Supplementary Data Appendix (intended for online publication)
(1) U.S. Military data

The bombing data in this paper are derived from the following files, housed at the National Archives in Record Group 218, "Records of the U.S. Joint Chiefs of Staff":

Combat Activities File (CACTA)

- October 1965 – December 1970; November 1967 not available. Monthly. Derived from Combat Activities Reports II/III (COACT II/III), detailing daily air combat operations flown by the US Navy, Marine Corps, and Pacific Air Forces. Carter et al. (1976) list data cards for Army and USMC helicopters as primary input sources.

Southeast Asia Database (SEADAB)

- January 1970 – June 1975. Daily records of allied air combat activities flown by the US Army, Navy, Air Force, and Marine Corps, as well as the (South) Vietnamese Air Force, Royal Lao Air Force, and Khmer (Cambodian) Air Force. Includes both fixed-wing aircraft and helicopters.

Combat Naval Gunfire File (CONGA)

- March 1966 – January 1973. Records of naval gunfire support in North and South Vietnam.

To the best of our knowledge, these data cover all air combat operations flown by all allied forces involved in the Second Indochina War, including Thai and Australian. Some of the original tape archives were damaged, so several months of data may be missing.

The data are geocoded at the district level, employing the codes and boundaries used by the General Statistical Office in the 1999 Population and Housing census. The air ordnance data are divided into 16 categories by type: ammunition, cannon artillery, chemical, cluster bomb, flare, fuel air explosive, general purpose (iron bomb), grenade, incendiary, mine, missile, other, rocket, submunition, torpedo, and unknown. All entries denote number of units, rather than weight, of ordnance expended by district. Nearly all entries denote single units; most ammunition-class entries denote thousands of units. The naval gunfire data are divided into approximately forty specific categories.

Type of ordnance, quantity of ordnance, and drop location were originally recorded by the pilots and gunners who fired the weapons. Such records were created every time ordnance was expended. The data were reported to Pacific Command and ultimately the Joint Chiefs, who declassified the CACTA, SEADAB, CONGA files in 1975, after which they were sent to the National Archives.

The data were provided by Tom Smith at the Defense Security Cooperation Agency (DSCA), in cooperation with Michael Sheinkman of the Vietnam Veterans of America Foundation (VVAF). We are indebted to Tom Smith, Michael Sheinkman, and Bill Shaw A01 (AW) USN (ret.) for their assistance in understanding the data. VVAF sought and obtained permission from the Technology Center for Bomb and Mine Disposal (BOMICO), a department of the Engineering Command of the Vietnam Ministry of Defense to provide us the data.

Clodfelter (1995: 216-7) summarizes U.S. ordnance: "Most bombs dropped by U.S. aircraft were either 750-pounders (favored by the U.S. Air Force) or 500-pounders (favored by the U.S. Navy), but bombs of up to 2,000 pounds and other ordnance of unconventional design and purpose were employed. Included among America's air arsenal were antipersonnel bombs whose outer casing opened to release a string of small warheads along a line of one hundred yards. Some of the other U.S. antipersonnel and high-explosive bombs were the Lazy Dog, which exploded thirty yards above the ground to release a steel sleet of hundreds of tiny darts; cluster bombs, which were ejected from large canisters by small explosive charges after they had penetrated the upper canopy of the forest; and Snake Eyes, which oscillated earthward under an umbrellalike apparatus that retarded the rate of fall long enough to allow the bombing aircraft to come in low with its bomb load and then escape the resulting effects of the detonation." The following table provides more details.

Supplementary Appendix Table 1: U.S. Ordnance Categories

Ordnance category	Description
General purpose bombs	Conventional iron bombs, free-falling and unguided. "These account for the greatest fraction of the total weight of aerial munitions used; they are carried by fighter-bombers, attack bombers, and high-flying strategic bombers (B-52s), and delivered by free fall. ... Weight ranges from 100 pounds to 3000 pounds; most common range is 500-1000 pounds; about 50 percent of weight is explosive. The bomb works mostly by blast effect, although shrapnel from the casing is also important. ... The crater from a 500-lb. bomb with impact fuze (e.g., MK 82) is typically 30 feet in diameter and 15 feet deep (this obviously varies greatly with the terrain). Shrapnel is important over a zone about 200 feet in diameter. Simple shelters (sandbags, earthworks, even bamboo) protect against all but close hits." (Littauer et al 1972: 222). "The biggest of [the GP bombs] was the 15,000-pound BLU-82B 'Daisy Cutter'." (Doleman 1984: 127)
Cluster bombs	Cluster bomb units (CBUs) scatter the submunitions they contain—ranging from under forty to over 600 in number—over a wide area, yielding a much broader destruction radius than conventional iron bombs. The outer casing is "blown open (by compressed gas) above ground level (typically 500-foot altitude), distributing bomblets over an area several hundred feet on a side." (Littauer et al 1972: 222). In our dataset these are primarily fragmentary general purpose, anti-personnel, and anti-material weapons, and occasionally tear gas or smoke, ranging in total bomb weight from 150 to over 800 lbs.
Missiles	Self-guided air-deployed munitions. Includes self-propelled air-to-air and air-to-ground missiles (that typically hone in on radiation from engines or radar) as well as free-fall "smart bombs" (guided toward their targets by laser reflection or electro-optical imaging, e.g., AGM-62 "Walleye"). "The most important anti-radiation air-to-ground missiles used by the U.S. forces in Vietnam were the AGM-45 Shrike and AGM-78 Standard ARM. Radar-directed like the Sparrow, the Shrike was carried by navy and air force jets, including the Wild Weasels. Its purpose was to knock out the ground radar stations that controlled the deadly SAMs and radar-guided anti-aircraft guns." (Doleman 1984: 125).
Rockets	Self-propelled unguided munitions. "The most common size is 2.75" diameter, delivered singly or in bursts from tubes mounted under the aircraft. Accuracy of delivery is generally higher than for free-fall weapons. Warheads include fragmentation (flechette), high explosive (including shaped charge against armored vehicles), and incendiary action (most white phosphorus or plasticized white phosphorus, PWP). Phosphorus may be used as anti-personnel weapon, but also serves to generate white smoke (often for target designation for further strikes)." (Littauer et al 1972: 223)

Cannon artillery	High-velocity projectiles too large to be labeled 'Ammunition'. Chiefly, high explosive shells from 105mm Howitzers. (Sources: personal communication with Bill Shaw, 4/16/04)
Incendiaries / white phosphorus	Napalm fire bombs and white phosphorus smoke bombs (<5%). Total fire bomb weights range from 250lb to 750lb, containing between 33-100 gallons of combustible napalm gel. Napalm was primarily successful as a wide-area anti-personnel weapon: "Most effective against entrenched infantry, napalm gave off no lethal fragments and could be used close to friendly forces without the dangers of fragmentation posed by conventional bombs. Often the fire from napalm would penetrate jungle that was immune to shrapnel. A single napalm canister spread its contents over an area a hundred yards long." (Doleman 1984: 127)
Land mines	Primarily air-dropped 'Destructor' mines. "Destructor Mines are general purpose low-drag [GP] bombs converted to mines. They can be deployed by air, either at sea as bottom mines or on land as land mines. … When dropped on land, they bury themselves in the ground on impact, ready to be actuated by military equipment, motor vehicles and personnel. When dropped in rivers, canals, channels, and harbors, they lie on the bottom ready to be actuated by a variety of vessels including war ships, freighters, coastal ships, and small craft." (FAS 2004) With just over 55,000 mines listed for the entire country in our dataset, compared with an outside estimate of 3,500,000 mines (UNMAS 2004), our data capture a trivial fraction of total presumed landmine presence in Vietnam. This is likely because a large share of landmines were placed in the ground by U.S. army troops.
Ammunition (000's of rounds)	Projectiles fired from air at high-velocity. Cross-sectional diameter (caliber) ranges from 5.56mm to 40mm, spanning the traditional categories of small-arms (≤0.50 caliber/inches = 12.7 mm), regular ammunition, and cannon artillery (≥20mm). (Sources: FAS (2004); personal communication with Bill Shaw, 4/16/04)

(2) Vietnam Poverty, Geographic, and Climatic Data

District-level estimates of poverty were provided by Nicholas Minot of the International Food Policy Research Institute (IFPRI). The estimates were generated through poverty mapping, an application of the small-area estimation method developed in Elbers et al (2003). This method matches detailed, small-sample survey data to less-detailed, large-sample census data across geographic units, to generate area-level estimates of an individual- or household-level phenomenon—in our case, district-level poverty incidence in Vietnam. For more detailed information, see Minot et al. (2003).

The two datasets used by Minot et al. (2003) are the 1997/8 Vietnam Living Standards Survey (VLSS) and a 33% subsample (5,553,811 households) of the 1999 Population and Housing Census. The VLSS, undertaken by the Vietnam General Statistical Office (GSO) in Hanoi with technical assistance from the World Bank, is a detailed household-level survey of 4270 rural and 1730 urban Vietnamese households. The 1999 Population and Housing Census was conducted by the GSO with technical support from the United Nations Family Planning Agency and United Nations Development Program (UNDP). We also use data from the 1992/3 and 2002 VLSS survey rounds in this paper.

Minot et al. use the VLSS data to estimate a household-level, log-linear regression of real cost-of-living-adjusted per capita consumption expenditure on 17 household characteristics common to both the VLSS and the Population and Housing Census. These characteristics include: household size, proportion over 60 years old, proportion under 15 years old, proportion female, highest level of education completed by head of household, whether or not head has a spouse, highest level of education completed by spouse, whether or not head is an ethnic minority, occupation of head over last 12 months, type of house (permanent; semi-permanent or wooden frame; "simple"), house type interacted with living area, whether or not household has electricity, main source of drinking water, type of toilet, whether or not household owns a television, whether or not household owns a radio, and region. Minot et al. (2003) partition the sample to undertake separate parameter estimates for the correlates of rural and urban poverty.

Predicted consumption expenditures per capita for each of the district-coded households in the 1999 Population and Housing Census sample are then generated using the parameter estimates from these regressions. Properly weighting by the size of each household, this enables Minot et al (2003) to generate an estimate of district-level poverty incidence, the percentage of the population in each district that lives below the official national poverty line of 1,789,871 Dong (VND) per person per year (GSO 2000).

All district-level topographic, geographic, and climatic data used in this paper were provided by Nicholas Minot and are identical to those used in Minot et al. (2003). The topographical data used in Minot et al. (2003) are taken from the United States Geological Survey.

Province population figures in the 1980s and 1990s are from the Vietnam Statistical Yearbooks (Vietnam General Statistical Office). Unfortunately, we have been unable to locate complete and consistently defined province level demographic data from the mid-1970s through the mid-1980s. These Yearbooks also contain information on total state investment flows by province from 1976-1985, data that is also used in the statistical analysis.

(3) Data from the pre-"American War" period

Pre-war, province-level demographic data on South Vietnam were taken from the 1959-1965 editions of the *Statistical Yearbook of Vietnam*, published by the National Institute of Statistics in Saigon, and for North Vietnam from the *Vietnam Agricultural Statistics over 35 Years (1956-1990)*, published by the GSO Statistical Publishing House in Hanoi (1991). Province level agricultural statistics are also available (e.g., rice paddy yields), but it is widely thought that such prewar data are unreliable as a result of the prewar ideological conflict between North and South Vietnam (Banens 1999), and thus we do not use those data in the analysis.

A final data source we considered is the HAMLA/HES database collected by the U.S. government starting in South Vietnam in 1967-68 (described in Kalyvas and Kocher 2003), which collected rough proxies for village socioeconomic conditions. The two main drawbacks of this data is that first, the exact procedure for assigning the local SES measures is not transparent or well-described in existing sources, and second the data was collected several years into the war, and thus may be endogenous to earlier U.S. bombing patterns. For these reasons we do not utilize this data in the analysis.

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