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Author(s): Joshua Angrist and Alan B. Krueger
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Why Do World War II Veterans Earn More than Nonveterans?

Joshua Angrist, *Hebrew University and National Bureau of Economic Research*

Alan B. Krueger, *Princeton University and National Bureau of Economic Research*

World War II veterans earn more than nonveterans in their cohort. We test whether the World War II veteran premium reflects nonrandom selection into the military of men with higher earnings potential. The estimation is based on the fact that from 1942 to 1947 priority for conscription was determined by date of birth. Information on individuals' dates of birth may therefore be used to construct instrumental variables for veteran status. Empirical results from the 1960, 1970, and 1980 censuses, along with two other microdata sets, support a conclusion that World War II veterans earn no more than comparable nonveterans and may well earn less.

Cross-sectional comparisons show that, on average, veterans of World War II earn more and have lower unemployment rates than nonveterans of the same age. In contrast, Vietnam-era veterans earn less and have experienced more unemployment than comparable nonveterans in their cohort.[1] Differences in the consequences of veteran status in different eras

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[1] For example, Rosen and Taubman (1982) estimate a 10% loss of earnings to Vietnam-era veterans and a 17% gain to World War II veterans. Martindale and Poston (1979), De Tray (1982), and Berger and Hirsch (1983) find the same pattern of veteran premiums. Cohany (1987) finds higher relative unemployment rates for veterans of the Vietnam period than World War II.

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raises questions about the operation of the labor market and of the military. In this article, we explore alternative explanations for the apparently successful civilian labor market experiences of World War II veterans.

One hypothesis that has been advanced to explain the observed pattern of veteran wage premiums is that because the Vietnam war was an unpopular cause, men who served during that era were discriminated against when they returned to the civilian labor market. In contrast, since World War II was a widely supported war, it has been argued that veterans from that period were given preferential treatment in civilian employment. Positive feelings about World War II may also have translated into political support for relatively generous subsidies for education and preferential treatment in hiring.[2] Alternatively, the "skills" learned in the military during World War II may be more rewarded in the civilian labor market than skills learned in the military during the Vietnam era.

The explanations mentioned above presume that the observed correlation between veteran status and earnings is truly caused by military service. A plausible alternative explanation, however, is that observed differences in labor market consequences of veteran status are instead generated by differences in the selection process for service. There is evidence that many college-educated young men from wealthy families avoided military service during the Vietnam period, while low-income young men were unable to avoid service or chose not to avoid service (e.g., see Cooper 1977). In contrast, nearly 75% of men from eligible cohorts served in the armed forces during World War II, and those who failed to serve were often physically or otherwise unfit. These selection forces are likely to induce a positive bias in estimates of the veteran premium for World War II veterans, and a negative bias for Vietnam-era veterans.

Angrist (1989, 1990) uses the Vietnam-era draft lottery to attempt to overcome selection problems in estimates of the effect of Vietnam-era military service on earnings. His main conclusion is that even after accounting for selection forces, white Vietnam-era veterans suffered substantial earnings losses when they returned to the civilian labor market, although black veterans may have suffered no loss in earnings. Additionally, he finds that the earnings differential associated with serving in the military during the Vietnam era appears to be accounted for by the fact that veterans have less civilian job experience. This finding naturally raises the question of why World War II veterans appear to have fared comparatively better than Vietnam-era veterans.

This article reexamines the World War II veteran premium using econometric techniques to control for nonrandom selection into the military. The key to our estimation is the use of instrumental variables that are correlated with veteran status but uncorrelated with other determinants

[2] Public perceptions of the treatment accorded returning Vietnam-era veterans are described in Veterans Administration (1980, p. 36).

of earnings. Instruments are available because after 1942 men were drafted for military service in chronological order of birth. Variations in military demand during the course of the war generate a correlation between birthdays and the probability of service, with men born in the beginning of the calendar year having a higher probability of conscription than men born later in the year. If birthdays are uncorrelated with unobserved personal characteristics, they can be used to identify the effect of veteran status on earnings.

Our econometric strategy is to use dummy variables indicating quarter of birth as instruments for veteran status in an earnings equation. Because a large sample of World-War-II-era men is necessary to precisely estimate the veteran's premium with this approach, most of the analysis is based on the 1980 census. In marked contrast to the ordinary least squares (OLS) estimates, the two-stage least squares (2SLS) estimates indicate that veterans of World War II actually earn less than comparable nonveterans. Furthermore, we find generally corroborative results in four other microdata sets. Under a variety of alternative identifying assumptions, our findings support the conclusion that positive estimates of the World War II veteran premium are due entirely to nonrandom selection into the military.

I. Selective Service in World War II

In 1940 Congress approved the first peacetime conscription measure in the history of the United States.[3] Some 16,354,000 men served in the armed forces during the World War II era (1940–47); 10 million of these men were drafted.[4] In the first step of the conscription process, the Pentagon requested that the Selective Service call a certain number of men to be inducted by a specific date. Local draft boards then filled requests for induction by notifying registered men to report for induction in the order assigned to them on the basis of state quotas and official "order numbers."

There were a total of seven national draft registrations between 1940 and 1947. Virtually all male U.S. citizens and resident aliens were required to register. In the first through fourth registrations, held from 1940–42, order numbers were assigned in local "fish bowl" lotteries.[5] In the fifth and sixth registrations, held from June 1942 to March 1947, order numbers were assigned on the basis of birthdays, with individuals born in the beginning of the year more likely to be called for induction. The sixth registration was divided into two parts, with the second part covering the period 1943–47. The second part of the sixth registration, which included

[3] Unless otherwise noted, the material in this section is drawn from Selective Service System (1946, 1947, 1948, 1950, 1952, 1955, and 1986).

[4] See *Statistical Abstract of the United States* (U.S. Department of Commerce 1987), table 550.

[5] The seventh registration was relatively small, involving only male citizens residing abroad.

men born between January 1, 1925, and March 31, 1929, is significant because voluntary enlistments were prohibited during this registration.

Local draft boards proceeded down their lists of registrants in chronological birth order to fill their calls. Once a draft board had successfully called enough men to satisfy its quota, remaining men on the registrant list were not at risk for conscription unless another call was issued to the draft board. This process generated a correlation between date of birth and the probability of military service. Our empirical analysis focuses on registrants whose order numbers were assigned in the second part of the sixth registration (born after January 1, 1925) because, as shown below, there is a correlation between date of birth and veteran status for these cohorts.

Following registration and assignment of order numbers, registrants were given a physical examination and classified by their local boards. More than six million men who were called for induction were found unsuitable for service and rejected by the Selective Service System. Sixty-four percent of registrants who were exempted or rejected for service were classified as physically or mentally unfit. Another 34% of deferments were for occupational reasons, such as wartime production (Selective Service System 1950, p. 322).

The minimum term of service in the armed forces for draftees was 18 months, with an additional requirement to serve in the reserves after the tour of duty expired. The requirement to serve in the reserves, however, was waived for draftees who agreed to stay in the regular army for an additional 24 months. The GI Bill of Rights, which was passed in 1944, entitled veterans to subsidized education and training benefits.

Stoufer et al. (1949, p. 312) estimate that "out of every four men in the Army one had a combat job and of the remaining three, one had a clerical job, one had a skilled job, and one had a semi-skilled or unskilled job." Military jobs may have provided skills that were transferable to the civilian labor market. However, in spite of the relatively low fraction of soldiers involved in combat, the battle-related death rate for U.S. forces during World War II was 1.8 per 100 troops, and 4.1 soldiers per 100 suffered a nonfatal wound.[6]

II. Data and Descriptive Analysis

Our main empirical analysis uses the 5% public-use sample of the 1980 census.[7] This data set contains information for a self-weighting sample of 11 million individuals in the United States as of April 1, 1980. We limit

[6] These statistics are derived from *Statistical Abstract of the United States* (U.S. Department of Commerce 1987), table 550.

[7] The 1980 census is described in the technical documentation for *Census of Population and Housing, 1980: Public-Use Microdata Samples* (U.S. Department of Commerce 1983).

our initial sample to male citizens who were born in the United States between 1919 and 1929 and resided in the 48 contiguous states or District of Columbia. The earnings information in the survey pertains to total wage and salary in the preceding calendar year (i.e., 1979). Men who served in the military between September 1940 and July 1947 are classified as veterans of the World War II period. Any individual whose response was imputed to the sex, age, quarter-of-birth, veteran status, veteran period, salary, or weeks worked questions was eliminated from the sample. We further restrict the sample to individuals whose weekly wage was between $25 and $5,000.

After these restrictions, our sample contains 335,989 men.[8] Descriptive statistics for this sample are provided in table 1. On average, World War II veterans earn higher wages and have more education than nonveterans. There is only a trivial difference, however, in the probability that veterans and nonveterans report that they have a disability that restricts the kind or amount of work that they can perform.

A. OLS Results by Birth Year

Table 2 presents OLS estimates of the World War II veteran premium along with the proportion of men who served in World War II by year of birth. In column 3, the veteran premium is the difference in mean log earnings between veterans and nonveterans, and in column 4, each veteran premium is estimated from a log earnings equation that includes education, disability status, race, marital status, and eight region dummy variables. The finding of a positive World War II veteran premium for most cohorts is consistent with results from previous studies, such as De Tray (1982).

The table also shows that the veteran premium is not constant across birth cohorts. The veteran premium tends to be lower for cohorts that have a relatively low fraction of World War II veterans. If veteran status were randomly assigned, we would not expect the veteran premium to vary with the fraction in each cohort who served.[9] In addition, the results indicate that the veteran premium is more than halved when covariates are included. Both of these findings suggest that at least part of the veteran premium is due to the correlation of veteran status with other characteristics that are related to earnings.[10] In terms of measurable characteristics, veterans tend to possess relatively more attributes that are rewarded in the workplace (see table 1).

[8] Before deletions the sample size was 449,362. The major reason for deleting an observation in 1980 was zero weeks worked.

[9] On the other hand, conditions and length of military service varied for these cohorts as well. Table 2 suggests that the men most likely to serve in wartime (presumably, under the worst conditions and longest terms) have the largest veteran's differential.

[10] See De Tray (1982) for an alternative explanation of why the veteran premium varies with the fraction who served based on the screening hypothesis.

Table 1
Means and Standard Deviations

Variable	World War II Veteran	World War II Nonveteran
Annual salary	21,386	19,251
	(12,915)	(12,714)
Weekly wage	442.59	398.45
	(281.68)	(272.17)
Years of education	12.36	11.38
	(3.21)	(3.97)
Attended college	.35	.28
	(.48)	(.45)
White	.95	.87
	(.23)	(.34)
Work disability	.10	.09
	(.30)	(.29)
Currently married	.90	.85
	(.31)	(.35)
Age	55.75	53.58
	(2.75)	(3.28)
Weeks worked in 1979	48.69	48.41
	(8.75)	(8.89)
Labor force participation rate*	.86	.83
	(.35)	(.38)
Sample size	215,272	120,717

NOTE.—Tabulated from the 1980 census. Sample includes men born between 1919 and 1929, inclusive. Except for the labor force participation rate, all variables are based on the sample of men with work experience in 1979. Standard deviations are shown in parentheses.

* Sample size for labor force participation rate is 268,374 for veterans and 160,798 for nonveterans.

B. Quarter of Birth and Veteran Status

The information on date of birth in the 1980 census is limited to respondents' quarter of birth. Table 3 shows how the probability of veteran status varies by quarter and year of birth for men who were at risk of being drafted in the fifth and sixth registrations. For example, 71% of men born in the first quarter of 1927 are World War II veterans, while only 58% of men born in the fourth quarter of 1927 are World War II veterans.

The probability of serving in the military declines monotonically with year of birth for men born after the third quarter of 1925. This decline reflects the fact that induction calls peaked in 1943 and decreased thereafter. For each birth cohort after 1925, those born in the first quarter of the year have a higher probability of serving in the military than those born in the fourth quarter of the year.

Table 3 also shows the marginal significance level for F-tests of the joint significance of three quarter-of-birth dummy variables in linear probability models of veteran status.[11] Two sets of significance levels are reported: the first is for an F-test with three degrees of freedom in a regression of World

[11] We note that the error variance in the linear probability model is necessarily heteroscedastic. When we correct for heteroscedasticity using weighted least squares, however, there is only a trivial difference in the marginal significance levels.

Table 2
The World War II Veteran Premium by Cohort in 1980

Birth Year (1)	Proportion of Male Workers Who Served in World War II (2)	Proportional Annual Earnings Differential: Without Covariates* (3)	Proportional Annual Earnings Differential: With Covariates† (4)	Sample Size (5)
1919	.732	.175 (.011)	.066 (.011)	23,469
1920	.755	.191 (.011)	.088 (.010)	27,494
1921	.779	.198 (.010)	.084 (.010)	29,042
1922	.780	.238 (.010)	.097 (.010)	29,314
1923	.766	.267 (.010)	.108 (.009)	30,196
1924	.759	.287 (.009)	.124 (.009)	32,043
1925	.750	.276 (.009)	.104 (.009)	32,233
1926	.739	.266 (.009)	.109 (.008)	32,271
1927	.656	.243 (.008)	.094 (.008)	33,759
1928	.308	.087 (.008)	.032 (.008)	33,091
1929	.122	−.034 (.012)	−.011 (.011)	33,077

NOTE.—Separate regressions were estimated for each birth year. Standard errors are shown in parentheses. The sample is drawn from the 5% sample of the 1980 census and excludes men living outside the continental United States.

* Calculated as the difference in mean log earnings between World War II veterans and nonveterans.

† Each differential is the coefficient on a World War II veteran status dummy variable from a log wage regression including the following controls: years of completed education, disability status dummy, white dummy, currently married dummy, eight region dummies, and an intercept.

War II veterans status on three quarter-of-birth dummies interacted with a full set of year-of-birth dummies; the second is for the same F-test in a regression that also includes a nonwhite dummy, a dummy for current marital status, a standard metropolitan statistical area (SMSA) dummy, years of completed education, a disability status dummy, and 48 state-of-birth dummies.

The prob-values indicate a statistically significant relationship between quarter of birth and World War II veteran status for men born from 1925–29. Men born during this period were at risk of being drafted in part 2 of the sixth registration. Moreover, the second part of the sixth registration coincides with the period in which voluntary enlistments were prohibited. Enlistments accounted for approximately 40% of World War II accessions from 1940–42 (Selective Service System 1948, table 113). Consequently, the wave of voluntary enlistments prior to January 1, 1943, may obscure any relationship between quarter of birth and veteran status for cohorts

Table 3
Proportion of World War II Veterans by Quarter of Birth

Year of Birth	Quarter of Birth 1	2	3	4	Marginal Significance Level of Quarter-of-Birth Dummies: Quarters Alone*	Quarters with Covariates†
1922	.779	.782	.782	.776	.8161	.5001
1923	.760	.769	.769	.767	.5386	.5230
1924	.759	.757	.760	.758	.9824	.9123
1925	.744	.745	.761	.749	.0380	.1762
1926	.749	.745	.732	.730	.0096	.0031
1927	.714	.695	.633	.581	.0000	.0000
1928	.445	.306	.254	.223	.0000	.0000
1929	.170	.126	.109	.085	.0001	.0001

* Significance level for F-test of joint significance of three quarter-of-birth dummies in a regression of veteran status of a full set of quarter-of-birth/year-of-birth interactions.

† Significance level for F-test of joint significance of three quarter-of-birth dummies each year in a regression of veteran status on a full set of quarter-of-birth/year-of-birth interactions, a nonwhite dummy, a current marital status dummy, 48 state of birth dummies, an SMSA dummy, years of completed schooling, and a disability status dummy.

born before 1925. In the empirical analysis below, we limit our sample to men born between 1925 and 1928 because these cohorts were entirely encompassed by part 2 of the sixth registration.

III. Estimation and Results

We estimate human capital earnings functions of the form

$$\ln W = V\beta + X\xi + \sum_j Y_j\tau_j + \varepsilon, \quad j = (1926, 1927, 1928), \qquad (1)$$

where W is earnings, X is a row vector of explanatory variables, V is a veteran-status dummy variable that equals one for veterans of World War II, β is (subject to the log approximation) the veteran premium, Y_j is a dummy variable indicating year of birth, ξ is a vector of parameters, and ε is an error term. Ordinary least squares estimates of equation (1) will be biased if V and ε are correlated. In particular, it is likely that OLS estimates of β are biased upward because the Selective Service tended to reject registrants with a low earnings capacity (e.g., low achievers on the armed forces qualifying exam and those with disabilities).

The institutional description in the previous section suggests the following "first-stage" equation for the determination of veteran status:

$$V = Z\theta + \sum_j Y_j\alpha_j + X\pi + \mu, \quad j = (1926, 1927, 1928), \qquad (2)$$

where V is a veteran status indicator variable, $Z = (Q_1, Q_2, Q_3, Q_1 * Y_{1926}, \ldots, Q_3 * Y_{1928})$ is a row vector of quarter-of-birth dummies and quarter-of-birth dummies interacted with year-of-birth dummies, Y_j is a year-of-birth dummy variable, X is the vector of explanatory variables in equation (1), μ is an error term, and θ, α, and π are conformable vectors of parameters.[12]

Since earnings capacity is likely to be independent of the date an individual is born, quarter of birth is an appealing instrument for veteran status. For this approach to give a consistent estimate of β, however, Z must not appear in the earnings equation after conditioning on year of birth. This assumption is particularly likely to hold for middle-aged workers, who tend to have a flat age-earnings profile.

A. Basic Results

Table 4 presents OLS and 2SLS estimates of earnings equations with alternate sets of covariates. In columns 1 and 4, results are shown for equations that include only dummies for year of birth and veteran status. These results show a dramatic difference between the OLS and 2SLS estimates—the veteran premium is 22% with a *t*-ratio exceeding 50 in the OLS equation and −13% with a *t*-ratio of −3.4 in 2SLS estimation using quarter of birth as an instrument for veteran status.[13] The contrast between the OLS and 2SLS estimates is also evident in columns 2 and 5, which report specifications including additional dummies for race, marital status, state of residence, and whether the individual works in an SMSA.

B. Results Conditional on Education and Disability Status

Columns 3 and 6 show the results of adding education and disability status to the list of regressors. These results are presented for two reasons. First, they may be viewed as giving the "partial" effect of veteran status because veteran status may influence earnings through its effect on education (e.g., the GI Bill) and health. Second, elsewhere we have shown that quarter of birth is related to educational attainment because of the interaction between compulsory schooling laws and age at school entry (Angrist and Krueger 1991). In particular, men born in the first half of the year complete approximately one-tenth of a year less schooling than men born in the second half. Although the effect of quarter of birth on

[12] The fact that the endogenous regressor (V) is a dummy variable suggests that a probability model is in order for the first-stage equation. However, consistent estimation of the reduced form is not necessary for consistent estimation of the structural parameters (see Heckman 1978; and Kelejian 1971).

[13] An (approximate) specification test (Durbin 1954; and Hausman 1978) for the difference between OLS and 2SLS estimates can readily be calculated because the standard error of the OLS estimate is so small that the standard error of the difference in coefficients is essentially the standard error of the 2SLS estimate. This test shows all three 2SLS estimates to be significantly different from the OLS estimates.

Table 4
Basic Results on the Return to World War II Service (1980 Census, Men Born 1925–28)

	OLS			2SLS*		
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Constant	9.586	9.008	8.053	9.846	9.136	8.086
	(.005)	(.014)	(.015)	(.030)	(.022)	(.034)
WW II veteran (1 = yes)	.215	.154	.078	−.132	−.149	−.064
	(.004)	(.004)	(.004)	(.039)	(.038)	(.034)
Born 1926	.016	.018	.011	.012	.015	.009
	(.006)	(.005)	(.005)	(.006)	(.005)	(.005)
Born 1927	.039	.036	.018	.007	.008	.005
	(.005)	(.005)	(.005)	(.007)	(.006)	(.006)
Born 1928	.124	.101	.050	−.029	−.032	−.012
	(.006)	(.006)	(.005)	(.018)	(.017)	(.016)
White	...	.344	.230	...	.418	.260
		(.007)	(.006)		(.012)	(.009)
Currently married	...	.342	.317	...	.364	.327
		(.006)	(.005)		(.006)	(.006)
48 state dummies	No	Yes	Yes	No	Yes	Yes
SMSA	...	.145	.112	...	.159	.116
		(.007)	(.007)		(.007)	(.007)
Years of completed education	...	...	.062	...	...	.065
			(.0005)			(.0008)
Disability	...	...	−.420	...	...	−.420
			(.006)			(.006)
R^2	.019	.094	.218	.0003	.083	.214
χ^2 (df = 11)	N.A.	N.A.	N.A.	15.4	18.3	22.3
Prob-value				.164	.074	.022

NOTE.—Sample size is 131,354. Dependent variable is log annual earnings in 1979. OLS = ordinary least squares; 2SLS = two-stage least squares; df = degrees of freedom; N.A. = not applicable. Standard errors are shown in parentheses.

* World War II veteran status is identified by the exclusion of quarter-of-birth dummies interacted with year-of-birth dummies.

educational attainment is small, it may be important to control for education when using quarter-of-birth dummies as instruments for veteran status.

Comparing columns 2 and 3 shows that the addition of education and disability status as covariates nearly halves the OLS estimate of the veteran premium. The results in column 6 indicate that the 2SLS estimate of the veteran effect is still negative once education and health are held constant, although the 2SLS estimate is also reduced in magnitude. Aside from the effects of veteran status on education, attenuation in the 2SLS estimates may also reflect the fact that education levels were increasing for succeeding generations of men in this era. Like the effects of compulsory attendance laws, this would also lead individuals born in the beginning of the year—who are more likely to be veterans—to have less education and therefore earn less.

The excluded instruments consist of three quarter-of-birth dummies interacted with four year dummies, so the 2SLS models are overidentified by 11 degrees of freedom. The last row of table 4 reports the generalized method of moments (GMM) overidentification test statistic for tests of instrument-error orthogonality (see, e.g., Newey 1985). All of the equations fail to reject the hypothesis of orthogonality at the 1% level, and only column 6 rejects at the 5% level. Given the large sample size, the failure to reject this null hypothesis in a classical hypothesis test is notable. These findings suggest that quarter of birth is a valid instrument for these equations.

C. Other Data Sets and Time Periods

Table 5 presents additional OLS and 2SLS estimates of the World War II veteran premium based on the 1960 census (1% sample), the 1970 census (3% sample), the first wave (1983) of the Survey of Income and Program Participation (SIPP; U.S. Department of Commerce 1985), and the 1973 Current Population Survey-Social Security Exact Match (CPS-SSA). To the extent possible, we constructed samples and variables that are comparable to our extract of the 1980 census (see the Data Appendix for details). Our motivation for examining these additional data sets is twofold: we would like to study how the World War II veteran premium evolves over the life cycle, and we are interested in exploring the robustness of the basic results in other samples.

Estimates based on the three censuses, which follow the same cohort of men over time, are reported in panel A. (For comparison, we also report the results of the 1980 census.) The OLS estimates show that the positive veteran premium declines as the cohort grows older. For example, when we control only for birth year, veterans earn 31% more than nonveterans in 1960, 26% more in 1970, and 22% more in 1980. A possible explanation for the declining veteran premium over time is that selection for military service took place in the 1940s, and the characteristics on which selection was based may have become "diluted" with time. For example, some individuals who were excluded from service because of a physical impairment at age 18 may have at least partially recovered from the impairment over time.

Panel B of table 5 reports results from the CPS-SSA Exact Match and the SIPP. The results in both panel A and panel B show that although the World War II veteran premium is positive and statistically significant when estimated by OLS, it becomes negative and statistically insignificant when quarter-of-birth dummies are used as instruments. Given the large sampling variation in the 2SLS estimates based on the CPS-SSA Exact Match and SIPP, however, it is difficult to draw meaningful conclusions about the magnitude of the veteran premium in these data sets.

The 2SLS estimate of the veteran premium is more negative in the 1980 census than in the 1960 and 1970 census. One explanation for this finding is based on age-related correlation between quarter of birth and earnings. Between 1960 and 1970, the cohorts we examine were between age 31 and

45, which would place them on the upward-sloping portion of the cross-sectional age-earnings profile. In contrast, by 1980 this cohort of men reached their early fifties and would have been at the peak or downward sloping portion of the cross-sectional age-earnings profile.[14] As a result, in 1960 and 1970 men born in the beginning of the year would be expected to earn more than men born at the end of the year, while in 1980 the exact opposite would be expected. Since quarter of birth is always negatively correlated with veteran status, the 2SLS estimates will be biased upward in 1960 and 1970, and possibly biased downward in 1980. This possibility led us to explore potential downward bias in the 1980 2SLS estimates in Section IV.

Finally, results from the three censuses have implications for the hypothesis that the effect of military service on civilian earnings is due to a loss of civilian labor market experience. Under the standard assumption of a concave experience-earnings relationship, the loss-of-experience hypothesis predicts that the (negative) veteran premium would decline (in absolute value) with labor market experience. Angrist (1990) and Crane and Wise (1987) tentatively conclude that the gap in earning between Vietnam-era veterans and nonveterans is consistent with this hypothesis. In contrast to the prediction of the loss-of-experience model, however, 2SLS estimates based on the censuses show that the World War II veteran premium may have become more negative over time.

IV. Specification Analysis

If quarter of birth cannot be legitimately excluded from equation (1), then the 2SLS estimates are inconsistent. We have taken three alternative approaches to gauge the extent of omitted variable bias in our basic 2SLS estimates. In the first and second approach, we assume that the relationship between earnings and quarters has a known parametric form and construct 2SLS estimators that are robust to misspecification. In the third approach, we use estimates of the effect of quarter of birth on earnings for a sample of men for whom veteran status is orthogonal to quarter of birth to control for bias due to an imperfect instrument.

Formally, let the correctly specified wage equation be

$$\ln W = V\beta + Z\gamma + \varepsilon, \tag{3}$$

where the variables are defined as before and we have dropped the covariates for expositional purposes. The inclusion of the term $Z\gamma$ signifies that some

[14] For example, Mincer's (1974) estimate of the experience-earnings profile implies that earnings peak at age 52 for high school graduates, and at age 56 for college graduates (see table 5.1). Murphy and Welch's (1990) less restrictive estimates of experience-earnings profiles show a peak at similar ages, but tend to be flatter around the peak.

Table 5
Estimates of the World War II Veteran Premium in Other Data Sets and Time Periods

Data Set and Year	Wage Variable	Covariates	OLS	2SLS	χ^2 Overidentification Statistic (df = 11)*
A:					
1960 census 1% sample (N = 37,469)	Log annual earnings in 1959	Three birth year dummies	.309 (.008)	−.001 (.080)	9.21 [.603]
		Above plus white; married; 48 state dummies; SMSA dummy	.201 (.007)	−.078 (.075)	6.59 [.831]
		Above plus education	.115 (.007)	−.023 (.069)	4.75 [.943]
1970 census 3% sample (N = 108,306)	Log annual earnings in 1969	Three birth year dummies	.258 (.005)	−.024 (.045)	19.20 [.058]
		Above plus white; married; eight region dummies; SMSA dummy	.184 (.005)	−.043 (.042)	15.78 [.149]
		Above plus education	.090 (.004)	.023 (.038)	15.83 [.148]
1980 census 5% sample (N = 131,354)	Log annual earnings in 1979	Three birth year dummies	.215 (.004)	−.132 (.039)	15.41 [.164]
		Above plus white; married; 48 state dummies; SMSA dummy	.154 (.004)	−.149 (.038)	18.33 [.074]
		Above plus education and disability dummy	.078 (.004)	−.064 (.034)	22.31 [.022]

B:					
1973 CPS-SSA Exact Match (N = 2,292)	Log annual earnings in 1972	Three birth year dummies	.171 (.034)	−.412 (.346)	11.34 [.415]
		Above plus white; married; eight region dummies; SMSA dummy	.143 (.033)	−.232 (.301)	10.75 [.464]
		Above plus education	.088 (.031)	−.092 (.270)	8.69 [.650]
1983 SIPP (N = 512)	Log monthly earnings in 1983	Three birth year dummies	.182 (.065)	−.094 (.340)	10.83 [.458]
		Above plus white; married; eight region dummies	.103 (.064)	−.260 (.331)	9.45 [.580]
		Above plus education and good health dummy	−.010 (.060)	−.355 (.310)	7.22 [.781]

NOTE.—Each sample contains men born in 1925–28. The data sets are described in the Data Appendix. OLS = ordinary least squares; 2SLS = two-stage least squares; df = degrees of freedom. Standard errors are shown in parentheses.

* Prob-value for generalized method of moments (GMM) overidentification test given in brackets.

function of the instruments, Z, is assumed to belong directly in the second-stage equation. In addition, we continue to assume that $\text{cov}(V, \varepsilon) \neq 0$, so that OLS estimates of (3) are biased and inconsistent. It can easily be verified that if $\ln W = Vb + \nu$ is estimated by 2SLS using the Z variables as instruments, the probability limit of the veteran premium b is given by

$$\text{plim } b = \beta + \text{plim}(V'P_z V)^{-1} V'Z\gamma, \tag{4}$$

where $P_z = Z(Z'Z)^{-1}Z'$.

To gauge the potential importance of this bias, note that if Z were a scalar variable the asymptotic bias of the 2SLS estimate of β simplifies to γ/ρ, where ρ is the coefficient from an OLS regression of V on Z. A typical OLS estimate of a quadratic experience-earnings profile would imply that, for 55-year-old men, those born in the first quarter of the year earn roughly .6% less than men born in the fourth quarter of the year (e.g., Mincer 1974). Therefore, we could take $-.006$ as a crude estimate of γ in a model that uses a first versus fourth quarter indicator variable as Z. Furthermore, the differential probability of veteran status between first and fourth quarter births is roughly 10%–20%, which we use as a rough estimate of ρ. Thus, in 1980 the bias in the 2SLS estimate of the veteran premium due to omitted age may be on the order of -3% to -6% for the 1925–28 cohort. Of course, the bias has the opposite sign in 1960 and 1970 because of the positive slope in the age-earnings profile.

A. Constructing an Instrument That Is Orthogonal to Age

Since veteran status and quarter of birth are related in a nonlinear way, it is possible to construct instruments from quarter of birth that are uncorrelated with age, but correlated with veteran status. Specifically, we rely on the fact that a dummy variable indicating whether an individual is born in the middle 2 quarters of the year is orthogonal to *linear* age if births are identically distributed over quarters of the year.[15]

The first three rows of table 6 present estimates of the World War II veteran premium using an indicator for the middle 2 quarters and interactions with the three year-of-birth dummies as instruments. Although the new instrument leads to a very imprecise estimate of the veteran premium, these estimates are close to zero or slightly negative. As would be expected if the sample under study were on the downward-sloping segment of the age-earnings profile, the orthogonal instrument yields estimates that are less negative than the previous 2SLS results.

[15] This approach was suggested to us by Orley Ashenfelter. In actuality, there is a slight peak in the birth distribution in the third quarter of the year (26.5% of births are in the third quarter in our data). This small deviation is unlikely to affect our estimates.

Table 6
Exploration of Robustness of Veteran Premium

Estimator	Covariates	Veteran Premium
1. Middle-of-the-year dummies interacted with year-of-birth dummies; orthogonal with age by construction	Three cohort dummies	−.048 (.134)
	Above plus white, married, 48 state dummies, and SMSA dummy	−.017 (.126)
	Above plus education and disability status	.012 (.114)
2. 2SLS controlling for quadratic age effect measured in quarters	Three cohort dummies, age, and age squared	−.125 (.113)
	Above plus white, married, 48 state dummies, and SMSA dummy	−.099 (.105)
	Above plus education and disability status	−.075 (.095)
3. Control fuction estimation	Three cohort dummies	−.071 (.048)
	Above plus white, married, 48 state dummies, and SMSA dummy	−.082 (.046)
	Above plus education and disability status	−.049 (.041)

NOTE.—Data set is 1980 census. The dependent variable is log annual earnings in 1979. Estimators 1 and 2 are based on a sample of 131,354 men born between 1925 and 1928. Estimator 3 is based on a sample of 193,593 men born between 1923 and 1928. Standard errors are shown in parentheses.

B. Controlling for Quadratic Age in Quarters

An alternative to the use of an instrument that is orthogonal to linear age is to assume that $Z\gamma$ has a more general functional form. For example, age-earnings profiles are often estimated with a quadratic specification. Even slight concavity of the within-birth-year age-earnings profile could lead to bias in the 2SLS estimates because differences in the probability of veteran status within birth years are also small. Assuming that the relationship between earnings and quarter of birth is quadratic leads to the following specification:

$$\ln W = V\beta + A\gamma_1 + A^2\gamma_2 + \sum Y_j\tau_j + \nu, \quad j = (1926, 1927, 1928), \qquad (5)$$

where A is age measured in quarter-years. The coefficient β can be consistently estimated by using quarter-of-birth dummies as instruments and including a quadratic age term along with the other regressors.

The results of 2SLS estimation of equation (5) are shown in rows 4–6 of table 6. The estimated veteran premium from this exercise is also imprecise, but the magnitude of the premium is similar to those estimated in our basic specification. It is also worth noting that the coefficients on the linear and squared age terms never exceed their standard errors.

C. Control Function Estimation

Our third set of specification analyses is based on the fact that the correlation between quarter of birth and veteran status was found to be insignificant for men born between 1922 and 1924. We can therefore control for a possible relationship between earnings and quarters conditional on veteran status by using the sample of men born in 1923 and 1924 to construct an estimate of γ while jointly estimating equation (3). In a different context, Heckman and Robb (1985) have referred to this approach as the use of a "control function."

Write the basic regression model for two samples, indexed by 1 (men born 1923–24) and 2 (men born 1925–28) as

$$\left.\begin{aligned} \ln W_1 &= X_1\xi_1 + Z_1\gamma + \{V_1\beta + \varepsilon_1\} \\ \text{and} \quad & \\ \ln W_2 &= X_2\xi_2 + V_2\beta + Z_2\gamma + \varepsilon_2 . \end{aligned}\right\} \qquad (6)$$

In the first sample, OLS regression of $\ln W_1$ on Z_1 is assumed to provide a consistent estimate of γ because Z_1 and V_1 are orthogonal. The effect of other covariates, X, is allowed to differ in the two samples, although the effect of veteran status and quarter of birth is restricted to be the same. Our strategy is to estimate (6) by stacking observations for men from the two subsamples. The stacked system is then estimated by 2SLS, treating V_2 as endogenous.[16]

Control function estimates of the veteran premium for the sample drawn from the 1980 census are presented in the last three rows of table 6. These estimates continue to show a negative, albeit attenuated, World War II veteran earnings premium. The negative control function estimates are particularly noteworthy because this identification strategy should eliminate bias from any sort of omitted variable, including cohort or compulsory schooling effects on education and an omitted within-year age-earnings profile.

Overall, the estimates in table 6 suggest that using quarter of birth as an instrument for World War II veteran status in 1980 leads to somewhat exaggerated estimates of the earnings loss experienced by World War II veterans. The control function estimates of −5% to −8% may be closer to the true earnings loss, and this range is similar to the 2SLS estimates based

[16] The two errors ε_1 and ε_2 are assumed homoscedastic, but the residual variance differs in the two samples because $V_1\beta$ is in the compound residual in sample 1. Therefore, we first estimate the system by 2SLS to provide an initial estimate of β. The reported estimates are from a second application of 2SLS, where the dependent variable in sample 1 is transformed to equal ($\ln W_1 - V_1\beta$), so that the stacked system has a homoscedastic error.

on the 1960 and 1970 censuses. These estimates, however, are still dramatically different from the large, positive OLS estimates.

V. Sources of Bias

The estimates in tables 5 and 6 indicate that an OLS estimate of the veteran effect (holding constant demographic characteristics, regional characteristics and education) is biased upward by about 10–12 percentage points. What is the source of this bias? Screening for military service during World War II was based on mental ability, physical fitness, and miscellaneous unfitness. We crudely controlled for physical fitness by including a dummy variable for disability status in 1980. In addition, the years of schooling variable is positively correlated with mental ability. Here we perform a rough calculation of the effect of omitting cognitive ability from the OLS wage regressions.

In May 1943 the military introduced the Army General Classification Test (AGCT). Induction into the military was based in part on individuals' percentile score on the AGCT; the minimum percentile score was set at about 5.5%. The AGCT included some subtests that later became part of the Armed Forces Qualifying Test (AFQT), and the AGCT was used to norm the first AFQT exams. This means that in practice percentile scores on the AGCT and AFQT are roughly comparable (Maier and Sims 1986). To get a rough idea of the difference in scores between those accepted for military service and those not acceptable, note that test score scales are designed to generate a symmetric distribution (Adjutant General's Office, 1945). Therefore, the 50th percentile is a lower bound on the average AGCT score of World War II draftees. Since the 5.5th percentile is the cutoff for service, this is a rough upper bound on the average percentile score for ineligibles.[17]

Griliches and Mason (1972, table 3) report coefficients on the AFQT percentile in log wage equations. These coefficients vary, but are on the order of .0015 for a sample of veterans in 1964. We assume that percentile rankings of the AFQT and AGCT exams have about the same effect on earnings. If the average percentile gap between veterans and nonveterans is 50 percentage points, than omission of test scores could account for as much as $(50 \times .0015) = 7.5$ percentage points of the upward bias in the veteran premium.[18] This crude calculation is likely to overstate the impact of omitting test scores, however, because our OLS wage equations (and the Griliches and Mason wage equations) also include years of schooling

[17] In actuality, the average AGCT score of nonveterans was probably higher than the 5.5th percentile because there were other reasons for not serving in the military.

[18] If selection for service was based entirely on test scores, then the difference in mean percentile scores between eligible and ineligible men would be 50 percentage points because percentile scores are uniformly distributed.

and other covariates. The Adjutant General's Office (1945, table 3) finds a correlation of .73 between AGCT percentile scores and years of schooling. Veterans have an average of about 1 more year or schooling than nonveterans (see table 1), so that adjusting for the correlation between veteran status and schooling will likely reduce the effect of omitting test scores on the veteran status coefficient.

Our "back-of-the-envelope" calculation gives a crude indication of the effect of omitting AGCT test scores from the OLS wage equations. We interpret the results as suggesting that omitting AGCT scores is responsible for roughly half of the upward bias in the OLS estimate of the veteran premium. The remainder is due to other omitted characteristics that differ between veterans and nonveterans. Nevertheless, the fact that omitting test scores (which were explicitly used in military selection) from the wage equation could account for up to half the bias in OLS estimates of the veteran premium strengthens our conclusion that the observed positive premium is due to nonrandom selection into the military.

VI. Conclusion

To test the hypothesis that the positive World War II veterans wage premium is the result of nonrandom selection into the military, we have implemented an instrumental variables strategy that exploits the relationship between date of birth and veteran status. Empirical results using the 1960, 1970, and 1980 censuses support a conclusion that World War II veterans earn no more than comparable nonveterans, and may well earn less. These findings suggest that the answer to the question "Why do World War II veterans earn more than nonveterans?" appears to be that World War II veterans would have earned more than nonveterans even had they not served in the military. Military service, in fact, may have reduced World War II veterans' earnings from what they otherwise would have been. This finding may help reconcile the contrasting OLS estimates of the effects of military service for veterans of World War II and veterans of the Vietnam era.

Data Appendix

Data and Sample Selection

I. 1970 Census of Population

The 1970 census is described in *Public-Use Samples of Basic Records from the 1970 Census* (U.S. Department of Commerce 1972). Our sample combines individuals from three separate public-use files—the State, County Group, and Neighborhood files. Each file contains a self-weighted, mutually exclusive sample of 1% of the population, yielding a total sample of 3% of the population. The public-use data sets we used are based on the questionnaire that was administered to 15% of the population. These samples were selected because they are the only public-use samples of the 1970 census that contain information on veteran status.

To the extent possible, the sample and variables were constructed to be comparable to the sample from the 1980 census. We limited the sample to men born in the United States between 1925 and 1928. Birth year was derived from reported age and quarter of birth. Individuals who had imputed responses to the age, sex, earnings, veteran status, or veteran period questions were excluded from the sample. Finally, individuals who were in the military as of the survey date were excluded from the sample.

The dependent variable, the log of annual earnings in 1969, is reported in intervals of $100. This variable was converted to a continuous variable by taking the arithmetic average of the interval endpoints. We found that our estimates were not very different when the geometric average was used instead of the arithmetic average.

Geographic information in the 1970 census is limited to nine major census regions since the state of residence is not available in two of the three public-use files. The Neighborhood file directly identifies region of residence instead of state of residence. For the County Group file, regions were identified by the location of county-groups since this file does not indicate state or major region. In some instances, county groups straddled two states. In these cases, counties were imputed to the region that contained the greatest landmass of the county group. For the States file, regions were derived from state of residence.

A dummy variable was created that equals one for men who served in the military during any part of the World War II period (defined as September 1940–July 1947), and zero otherwise. The marital status dummy variable equals one if the individual is currently married, and zero otherwise. Years of education is the number of years of schooling completed. A dummy variable is included that equals one for men who indicate their race as white and zero otherwise. Three dummy variables were constructed indicating year of birth on the basis of individuals' current age and quarter of birth.

Unlike the 1980 census, information is not available on disability status in the 1970 or 1960 censuses. As a result, we do not control for disability status in the analyses of the 1960 and 1970 censuses.

II. 1960 Census of Population

A description of the 1960 census is provided in *A Public-Use Sample of Basic Records from the 1960 Census* (U.S. Department of Commerce 1975). Our sample is drawn from the 1% State sample.

To the extent possible, the sample and variables were constructed to be comparable to the sample from the 1980 census. We limited the sample to men born in 1925–28. Birth year was derived from reported age and quarter of birth. The 1960 census has a smaller set of imputed flags than the later censuses. Individuals who had imputed responses to the date of birth or veteran status questions were deleted from the sample. In addition, individuals residing in Hawaii and Alaska were deleted from the sample. Finally, individuals who were in the military as of the survey date were excluded from the sample.

The dependent variable, the log of annual earnings in 1959, is reported in intervals of $100 for those earning less than $10,000 and in intervals of $1,000 for those earning more than $10,000. This variable was converted to a continuous variable by taking the arithmetic average of the interval endpoints. We found that our estimates were not very different when we used the geometric average instead of the arithmetic average.

A dummy variable was created that equals one for men who served in the military during any part of the World War II period (defined as September 1940–July 1947), and zero otherwise. The marital status dummy variable equals one if the individual is currently married, and zero otherwise. Years of education is the number of years of schooling completed. A dummy variable is included that equals one for men who indicate their race as white and zero otherwise. Three year of birth dummies were constructed on the basis of current age and quarter of birth. Eight region of birth dummies were derived from the state of birth question.

III. 1973 CPS-SSA Exact Match

This data set is described in *Studies from Interagency Data Linkages*, report no. 9 (U.S. Department of Health, Education and Welfare 1979).

The CPS-SSA Exact Match data set consists of matched records from the March 1973 Current Population Survey and administrative Social Security records. The two data sources were matched on the basis of respondents' Social Security numbers. Some variables in our analysis are obtained from the SSA administrative data, and others are taken from the CPS.

We first describe the variables derived from the CPS. The dependent variable, the log of annual earnings in 1972, was derived from the CPS question. A World War II veteran status dummy variable was created that equals one for men who served in the military during any part of the World War II period (defined as September 1940–July 1947), and zero otherwise. The marital status dummy variable equals one if the individual is currently married, and zero otherwise. Years of education is the number of years of schooling completed. Finally, eight region dummies and a dummy variable for residence in an SMSA were created from the CPS fields.

The variables taken from the SSA portion of the data set were month of birth (which was used to create quarter-of-birth dummies), birth year (which was used to create cohort dummies), and race.

The sample was narrowed to individuals born in 1925–28, and who were categorized as males in both the CPS and SSA portions of the data set.

IV. The Survey of Income and Program Participation (SIPP)

This data set is described in *Survey of Income and Program Participation User's Guide* (U.S. Department of Commerce 1984). The extract we use is drawn from the SIPP 1984 Panel, Wave I Rectangular File (U.S. Department of Commerce 1985). The data refer to the interview month and the 4 preceding months. Reference month 4 is the month preceding the interview month and is one of chronological months September 1983–December 1983. The SIPP variable mnemonics used in the *User's Guide* are given in parentheses in the description below.

The sample was selected using the following rules:

1. birth year between 1925 and 1928 (U_BRTHYR);
2. wage and salary earnings in reference month 4 not imputed (WS1CAL01);
3. not a resident of Hawaii in reference month 4 (H4_STATE ≠ 15);
4. had wage and salary earnings in reference month 4 (WS1_2032 > 0); and
5. weekly wage between $25 and $5,000, where the weekly wage is the monthly wage and salary earnings divided by weeks worked in reference month 4 (WS1_WKS4).

The dependent variable is the log of wage and salary earnings in reference month 4 (WS1_2032). Instruments consist of quarter-of-birth dummies derived from month of birth (U_BRTHMN). The tape location for month of birth does not appear in the SIPP codebook, but month of birth is on the Wave I Rectangular File public-use tape in columns 5343–44.

The following regressors were used in the analysis:

1. health affects work dummy (SC1386 = 1);
2. World War II veteran dummy, defined as a veteran (VETSTAT = 1) who served in the World War II era (U_SRVDTE = 3);
3. white dummy (RACE = 1);
4. married in interview month dummy, defined as married, spouse absent or present (MS_5 = 1 or 2);
5. education, defined as highest grade (HIGRADE) completed; and
6. eight region dummies based on state of residence in reference month 4 (H4_STATE).

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