Long-Run Mortality Effects of Vietnam-Era Army Service: Evidence from Australia's Conscription Lotteries

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Research on the effects of Vietnam-era military service has benefited from the random assignment of draft eligibility in the US conscription lotteries. To our knowledge, no previous study has exploited the somewhat similar conscription scheme which operated in Australia between 1965 and 1972. Over 800,000 20-year-old Australian men registered for one of 16 biannual National Service ballots (lotteries). Each ballot was relevant for a particular six-month birth cohort. For each cohort, the "ballot outcome" (draft eligibility) was determined by a random drawing of marbles, each representing an individual date of birth, from a lottery barrel (Sue Langford 1997). Several features of the Australian conscription experience are useful for research purposes. First, the context of service varied greatly among the 16 cohorts. In particular, nobody from the last four cohorts served in Vietnam. This aids in delineating the roles of domestic versus Vietnam army experience. Second, the standard of proof on disability compensation claims (under the Veterans Entitlements Act 1986 (VEA)) is much more generous for veterans who served in Vietnam compared with their contemporaries who only served in Australia, facilitating investigation of the role of the veterans' benefit system. Third, there was no GI Bill in Australia, and there is little or no effect of ballot outcome on educational attainment. This is useful for estimating returns to military experience. It also simplifies interpretation of mortality effects, since education may

negatively affect mortality. In the United States, a finding of no mortality effect could feasibly reflect elevated mortality associated with military experience, offset by lower mortality associated with higher education.

In an ongoing project, we are analyzing the long-run effects of Vietnam-era army service on economic and social outcomes for Australian national servicemen. Here we consider mortality.

I. Australia's Involvement in the Vietnam War

For both Australia and the United States, the principal period of deployment in Vietnam was from 1965 to 1970–72. Australian troop commitments were much smaller, around 60,000 in total compared with over 3 million for the United States, and were largely confined to the Phuoc Tuy Province, southeast of Saigon. Australia's losses were far more modest: 520 were killed in Vietnam compared with over 58,000 American fatalities. However, Australian troops were engaged in several fierce battles, such as that of Long Tan in August 1966. Both nations drew on conscripts who served for two years, which for some included 12 months in Vietnam, mostly in the infantry. National Servicemen (draftees) constituted about a third of Australia's Vietnam military personnel and a similar proportion of America's.

II. Previous Research on Mortality Effects

Over the last three decades, the Australian government has conducted or commissioned several major studies into the post-service mortality and health of Vietnam veterans. The mortality studies fall into two categories. In the first set, mortality rates of veterans are compared with those of the general community (most recently Eileen Wilson, Keith Horsley, and Robert van der Hoek 2005a). In the second set, mortality rates of National Servicemen who served in Vietnam are compared with those who remained in Australia (most recently Wilson, Horsley,

and van der Hoek 2005b). Both methods suffer the serious limitation of nonrandom selection of men into Vietnam service (although bias due to the "healthy soldier effect" is avoided in the second set). Nevertheless, the findings of the most recent studies are briefly summarized. The mortality rate for veterans is lower than for the general population, presumably due to the high medical standards required for admittance into the army. The mortality rate for National Service veterans who served in Vietnam is significantly higher than for National Service nonveterans who served in Australia only. Deaths from neoplasms and liver disease are elevated in both sets of comparisons. Deaths from external causes are also higher for National Service veterans than for nonveterans.

Similarly, many US studies have compared Vietnam veterans to non-Vietnam veterans and thus suffer from possible selection bias. We do not review those here. We know of only three mortality studies that have avoided these issues by exploiting the draft lottery. Norman G. Hearst, Thomas B. Newman, and Stephen B. Hulley (1986) found elevated rates of mortality overall, as well as for suicide and motor vehicle accidents. Reanalyzing these data, Joshua D. Angrist, Guido W. Imbens, and Donald B. Rubin (1996) found no significant effects. More recently, using data on all deaths in the United States during 1989–2002, Dalton Conley and Jennifer A. Heerwig (2009) also found no evidence of differential mortality rates associated with ballot eligibility.

III. Estimation Strategy

We seek to estimate β, the effect of Vietnam-era Army service (r) on the probability of dying between 1994 and 2007 (y):

$$y_i = \beta r_i + \gamma' C_i + \mu_i,$$

where C is a vector of 16 binary indicators representing six-month birth cohorts. Since r is almost certainly correlated with μ, we utilize a binary ballot outcome indicator (z) interacted with C as a set of 16 instrumental variables in a first stage regression[1]:

$$r_i = \pi_1' z_i C_i + \pi_2' C_i + \varepsilon_i.$$

A 2SLS estimate of β is a weighted average of the 16 (nonparametric) Wald estimates which correspond to Local Average Treatment Effects (LATEs) for "compliers" in each cohort (Imbens and Angrist 1994). Our approach resembles Two Sample 2SLS (Inoue Atsushi and Gary Solon 2010), since the first stage regression uses one dataset and the second stage uses a separate dataset with "cross-sample" fitted values. However, each "sample" here is actually the same (complete) population, and so we treat the first stage coefficients as known.[2]

Next, under the assumption that mortality was affected only for personnel who served in Vietnam, we reestimate the equations, replacing r with v (army service in Vietnam).

Finally, we consider a specification which includes both r and v as endogenous regressors (with two corresponding first stage regressions). The coefficients of r and v are separately identified by differences between cohorts in the probability of serving in Vietnam. If mortality effects differ between those who served in Vietnam and those who remained in Australia, this will be reflected in the coefficient of v.

IV. Data

The study population is the set of males born in 1945–1952 who were Australian residents when they turned 20 years of age. We construct two unit record population level databases.

Mortality Data.—Deaths data were obtained from the Australian Institute of Health and Welfare (AIHW) National Mortality Database, excluding men who immigrated after the age of 20. This database includes all deaths registered in Australia from 1965 onwards. Date of birth (DOB), however, is included only from 1994 onwards. The majority (approximately 58 percent) of post-ballot deaths were registered during 1994–2007. We exclude records with missing DOB. We also exclude records where DOB is recorded as the 15th day of any month, since this is the value used in the administrative system when the true day is unknown. With these exclusions, coverage of deaths registered in 1994–2007 is approximately 83 percent for this

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[1] A single binary ballot outcome instrument also yields consistent (and similar) estimates, but these are less precise (see table notes).

[2] While they include the same population, the two datasets cannot be linked.

population. Some 37,196 deaths are thus identified, corresponding to 4.4 percent of the population. There is no apparent reason to suspect that missing DOBs are more prevalent among balloted-in men. If the period of deaths registered is restricted to 2002–2007, coverage increases to 95 percent, and while the point estimates are larger, they remain statistically insignificant at the 5 percent level.

First Stage Data.—The first stage data are described in summary form here and detailed more fully elsewhere (Peter Siminski 2010). For the first stage, we need only v, r, Z, and C for each observation. Note that v and r are binary, while Z and C are derived from DOB.

For army men who served in Vietnam ($r = 1$; $v = 1$), we use records from the Nominal Roll of Vietnam Veterans (NRVV), obtained from the Department of Veterans' Affairs. For army men who did not serve in Vietnam ($r = 1$; $v = 0$), we use a Vietnam-era database (VED), obtained from the Australian Institute of Health and Welfare. We synthesize records for the remainder of the population ($r = 0$; $v = 0$), drawing on published estimates of the population of 20-year-old men at June 30 in each year from 1965 to 1973, under the assumption that men are distributed uniformly across DOBs within each six-month birth cohort. To concord with mortality data, we exclude men born on the 15th day of any month.

V. Results

Results from the first stage and reduced form regressions are shown in Table 1. The IVs are strong predictors of both r and v, with large first-stage F-statistics. Ballot outcome for the 16th cohort (zc16) is not statistically significant in either first stage regression, reflecting the fact that men in the 16th cohort were never called up and had no apparent incentive to volunteer. Ballot outcome is a strong determinant of v for the first 11 cohorts, but not the last five.

In contrast, the reduced form mortality regression shows that ballot outcome is not a significant determinant of mortality for any cohort. None of the ballot outcome instruments are individually significant. If the effect of ballot outcome is constrained to be equal across cohorts, its estimated coefficient is 0.0004 (Standard

Error = 0.0005). This is the "Intention to Treat" interpretation of the results.[3]

The 2SLS results, shown in Table 2, reveal that army service is not statistically significant in any of the three specifications. The estimated effect of army service (r) on the probability of death during 1994–2007 is +0.0012 (95 percent CI: −0.0037, +0.0060). If ballot outcome is assumed only to affect mortality through induced service in Vietnam (v), the effect of v on the probability of death is +0.0022 (95 percent CI: −0.0124, +0.0168). When r and v are both included as endogenous regressors, neither is statistically significant, and point estimates are close to zero. There is also no evidence of elevated mortality for any specific cause of death (at ICD-10 Chapter level) (results available on request).

Next, we translate the results to approximate Relative Risks (RR) of mortality under feasible assumptions. We know the proportion of each cohort that died (and DOB was validly recorded) in the period under consideration. We also know that the mortality rate for National Servicemen (who are a similar population to the set of balloted-in compliers) was 27 percent lower than community norms between 1966 and 2001 (Wilson, Horsley, and van der Hoek 2005b). Using these results and the distribution of compliers between cohorts, we estimate the mortality rate for army service compliers to be 3.53 percent. Their counterfactual mortality rate is 0.12 percentage points lower (from regression results, Specification 1, Table 2). Thus the estimated RR is 3.53 percent/3.41 percent = 1.03 (95 percent CI: 0.91, 1.21). Using a corresponding procedure assuming that only Vietnam veterans were affected, the estimated RR is 1.06 (95 percent CI: 0.77, 1.66). We feel that the precision of the estimates is best gauged when expressed in such terms.

VI. Conclusion

Using population data, we find no evidence of elevated mortality between 1994

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[3] Following Conley and Heerwig (2009), we repeated the analysis using the same DOBs for females as a "falsification test." The "Intention to Treat" estimate is also statistically insignificant and positive for females (and slightly larger than for males). Similarly, none of the 16 IVs are individually significant in the reduced form specification for females. Results available on request.

TABLE 1—FIRST STAGE AND REDUCED FORM REGRESSION RESULTS

	Army service (r) (1)		Army service in Vietnam (v) (2)		Reduced form mortality (y) (3)	
zc1	0.3266***	(0.0033)	0.1198***	(0.0025)	−0.0021	(0.0023)
zc2	0.3100***	(0.0039)	0.1193***	(0.0029)	−0.0012	(0.0023)
zc3	0.2824***	(0.0043)	0.1185***	(0.0033)	−0.0018	(0.0024)
zc4	0.2844***	(0.0043)	0.1391***	(0.0034)	0.0045*	(0.0024)
zc5	0.2641***	(0.0041)	0.1260***	(0.0032)	−0.0005	(0.0022)
zc6	0.2547***	(0.0045)	0.1325***	(0.0036)	−0.0003	(0.0023)
zc7	0.2665***	(0.0042)	0.1235***	(0.0032)	0.0037*	(0.0022)
zc8	0.2765***	(0.0047)	0.1105***	(0.0034)	−0.0009	(0.0023)
zc9	0.2581***	(0.0039)	0.0871***	(0.0026)	−0.0007	(0.0020)
zc10	0.2632***	(0.0051)	0.0610***	(0.0030)	0.0018	(0.0024)
zc11	0.2510***	(0.0050)	0.0321***	(0.0024)	0.0011	(0.0023)
zc12	0.2371***	(0.0041)	0.0063***	(0.0013)	0.0018	(0.0020)
zc13	0.2115***	(0.0034)	0.0007	(0.0009)	0.0025	(0.0018)
zc14	0.1901***	(0.0034)	0.0008	(0.0007)	0.0001	(0.0017)
zc15	0.1275***	(0.0030)	−0.0013***	(0.0004)	−0.0027	(0.0017)
zc16	0.0015	(0.0015)	−0.0002	(0.0001)	0.0018	(0.0018)
F-stat for IVs	8,194		2,608			
Angrist-Pischke Multivariate F-stat	1,727		550			

Notes: Sixteen cohort dummies are included in each regression (but no constant). zcl–zc16 represent the effects of ballot outcome for cohorts 1–16, where cohort 1 is the oldest. Robust standard errors are in parentheses. If a single ballot outcome dummy is used instead of the full set of 16 IVs, its estimated coefficients are 0.2351 (0.0010), 0.0717 (0.0006), and 0.0004 (0.0005) in the regressions for r, v, and y, respectively. $N = 840,071$ in each specification.

   ***Significant at the 1 percent level.
  **Significant at the 5 percent level.
 *Significant at the 10 percent level.

TABLE 2— 2SLS REGRESSION RESULTS

	(1)	(2)	(3)
r	0.0012 (0.0025)		0.0021 (0.0048)
v		0.0022 (0.0074)	−0.0030 (0.0147)

Notes: These estimates are from a linear regression of mortality on cross-sample fitted values of r and v from the first stage. Sixteen cohort dummies are included in each regression (but no constant). Standard errors in parentheses account for clustering within cohorts using a group means approach. Each specification includes the full set of 16 IVs. When a single ballot outcome IV is used instead, the corresponding results are 0.0016 (0.0025) for column 1 and 0.0053 (0.0084) for column 2. $N = 840,071$ in each specification.

   ***Significant at the 1 percent level.
  **Significant at the 5 percent level.
 *Significant at the 10 percent level.

and 2007 among Australian Vietnam-era army conscripts. One interpretation is that the compensation and programs received by veterans under the VEA, particularly health care and pension payments, have on average offset any direct negative long term effects of army service. We suggest that methods which exploit the ballot are best suited for further monitoring of mortality effects.

Two qualifications are necessary. Firstly, the arguably large standard errors should be taken into account. Secondly, since the estimated effects are not conditioned on survival to 1993, the probability of death in 1994–2007 could be artificially low for veterans if their earlier death rates were elevated. However, our results are virtually unchanged if servicemen who died in Vietnam are excluded from the analysis entirely (RRs increase by about 0.01). Similarly, if the results of Michael Fett et al. (1987) and Philip Crane et al. (1997) are taken as a guide, the number of excess postservice deaths up to 1994 among National Service Vietnam Veterans is roughly half that of the number who died in Vietnam. Finally, we find no evidence of "missing" balloted-in men in the 2006 Census (Siminski 2010).

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