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 a number of 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% 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% greater, among those who are employed in 1980, relative to comparable females who are not veterans. Because service was entirely voluntary for females, I use enlistment records, eligibility requirements, 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. In particular, when instrumenting for female veterans' educational attainment using age at the time of the G.I. Bill's announcement, I find that female veterans' earnings increased by $1,350 (11.6%) per year of G.I. Bill-induced education. My IV estimates imply that G.I. Bill-related education can explain about 73% of the overall difference between veteran and non-veteran females' earnings in 1980.

Keywords: Female Labor Market Outcomes, Gender Wage Gap, G.I. Bill, World War II

JEL: J31, I22, I24, I28, J71, N31, N42

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1 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.[1] The G.I. Bill, however, is perhaps best known for providing generous educational and training benefits. Depending on length of service, 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 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.[2] 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.[3]

Studying the effect of the G.I. Bill, Bound and Turner (2002) use a cohort-based approach to show that the combined effect of WWII service and the G.I. Bill was responsible for at least a 16 percent increase in the number of years of college and a 23 percent increase in college completion rates among male veterans. Stanley (2003) finds that Korean War and WWII G.I. benefits increased years of college for male veterans by between 15 to 20 percent. Little is known, however, about the causal effects of the G.I. Bill for the 330,000 females who served in WWII, despite the fact that records show that 19.5% of veteran females elected to use their G.I. benefits to pursue a college education, compared to only 15% of males.[4]

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 wages among veteran and non-veteran females using a cohort-based approach similar to that employed by Bound and Turner (2002). My estimates rely on data from the 1980 5% 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, my cohort-based regression

[1] Unemployment benefits were $20 per week for one year. Note that there is considerable disagreement regarding what "G.I." stands for. Some sources say it refers to Government Issue, others say it stands for Ground Infantry or even Galvanized Iron, referring to the metal used to manufacture older weaponry.

[2] 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).

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

[4] To be precise, 64,728 servicewomen attended college under the program out of a total of 332,178 eligible female veterans. See https://www.womensmemorial.org/history-highlight (last accessed 8/5/2020) for further discussion and information.

estimates suggest that WWII veterans were 19 percentage points (56.7%) more likely to report attending college, 7.8 percentage points (57.8%) more likely to report having completed their degree, and complete about one semester more college (52.6%) relative to comparable non-veterans. Among those who are employed in 1980, I find that female veterans earn $1,887 more per year, a 19.8% earnings boost relative to non-veteran females. Note that I focus on those born before 1926 because, in addition to being a high school graduate, female enlistees had to be 21 or older, meaning that a female born in 1926 would be too young to be a WWII veteran.[5] I exclude those born prior to 1919 because I want to avoid bias from endogenous retirement decisions - anyone born prior to 1919 would be eligible for early Social Security benefits in 1980. I examine the robustness of my findings to different sample restrictions in later sections.

While my cohort-based approach produces estimates that 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 findings may not have a causal interpretation. The first is that female veterans who volunteered for service may have 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 mention 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 solely related to college attendance after their period of service. To provide more direct evidence, 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. That being said, the number of females who were high school graduates and aged 21 or older who had not already attended college and, yet, 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 choose not

[5] See https://armyhistory.org/skirted-soldiers-the-womens-army-corps-and-gender-integration-of-the-u-s-army-during-world-war-ii/ for more on the requirements for female enlistees. Last accessed 10.13.2020.

to enlist in the army, further delaying their intended path, unless they knew that service would lead to generous educational benefits.[6] 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.[7] Furthermore, if many females enlisted only to obtain benefits, I would expect to see greater educational attainment among veterans who enlisted after the G.I. Bill was instituted. Instead, when I examine outcomes for females who were too young to enlist until 1944, I find that they were less likely to attend college compared to veterans who who were old enough to enlist prior to 1944.[8] Such a pattern also suggests that service itself does not lead to greater educational attainment.

While I revisit issues of selection in Section 4, the age profile and enlistment requirements for female veterans, the difference in behavior among those who enrolled at different times, along with the retroactive and unexpected nature of the G.I. Bill's benefits appear to suggest that relatively few female veterans would have attended college absent the G.I. Bill's educational benefits. That means that, while my data only allows me to identify female veteran status rather than those who qualified for significant G.I. Benefits, my estimates are consistent with the G.I. Bill being largely responsible for the additional educational attainment and associated higher earnings of female veterans rather than selection into or the experience of service itself. 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 are no idiosyncratic shocks to educational attainment that are also correlated with the decision to enlist during WWII.

When examining later-life earnings, leaving aside issues of selection into service, a third threat to identification is that service in the military may help to develop valuable skills that increase future earnings, absent any additional education. To separate the effect of military service from G.I. Bill-related education, 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 enlisted earlier in the war effort would receive more post-service support, at least on average. When I

[6] Such negative selection would work against finding any treatment effect and my estimates would then represent only a lower bound on the G.I. Bill's effect. Naturally, this is less concerning than the bias introduced by positive selection.

[7] 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.

[8] See Table 4 for these estimates.

instrument for educational attainment, my two-stage least squares estimates suggest that female veterans' earnings are larger by $1,350 (11.6%) per year of additional education. Combining female veterans' additional educational attainment with my IV estimates of the returns to an additional year of education implies that 73% of the overall earnings boost for female veterans can be explained by the effect of the G.I. Bill on educational attainment among veterans.[9] Note that because age in 1944 is not likely to be correlated with unobserved ability, at least among female veterans born between 1919 and 1925, my IV estimates also ease concerns that veterans who attend college because of the G.I. Bill would have higher earnings even absent that additional education.

My findings provide three significant contributions. 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 lead to significant later-life gains in earnings for female veterans, largely via increases in education rather than any 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, using data from the Panel Study of Income Dynamics, Blau and Kahn (2017) show that, in 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 causal estimate of the long term return to college for females during a uniquely interesting period in U.S. economic history.

[9] My 73% approximation combines regression based estimates of the increase in any college (19 percentage points) and college completion (41% of those who have any college) along with IV estimates of the returns to education for those induced to attend ($6,495) or complete college ($8,214). Specifically, $\$6{,}495\times.19\times.59 + \$8{,}214\times.19\times.41 = \$1{,}368$, which is 73% of $1,887, the overall difference in earnings for female veterans. See Section 4 for more on this.

I proceed as follows. In Section 2, I situate my work within and explain how it expands upon the literature that studies military service-related benefits. I also consider the literature on how and why female labor market outcomes have changed since WWII. In Section 3, I summarize the 1980 5% Census Public-Use Microdata Sample and describe my approach to estimation. I present my main findings in Section 4 along with estimates using different cohorts as control groups and various checks on robustness (see Appendix A, also). I offer concluding remarks in Section 5.

2 G.I. Bill Background and Literature

Military records show that more than 330,000 females served in the U.S. military forces 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). To a lesser degree, women also served in the Marines and the Coast Guard.[10] While 60,000 females served in the Army Nurse Corps a majority of servicewomen held clerical positions: typists, clerks, mail sorters, and so on. Such roles were essential to the war effort as having women fill these jobs freed up more men to engage in armed conflict.[11] To help veterans readjust to civilian life, congress passed the Servicemen's Readjustment Act in 1944, providing 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 on entirely on males. As I briefly mention earlier, Bound and Turner (2002) use data from the 1970 3% Census Sample to compare the collegiate attainment of white male WWII veterans relative to non-veterans. They find that college completion rates for veterans are at least four percentage points greater than comparable non-veterans when using a within-cohort approach (i.e., comparing across groups born in the same years) and up to 10 percentage points greater in a between-cohort approach (i.e., comparing veterans to those born just a few years later). Bound and Turner's between-cohort approach is likely biased, however, because men who served in WWII were

[10] See https://libguides.mnhs.org/wwii_women.

[11] The Nurse Corps served in both the U.S. and overseas. For more, see https://e-anca.org/History/ANC-Eras/1940-1950. Note that I present estimates where I exclude females who report being either doctors or nurses as an appendix item. Reassuringly, my findings are only very mildly attenuated when limiting the sample in this manner.

positively selected and men who were too young to serve in WWII had a high probability of serving in the Korean War. Potentially biasing estimates further, those who served in WWII were generally exempt from Korean War-related conscription while Korean War veterans later obtained educational benefits from the Veterans' Readjustment Assistance Act of 1952.

Instead of viewing 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. He then uses those findings to bound similar estimates for WWII veterans. Using data from the 1973 Survey of Occupational Change in a Generation, the identification provided by the sharp 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."

Estimating how the 1944 G.I. Bill affects male educational outcomes requires complex approaches to identification because the majority of men born between 1920 and 1935 served in either WWII or the Korean War, and sometimes both. The problem is that those who did not serve are either negatively selected in terms of physical fitness or had the knowledge and resources to be able to avoid service. To the extent that relatively few females served, that they had to be 21 and a high school graduate, and that their selection for service did not require them to be available for armed conflict, non veteran females who were born in the same years as females who served in WWII are likely a more valid within-cohort control group. Further, because it is also true that relatively few females served in the Korean War, those born just too late (1926 or later) to serve in WWII are a more valid between-cohort control group. For that reason, I adopt Bound and Turner's within-cohort approach (comparing outcomes among females born in the same years) for my main estimates and employ a between-cohort approach (comparing outcomes for veterans to those of otherwise similar females born just too late to serve in WWII) mainly as a robustness/sensitivity check.

On the other hand, the number of men who served ensured that WWII also affected non-veteran females, at least in the short term. As one example, Acemoglu et al. (2004) show that between 1940 and 1945 the percent of U.S. women over the age of 15 in the labor force increased by 21.5 percent (about 6 percentage points).[12] Acemoglu et al. use this response to the war effort to explore how increased female labor force participation affects male and female wages. Relying on differences in

[12]By 1990, the female labor force participation rate exceeded 57% (p. 498 of Acemoglu et al., 2004).

"military mobilization" (defined as the fraction of men who left to serve in the war) across states, they find that a 10 percent increase in female labor force participation reduced female wages by 7 to 8 percent but reduced male wages by only 3 to 5 percent. Notably, the war's impact on females was not limited to one generation; Fernández 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), later occupational choices (Bellou and Cardia, 2016), and contemporaneous educational choices (Jaworski, 2014). It is worth emphasizing, however, that Jaworski (2014), using the same "mobilization" approach as Acemoglu et al. (2004), finds that differences in educational attainment, labor market outcomes, and fertility disappear by 1970. Because I use 1980 data in my analysis and because WWII's impact on non-veteran females largely dissipates with time, Jaworski's findings provide further support for my within-cohort approach.

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 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%, so that use of veterans' benefits raises annual earnings by around 6% (1.4 years times 4.3%)." Angrist notes that this premium "appears to accrue primarily to the 77% of benefit users who attended college or graduate school" but not other types of eligible training.[13] 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

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

degree."[14] Females were not conscripted and were not required to serve for any particular period of time, 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 control 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 Deschênes, 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 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

[14] See Stanley (2003), p. 675.

[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).

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 examines whether the G.I. Bill caused many veteran females to obtain more education and whether such education for females lead to increased earnings.

3 Estimation Strategy and Data

To estimate the effect of the G.I. Bill on female labor market outcomes, I exploit variation in World War II service eligibility across birth-year cohorts. The general econometric specification is as follows;

$$Y_i = \alpha + \tau D_i + X_i\beta + \epsilon_i. \tag{1}$$

In equation (1), Y_i represents some educational or labor market outcome of interest for female veteran 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 treatment effect on female veterans using data from the 1980 5% 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% 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 turn 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 (i.e., 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% of those born in 1915, 66% of those born in 1916, 57% of those born in 1917, and 51% of those born in 1918 were not in the labor force. Among those born in 1919 and 1920, 49.4% and 46% were not in the labor force. Of those born in 1925, only 35% 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 prior in 1918 are the first cohort where a majority of females are not in the labor force. Notably, those born in 1918 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 a further selection issue in my sample.

The third reason is to make my main estimation sample as similar as possible to those born too late to serve in WWII when I examine between-cohort estimates. These between-cohort estimates examine differences in educational attainment and labor market outcomes for female veterans who turned 21 during World War II (born between 1919 and 1925) relative to females who were just too young to enlist (those born after 1925).[17] The idea here, similarly to Bound and Turner's approach, is that serving in WWII ensured that veterans delayed their entry into adult civilian life by a number

[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 allows those who enlist as late as 1946 to obtain at least some quantity G.I. Benefits.

of years. For that reason, the appropriate control group might be those who were born too late to serve in World War II. Including those born in 1918, 1917, and so on, would make the two groups increasingly dissimilar. I present estimates that also include earlier born females (1915 to 1918) as an appendix item. 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 are high school graduates. I also provide the same information for female high school graduates who turn 21 between 1947 and 1951 (i.e., born between 1926 and 1930). The summary statistics demonstrate that, in 1980, WWII veterans have higher earnings, more education, are more likely to be white, and are less likely to be married. The marital status patterns are noteworthy, with veterans being less likely to be married, and particularly so if they have 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 are less likely to be married.[18] Note that the summary statistics also demonstrate female patterns of enrollment in the army, with 3.26% (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% of those born in 1922 before declining markedly for those eligible to enlist after 1944. Such a pattern helps to ease concerns that females entered the army *in response* to the benefits provided by the G.I. Bill.

Alongside the information on cohort sizes by year of birth, I provide the percent of each cohort that attend any college. Notice that females who were born earlier, and therefore eligible to enlist in the war effort sooner, are 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 cohort 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.

[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.

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

		WWII Veterans		**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 ($\leq$3 years of College)		$ 11,316	8,097	$ 9,615	7,182	$ 9,457	7,104
Annual Earnings ($\geq$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	
Race	% White	97.4		93.1		91.2	
	% Black	1.9		5.4		6.8	
	% Other	0.7		1.5		2.0	
Observations		9,005		247,295		197,537	

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

4 Main Findings

I present my main findings in four subsections. First, I provide largely descriptive cohort-based estimates of the association between veteran status, labor market outcomes, and educational attainment in 1980. I then use the available information on the take-up of G.I. Bill benefits, differences in education in 1980, 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 unless the G.I. Bill was available by appealing to the variation provided by the G.I. Bill's announcement. Last, I use 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.

4.1 Descriptive Cohort-Based Estimates

To establish that the G.I. Bill is correlated with increased female earnings and educational attainment, I first examine the impact of WWII veteran status on indicators for any college, having completed four or more years of college (i.e., a Bachelor's degree or more), 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 mention earlier, because females had to be high school graduates to be eligible for WWII service, both my treatment (WWII veterans) and control (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, and race in each specification. I also cluster my standard errors at the state level.

Using an OLS-based Linear Probability Model, I find that female veterans (in 1980) are 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 are 4.5 percentage points more likely to be in the labor force relative to non-veteran female high school graduates. Female veterans, however, are 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 complete 49.8% 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 differ in ways that could affect earnings from employment. Confirming this suspicion, OLS estimates in column six suggest that WWII veterans earn $1,887 more in annual wages compared to non-veterans. Given annual wages of $9,518 for non-veterans, my findings imply that being a veteran is associated with a 19.8% boost in earnings relative to similar non-veterans. As an appendix item, I show that accounting for selection into the labor force (using a Heckman selection approach) leads to very similar estimates of the greater earnings of female veterans.

Note that I intentionally do not control for education when examining wages 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. I present estimates where I control for education and occupation as an appendix item. While the additional earnings of veterans are still large and statistically significant in those estimates, including education and occupation controls attenuates the effect of veteran status on earnings. Such a pattern suggests that the additional earnings of veterans comes, at least in part, from the additional education and subsequent occupation choices of veterans. 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 choice, and so on) for younger females, females from the same age cohort (born 1919 to 1925) are perhaps not the right control group. 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 still experience large and statistically significant increases in educational attainment and annual wages, regardless of the comparison group.

[19] In estimates not reported here, I find that veterans complete 6.4% more years of college than non-veteran females, conditional on attending at least some college.

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 Wages
	(OLS)	(OLS)	(Poisson)	(OLS)	(OLS)	(OLS)
WWII Veteran	0.190***	0.078***	0.498***	0.032***	-0.004	1,887.05***
	(0.005)	(0.005)	(0.015)	(0.007)	(0.003)	(139.03)
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	131,131
R-squared	0.032	0.020	-	0.070	0.003	0.30
	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 Wages
	(OLS)	(OLS)	(Poisson)	(OLS)	(OLS)	(OLS)
WWII Veteran	0.141***	0.043***	0.319***	0.022***	-0.003	1,730.46***
	(0.009)	(0.005)	(0.022)	(0.007)	(0.003)	(182.66)
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	0.31

Data: 1980 PUMS 5% Census Sample. Standard errors, clustered at the state level, 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, age (measured in quarters), and race.

As I mention earlier, 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 can affect earnings in at least two ways. First, veterans select into service, and may have 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 had access to G.I. benefits, reducing the cost of obtaining more education. The effect of WWII veteran status on wages 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 Sections 4.2 and 4.3, to 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, in Section 4.4, 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 attainments.

4.2 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 VA reports that 19.5% 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

[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.

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 WAC Enlistment Records.

female veterans aged between 21 and 26 at the time of enlistment.[23] Using the WAC enlistment records, I compare educational 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.[24] 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

[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.

[24]Census data retrieved from IPUMS (Ruggles, 2020).

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.

4.3 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).[25] 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 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 the available

[25]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).

Table 4: Selection After G.I. Bill Announced

	(1) Any College (OLS)	(2) Completed Degree (OLS)	(3) Years of College (Poisson)	(4) In Labor Force (OLS)	(5) Employed (OLS)	(6) Annual Wages (OLS)
WWII Vet × (b. 1923 or later)	-0.090***	-0.064***	-0.271***	0.010	-0.004	-116.09
	(0.011)	(0.009)	(0.028)	(0.008)	(0.007)	(269.73)
Observations	256,326	256,326	256,326	256,326	135,818	131,131
R-squared	0.032	0.020		0.062	0.003	0.30

Data: 1980 PUMS 5% Census Sample. 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.

evidence suggests few female veterans were likely to attend college without G.I. benefits, and the fact that enlistment is 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 be 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, data on college attendance in Table 1 illustrates 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 are somewhat less likely to attend college, complete their degree, and have fewer years of college compared to those who could enlist before the G.I. Bill was announced. They also have earnings that are lower but the estimate is not statistically significant. The lack of precision perhaps arises because those estimates are limited to only those who are employed and because only a relatively small proportion of the estimation sample consists of female veterans born after 1923. These estimates suggest that females selecting into service upon learning of the G.I. Bill's potential benefits are not driving my estimates.

Table 5: Education Interaction Estimates

	(1) Annual Wages	(2) Annual Wages	(3) Annual Wages
Any College?	6,342.98***		
	(155.30)		
WWII Veteran × Any College?	-286.66		
	(190.95)		
Years of College		745.86***	
		(97.69)	
WWII Veteran × Years of College		-213.78	
		(313.52)	
Degree (= 4 or more Years of College)			6,361.64***
			(157.91)
WWII Veteran × Degree (= 4 or more Years of College)			-583.55**
			(234.25)
Observations	131,163	131,163	131,163
R-squared	0.11	0.11	0.11

Data: 1980 PUMS 5% Census Sample. Standard errors, clustered at the state level, 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.

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 cause people 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

experience 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 is consistent with the higher average wages of veterans relative to non-veterans among those who do not attend any college (see Table 1).

4.4 IV Estimates

Before turning to an IV approach, I briefly summarize my findings. In Table 2, I show that WWII veterans' educational attainment and annual earnings from employment are 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 be those that 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. 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;

$$Educ_i = \alpha + \tau Age_{i,1944} + X_i\beta + \epsilon_i. \tag{2}$$

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 ($\widehat{Educ_i}$) I then estimate how additional education affects veterans' earnings;

$$Wages_i = \theta + \phi\widehat{Educ_i} + X_i\Gamma + \mu_i. \tag{3}$$

In practice, I use age in 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. I present two-stage least squares estimates, alongside the associated reduced-form OLS estimates, in Table 6. All specifications adjust standard errors for clustering at the state level and include state fixed effects while controlling for marital status and race. My OLS estimates further control for year-quarter of birth. My IV estimates do not control for year-quarter of birth because I use age as an instrument. The OLS estimates show that attending any college increases veteran's earnings by $2,392, completing at least four-years of college increases earnings by $3,567, and that each additional year of college corresponds to a $919 increase in earnings relative to veterans with only a high-school education.[26] Each estimate is significant at the 1% 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. In my IV estimates, where I instrument for later educational attainment using age in 1944, I find evidence that the OLS estimates likely underestimate the effect of G.I. Bill-induced education on earnings for female veterans. Specifically, the estimates suggest that female veterans induced to attend at least some college by the G.I. Bill have $6,485 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% annual return). Each estimate is significant at the 10% level and first stage F-statistics indicate that the instrument is not weak. Note again that using age in 1944 as an instrument (among individuals born between 1919 and

[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.

Table 6: Two-Stage Least Squares Wage Estimates

	OLS Estimates			IV Estimates (IV = Age at time of GI Bill Announcement)		
	(1)	(2)	(3)	(4)	(5)	(6)
	Annual Wage	Annual Wage	Annual Wage	Annual Wage	Annual Wage	Annual Wage
Any College	2,391.88***			6,495.00*		
	(213.60)			(3,354.15)		
≥Bachelor's Degree		3,566.96***			8,214.15*	
		(220.78)			(4,322.14)	
Years of College			918.80***			1,350.18*
			(53.65)			(696.94)
F-Stat First Stage				32.92	24.60	46.78
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

Data: 1980 PUMS 5% Census Sample restricted to female veterans born 1919 to 1925. Standard errors, clustered at the state level, 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.

1925) 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). 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).

Finally, while an 11.6% return to an additional year of education seems large, Card (1999) reviews the literature on the returns to education and finds that IV estimates range between 6% (Angrist and Krueger, 1991) and 15.3% (Harmon and Walker, 1995) in studies that use data from the 1970s, 1980s, and 1990s. Moreover, most of those studies focus on male earnings while Dougherty (2005) highlights that the literature tends to find that females benefit more from college education. Dougherty then shows that females experience an additional boost from education by reducing the gap in male and female earnings attributable to "discrimination, tastes, and circumstances." That is, education appears to provide generally similar skills and knowledge to men and women, but serves as a signal

that reduces bias and discrimination toward females. Note that Hubbard (2011) documents that the additional premium for female college attendance has dissipated in recent years.

My two-stage least squares estimates suggest that 72.5% 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. My back-of-the-envelope calculation relies on my earlier OLS estimates of the increase in any college (19 percentage points) and college completion (41% 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, $\$6{,}495\times.19\times.59 + \$8{,}214\times.19\times.41 = \$1{,}368$, which is 72.5% of the $1,877 overall increase in earnings for female veterans.

My IV estimates further limit concerns regarding positive selection relative to 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.

5 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. While several studies examine how the G.I. Bill affected male veterans, 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% 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, 7.8 percentage points more likely to report completing four years of college or more, and are 4.5 percentage points more likely to be in the labor force relative to non-veteran female high school graduates. 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 female veterans have $1,887 in additional annual earnings relative 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 (and that no non-veterans obtain G.I. benefits), my estimates are potentially a lower bound of the G.I. Bill's true effects.

I further 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 records, 1940 census data, and enlistment records to establish that attendance after service explains virtually all of the gap in female veterans' educational attainment. 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 overall 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. Notably, my IV estimates imply that 72.5% 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% of the overall wage 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 wage gap is consistent with studies that examine the returns to higher education for females (see Black et al., 2008, for example). Overall, however, my findings strongly suggest that the G.I. Bill caused significant additional educational attainment among females, and that such education lead to substantial increases in earnings for those females across their lifetime.

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Appendix A Additional Estimates

A.1 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."[A1] 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.

A.2 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.

A.3 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%) 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, who are my "between-cohort" control group. To formally illustrate, however, that I am not

[A1] See https://armyhistory.org/skirted-soldiers-the-womens-army-corps-and-gender-integration-of-the-u-s-army-during-world-war-ii/. Last accessed 10.13.2020.

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 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.

A.4 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-veteran's educational attainment. Such a pattern is consistent with Bound et al. (1995) who examine the bias associated with weak instruments.

A.5 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 wages 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 denotes a wage 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 model where the selection variable is employment status (employed/not-employed). The estimates from a Heckman selection approach are negligibly different relative to OLS estimates.

A.6 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.

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 Wages
	(OLS)	(OLS)	(Poisson)	(OLS)	(OLS)	(OLS)
WWII Veteran	0.236***	0.096***	0.795***	0.039***	0.001	2,372.37***
	(0.005)	(0.006)	(0.023)	(0.006)	(0.003)	(126.20)
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

Data: 1980 PUMS 5% Census Sample. Standard errors, clustered at the state level, 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 Wages
	(OLS)	(OLS)	(Poisson)	(OLS)	(OLS)	(OLS)
WWII Veteran	0.166***	0.071***	0.451***	0.017**	-0.006*	1,610.11***
	(0.005)	(0.006)	(0.013)	(0.008)	(0.004)	(140.46)
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

Data: 1980 PUMS 5% Census Sample. Standard errors, clustered at the state level, 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 Wages
	(OLS)	(OLS)	(Poisson)	(OLS)	(OLS)	(OLS)
WWII Veteran	0.201***	0.091***	0.526***	0.029***	-0.003	1,846.68***
	(0.005)	(0.005)	(0.016)	(0.005)	(0.003)	(137.37)
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

Data: 1980 PUMS 5% Census Sample. Standard errors, clustered at the state level, 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 Wage Estimates, Placebo Using Non-Veterans

	OLS Estimates			IV Estimates (IV = Age at time of GI Bill Announcement)		
	(1)	(2)	(3)	(4)	(5)	(6)
	Annual Wage	Annual Wage	Annual Wage	Annual Wage	Annual Wage	Annual Wage
Any College	2,594.64***			57,039.50		
	(109.35)			(95,201.78)		
≥Bachelor's Degree		4,332.73***			48,281.92	
		(142.17)			(66,355.22)	
Years of College			1,003.46***			6,992.74
			(28.71)			(5,974.64)
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	0.10			

Data: 1980 PUMS 5% Census Sample restricted to female non-veterans born 1919 to 1925. Standard errors, clustered at the state level, 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.

Table A5: Heckman Selection Model

	OLS		Heckman Selection Model
	(1)	(2)	(3)
	Annual Wages	Annual Wages	Annual Wages
WWII Veteran	1,414.41***	1,887.05***	1,926.13***
	(98.64)	(139.03)	(101.15)
Observations	256,326	131,163	256,326
Estimation Sample	All	Employed Only	All
Heckman Selection Variable			Employment Status

Data: 1980 PUMS 5% Census Sample restricted to female non-veterans born 1919 to 1925. Standard errors, clustered at the state level, in parentheses in OLS estimates. Clustering is not possible in a Heckman Two-Step Selection Model. *** 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) Annual Wages	(2) Annual Wages	(3) Annual Wages	(4) Annual Wages
WWII Veteran	1,887.05***	1,336.52***	904.53***	771.95***
	(139.03)	(146.55)	(132.937)	(135.593)
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

Data: 1980 PUMS 5% Census Sample restricted to female non-veterans born 1919 to 1925. Standard errors, clustered at the state level, 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.