PRELIMINARY AND INCOMPLETE
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The Long Run Impact of Bombing Vietnam♦

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Abstract: We estimate the impact of U.S. bombing on later economic development in Vietnam. The Vietnam War featured the most intense bombing campaign in military history. We use a unique U.S. military dataset containing bombing intensity at the district level (N=585), and match it up to district data on population density, poverty rates and consumption growth in the 1990s. We compare the heavily bombed districts to other districts, controlling for baseline demographic characteristics and district geographic factors. U.S. bombing does not have a statistically significant impact on long-run population density, or most economic outcomes. This is consistent with the view that the capital stock and infrastructure matter less for long run economic growth than institutions and geography.

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1. Introduction

The horrors inflicted by war are clear to all, and so are its disruptive effects for many lives in the short and medium term. Indeed, war destroys lives, capital and infrastructure, produces negative environmental impacts, damages the social fabric, endangers civil liberties, displaces populations and creates potential health and famine crises. Any of these effects could be argued to have long run impacts on economic growth and development, and their combined effect even more. Jean Drèze for one forcefully expresses the view that "[w]ars or rather militarism is the major obstacle to development in the contemporary world" (Drèze, 2000, 1171).

In contrast, some have argued that wars can instead have a positive effect on long-run economic growth. Military research and development expenditures may result in faster technological progress. Wars may also encourage state formation and nation building as was the case with the European nation states (Tilly XX), and may induce social and political progress via greater popular participation. For instance, political enfranchisement has often been a byproduct of war (Keyssar 2000). Social and political progress may in its turn enhance public goods provision. The net long run effect is thus not clear a priori on theory grounds alone.

Surprisingly, the long run economic impacts of war remain largely unexplored empirically. Knight et al. (1996) find in a cross-country study that military spending has a negative effect on economic growth, via lower capital accumulation and distorted resource allocation. On the other hand, in an influential recent article Davis and Weinstein (2002) find that the U.S. bombing of major Japanese cities during World War II had no long run impact on population growth in those cities, relative to preexisting trends. Organski and Kugler (1980) similarly find that the economic effects of the two world wars on European countries tended to dissipate after only 15 to 20 years, after which there was a return to prewar growth trends.

However, further work is needed to understand the relationship between economic development and war in contemporary less developed countries, societies far poorer than Japan or

Europe, where most wars currently take place. The assumption of firm profit maximizing behavior made in the economic geography models tested in Davis and Weinstein (2002) is also unlikely to apply in many less developed countries, like Vietnam, where the state plays a leading role in determining patterns of economic activity and even residential location.

We exploit a unique historical episode to estimate the impact of war on long-run economic performance: the U.S. bombing of Vietnam (what Vietnamese call "the American War"). The Indochina War, centered in Vietnam, was the most intense episode of bombing known in human history: "the United States Air Force dropped in Indochina, from 1964 to August 15, 1973, a total of 6,162,000 tons of bombs and other ordnance. U.S. Navy and Marine Corps aircraft expended another 1,500,000 tons in Southeast Asia. This tonnage far exceeded that expended in World War II and in the Korean War. The U.S. Air Force consumed 2,150,000 tons of munitions in World War II -- 1,613,000 tons in the European Theater and 537,000 tons in the Pacific Theater --- and 454,000 tons in the Korean War"(Clodfelter, *Vietnam in Military Statistics*, 1995). So for the U.S. Air Force, Vietnam War bombing represented nearly three times as much (by weight) as both European and Pacific theater World War II bombing combined, and about thirteen times total tonnage in the Korean war. For another comparison, the atomic bombs dropped at Hiroshima and Nagasaki had the power of 15,000 and 20,000 tons of TNT, respectively (Grolier 1995 encyclopedia XX). Since General Purpose Bombs (GPB) – by far the most common type of bomb used in Vietnam – are approximately 50% explosive material by weight, the atomic bombs translate into roughly 30,000 to 40,000 tons of munitions. Measured this way, U.S. bombing in Indochina represents 90 times the combined impact of the Hiroshima and Nagasaki atomic bombs. The effect of U.S. bombing on economic outcomes in Vietnam may thus represent an upper bound on bombing impacts more generally.

This study employs an unusual U.S. military district-level dataset on total bombs, missiles, and rockets dropped by the U.S. Air Force and Navy in Vietnam. We use this data to estimate

impacts on later economic development outcomes[1]. The U.S. bombing of Vietnam was largely concentrated in a subset of regions: roughly 70% of all bombs were dropped in only 10% of the 585 districts in the sample. Figure 1 shows the geographic location of the 10% most heavily bombed districts (in terms of bombs per km^2), and these are scattered throughout the country. The heaviest bombing took place in Quang Tri province in the central region of the country near the 17^{th} parallel, the former border between North Vietnam and South Vietnam during the war. Quang Tri province was bombed flat during the war, with most capital and infrastructure destroyed; only 11 out of 3,500 villages left unbombed at the end of the war (CITE). Provinces immediately north and south of Quang Tri also received heavy U.S. bombing, though with more variation than in Quang Tri. Coastal regions of North Vietnam, as well as some districts of Hanoi, were heavily bombed, while in the South, the so-called "Iron Triangle", the region adjacent to Cambodia near Saigon, was also heavily bombed. This southern region was the location of incursions by North Vietnamese troops and Vietcong guerrillas into South Vietnam through the so-called Ho Chi Minh trail that ran from North Vietnam through Cambodia into the South.

[INSERT FIGURE 1]

There are many reasons to think U.S. bombing could have major long-run impacts on Vietnamese development. First of all, U.S. bombing displaced populations on a large scale, and this could potentially disrupt local economic activity if many individuals never returned. Second, the massive U.S. destruction of roads, bridges and local infrastructure may have inhibited local commerce, and induced later resource reallocation towards other regions of country not heavily damaged in the war. Third, a non-trivial number of dropped bombs did not explode, and become unexploded ordnance (UXO). According to surveys in Quang Tri, 90% of postwar ordnance-related injuries were caused by UXOs rather than landmines. UXOs as well as landmines can impair the use

[1] The data on land mines are incomplete since we miss the many mines also placed by U.S. ground forces, and thus we do not focus on land mines in the analysis below.

of agricultural land, and are expensive to find and remove. While UXOs and landmines can seriously hurt farming families when an income earner is victimized, overall UXO and landmine injury rates in Vietnam during the 1980s and 1990s appeared only moderate (CITE). Finally, the chemical agents used by the U.S. could generate long term damage to population health and the environment. The most famous, Agent Orange, is a defoliant containing dioxins thought to have adverse health effects, and as late as 2001, traces of TCDD, the dioxin specific to Agent Orange, were still found in human blood in areas contaminated by the war (Hatfield report, chapter 6). Deforestation itself could also negatively affect the environment, by creating soil instability and affecting wildlife.

In this paper, we exploit the extensive variation in U.S. bombing intensity across 585 Vietnamese districts to estimate long-run population and economic impacts of the war. It is important to note that while this econometric strategy provides reliable estimates of differences across districts more and less affected by the war, this approach is unable to capture any aggregate nation-wide effects of the war on subsequent Vietnamese economic development. This is a potentially important issue to the extent that the war led to major national institutional changes, or if cross-district spillovers are large. Still the rapid rate of economic growth in Vietnam since the early 1990s – at 6% on average between 1993 and 2003 (World Bank 2004) – suggests that any nation-wide impacts on long-run economic growth are unlikely to be that negative.

We focus primarily on Vietnam's central and southern regions in the analysis, regions where U.S. bombing was most intense and which were largely rural and at broadly similar levels of economic development in the early 1960s before the war, and also include baseline population density, and geographic and climatic characteristics as regression controls in the main specifications. In the paper's main finding, we find no long term impact of U.S. bombing on local population density, poverty rates, consumption growth, or infrastructure measures in the 1990s. If anything more heavily bombed districts have somewhat less poverty in the 1990s than other districts, and this result is robust to a variety of alternative specifications and samples. There is no effect of U.S. bombing on

consumption expenditure levels in 1997/1998, but suggestive evidence of a moderate negative effect in 1992/1993, suggesting that there may have been negative short run bombing effects, but that these largely dissipated over time.

Why did the most intense bombing campaign in human history display no long run economic impacts roughly 25 years later? There are a variety of explanations that we mention here and elaborate on below. First, most U.S. bombing targeted South Vietnam, with the purpose of impeding the progress of enemy (both North Vietnamese Army and Vietcong guerrilla) troops, and took place in rural areas. These areas often had little fixed infrastructure to destroy, and instead mostly led to the destruction of forest and farmland, much of which could be expected to recover naturally over time.

Second, population displacement seems to have been mostly temporary. Vietnamese communities developed elaborate strategies for avoiding injury during periods of intense U.S. bombing, including hiding in underground tunnels, while others fled temporarily to towns and cities. After the war many returned to their original homes. Finally, there was a major government reconstruction effort after the war, with massive mobilization of labor and resources to de-mine the country and rebuild damaged infrastructure (see e.g. the World Bank *Vietnam Development Report 2002*). The rebuilding of destroyed infrastructure could have generated "leapfrogging" effects in some cases, as newer technologies were introduced into war-damaged regions.

The empirical results resonate with both Davis and Weinstein (2002) and Organski and Kugler's (1980) findings that war did not have major long-run impacts on Japanese city population growth, or European economic growth, respectively. We view our results as complements with theirs. Vietnam was an overwhelmingly rural country during the 1960s and 1980s, and much poorer than either Japan or Europe, and thus provides a useful contrast to the earlier studies. XX

The rest of the paper is organized as follows. Section 2 presents the data. Section 3 discusses determinants of U.S. bombing, the main empirical analysis is presented in section 4, and the final section concludes.

2. The Data

We exploit a database assembled by the Defense Security Cooperation Agency (DSCA) housed at the National Archives in Record Group 218, called "Records of the U.S. Joint Chiefs of Staff". We obtained the data from the Vietnam Veterans of America Foundation (VVAF) with authorization from DSCA and BOMICO (Technology Center for Bomb and Mine Disposal, Vietnam Ministry of Defense).

The database contains information on all ordnance dropped from U.S. airplanes and helicopters in Vietnam between 1965 and 1975,[2] as well as all ordnance from B-52 airplanes, artillery fired from naval ships[3] and sea mines dropped during the same time period. To our knowledge, the files we have embody the most complete, comprehensive and reliable summary available of U.S. and allied air and sea ordnance expended during the Vietnam War, although some of the original tape archives were reportedly damaged so several months of data may be missing (unfortunately we are unable to determine the precise extent of any damage). The data were originally recovered from U.S. mission logs, and then reported to U.S. Pacific Command and the Joint Chiefs of Staff. They were declassified in 1975 and provided to the Vietnamese government following the war.

The raw data include the location of the bombing, a summary bomb damage assessment (which we do not have access to), and the quantity of ordnances by category and type. Categories include general purpose bombs (GPB)[4], cluster bombs[5], chemical, fuel air explosive, incendiary, rockets, missiles, projectiles, ammunition, flares, and sensors. Data entries are measured in the number of units rather than by weight. Since the source of the data is the U.S. Air Force and Navy,

[2] In particular, these data come from the 1965-70 Combat Activities, Air (CACTA) and 1970-1975 South East Asia (SEADAB) databases.
[3] The Combat Naval Gunfire (CONGA) file.
[4] Namely, the 500 lb GP Mark 82 and Mark 36 Destructor. GPBs typically weighed between 500-750 lbs.
[5] Cluster bomb types include CBU 24/29, CBU 2A, and CBU 12.

we miss the anti-personnel landmines that were placed by U.S. Army ground forces, which probably accounts for a large share of U.S. landmines, and thus the landmine data are likely to be less reliable than the other data. The raw data were then geo-coded using current Vietnamese district boundaries, used by the Vietnam General Statistical Office for the 1999 Population and Housing Census, to yield the dataset that we use in the analysis. (Examples of the raw bombing data are presented in Appendix Figures 1 and 2.)

General purpose bombs are by far the most common category of bombs (Table 1). Average bombing intensity is high, with an average of 32.3 bombs per km^2 nationwide, and there is extensive variation across districts in all ordnance categories. The distribution of bombs was skewed, with 10% of districts receiving nearly 70% of all bombs, and some districts receiving as much as 561 bombs per km^2.[6] The most intense bombing took place near the 17th parallel that formed the border between North Vietnam and South Vietnam during the war. We focus at times on the central region of the country, which as we define it includes 22 provinces and 229 districts, and includes nearly all districts in the top 10% most bombed group. This "Central region" sample excludes the major cities of Da Nang, Saigon (now Ho Chi Minh City), Hanoi, and Haiphong as well as both the extreme north of the country bordering China and the southern Mekong Delta region. Bombing intensity in the Central region is nearly double that for the nation as a whole, and there is also considerably more variation in bombing intensity there (Table 1), making it a particularly useful region to focus on.

[INSERT TABLE 1]

Figure 2 allows us to better visualize the geographic distribution of bombing intensity in Vietnam. The poor northwestern region of Vietnam was hardly bombed at all, in part because of the Johnson administration's reluctance to antagonize China by bombing Vietnamese regions near its borders. While bombing intensity was highest near the 17th parallel, it was also high in the "Iron

[6] Quang Tri district in Quang Tri province, which is only 6 km^2 in size, received over 3000 bombs per km^2 during the war, the highest in the dataset by far. We exclude this outlier in the empirical analysis below, since it is an influential observation, although results do not change substantially if it is included (not shown).

Triangle" region of South Vietnam adjacent to Cambodia, the endpoint of the Ho Chi Minh Trail, as well as in some parts of North Vietnam.

[INSERT FIGURE 2]

There is a large, positive and statistically significant correlation between all U.S. ordnance categories (Table 2). In the regression analysis below, we mostly employ total intensity (per km^2) of bombs, missiles, and rockets, but given the correlation with other ordnance categories (e.g. ammunition), it can be thought of as a good proxy for the overall intensity of local war activity.

[INSERT TABLE 2]

We obtained provincial data on population density in 1960-61, and use those data as baseline controls in the main regressions (Table 3). Note the sharp increase in population density from 1960-61 to the 1999 Vietnam Population and Housing Census.[7] A variety of local geographic and climatic characteristics, including proportion of land at high altitude, total district land area, average district temperature and precipitation, location in former South Vietnam, and proportion of land in 18 different soil type categories (not shown), are also included as district controls in most specifications to at least in part control for agricultural productivity, as well as potentially certain military factors.

We focus on several economic outcomes. Poverty rate estimates are from Minot et al. (2003), using the local regression method in Elbers et al (2003). This approach matches up 1999 Population and Housing Census data, which has excellent coverage but limited household characteristics, with detailed 1997/8 Vietnam Living Standards Survey (VLSS) household data, and runs log-linear regressions of real, cost-of-living-adjusted, per capita consumption expenditures on seventeen different household characteristics included in both the census and VLSS to predict household consumption. The poverty rate is the percentage of district population living on less than 1,789,871 Vietnamese Dong per year, the Vietnam General Statistical Office poverty line, and approximately

[7] We also obtained baseline data on rice paddy yields, but these are not reported because they are thought be less reliable than the population density data (CITE).

41% of the population meets this criterion (Table 3). The 1999 census also provides detailed information on household access to infrastructure, including electricity (71% of households have access to electricity). Finally, we obtained per capita consumption expenditure data from both the 1992/3 and 1997/8 waves of the VLSS, although this data is only available for a sample of households in a subset of districts, reducing the sample (the districts with VLSS data are presented in Appendix Figure 3). This data allows us to assess changes in consumption levels over time during the rapid economic expansion of the 1990s.

[INSERT TABLE 3]

3. Determinants of U.S. Bombing Intensity

This section investigates the district characteristics correlated with higher bombing intensity. Before presenting the econometric analysis, we briefly discuss the existing literature on U.S. bombing strategy during the Vietnam war.

A distinction is sometimes made between the nature of bombing of North Vietnam and South Vietnam. U.S. bombing in North Vietnam is considered largely *strategic bombing*, targeting transportation capabilities (airfields, railroads, bridges, ports, roads), as well as military barracks, industrial plants, and storage depots (Clodfelter 1995, 134). The selection of targets in North Vietnam was directly supervised by Washington officials on a weekly basis during the Johnson administration (Littauer et al., 1972, 37), and the number of approved targets regularly fell below the requests of the military, with the bombing of Hanoi, Haiphong and areas near the Chinese border ruled out. A far broader set of targets in North Vietnam were approved for bombing under the Nixon administration, however, including the main population centers of the North.

Bombing in South Vietnam, in contrast, was typically *interdiction bombing*, which aimed to disrupt enemy troop movements and support U.S. ground troops, rather than explicitly to destroy infrastructure. Bombing in South Vietnam was somewhat more intense on average than in the North.

Below we present empirical results broken down by former North and South Vietnamese regions, to investigate whether the different nature of bombing had different long-run impacts.

[INSERT TABLE 4]

Prewar province population density in 1960-61, and an indicator for former South Vietnam regions, are not significantly related to our main measure of bombing intensity, total U.S. bombs, missiles and rockets per km^2 (Table 4, regression 1). District altitude, land area and temperature are not significantly related to bombing density, but average precipitation is positively associated with bombing density. The coefficient estimate on initial population density is negative (though small), suggesting that more urbanized regions were bombed somewhat less on average than the countryside (regression 2). The results are largely unchanged when Quang Tri province, the most heavily bombed province, is excluded, though standard errors fall considerably (regression 3).

We next focus on the Central region which experienced the most intense U.S. bombing. Results are broadly similar except that population density is not a significant predictor of U.S. bombing when Quang Tri province is included in the sample. Figure 3 graphically presents the weak negative relationship between baseline 1960-1 population density and U.S. bombing intensity for both All Vietnam (panel A) and for the Central region (panel B).

Taken together, the results suggest that somewhat heavier bombing took place on average in less densely populated areas, areas that are also likely to be less economically developed. Thus to the extent that the explanatory variables control imperfectly for baseline poverty levels, omitted variable bias should likely lead us to overstate the negative impact of U.S. bombing on later poverty rates. Despite this hypothesized bias, there is no statistically significant relationship between bombing intensity and later economic outcomes, as we discuss below.

[INSERT FIGURE 3]

4. The long run impact of bombing Vietnam

4.1 Impacts on population density

We first consider bombing impacts at the province level, for three main reasons. First, U.S. bombing of one district could generate externalities for other nearby districts, and provincial level regressions are one way to partially capture those externalities (although this specification still misses out on any cross-province externalities of U.S. bombing). Second, the main baseline 1960-61 population density control is at the province level, and thus for population density figures at least, the analysis utilizes a proper panel. Finally, the province level results serve as an important robustness check for the district level analysis.

Total U.S. bombing intensity in a province during 1965-1975 is not significantly related to province population density in 1999 (Table 5, regression 1), with a point estimate of -0.28 (standard error 0.27). Provinces that had high population density in 1960-61 also have high density in 1999 (point estimate 1.86, standard error 0.09), and former South Vietnam has somewhat higher 1999 population density than former North Vietnam, although that difference is not statistically significant.

In specifications either including Quang Tri province (Table 5, regression 2) or excluding it (regression 3), total U.S. bombing intensity is not statistically significantly related to 1999 population density. District geographic area is negatively related to 1999 population density, perhaps in part since rural areas tend to be larger than urban districts, although changes in district definitions after the war somewhat complicate interpretation of this association.

[INSERT TABLE 5]

Restricting attention to the Central region, U.S. bombing intensity is negatively related to 1999 population density at the province level (Table 5, regression 4), but the relationship is much weaker and is statistically insignificant at the district level (regressions 5 and 6). The signs of coefficient estimates are similar in both the All Vietnam and Central region specifications. Figure 4 presents the province level relationship graphically.

[INSERT FIGURE 4]

There is similarly no significant effect of U.S. bombing intensity on 1999 district population density in a variety of samples and specifications, including in former North Vietnam (Table 6, regression 1) and South Vietnam (regression 2); in rural areas (districts with baseline 1960-1 population density less than 200 per km^2, regression 3) and urban areas (regression 4), the latter a specification related closely to Davis and Weinstein (2002); when province fixed effects are included for both All Vietnam (regression 5) and the Central region (regression 6); and using an alternative measure of bombing intensity (regressions 7 and 8). The bottom line is that more heavily bombed districts are indistinguishable from other districts in terms of population density 25 years after the end of fighting.

[INSERT TABLE 6]

This lack of an effect on population density is not due to large postwar inflows of migrants into heavily bombed districts. Using the VLSS data, there is no statistically significant difference between the proportion of 1997/8 individuals not born in their current village of residence as a function of U.S. bombing intensity (Table 7, panel A), in either the All Vietnam or Central region samples, and whether or not Quang Tri province is excluded. However, note the large positive coefficient estimate on the former South Vietnam indicator variable. This indicates that households in the former South Vietnam were significantly more likely to relocate, either voluntarily or as part of a central government relocation program, than those in the North.

[INSERT TABLE 7]

U.S. bombing intensity is significantly positively related, however, to the proportion of current inhabitants who were members of a war veterans association in 1997/8 in most specifications (Table 7, panel B), suggesting some persistence in residential patterns from the war period through the late 1990s. Not surprisingly, the proportion of war veterans is consistently lower in the former South Vietnam, since official veterans associations exclude those who served the old anti-communist South Vietnamese regime.

It would be ideal to trace out bombing effects over time from the mid-1970s through the 1990s. Unfortunately, we have been unable to locate reliable district disaggregated population data from the end of the war until the beginning of economic reforms in the late 1980s and early 1990s. XX VIETNAMESE YEARBOOKS XX

4.2 Impacts on poverty

Total U.S. bombing intensity is negatively associated with 1999 poverty rates in most regressions (Table 8), and in some cases the effect is statistically significant. While the point estimate of bombing intensity on the poverty rate is negative in all specifications, point estimates are more consistently negative for the All Vietnam specifications (regressions 1-3) than for the Central region (regressions 4-6). This may in part reflect the fact that some of the poorest provinces in Vietnam, those in the northwest, were rarely bombed by the U.S. due to their proximity to China; these provinces are excluded from the Central region sample. The negative relationship between bombing intensity and poverty at the province level and district level are presented graphically in Figures 5 and 6, respectively.

[INSERT TABLE 8]

[INSERT FIGURE 5]

[INSERT FIGURE 6]

In our preferred specification, at the district level for the Central region sample (Table 8, regression 5), the coefficient estimate on total bombing intensity is -0.00018 (with standard error 0.00020). To get an idea of the magnitude of bombing impacts on poverty, first consider the effect of the change from zero bombing up to the average bombing intensity in the Central region, which is an intensity of 56.7 bombs, missiles, and rockets per km^2. The average effect, in this sense, is (56.7)*(-0.00018) = -0.010. This is a very small average effect, a reduction in the poverty rate by 1.0 percentage point, and this effect is not statistically significant. In terms of how tight the estimated

effect is, the 95% confidence band ranges from -0.00018 – 2*0.00020 = -0.00058, up to -0.00018 + 2*0.00020 = 0.00022. Thus again considering the effect of going from zero bombing up to the average intensity of 56.7, the 95% confidence band range of estimates is (56.7)*(-0.00058) = -0.033 to (56.7)*(0.00022) = 0.012. In other words, plausible average effects range from a three percentage point reduction in poverty up to a one percentage point increase in poverty in the Central region, on a base poverty rate in that region of 43%. This is a reasonably tight range of estimates, and we can rule out almost any increase in poverty due to U.S. bombing.

In terms of other determinants of 1999 poverty, higher initial 1960-1 population density is associated with lower poverty levels in 1999 as expected (for instance, in Table 8, regression 2), the former South Vietnam has far lower poverty rates than former North Vietnam (point estimate -0.18, standard error 0.05), high altitude districts have substantially higher poverty rates, as do geographically larger districts and those with greater average precipitation.

There are moderate negative, but not statistically significant, effects in both former North Vietnam (Table 9, regression 1) and South Vietnam (regression 2). Effects are similarly negative in both rural areas (districts with baseline 1960-1 population density less than 200 per km^2, regression 3) and urban areas (regression 4), although point estimates are slightly more negative for the more urban areas. Point estimates become more negative and statistically significant when province fixed effects are included, for both All Vietnam (regression 5) and the Central region (regression 6), and when using an alternative measure of bombing intensity (regressions 7 and 8). The main finding is that, if anything, more heavily bombed districts have somewhat lower poverty rates than other districts 25 years after the Vietnam war. Although the baseline population density figures and detailed district controls partially address omitted variable concerns, we cannot entirely rule out that omitted variable bias is driving part of the estimated relationship.

[INSERT TABLE 9]

We next explore this relationship using the more detailed household consumption expenditure data from the VLSS. Consistent with the 1999 poverty findings, average household consumption expenditures per capita are somewhat higher in areas that were more heavily bombed both for All Vietnam and the Central region (Table 10, panel A, regressions 1-4), although the estimated effect is typically not statistically significantly different from zero. However, the pattern shifts when examining earlier consumption levels: average consumption expenditures per capita in 1992/93 are actually slightly lower in more heavily bombed districts (panel B, regressions 1-4), although once again they are not robustly significant. This suggests that more heavily bombed areas were initially poorer than other areas in the immediate aftermath of the war, but that they later caught up during the Vietnamese economic boom of the 1990s, after economic liberalization reforms began in earnest. The positive estimated impact of U.S. bombing on consumption growth rates from 1992/3 to 1997/8 (panel C) is consistent with this view.

[INSERT TABLE 10]

In order to explore the sources of this differential growth performance, we next examine infrastructure access across Vietnamese districts. Infrastructure investment decisions in Vietnam in the 1980s and 1990s are likely to reflect both government redistributive goals as well as potential private profits, and unfortunately it is difficult to disentangle these motives. Still, there is a striking positive relationship between U.S. bombing intensity and 1999 access to electricity across all three All Vietnam specifications (Table 11, regressions 1-3). The relationship does not hold in the Central region (regressions 4-6), however.

5. Conclusion

There is no robust long run impact of U.S. bombing on local population density, poverty rates, consumption levels and growth, or access to electricity in Vietnam 25 years after the end of the war. If anything, the bulk of the empirical results point to moderate reductions in poverty, and better

infrastructure access, in the areas more affected by U.S. bombing. Any adverse short-run effects of the most intense bombing campaign in history appear to have completely dissipated after 25 years.

However, as discussed above, our estimation approach – comparing more heavily bombed districts to others – misses any nation-wide effect on Vietnamese economic development due to the war. For instance, if regions not so greatly affected by the war ended up assisting the more heavily bombed regions, overall Vietnamese growth rates might fall but no difference would be observed between the more and less heavily bombed areas 25 years later. On the other hand, the war undoubtedly fostered a sense of strong nationalism, and forged capable North Vietnamese institutions, and both of these outcomes may have contributed to faster postwar recovery. Nonetheless, any negative impact of the war on recent Vietnamese economic growth must be relatively small: Vietnamese economic growth in terms GDP per capita has been among the fastest in the world, at a healthy 6% per year between 1993 and 2003 (World Bank 2004). The legacy of war has not prevented Vietnam from achieving rapid economic growth.

The main empirical result is consistent with recent findings in macroeconomics that capital and infrastructure investments matter less to long term economic growth than institutions and geography (for instance, see Hall and Jones, 1999: Acemoglu et al., 2002). Indeed, while institutions may be affected by war, they can be very resilient and may even become stronger as a result of war. Countries with "pro-growth" institutions appear able to recover reasonably rapidly from wars, after an initial heavy investment to erase the damages from war.

Still the broader lessons of this paper for other less developed countries today are unclear. Unlike many other poor countries, the Vietnamese community regime created strong, centralized political institutions able to mobilize vast human and material resources in the postwar reconstruction effort. Vietnam also emerged from war out of a long struggle for national liberation against foreign occupiers (the French, the Japanese briefly, and finally the U.S.), an experience that provided its postwar national leaders unique political legitimacy. In contrast the bulk of wars in the world today

are civil conflicts, which may exacerbate political and social divisions rather than strengthening national institutions. The most conflict prone region today is Sub-Saharan Africa, where state institutions are notoriously weak (Herbst 2000). In such a setting, postwar reconstruction may drag on for far longer than in Vietnam (or in Japan and Western Europe, where postwar political institutions were also strong) leading to more persistent adverse legacies of war.

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Figure 1: Map of Vietnam – 10% of districts with the highest total U.S. bombs, missiles, and rocket intensity (per km^2) shaded

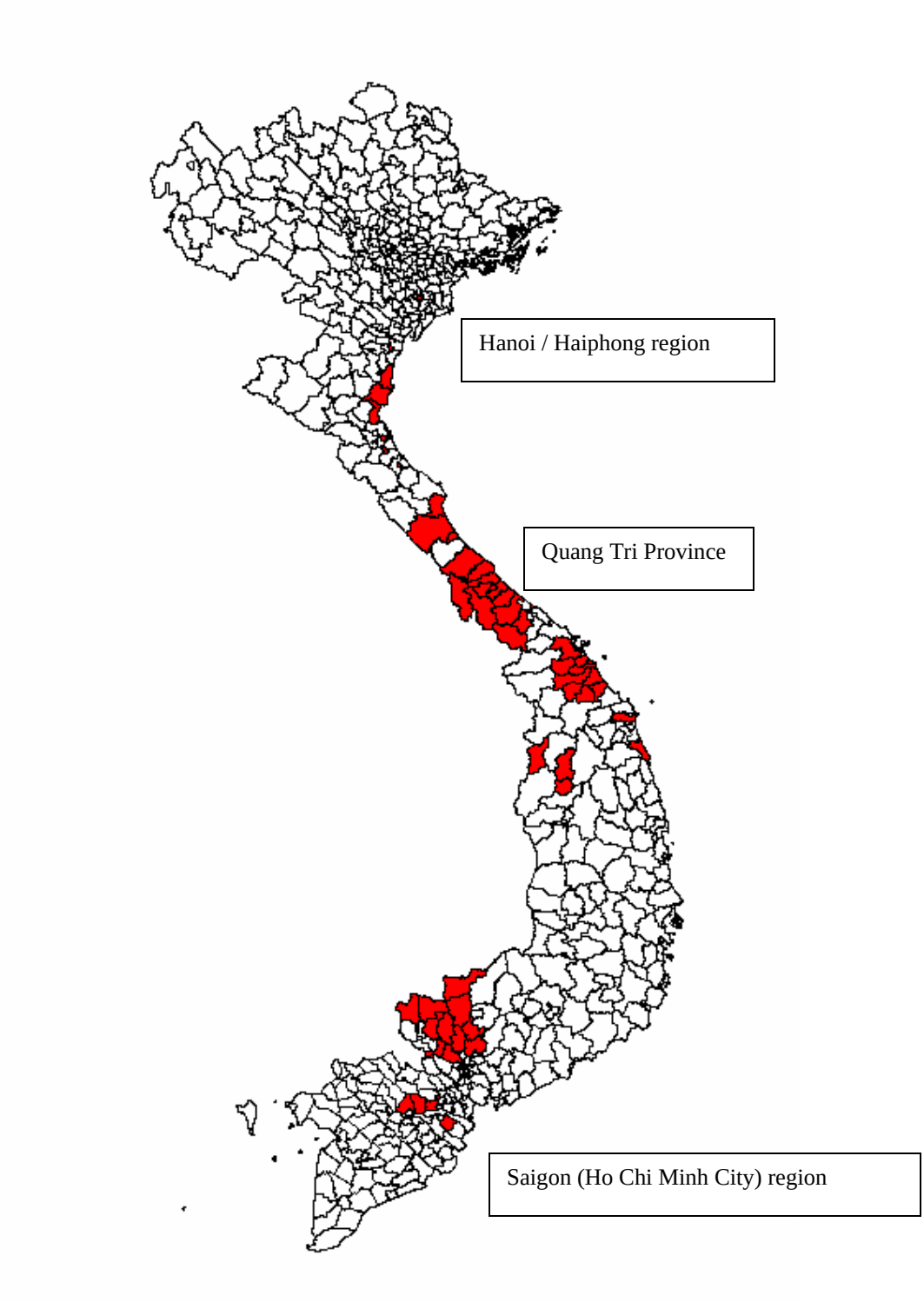


Figure 2: Map of Vietnam – Total U.S. bombs, missiles, and rocket intensity per km^2
(20 quantiles, darker colors denote higher intensity districts)

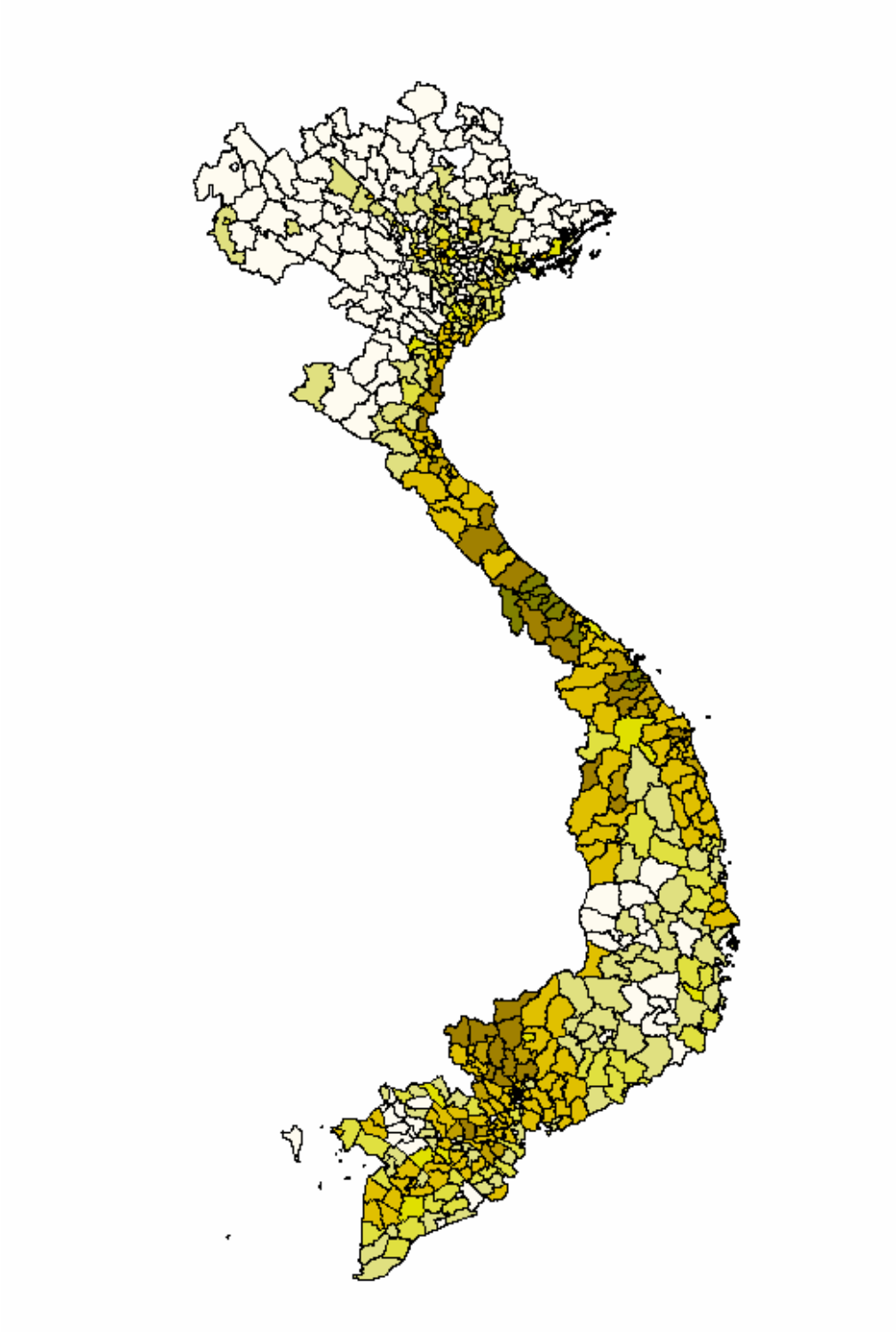
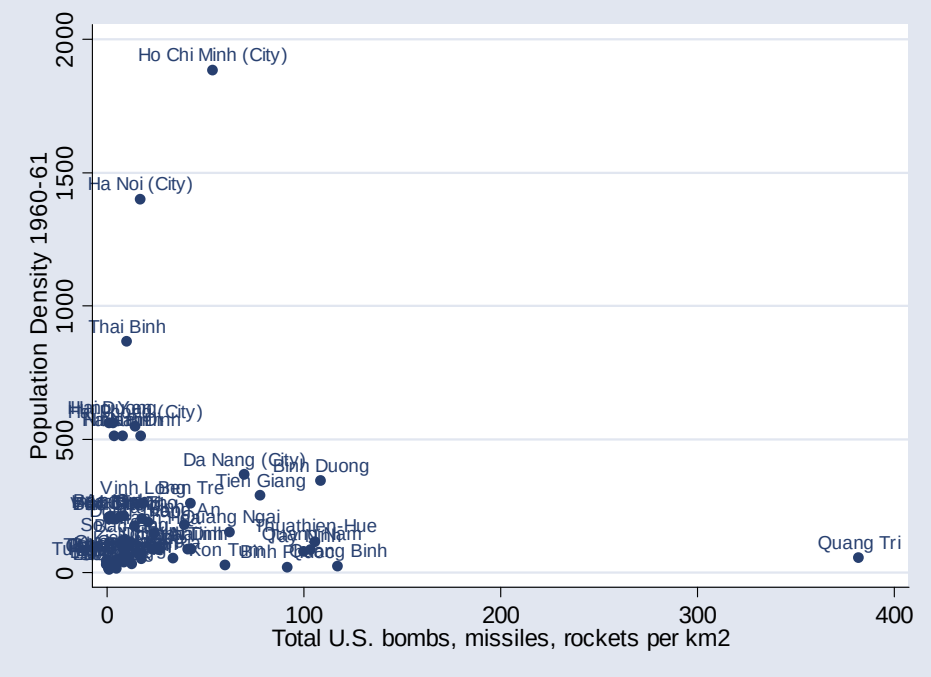


Figure 3: 1960-61 province population density vs.
Total U.S. bombs, missiles, and rocket intensity per km^2 in the province

(a) All Vietnam



(b) Central region

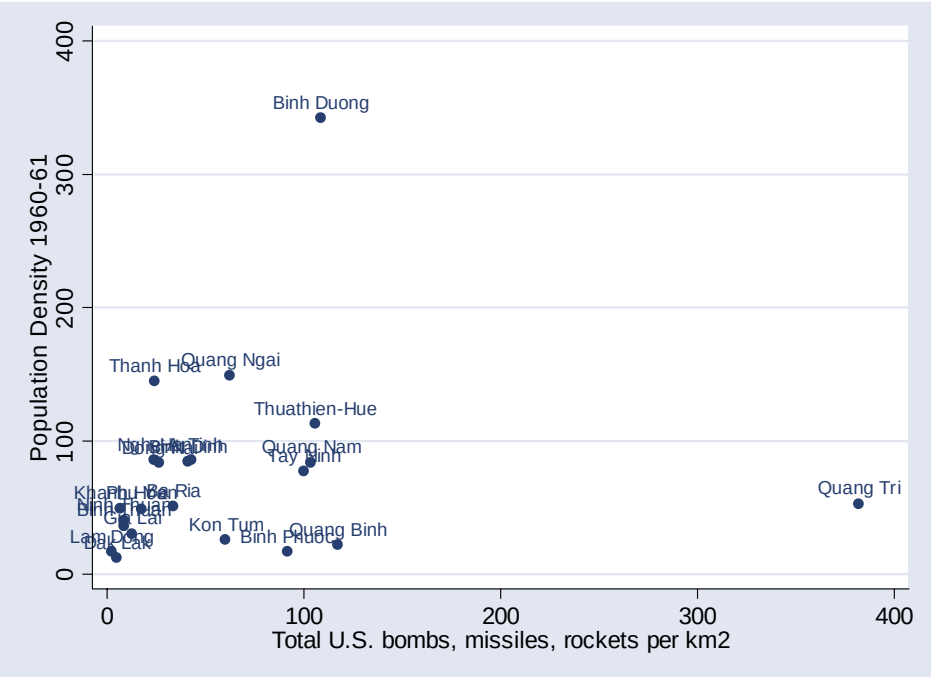
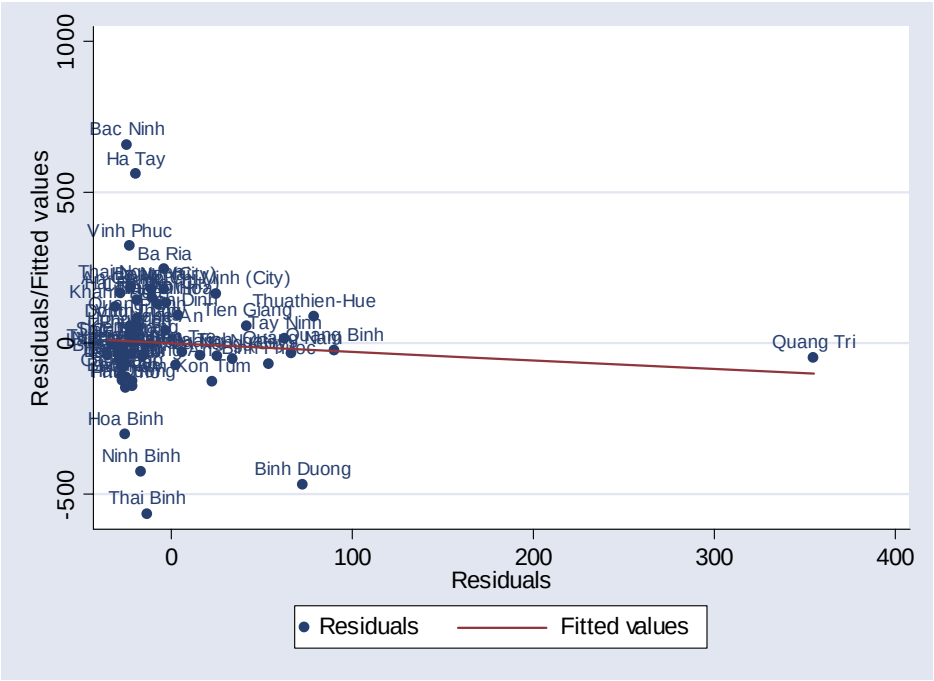


Figure 4: 1999 province population density vs.
Total U.S. bombs, missiles, and rocket intensity per km^2 in the province

(a) All Vietnam – conditional on 1960-61 province population density, South Vietnam indicator



(b) Central region – conditional on 1960-61 province population density, South Vietnam indicator

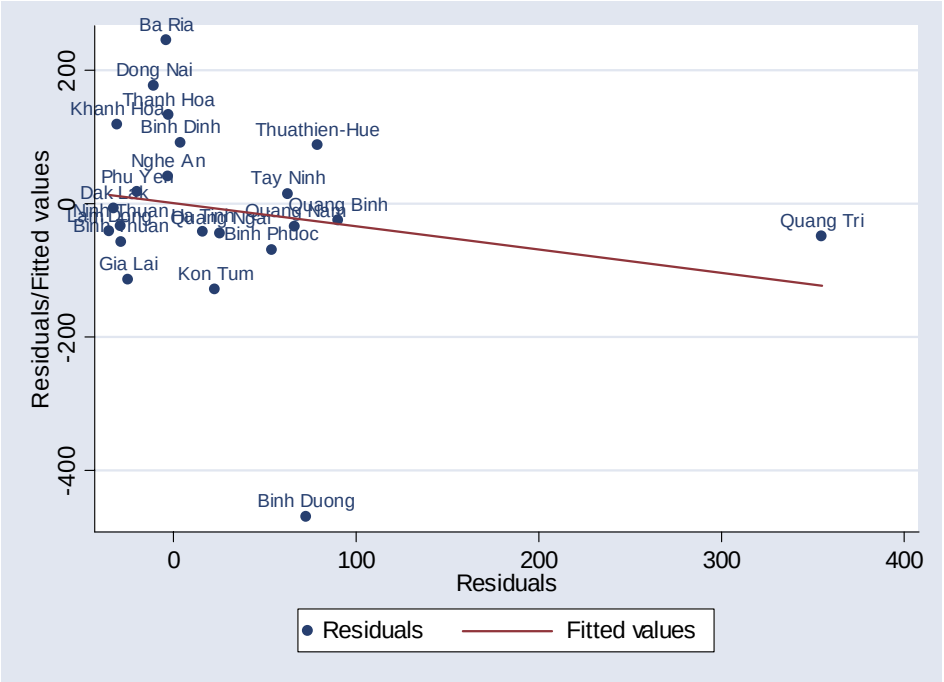
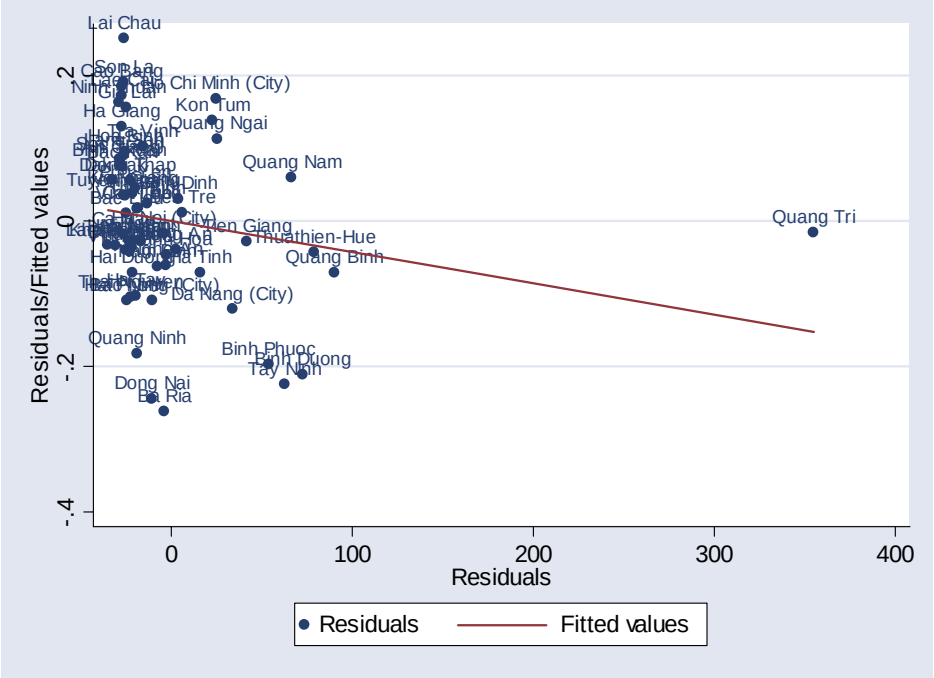


Figure 5: 1999 estimated province poverty rate vs.
Total U.S. bombs, missiles, and rocket intensity per km^2 in the province

(a) All Vietnam – conditional on 1960-61 province population density, South Vietnam indicator



(b) Central region – conditional on 1960-61 province population density, South Vietnam indicator

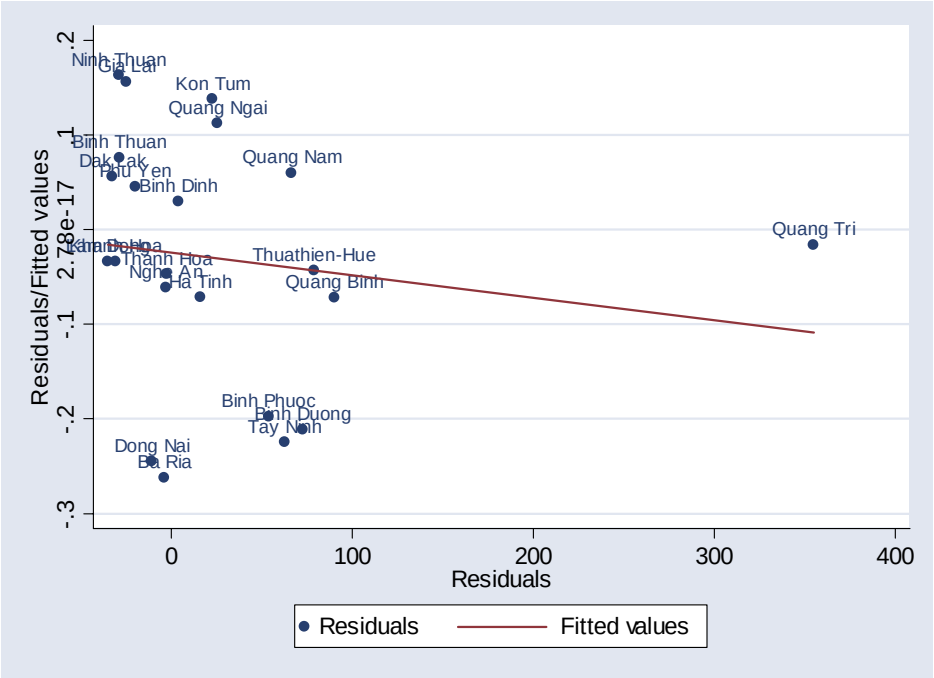
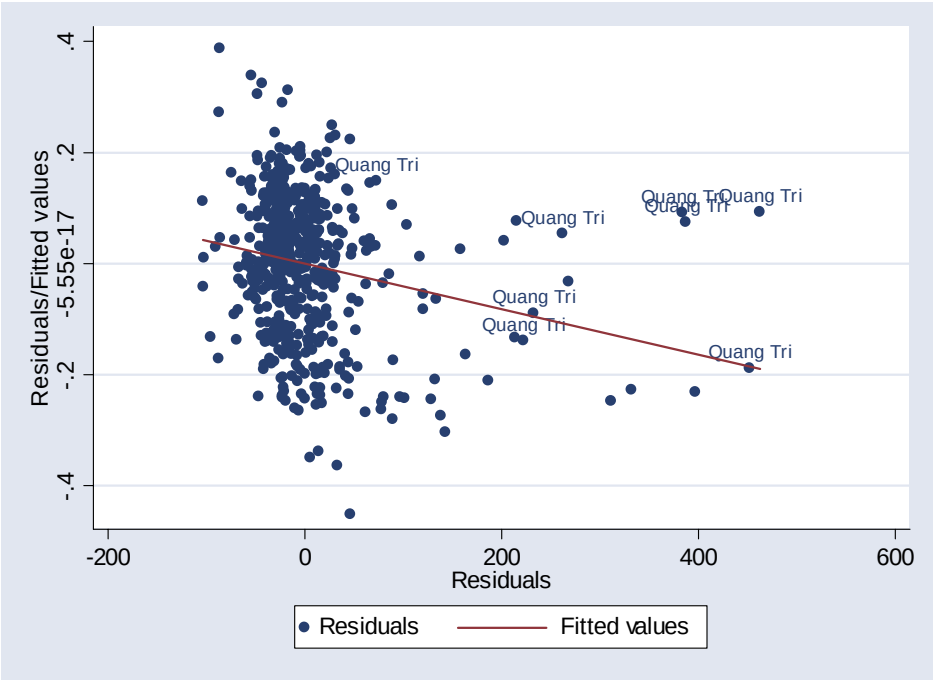


Figure 6: 1999 estimated district poverty rate vs.
Total U.S. bombs, missiles, and rocket intensity per km^2 in the district

(a) All Vietnam – conditional on 1960-61 province population density, South Vietnam indicator, district average temperature, average precipitation, elevation, and land area and area squared



(b) Central region – conditional on 1960-61 province population density, South Vietnam indicator, district average temperature, average precipitation, elevation, land area and area squared, and soil types

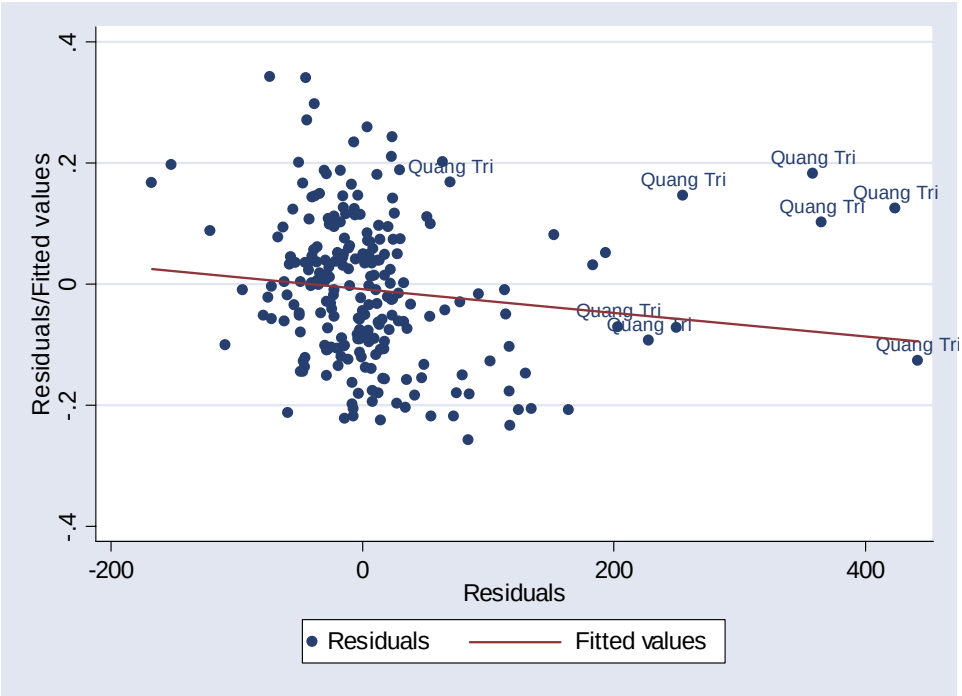


Table 1: U.S. ordnance data summary statistics

	All Vietnam					Central region				
	Mean	S.D.	Min.	Max.	Obs.	Mean	S.D.	Min.	Max.	Obs.
Total U.S. bombs, missiles, and rockets intensity per km^2	32.3	68.4	0	561.5	585	56.7	91.0	0.234	561.5	229
Total U.S. bombs, missiles, and rockets	14667	37322	0	365449	585	32011	54645	31	365449	229
General purpose bombs	11105	30756	0	322111	585	24583	45580	31	322111	229
Cluster bombs	705	2266	0	32403	585	1433	3322	0	32403	229
Missiles	25	122	0	1600	585	49	191	0	1600	229
Rockets	2824	7202	0	106445	585	5927	10609	0	106445	229
Cannon artillery	8.5	51.8	0	772	585	19.5	80.4	0	772	229
Incendiaries	794	1642	0	11667	585	1545	2186	0	11667	229
White phosphorus	71	306	0	3580	585	165	466	0	3580	229
Land mines	94	353	0	4638	585	211	537	0	4638	229
Ammunition (000's of rounds)	5667	11054	0	136416	585	10244	14678	0	136416	229

Notes: The Central region includes the following provinces: Ba Ria, Binh Dinh, Binh Duong, Binh Phuoc, Binh Thuan, Dak Lak, Dong Nai, Gia Lai, Ha Tinh, Khanh Hoa, Kon Tum, Lam Dong, Nghe An, Ninh Thuan, Phu Yen, Quang Binh, Quang Nam, Quang Ngai, Quang Tri, Tay Ninh, Thanh Hoa, and Thuathien-Hue, and excludes Da Nang (City) and Ho Chi Minh (City). The summary statistics are not weighted by population.

These samples exclude Quang Tri district (in Quang Tri province), which has by far the highest total U.S. bombs, missiles, and rockets intensity per km^2, at 3148. This outlier is excluded from the analysis.

Table 2: Estimated correlations among U.S. ordnance categories, by district

	General purpose bombs	Cluster bombs	Missiles	Rockets	Cannon artillery	Incendiaries	White phosphorus	Land mines
General purpose bombs	1							
Cluster bombs	0.59***	1						
Missiles	0.27***	0.18***	1					
Rockets	0.64***	0.56***	0.34***	1				
Cannon artillery	0.37***	0.49***	-0.00	0.11**	1			
Incendiaries	0.65***	0.58***	0.09**	0.40***	0.43***	1		
White phosphorus	0.27***	0.22***	0.08**	0.39***	0.13***	0.24***	1	
Land mines	0.43***	0.33***	0.30***	0.67***	0.00	0.04	0.26***	1
Ammunition (000's of rounds)	0.54***	0.58***	0.06	0.32***	0.60***	0.82***	0.18***	-0.02

Notes: Estimated correlation coefficients. Significant at 90 (*), 95 (**), 99 (***) percent confidence. The results are for All Vietnam.

Table 3: Summary statistics – economic, demographic, climatic, and geographic data

	All Vietnam					Central region				
	Mean	S.D.	Min.	Max.	Obs.	Mean	S.D.	Min.	Max.	Obs.
Panel A: Province level data										
Population density, 1960-61	213	322	9	1881	61	75	71	12	342	22
Population density, 1999	517	626	45	3797	61	259	136	58	502	22
Proportion not born in current village, 1997/98	0.26	0.24	0	1	56	0.32	0.30	0	1	21
Per capita consumption expenditures, 1992/93	1734	588	847	3487	56	1673	588	847	3417	21
Per capita consumption expenditures, 1997/98	2561	1064	1324	6335	56	2664	865	1559	4910	21
Growth in per capita consumption expenditures 1992/93-1997/98	0.76	0.47	0.01	2.26	56	0.92	0.47	0.04	2.26	21
Panel B: District level data										
Population density, 1999	1656	5841	10	52382	585	407	605	10	4098	229
Estimated district poverty rate, 1999	0.41	0.20	0.03	0.94	585	0.43	0.20	0.04	0.88	229
Proportion of households with access to electricity, 1999	0.71	0.27	0.08	1.00	585	0.67	0.26	0.10	1.00	229
Literacy rate, 1999	0.88	0.11	0.24	1.00	585	0.86	0.11	0.40	0.98	229
Proportion of land area 0-250m	0.75	0.37	0.00	1.00	585	0.64	0.39	0.00	1.00	229
Proportion of land area 250-500m	0.11	0.19	0.00	1.00	585	0.15	0.18	0.00	0.95	229
Proportion of land area 500-1000m	0.11	0.21	0.00	1.00	585	0.18	0.25	0.00	1.00	229
Proportion of land area over 1000m	0.03	0.11	0.00	1.00	585	0.04	0.13	0.00	1.00	229
Total district land area (km^2)	528.1	512.6	4	3230	585	741.6	550.1	10	2806	229
Average precipitation (cm)	154.6	30.1	84.2	282.0	585	167.4	38.5	84.2	282.0	229
Average temperature (celsius)	24.3	1.9	19.4	27.3	585	24.4	1.1	21.6	26.9	229
Former South Vietnam	0.49	0.50	0	1	585	0.65	0.48	0	1	229

Notes: The Central region includes the following provinces: Ba Ria, Binh Dinh, Binh Duong, Binh Phuoc, Binh Thuan, Dak Lak, Dong Nai, Gia Lai, Ha Tinh, Khanh Hoa, Kon Tum, Lam Dong, Nghe An, Ninh Thuan, Phu Yen, Quang Binh, Quang Nam, Quang Ngai, Quang Tri, Tay Ninh, Thanh Hoa, and Thuathien-Hue, and excludes Da Nang (City) and Ho Chi Minh (City). The summary statistics are not weighted by population.

Table 4: Predicting bombing intensity

	Dependent variable: Total U.S. bombs, missiles, and rockets intensity per km^2					
	----------All Vietnam----------			----------Central region----------		
	(1)	(2)	(3)	(4)	(5)	(6)
Population density, 1960-61	-0.005	-0.0035*	-0.0024**	0.110	-0.319	-0.163**
	(0.015)	(0.0020)	(0.0011)	(0.152)	(0.200)	(0.072)
Former South Vietnam	10.3	-50.7	-6.4	-71.6	-87.5	-15.4
	(15.0)	(42.0)	(17.3)	(57.1)	(64.1)	(17.8)
Proportion of land area 250-500m		-8.8	-25.0*		-39.4	-47.7
		(21.1)	(14.0)		(40.9)	(29.8)
Proportion of land area 500-1000m		14.4	-6.0		-7.4	-17.9
		(27.4)	(20.6)		(32.8)	(26.8)
Proportion of land area over 1000m		-6.2	-34.0		27.4	-25.5
		(42.5)	(25.4)		(63.6)	(30.4)
Total district land area (km^2)		-0.004	-0.009		-0.047	-0.012
		(0.021)	(0.019)		(0.055)	(0.040)
(Total district land area (km^2))^2 / 1000		0.000	0.003		0.013	0.004
		(0.007)	(0.006)		(0.017)	(0.013)
Average precipitation (cm)		0.77***	0.49***		0.78**	0.52***
		(0.28)	(0.10)		(0.30)	(0.11)
Average temperature (celsius)		14.5	3.0		26.8	11.0
		(11.3)	(5.1)		(16.3)	(7.8)
District soil type controls	No	No	No	No	Yes	Yes
Exclude Quang Tri province	No	No	Yes	No	No	Yes
Observations	61	585	577	22	229	221
R^2	0.01	0.08	0.11	0.18	0.37	0.35
Mean (s.d.) dependent variable	31.5 (55.9)	32.3 (68.4)	27.1 (50.6)	63.2 (81.5)	56.7 (91.0)	44.1 (58.5)

Notes: Robust Huber-White standard errors in parentheses. Significant at 90(*), 95(**), 99(***) percent confidence. Disturbance terms are clustered at the province level in regressions 2-3 and 5-6. The district soil type controls include the proportion of district land in 18 different soil categories. Soil controls are not included in regressions 2-3 since they are missing for most urban districts.

Table 5: Local war impacts on 1999 population density

	Dependent variable: Population density, 1999					
	----------All Vietnam----------			----------Central region----------		
	(1)	(2)	(3)	(4)	(5)	(6)
Total U.S. bombs, missiles, and rockets intensity per km^2	-0.28	0.47	2.55	-0.49**	-0.25	0.20
	(0.27)	(7.53)	(12.19)	(0.19)	(0.50)	(1.05)
Population density, 1960-61	1.86***	0.40	0.40	0.95*	1.24***	1.26***
	(0.09)	(0.56)	(0.57)	(0.51)	(0.35)	(0.38)
Former South Vietnam	41.3	99.9	57.7	-53.2	23.1	21.8
	(46.7)	(808.9)	(673.4)	(57.9)	(120.8)	(122.8)
Proportion of land area 250-500m		2471	2513		117	100
		(2771)	(2674)		(182)	(201)
Proportion of land area 500-1000m		1423	1438		77	60
		(1868)	(1795)		(158)	(173)
Proportion of land area over 1000m		3204	3328		202	210
		(3609)	(3464)		(187)	(213)
Total district land area (km^2)		-9.9*	-9.9*		-1.33***	-1.33***
		(5.6)	(5.7)		(0.30)	(0.30)
(Total district land area (km^2))^2 / 1000		3.4*	3.4*		0.470***	0.472***
		(2.0)	(2.0)		(0.124)	(0.125)
Average precipitation (cm)		0.48	0.15		-1.08	-1.20
		(7.82)	(8.13)		(1.00)	(1.08)
Average temperature (celsius)		412.4	418.7		63.0	56.8
		(744.4)	(708.8)		(66.6)	(69.0)
District soil type controls	No	No	No	No	Yes	Yes
Exclude Quang Tri province	No	No	Yes	No	No	Yes
Observations	61	585	577	22	229	221
R^2	0.91	0.14	0.14	0.30	0.60	0.60
Mean (s.d.) dependent variable	517 (626)	1656 (5841)	1675 (5879)	259 (136)	407 (605)	413 (613)

Notes: Robust Huber-White standard errors in parentheses. Significant at 90(*), 95(**), 99(***) percent confidence. Disturbance terms are clustered at the province level in regressions 2-3 and 5-6. The district soil type controls include the proportion of district land in 18 different soil categories. Soil controls are not included in regressions 2-3 since they are missing for most urban districts.

Table 6: Local war impacts on estimated 1999 population density, alternative specifications

	Dependent variable: Estimated poverty rate, 1999							
	Ex-North Vietnam	Ex-South Vietnam	Rural: 1960-1 pop. density < 200 per km^2	Urban: 1960-1 pop. density ≥ 200 per km^2	All Vietnam	Central region	All Vietnam	Central region
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total U.S. bombs, missiles, and rockets intensity per km^2	10.70	-16.53	-0.45	-5.34	7.35	-0.39		
	(7.73)	(11.06)	(0.73)	(18.99)	(11.55)	(1.01)		
Top 10% of districts, total U.S. bombs, missiles, and rockets intensity per km^2							14.56	-32.60
							(400.44)	(60.92)
Population density, 1960-61	7.39***	0.00	0.07	-0.67			0.40	1.28***
	(2.02)	(0.41)	(1.02)	(0.61)			(0.55)	(0.31)
Former South Vietnam			231.8	-29814			77.7	39.1
			(205.3)	(18135)			(591.8)	(103.1)
District geographic, climatic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects	No	No	No	No	Yes	Yes	No	No
District soil type controls	No	No	No	No	No	Yes	No	Yes
Observations	301	284	409	176	585	229	585	229
R^2	0.37	0.19	0.23	0.43	0.48	0.62	0.14	0.59
Mean (s.d.) dependent variable	1348 (4069)	1982 (7256)	451 (976)	4457(10018)	1656 (5841)	407 (605)	1656 (5841)	407 (605)

Notes: Robust Huber-White standard errors in parentheses. Significant at 90(*), 95(**), 99(***) percent confidence. Disturbance terms are clustered at the province level. District geographic and climatic controls include Proportion of land area 250-500m, Proportion of land area 500-1000m, Proportion of land area over 1000m, Total district land area (km^2), (Total district land area (km^2))^2 / 1000, Average precipitation (cm), Average temperature (celsius). The district soil type controls include the proportion of district land in 18 different soil categories. Soil controls are not included in regressions 5 and 7 since they are missing for most urban districts.

Table 7: Local war impacts on 1997/98 population characteristics (VLSS data)

	----------All Vietnam----------		----------Central region----------	
	(1)	(2)	(3)	(4)
Panel A: Dependent variable: 1997/98 proportion not born in their current village				
Total U.S. bombs, missiles, and rockets intensity per km^2	-0.00030	-0.00008	-0.00029	-0.00025
	(0.00025)	(0.00072)	(0.00030)	(0.00120)
Population density, 1960-61	0.00011	0.00011	-0.00061	-0.00062
	(0.00009)	(0.00009)	(0.00054)	(0.00054)
Former South Vietnam	0.20***	0.19***	0.34***	0.34***
	(0.06)	(0.06)	(0.08)	(0.08)
Exclude Quang Tri province	No	Yes	No	Yes
Observations	56	55	21	20
R^2	0.19	0.17	0.34	0.30
Mean (s.d.) dependent variable	0.26 (0.24)	0.26 (0.24)	0.32 (0.30)	0.34 (0.30)
Panel B: Dependent variable: 1997/98 proportion of households heads in a Veterans Association				
Total U.S. bombs, missiles, and rockets intensity per km^2	0.00024**	0.00015	0.00023***	0.00023
	(0.00010)	(0.00034)	(0.000076)	(0.00041)
Population density, 1960-61	-0.000018	-0.000017	-0.00022*	-0.00022
	(0.000015)	(0.000016)	(0.00012)	(0.00018)
Former South Vietnam	-0.12***	-0.12***	-0.14***	-0.14***
	(0.01)	(0.02)	(0.03)	(0.03)
Exclude Quang Tri province	No	Yes	No	Yes
Observations	56	55	21	20
R^2	0.60	0.57	0.75	0.68
Mean (s.d.) dependent variable	0.075 (0.077)	0.072 (0.075)	0.059 (0.086)	0.050 (0.077)

Notes: Robust Huber-White standard errors in parentheses. Significant at 90(*), 95(**), 99(***) percent confidence.

Table 8: Local war impacts on estimated 1999 poverty rate

	Dependent variable: Estimated poverty rate, 1999					
	----------All Vietnam----------			----------Central region----------		
	(1)	(2)	(3)	(4)	(5)	(6)
Total U.S. bombs, missiles, and rockets intensity per km^2	-0.00043	-0.00041**	-0.00072***	-0.00015	-0.00018	-0.00067**
	(0.00031)	(0.00019)	(0.00016)	(0.00024)	(0.00020)	(0.00027)
Population density, 1960-61	-0.00026***	-0.000019**	-0.000019**	-0.00078***	0.00009	0.00007
	(0.00006)	(0.000007)	(0.000007)	(0.00026)	(0.00018)	(0.00018)
Former South Vietnam	-0.16***	-0.18***	-0.17***	-0.16***	-0.08**	-0.06
	(0.03)	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)
Proportion of land area 250-500m		0.16***	0.15***		0.23**	0.20*
		(0.05)	(0.05)		(0.10)	(0.10)
Proportion of land area 500-1000m		0.15**	0.14**		0.12*	0.11
		(0.06)	(0.06)		(0.07)	(0.07)
Proportion of land area over 1000m		0.30***	0.28**		-0.26***	-0.30***
		(0.11)	(0.11)		(0.06)	(0.07)
Total district land area (km^2)		0.00035***	0.00034***		0.00018**	0.00017**
		(0.00006)	(0.00006)		(0.00006)	(0.00007)
(Total district land area (km^2))^2 / 1000		-0.000099***	-0.000095***		-0.000050*	-0.000045
		(0.000024)	(0.000024)		(0.000025)	(0.000027)
Average precipitation (cm)		0.00081*	0.00084*		0.00099**	0.00111**
		(0.00045)	(0.00045)		(0.00046)	(0.00046)
Average temperature (celsius)		0.017	0.013		-0.057***	-0.061***
		(0.013)	(0.014)		(0.018)	(0.018)
District soil type controls	No	No	No	No	Yes	Yes
Exclude Quang Tri province	No	No	Yes	No	No	Yes
Observations	61	585	577	22	229	221
R^2	0.53	0.64	0.65	0.32	0.72	0.75
Mean (s.d.) dependent variable	0.41 (0.16)	0.41 (0.20)	0.41 (0.20)	0.37 (0.15)	0.43 (0.20)	0.43 (0.20)

Notes: Robust Huber-White standard errors in parentheses. Significant at 90(*), 95(**), 99(***) percent confidence. Disturbance terms are clustered at the province level in regressions 2-3 and 5-6. The district soil type controls include the proportion of district land in 18 different soil categories. Soil controls are not included in regressions 2-3 since they are missing for most urban districts.

Table 9: Local war impacts on estimated 1999 poverty rate, alternative specifications

	Dependent variable: Estimated poverty rate, 1999							
	Ex-North Vietnam	Ex-South Vietnam	Rural: 1960-1 pop. density < 200 per km^2	Urban: 1960-1 pop. density ≥ 200 per km^2	All Vietnam	Central region	All Vietnam	Central region
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total U.S. bombs, missiles, and rockets intensity per km^2	-0.00031	-0.00067	-0.00021	-0.00047***	-0.00050***	-0.00033**		
	(0.00019)	(0.00041)	(0.00021)	(0.00010)	(0.00010)	(0.00013)		
Top 10% of districts, total U.S. bombs, missiles, and rockets intensity per km^2							-0.114***	-0.065**
							(0.034)	(0.025)
Population density, 1960-61	-0.00012***	-0.000016***	0.00081***	-0.000010*			-0.000018***	0.00007
	(0.00003)	(0.000004)	(0.00020)	(0.000005)			(0.000007)	(0.00019)
Former South Vietnam			-0.14***	-0.26			-0.18***	-0.08*
			(0.04)	(0.17)			(0.04)	(0.04)
District geographic, climatic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects	No	No	No	No	Yes	Yes	No	No
District soil type controls	No	No	No	No	No	Yes	No	Yes
Observations	301	284	409	176	585	229	585	229
R^2	0.76	0.49	0.62	0.78	0.82	0.83	0.64	0.73
Mean (s.d.) dependent variable	0.46 (0.20)	0.35 (0.18)	0.46 (0.19)	0.29 (0.16)	0.41 (0.20)	0.43 (0.20)	0.41 (0.20)	0.43 (0.20)

Notes: Robust Huber-White standard errors in parentheses. Significant at 90(*), 95(**), 99(***) percent confidence. Disturbance terms are clustered at the province level. District geographic and climatic controls include Proportion of land area 250-500m, Proportion of land area 500-1000m, Proportion of land area over 1000m, Total district land area (km^2), (Total district land area (km^2))^2 / 1000, Average precipitation (cm), Average temperature (celsius). The district soil type controls include the proportion of district land in 18 different soil categories. Soil controls are not included in regressions 5 and 7 since they are missing for most urban districts.

Table 10: Local war impacts on consumption expenditures and growth (VLSS data)

	----------All Vietnam----------		----------Central region----------	
	(1)	(2)	(3)	(4)
Panel A: Dependent variable: 1997/98 per capita consumption expenditures				
Total U.S. bombs, missiles, and rockets intensity per km^2	1.65	6.87**	0.16	5.65
	(1.77)	(2.93)	(1.65)	(4.75)
Population density, 1960-61	1.95***	1.89***	1.11	-0.26
	(0.45)	(0.45)	(1.48)	(1.68)
Former South Vietnam	920***	783***	969***	975***
	(194)	(199)	(242)	(250)
Exclude Quang Tri province	No	Yes	No	Yes
Observations	56	55	21	20
R^2	0.49	0.52	0.27	0.27
Mean (s.d.) dependent variable	2561 (1064)	2579 (1065)	2664 (865)	2719 (849)
Panel B: Dependent variable: 1992/93 per capita consumption expenditures				
Total U.S. bombs, missiles, and rockets intensity per km^2	-1.22**	-1.33	-0.92	-0.06
	(0.48)	(1.49)	(0.65)	(2.60)
Population density, 1960-61	0.70***	0.70***	-0.27	-0.49
	(0.17)	(0.17)	(0.76)	(0.65)
Former South Vietnam	679***	682***	658***	659***
	(113)	(128)	(129)	(128)
Exclude Quang Tri province	No	Yes	No	Yes
Observations	56	55	21	20
R^2	0.45	0.42	0.35	0.27
Mean (s.d.) dependent variable	1734 (588)	1750 (581)	1673 (588)	1714 (571)
Panel C: Dependent variable: Growth in consumption, 1992/93- 1997/98				
Total U.S. bombs, missiles, and rockets intensity per km^2	0.0020**	0.0043***	0.0008	0.0018
	(0.0008)	(0.0014)	(0.0007)	(0.0022)
Population density, 1960-61	0.00042**	0.00040**	0.00075	0.00052
	(0.00017)	(0.00017)	(0.00089)	(0.00081)
Former South Vietnam	0.04	-0.02	0.05	0.05
	(0.12)	(0.12)	(0.17)	(0.17)
Exclude Quang Tri province	No	Yes	No	Yes
Observations	56	55	21	20
R^2	0.14	0.17	0.03	0.04
Mean (s.d.) dependent variable	0.76 (0.47)	0.75 (0.47)	0.92 (0.47)	0.91 (0.48)

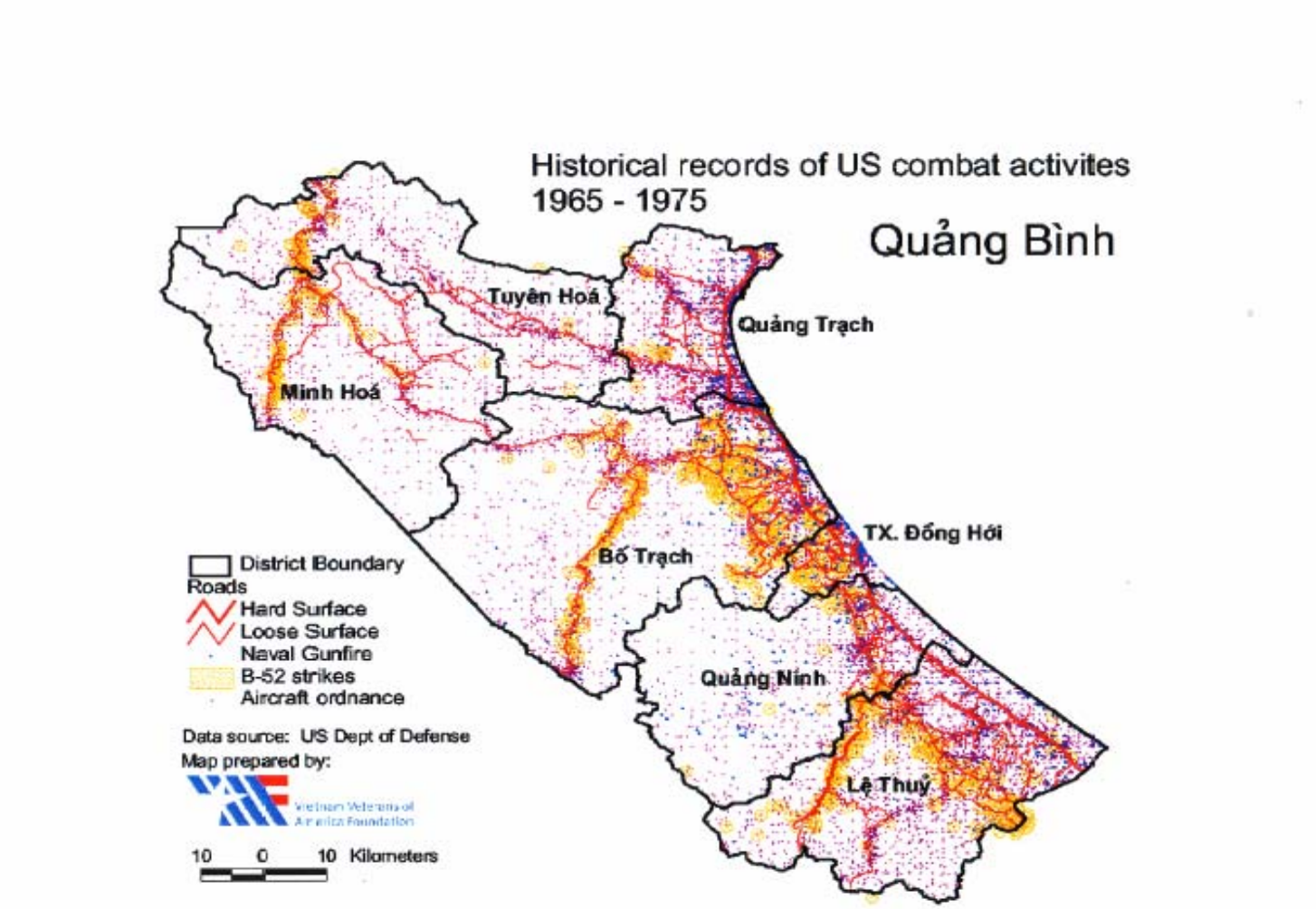
Notes: Robust Huber-White standard errors in parentheses. Significant at 90(*), 95(**), 99(***) percent confidence.

Table 11: Local war impacts on 1999 proportion of households with access to electricity

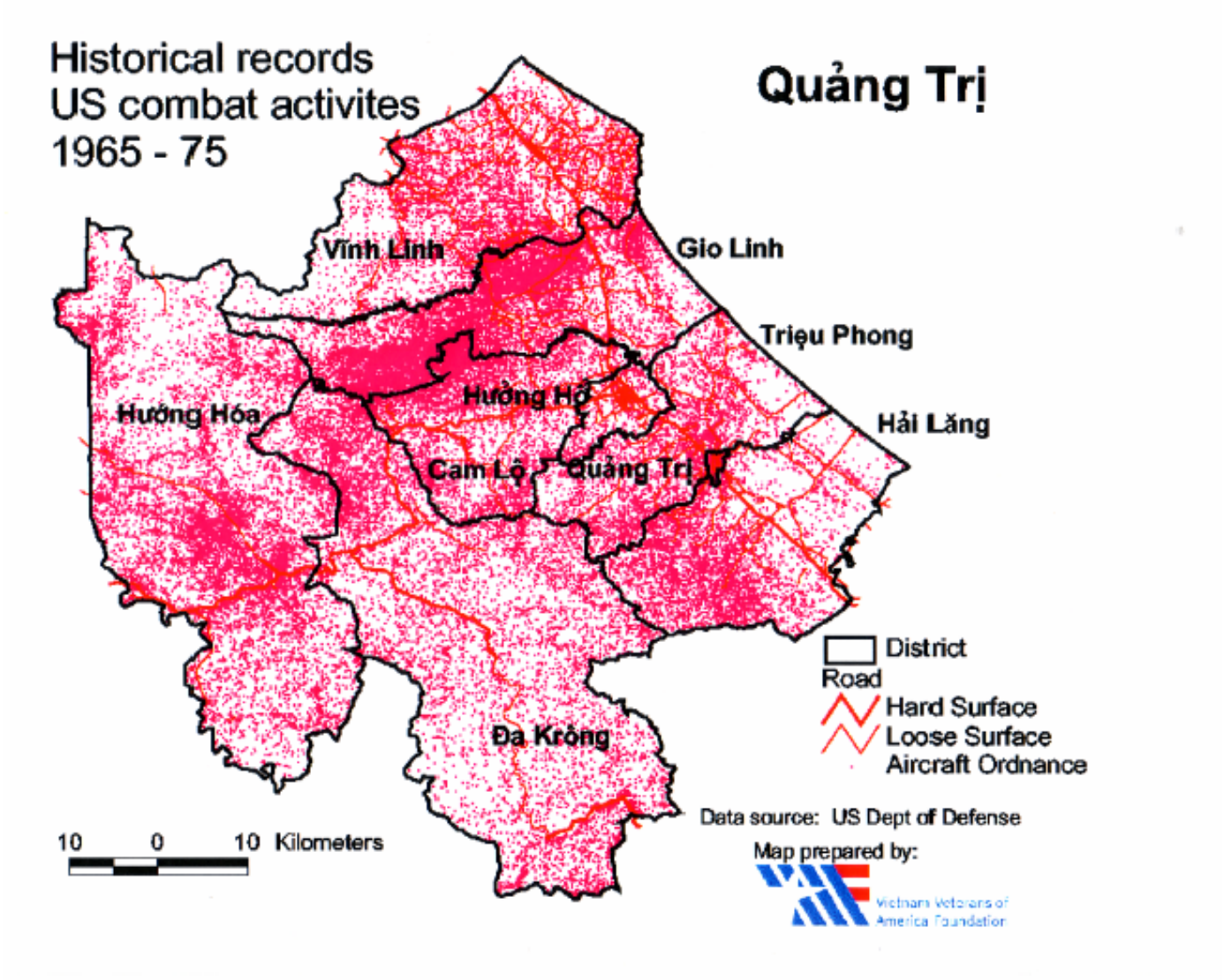
	Dependent variable: Proportion of households with access to electricity, 1999					
	----------All Vietnam----------			----------Central region----------		
	(1)	(2)	(3)	(4)	(5)	(6)
Total U.S. bombs, missiles, and rockets intensity per km^2	0.00056*	0.00044***	0.00056***	-0.00027	0.00018	0.00028
	(0.00032)	(0.00014)	(0.00021)	(0.00028)	(0.00015)	(0.00029)
Population density, 1960-61	0.000311***	0.000020***	0.000020***	0.00082**	-0.000044	-0.000036
	(0.000071)	(0.000005)	(0.000005)	(0.00031)	(0.000199)	(0.000197)
Former South Vietnam	-0.13***	0.04	0.03	-0.14***	-0.05	-0.07
	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)
District geographic, climatic controls	No	Yes	Yes	No	Yes	Yes
District soil type controls	No	No	No	No	Yes	Yes
Exclude Quang Tri province	No	No	Yes	No	No	Yes
Observations	61	585	577	22	229	221
R^2	0.35	0.59	0.59	0.34	0.67	0.67
Mean (s.d.) dependent variable	0.71 (0.21)	0.71 (0.27)	0.71 (0.27)	0.73 (0.14)	0.67 (0.26)	0.66 (0.26)

Notes: Robust Huber-White standard errors in parentheses. Significant at 90(*), 95(**), 99(***) percent confidence. Disturbance terms are clustered at the province level in regressions 2-3 and 5-6. District geographic and climatic controls include Proportion of land area 250-500m, Proportion of land area 500-1000m, Proportion of land area over 1000m, Total district land area (km^2), (Total district land area (km^2))^2 / 1000, Average precipitation (cm), Average temperature (celsius). The district soil type controls include the proportion of district land in 18 different soil categories. Soil controls are not included in regressions 2-3 since they are missing for most urban districts.

Appendix Figure 1: Raw DSCA bombing data, Quang Binh province



Appendix Figure 2: Raw DSCA bombing data, Quang Tri province



Appendix Figure 3: Map of Vietnam – districts with VLSS data