS		Heckman Selection Model
	(1)	(2)	(3)
	Annual Earnings	Annual Earnings	Annual Earnings
WWII Veteran	1,414.41***	1,887.05***	1,913.36***
	(89.44)	(121.77)	(101.08)
Observations	256,326	131,163	256,326
Estimation Sample	All	Employed Only	All
Heckman Selection Variable			Employment Status

Source: 1980 PUMS 5 Percent Census Sample restricted to female non-veterans born 1919 to 1925. Note: Standard errors, corrected for heteroskedasticity, in parentheses. In the model, I use other household income to predict employment status. *** p<0.01, ** p<0.05, * p<0.1. Dollar values are $1980. All specifications include state fixed effects and control for marital status, race, and year-quarter of birth.

Table A6: Earnings Estimates with Additional Controls

	(1)	(2)	(3)	(4)
	Annual Earnings	Annual Earnings	Annual Earnings	Annual Earnings
WWII Veteran	1,887.05***	1,336.52***	904.53***	771.95***
	(121.77)	(119.55)	(112.65)	(112.29)
Observations	131,163	131,163	131,133	131,133
State Fixed Effects	Y	Y	Y	Y
Race, Marital Status, and Year-Quarter of Birth Controls	Y	Y	Y	Y
Education		Y		Y
Occupation			Y	Y

Source: 1980 PUMS 5 Percent Census Sample restricted to female non-veterans born 1919 to 1925. Note: Standard errors, corrected for heteroskedasticity, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dollar values are $1980. All specifications include state fixed effects and control for marital status, race, and year-quarter of birth. The second column adds education, the third, occupation, and the fourth adds both education and occupation as controls. These estimates highlight how much of the gross increase in Annual Earnings is attributable to differences in educational attainment and occupational choices.

Table A7: Adding Covariates Sequentially

	(1) Any College	(2) Completed Degree	(3) Years of College	(4) In Labor Force	(5) Employed	(6) Annual Earnings
Panel A						
WWII Vet	0.203***	0.083***	0.534***	0.047***	-0.004	2,079.60***
	-0.005	-0.004	-0.012	-0.005	-0.003	-123.34
Controls: None						
Panel B						
WWII Vet	0.205***	0.084***	0.544***	0.052***	-0.004	2,105.51***
	-0.005	-0.004	-0.012	-0.005	-0.003	-123.39
Controls: Race						
Panel C						
WWII Vet	0.199***	0.079***	0.518***	0.035***	-0.004	1,934.27***
	-0.005	-0.004	-0.012	-0.005	-0.003	-121.7
Controls: Race, Marital Status						
Panel D						
WWII Vet	0.190***	0.077***	0.493***	0.039***	-0.004	1,873.90***
	-0.005	-0.004	-0.012	-0.005	-0.003	-121.4
Controls: Race, Marital Status, State of Residence						
Panel E						
WWII Vet	0.190***	0.078***	0.498***	0.032***	-0.004	1,887.05***
	-0.005	-0.004	-0.012	-0.005	-0.003	-121.77
Controls: Race, Marital Status, State of Residence, Year-Quarter of Birth						
Observations	256,326	256,326	256,326	256,326	135,818	131,163

Source: 1980 PUMS 5 Percent Census Sample restricted to female non-veterans born 1919 to 1925. Note: Standard errors, corrected for heteroskedasticity, in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dollar values are $1980. Here, in each set of estimates, I sequentially add controls and fixed effects for race, marital status, state of residence, and year-quarter of birth.

Appendix 2 - Additional Information

Additional Information on Enlistees in 1940s and Veterans in 1980

In Table B1 I provide summary statistics regarding age at enlistment, race, marital status, and dependents for high school graduates, those with some college, and college graduates born between 1915 and 1925 who appear in the Women's Army Corp Enlistment Records. Notice that there are a small number who do not appear to meet the requirements of enlistment - including individuals who report that they are under age 20. That being said, these records come from digitized enlistment punch cards. Leaving aside human error, the National Archives explains that "[a]bout 35 percent of the electronic WWII Army Enlistment Records have a scanning error. Most of these errors are because of the poor condition of the microfilm and the scanning mechanism could not properly "read" various characters on the punch cards."[2] It is possible, therefore, that those recorded as teenagers in the enlistment records were actually 27-, 28-, or 29-years-old. Further, enlistees engaged in training prior to service. It is possible that those close to age 21 were able to enlist if they would turn 21 prior to the end of that training. I cannot find any information, however, to either confirm or deny such a conjecture.

Notice that the majority of the sample consists of single females who have no children, are aged 21 to 27, and have only a high school diploma at time of enlistment. In addition, Figure B1 shows the geographic distribution of WAC enlistees. For completeness, Figure B2 shows the geographic distribution of female veterans in 1980. Both figures are what we might expect given population trends in the twentieth century. Finally, in Table B2, I show the most common occupations for females and non-females born between 1919 and 1925 and who have a high school diploma. Unsurprisingly, there are differences across the two groups that arise from the different education levels of the two groups. The prevalence of registered nurses among veterans highlights how important it is to examine my estimates when excluding nurses from my estimation sample (see Appendix A.2).

Background Information on Service Eligibility Standards

It is worth noting that while women served in various roles, the legislation establishing the Women's Army Corps only authorized "non-combatant service."[3] With women's roles being more like civilian employment – sorting and delivering mail, driving buses, and so on – it is not clear that stringent physical or educational requirements would be necessary. Indeed, the text of the 1942 legislation that established the Women's

[2] See https://aad.archives.gov/aad/content/aad docs/rg64 army serial faq.pdf.
[3] See https://www.loc.gov/law/help/statutes-at-large/77th-congress/session-2/c77s2ch312.pdf.

Auxiliary Army Corps (WAAC) states only that "The Secretary [of Defense] is authorized to have enrolled in the corps [...] women of excellent character in good physical health, between the ages of twenty-one and forty-five years and citizens of the United States."[4] The same legislation also states that "The Secretary is authorized to establish and maintain such number of schools as he may consider necessary for the purpose of training candidates for officers of the corps. The Secretary may establish by regulation the qualifications for entry into such schools" (emphasis added). The legislation itself says nothing more about selection procedures but the National Museum of the United States Army reports that the Army ultimately required that "WAACs be high school graduates between 21 and 45 years of age, between five and six feet tall, between 105 and 200 pounds, and of good health and character."[5]

The Women's Auxiliary Army Corps (later renamed to Women's Army Corps) was the largest all-female branch of the military during WWII (about 150,000 served). However, many women joined the nursing corps (estimates suggest the Army Nurse Corps enlisted about 60,000 over the war period) and the navy (the Women Accepted for Volunteer Emergency Service had more than 80,000 enlistees). Note that the Army Nurse Corps enlisted only registered nurses. Registered nurses naturally had to be high school graduates who had also completed the three years of training required for an RN license. For WAVES, it is worth noting that enlistees only had to be 20.[6] There is also evidence to suggest women with small children would not be accepted. That being said, it appears that WAVES sometimes allowed experience or other forms of education to serve as a substitute for having a high school degree.[7]

While all female branches of the military (excepting WASP, see below) were eligible for G.I. benefits, the variations in recruitment eligibility across army branches provide further motivation for the estimates I discuss in Appendix A1, A2, and A3.[8] Those estimates show that my findings are robust to excluding nurses/doctors, adding those without a high-school degree back to the sample, and expanding the sample to include more birth years.

WASP: A Unique Case

The Women Airforce Service Pilots (WASP) was created in 1943 by merging the Women's Auxiliary Ferrying Squadron (WAFS) and the Women's Flying Training Detachment (WFTD). The WAFS consisted

[4] See https://www.loc.gov/law/help/statutes-at-large/77th-congress/session-2/c77s2ch312.pdf.

[5] See https://armyhistory.org/skirted-soldiers-the-womens-army-corps-and-gender-integration-of-the-u-s-army-during-worldwar-ii/.

[6] See https://www.loc.gov/law/help/statutes-at-large/77th-congress/session-2/c77s2ch538.pdf..

[7] See https://www.history.navy.mil/research/library/online-reading-room/title-list-alphabetically/h/how-to-serve-your-countryin-the-WAVES.html.

[8] See https://www.loc.gov/law/help/statutes-at-large/78th-congress/session-2/c78s2ch268.pdf.

of a few dozen pilots who typically moved military planes from factories to bases. Only commercially licensed female pilots with at least 500 hours flying-time were eligible for the WAFS. In the WFTD, trainees were between 21 and 35 years old, and had to have at least 200 hours of flying experience. The program consisted of 6+ months of training including 200+ hours of flight time. Enlistment requirements were later reduced to 35 hours of flight time, and it appears that WASP enlisted women aged under 21 who met the other necessary criteria.[9]

Given few people in the 1940s would have the opportunity to obtain even one hour of flight experience, it is not surprising that the National Museum reports that only 1,074 women served as part of WASP.[10] While those WASP veterans are likely to have valuable and unique skills, a 5 percent census sample would be expected to contain around 50 WASP veterans in total, assuming they all lived. Note that I cannot separately identify veterans from the various branches of the military in my data. Of these 50, however, only some would have been born between 1919 and 1925 and, of that group, only a fraction would still be in the labor force in 1980. It is therefore likely that I have very few WASP veterans in my main estimation sample, which limits any effect they could have on my estimates. Note that WASP servicewomen were eventually granted full military recognition and benefits (including G.I. Bill benefits) only in 1977.[11]

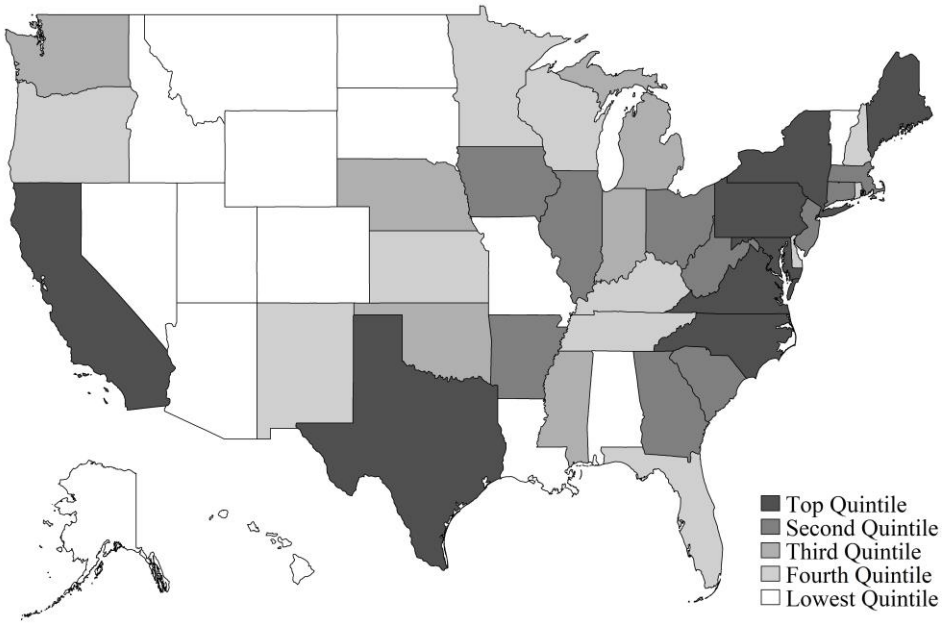
Figure B1: Distribution of Women's Army Corp Enlistees by State in the 1940s

[9] See https://www.nationalmuseum.af.mil/Portals/7/documents/education/teacher resource flying for freedom.pdf.

[10] See https://www.nationalmuseum.af.mil/Portals/7/documents/education/teacher resource flying for freedom.pdf.

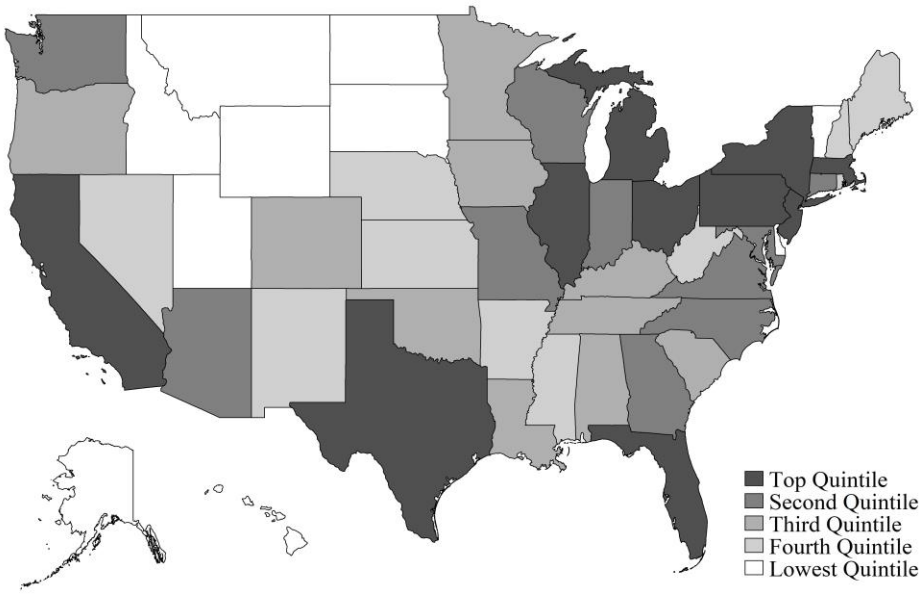
[11] See Title IV of Public Law 95-2020, https://www.govinfo.gov/content/pkg/STATUTE-91/pdf/STATUTE-91-Pg1433.pdf.

Figure B1: Distribution of Female Enlistees by State in 1940



Source: Data from 1940 to 1946 Women's Army Corp Enlistment Records for individuals born between 1915 and 1925, but excluding records with missing age, race, marital status, education, dependent, or state information. Note: Darker shades indicate that more individuals enlisted from those states.

Figure B2: Distribution of Female Veterans by State in 1980



Source: Data from 1980 5% Census Sample. Note: Darker shades indicate that more veterans live in those states.

Table B1: Summary Statistics for Enlistees in 1940s

	Education Level							
	High School Grad		Some College		College Grad		Total	
	N	%	N	%	N	%	N	%
Age at Enlistment								
17	2	66.7%	1	33.3%	0	0.0%	3	100.0%
18	9	69.2%	2	15.4%	2	15.4%	13	100.0%
19	28	77.8%	8	22.2%	0	0.0%	36	100.0%
20	4,646	83.3%	891	16.0%	38	0.7%	5,575	100.0%
21	7,808	78.0%	1,899	19.0%	309	3.1%	10,016	100.0%
22	8,751	73.7%	2,420	20.4%	703	5.9%	11,874	100.0%
23	5,797	70.8%	1,634	20.0%	757	9.2%	8,188	100.0%
24	4,139	67.6%	1,267	20.7%	719	11.7%	6,125	100.0%
25	3,354	66.8%	1,050	20.9%	620	12.3%	5,024	100.0%
26	2,623	65.3%	834	20.8%	561	14.0%	4,018	100.0%
27	2,135	64.6%	686	20.7%	486	14.7%	3,307	100.0%
28	1,382	65.0%	456	21.4%	289	13.6%	2,127	100.0%
29	494	67.3%	151	20.6%	89	12.1%	734	100.0%
30	141	70.9%	39	19.6%	19	9.5%	199	100.0%
31	21	77.8%	5	18.5%	1	3.7%	27	100.0%
Race								
White	38,850	72.6%	10,372	19.4%	4,311	8.1%	53,533	100.0%
Other	2,480	66.4%	971	26.0%	282	7.6%	3,733	100.0%
Marital Status								
Single	27,359	70.0%	8,083	20.7%	3,665	9.4%	39,107	100.0%
Married	11,554	76.8%	2,670	17.7%	820	5.5%	15,044	100.0%
Divorced/Widowed	2,417	77.6%	590	18.9%	108	3.5%	3,115	100.0%
Has Dependents?								
No	40,515	72.1%	11,154	19.8%	4,527	8.1%	56,196	100.0%
Yes	815	76.2%	189	17.7%	66	6.2%	1,070	100.0%
Observations	41,330	72.2%	11,343	19.8%	4,593	8.0%	57,266	100.0%

Source: Enlistees born between 1915 and 1925 in the Women's Army Corp Enlistment Records excluding records with missing age, race, marital status, education, dependent, or state information.

Table B2: Occupations in 1980

	Count	%	Cumulative %
Non-Veteran Females			
Secretaries	14,951	11.44	11.44
Bookkeepers and accounting and auditing	8,158	6.24	17.69
Salespersons, n.e.c.	7,631	5.84	23.53
Primary school teachers	6,393	4.89	28.42
Managers and administrators, n.e.c.	6,273	4.8	33.23
General office clerks	5,769	4.42	37.64
Registered nurses	4,381	3.35	41
Nursing aides, orderlies, and attendant	2,786	2.13	43.13
Cashiers	2,730	2.09	45.22
Cooks, variously defined	2,631	2.01	47.23
Total	61,703	47.21	
Veteran Females			
Registered nurses	761	14.69	14.69
Secretaries	553	10.68	25.37
Managers and administrators, n.e.c.	285	5.5	30.87
Primary school teachers	215	4.15	35.02
Salespersons, n.e.c.	207	4	39.02
General office clerks	205	3.96	42.97
Bookkeepers and accounting and auditing	200	3.86	46.83
Typists	96	1.85	48.69
Nursing aides, orderlies, and attendant	81	1.56	50.25
Office supervisors	80	1.54	51.79
Total	2,683	51.79	

Source: 1980 PUMS 5 Percent Census Sample. Note: As in my main estimates, I restrict the sample to females who turned 21 between 1940 and 1946 who have a high school diploma. Non-veterans are, therefore, all females with a high-school diploma born between 1919 and 1925 who do not enlist in the armed forces during the WWII period.

Appendix 3 - Cohort Level Estimates

One alternative to my within-cohort approach is to follow Bound and Turner (2002). Specifically, Bound and Turner "collapse" their data to summary statistics by birth year-quarter cohort. They then regress educational attainment for each cohort on the share of the cohort that is a male veteran. Their OLS estimates suggest that the share of veterans in a cohort is positively related to greater educational attainment. They also present IV estimates where they use an indicator variable for being born prior to 4Q 1927, and thus having turned 18 prior to V-J Day (Victory over Japan Day, August 15, 1945), as an IV to predict the share of a cohort that are veterans. Note that V-J Day works as an IV because Japan's surrender essentially marked the end of draft requirements. In turn, the share of WWII veterans by cohort declines swiftly for cohorts turning 18 after that day (See Figure 2 in Bound and Turner, 2002, p. 799).

Because so few females served and because there were no draft requirements for females, such a cohort level analysis is immediately limited when applied to females. Moreover, non-veteran female educational attainment and labor supply decisions were also affected by the events of WWII (Acemoglu et al., 2004; Jaworski, 2014). For completeness, however, I present estimates that mirror Bound and Turner's approach in Table C1. In the table, I provide OLS estimates along with IV estimates that use an indicator variable for being born prior to 4Q 1924, and thus having turned 21 prior to V-J Day, as an instrument to predict the share of a cohort that are veterans. I present estimates for cohorts of female high school graduates born between 1919 and 1925, 1919 and 1926, and 1919 and 1930. To follow Bound and Turner as closely as possible, I also include a birth year-quarter linear time trend in all specifications. The coefficients in the table refer to the effect on the outcome of interest for a one percentage point increase in the female veteran share in the cohort.

I find mostly null effects on labor force participation, employment, and earnings, regardless of approach to estimation. In contrast, I find negative effects on college attendance, years of college, and degree completion. That is, estimates suggest that a greater share of veterans in a birth year-quarter cohort leads to lower educational attainment. Because we know already that veterans have greater educational attainment and earnings, it must be the case that the war also affected non-veteran females' outcomes. As I mention in the body of the paper, this is consistent with Acemoglu et al. (2004) and Jaworski (2014) who show large increases in labor force participation among women, at the expense of further education during the war period.

The main consequence here is that my within-cohort approach is likely to mildly overestimate the effect of veteran status on female veterans' later life outcomes. I discuss the potential size of any overestimate when discussing my findings in the main body of the paper along with how it compares to Jaworski's estimate of the reduction in educational attainment due to WWII among females in affected cohorts.

Table C1: Cohort Level Analyses

	(1) Any College	(2) Completed Degree	(3) Years of College	(4) In Labor Force	(5) Employed	(6) Annual Earnings
Panel A: OLS (b. 1919 to 1925)						
Share WWII Vet	-0.001	-0.005***	-0.016***	0.001	-0.001	19.26
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(26.55)
Panel B: IV (b. 1919 to 1925)						
Share WWII Vet	-0.002	-0.005***	-0.021***	-0.000	-0.001*	1.18
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(23.68)
First Stage F-Stat	29.02	29.02	29.02	29.02	29.02	29.02
No. of Birth Quarters	28	28	28	28	28	28
Panel C: OLS (b. 1919 to 1926)						
Share WWII Vet	-0.003**	-0.006***	-0.023***	0.002	-0.001	19.5
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(22.50)
Panel D: IV (b. 1919 to 1926)						
Share WWII Vet	-0.003**	-0.006***	-0.025***	0.000	-0.001*	3.76
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(21.00)
First Stage F-Stat	35.64	35.64	35.64	35.64	35.64	35.64
No. of Birth Quarters	32	32	32	32	32	32
Panel E: OLS (b. 1919 to 1930)						
Share WWII Vet	-0.003***	-0.006***	-0.025***	0.001	-0.000	18.64
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(25.52)
Panel F: IV (b. 1919 to 1930)						
Share WWII Vet	-0.002	-0.005***	-0.020***	-0.003	-0.000	-19.44
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(23.07)
First Stage F-Stat	41.67	41.67	41.67	41.67	41.67	41.67
No. of Birth Quarters	48	48	48	48	48	48

Source: 1980 PUMS 5 Percent Census Sample. Note: I restrict the sample to females and study birth quarter level cohort outcomes for varying birth years as indicated in the table. In the IV estimates, I instrument for the share of a birth quarter cohort who are WWII veterans using an indicator that equals one if the birth quarter is strictly before 4Q 1924. Those born before 4Q 1924 would be military-eligible prior to V-J Day (therefore, I am using the same instrument as Bound and Turner, 2002). Following Bound and Turner, I include a birth-quarter linear time trend and standard errors are corrected for heteroskedasticity. All estimates use OLS, event when looking at Years of College.