SHORT-TERM AND LONG-TERM IMPACT OF WAR ON THE ECONOMIC PERFORMANCE:

EVIDENCE FROM VIETNAM

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Abstract

Based on the rich historical population and other economic data at province-level in Vietnam, I confirm that the short-term impact of war on the economic performance is highly statistically significant and differs among North, South and Middle region provinces. In the long-run, the war has not shown significant or negative impact on the concentration of firm or the wealth of provinces. Zipf slopes, DID method, time-series data as well as cross-section data are used in this research.

Keyword: war, bombing, density, population, concentration, province-level data, Zipf, DID

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1. Introduction

Vietnam has a long history of war like many countries that have the location beside the beach which have the advantage in sea transportation and are near the equator in the Northern Hemisphere of Earth where is targets of invasion from other bigger countries. The countries in the North often are stronger and have male characteristic and make war while countries in the South with female characteristics are always countries are invaded. In this case, Vietnam was invaded by China for many years until the 11th century with many kings as well as changes in the territory, before becoming an independent country. After escaping the domination of China, Vietnam also experienced a lot of ups and downs with the civil war split the country into 2 regions such as North and South or 3 regions including North, Central, and South until the end of the 19th century when the first time French shot South of Vietnam in 1858. In this period, Vietnam had been divided into 3 regions. In 1945, the abdication of the last King Bao Dai has ended the feudal era that existed for thousands of years in Vietnam. At the same time, the Democratic Republic of Vietnam country was born which united 3 regions into an independent Vietnam country. The process of US intervention in Vietnam (1948-1975) is the evolution of a series of policies and measures of political, diplomatic and military to fulfill their objectives in Indochina region (where Vietnam is the main focus). This process is considered to be the direct cause leading to a prolongation of the Indochina War and was the spark for the Vietnam War ensued. The US role has slowly gone from aid, adviser to the direct military intervention. In the time of "War against the US"[1], this country split again into 2 regions which are North and South from 1954-1975 before the unification to become the Republic of Socialist Vietnam until now.

During the time of division from 1954 to 1975, US had been long and heavy bombing to the center of Vietnam. In the history of world wars, Vietnam is the country which has the most bombs thrown. US bombs dropped on Vietnam are nearly 3 times of total bomb used in the First World War II, the so-called "lunarization" policy, and about fifteen times total tonnage in the Korean War. In the years from 1966 to 1968, the US and allied aircraft threw 2,865,808 tons of bombs on Vietnam, Laos, and Cambodia. Until 1975, the US military has thrown seven million tons of bombs and artillery shells into North and South of

[1] Some people feel that the name War against the US is not neutral because of there were Vietnamese who fought on the same side with the United States. Some argue that the Vietnam War name shows the Westerners' view rather than Vietnamese. However, in terms of academics, scholars and authors of books and journals outside of Vietnam often use the name "Vietnam War" because of its international nature. In this research, the Vietnam War or War against the US is used with the same meaning.

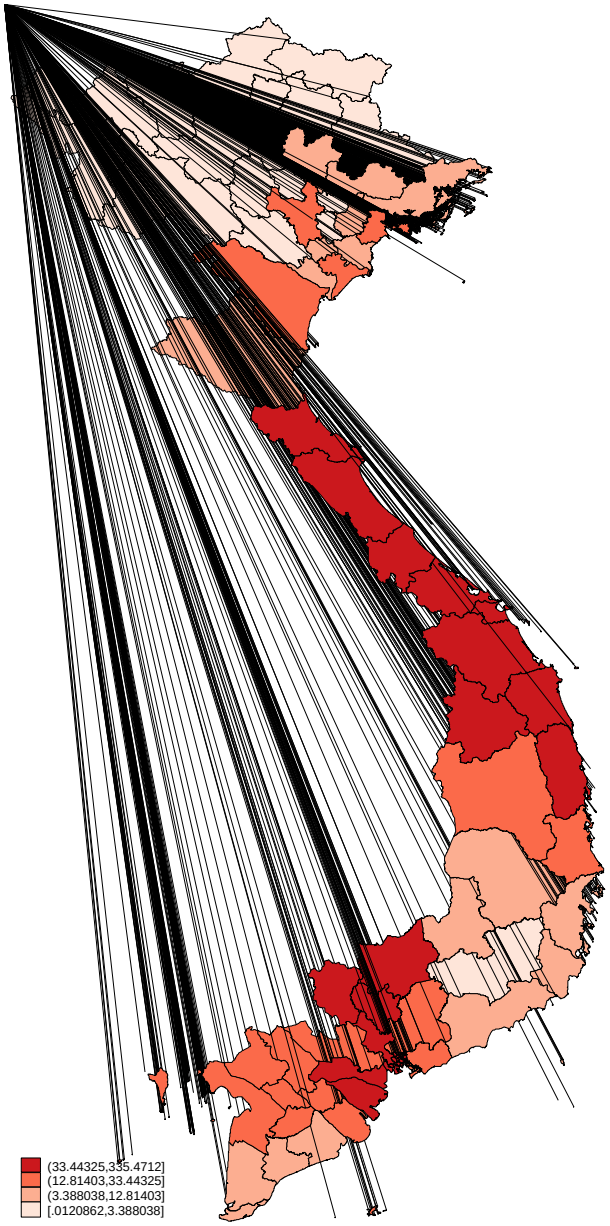
Vietnam. The war ended, but the country has about 66,000 km2 unexplored bombs and mines. An estimated of 600,000 tons of unexplored mine underground or scattered across the country, especially the provinces of Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien - Hue, Quang Nam, and Quang Ngai ... The mine was removed only by about 20%. On average, each year there are about 20,000 hectares of land cleaned. With this progress, it will take about 300 years to eliminate all kinds of unexploded bombs. Landmines left from the war continue to cause heavy losses of life, property and the lives of people. 10,529 people were killed, and 12,231 people of whom 25% are children ages 14 and younger were injured by this landmine which severely affects economic development and society.

The map of bomb density shows where the most serious bombing places in Vietnam are. From the map, the provinces in the Center Region such as Quang Binh, Quang Tri, Thua Thien Hue have the heaviest bomb density.

The question for this research is whether there are short-term and long-term impacts of US bombing on Vietnamese economic performance. Actually, there were much of research on this topic such as research of Miguel and Roland (2011) show no negative impacts on local poverty, consumption, infrastructure, literacy or population density. However, measure both temporary and long-term impacts at the same time with historical rich-data under both cross section at province level and time series format of data is not considered in any research. Moreover, this research has not only population data as a proxy of economic performance in the past but also has some other economic indicators at province level in the past like area of paddy, the productivity of paddy, the number of hospital and bed in the hospital for both regions in division period. This research also is different with research of Miguel and Roland (2011) which has a number of firms, a number of labors or GDP at province level as dependent variables. To make the data for this research, authors need a lot of labor-intensive effort for this paper which is present more detail in the data description part. Methodology and measurement which are used in this paper are OLS, DID, Zipf law of population, and regressions for time series data.

The structure of this research is as follow: coming after the introduction part, the section 2 is literature review which introduces some most impact papers in the field of the effect of war on economic growth.

Section 3 continues with data description while section 4 introduces the framework for the empirical analysis of the long-term impact of war as well as the results and analysis. The short-term impact is measured in section 5 with time series data and Zipf law. The conclusion is presented in the section 6.



Map 1 : Total US bombs per km2 by province in Vietnam from 1965-1975

2. Literature review

There are two aspects of the research topic that examines the impact of war on the economy including long-run impacts and short-term. This section describe the literatures about these two trends.

Many authors consider the long-run impact of war on the economic development, education or other social life quality. Some researches show the positive impact, some other shows the negative impact and some shows not significant relationship. One of the most popular research about this topic is the Miguel and Roland (2011) has investigated the impact of U.S. bombing in Vietnam. The dependent variable they used is local poverty rates, consumption levels, infrastructure, literacy, and population density through 2002. In the period from 1965 to 1975, Vietnam suffered the most intense bombing campaign in military history and had massive humanitarian costs. With unique U.S. military dataset containing bombing intensity at the district and province level, they have examined the damage of war led to the local poverty trap that using an instrumental variable approach. The result shows no negative impacts of U.S. bombing on the local poverty even this is the heaviest bombing in human history.

Another research about this topic is research of Che, Du, Lu, and Tao (2015) about the long-term impact of conflicts between countries on cross-border trade and investment with the case of Japan and China due to the Japanese invasion. The research shows the historical animosity still influences the international trade and investment despite the globalized world. The data of civilian casualties in Chinese regions is proxy of war damage and use difference-in-differences estimation to measure the long-run impacts of the war. Their study finds that the regions with larger war casualties have attracted less investment from Japan and engaged in less trade with Japan. Therefore the historical animosity still matters in international trade and investment.

Considering the labor economic aspect, the research of Ichino and Winter-Ebmer (2004) finds that in the World War II, children in Europe were significantly less likely to proceed in to higher education. This research also estimate the earning losses implied the loss of GDP for their country suffered by those people who did not receive the higher education because of the war. Instrument Variable estimates is use as measures of the Local Average Treatment Effects of education.

Unlike above researches, Davis and Weinstein (2002) use a very rich population data from Stone Age to the modern era to investigate the distribution of economic activity within a country according to three theories: increasing returns, random growth and locational fundamentals. Their research confirms that long-run city size is robust even to large temporary shocks.

Short-term impact of war has been discussed in the research of Redding, Sturm, and Wolf (2011). The question in this research is whether the industry location is determined by fundamentals or a shift between multiple steady-states. Using the case of Germany where is divided after Second World War and has a reunion after that as the exogenous shock to industry location, this paper provides evidence that the relocation of Germany's air hub from Berlin to Frankfurt is a shift between multiple steady-states. The model is used in this research allows changes in trends and intercepts of airport passengers shares for each airport during the prewar, division and reunification periods. Moreover, difference-in-differences estimations are introduced to examine how the division effect on the location of Germany's leading airport. In a similar way, my paper does the same method to see how the population of Vietnamese provinces change through three periods including union, division, and reunion as presented in the next sections. A slightly different motivation in the research of Redding and Sturm (2008) has confirmed the importance of market access for economic development. The theory framework of this research is two agglomeration forces are "home market effect" and "cost of living effect" and dispersion forces are "market crowding effect" and "congestion effect". The empirical specification tries to measure the impact of the border as treatment group of cities and co-interaction term border*division on the population growth of cities. The results shows that division's negative impact on cities close to the East-West German border through market access. In the common voice, research of Nakajima (2008) in case of Japan confirms that the cities located close to Korea suffered greater division shock because of the decline in market access. Population growth rates of border cities declined significantly from 1950 to 1970.

In this paper, we combine three papers those are Davis and Weinstein (2002), Redding et al. (2011) and Miguel and Roland (2011) to find both short-term and long-term impact of war on the distribution of

firm as well as the economic performance of provinces in Vietnam with unique historical population data from 1921 until now.

3. Data description

To make the cross-section and time-series data, I have done a huge labor intensive job to aggregate data into a consistent package. Moreover, I have merged data form two main databases including Vietnamese Enterprise Census and Vietnamese Population Census. This section describes how I get the data, the source of data, the data types and description of data.

3.1 Population data aggregation methodology

Due to the change of provinces area and name along history, data of population has been aggregated into 40 provinces in general. This data had been separated to several periods that depends on the division and reunion time and the change of policy of Vietnam. The oldest data is from 1921-1953 where there is 72 provinces. Second period is from 1954 to 1975 with about 70-78 provinces but the names of provinces change widely compare to previous period because from 1954 Vietnam is divided into two regions North of Vietnam and South of Vietnam. There were two separated governments at that time. The third periods with only 40 provinces is from 1976 to 1984 after the reunion of North and South of Vietnam and US army withdrew back to home country. This provinces merging was made because the management purpose of government as well as the lack of labor force to handle more than 70 provinces as before. The number of provinces increased through later periods such as 1985, 1990-2003 and 2004-2007 are 52, 61 and 64 provinces consequently. From 2008 Hanoi was expanded and there are 63 provinces until recent. The name and the way to combine data are shown in appendix 1. The source of population data is extracted from the series of book namely "Vietnam statistical data in the 20th century" which is published by General Statistics Office of Vietnam. The series include 6 parts divided into 3 books with total about 5000 pages. The first book is Vietnam statistical data from 1901 to 1975 which has three part (Vietnam statistical data from 1901-1954, and statistics of North of Vietnam from 1955 to 1975, and statistics of South of Vietnam from 1955-1975). This is the most valuable source of historical data among three books and many of them are published for the first time which become useful for researcher about Vietnam. The second database is for the period

from 1976 to 2000 and the third book is about "21 statistical large-scale surveys and censuses in the 20th century".

Beside population data, other data can be good candidates for economic performance also available in 1954-1975 such as of agricultural, forestry, health and transportation industries at province level. I have data of population from 1921 until 1953 to be the proxy of economic development of each province. From 1954, the data was divided into two regions that are North and South. For example, the data of agriculture industry in the North in this period includes the number of agriculture co-operative societies (which is "hợp tác xã" in Vietnamese), the number of generator and working machines; planted area or productivity or yield of food crops, paddy, maize, sweet potatoes, cassava for both season and Spring and winter season separately; the number of buffaloes, cattle, pigs that is produced or supplied to the State. In addition, forestry, health, and transportation related statistics also recorded in the books. At the same time, the statistics for the South of Vietnam are quite similar with the North. Finally, I got some common indicators for the whole country in this division period which are the paddy area, paddy productivity, a number of hospital and number of hospital beds by the province for some years as presented in the statistics summary table 1.

I have taken the data of the number of firms, the number of labors from the Vietnamese Firm Surveys in 2006. This data and area data has is 64 observations in province-level, while the bomb data from research of Miguel and Roland (2011) has data of 61 provinces-level observation. This database includes district-level bomb data as well from 1965 to 1975. To merge them with population data, all statistics are downsized to 40 province-level observations.

3.2 Database types

This research uses two types of the database to measure both short-run and long-run impacts of bombing into Vietnam. The first database is cross-section data for measuring the long-run impact while the time-series data is used to investigate the short-run impact. To make this databases consistently, data are aggregated downsize to 40 provinces as the biggest number of observations. All the changes of each province in 20th century such as names changing, expanding and narrowing is taken into consideration with a lot of effort. The aggregation coding method for provinces is presented in appendix 1 that have the basic

year is 1976-1884 when the number of the province is lowest. Provinces of all other years are merged under the same names with provinces in this period.

3.3 Data descriptions

The summary statistic table 1 describes the number of observations, mean, standard deviation, min and max values of number of firm and labor, area, GDP, bomb, population, agriculture and health of the cross-section data. The number of firms and labors at each province is data in the year 2006 because this time are not affected by the economic crisis from 2008. From this table, the mean value of firm number is 2978 firms and of labor is 159 thousand labors. The data are divided into three groups including State-Owned Enterprises (SOE), private enterprises (NonSOE), Foreign Direct Investment Enterprises (FDI). Among this three groups, the most populous is private firms with more than 111 thousand enterprises in total and they also create biggest number of labor for the economy with more than three million labors. The number of FDI firm is bigger than the number of SOE firm but the SOE firms provide more job opportunities than the FDI firms. In some provinces, there is no FDI firm such as Ha Tuyen province, Cao Bang province which are the North provinces and An Giang province located in the South. The city that has largest number of firm is Ho Chi Minh City.

The mean value of area of provinces is 7,723 square km with min value is 920 that is Hanoi Capital before enlargement in 2008. Each province has average number of GDP that is 14 trillion VND while the richest city in terms of this value also is Hochiminh City. The provinces in mountain region such as Cao Bang always are the poorest place.

The mean value of population for each province ranges from 390 thousand people in 1921 to 1343 thousand people in 1980. This table does not describe the population statistics for later years but they are available in the cross-section data. The area of planted paddy does not has big change through 1960 to 1973 but the productivity of paddy was much higher in 1973. The total number of hospital in 1968 was 390 hospital with 37,999 hospital beds while the average hospital is around 10 to 11 ones but the average hospital beds was much larger in 1973.

Missing value error appears with zero value in some province there is no FDI firms or population or planted area. To make the zero value not become missing after taking logarithm, 10^{-10} are added in the number for all provinces before doing the logarithm calculation to solve the missing problem.

Table 0.1. Data description

Variables	Number of Provinces	Total	Mean	Sd	Min	Max
Number of firms	40	119,134	2,978	5,610	346	32,482
Number of SOE firms	40	3,531	88	118	22	672
Number of NonSOE firms	40	111,574	2,789	5,313	310	30,816
Number of FDI firms	40	4,029	101	247	-	1,218
Total labor (thousand labors)	40	6,346	159	284	14	1,485
Number of SOE labors (thousand labors)	40	1,705	43	94	4	561
Number of NonSOE labors (thousand labors)	40	3,201	80	140	9	831
Number of FDI labors (thousand labors)	40	1,440	36	88	-	407
Area of provinces (square km)	40	308,991	7,723	5,783	920	25,110
GDP of province in 2006 (trillion VND)	40	538	14	16	2	101
Total U.S. bombs, missiles, and rockets	40	8,580	215	503	0	3,020
Total U.S. bombs, missiles, and rockets per km2	40	1,746	44	92	0	558
Population in 1921 (thousand people)	40	15,584	390	360	1	1,531
Population in 1931 (thousand people)	40	17,681	442	394	5	1,826
Population in 1936 (thousand people)	40	18,952	474	415	7	1,901
Population in 1943 (thousand people)	40	22,615	565	509	5	2,235
Population in 1960 (thousand people)	40	29,989	750	554	1	2,054
Population in 1965 (thousand people)	40	33,449	836	609	52	2,411
Population in 1968 (thousand people)	40	35,612	890	645	73	2,777
Population in 1974 (thousand people)	40	44,476	1,112	764	123	3,665
Population in 1976 (thousand people)	40	49,160	1,229	786	-	3,602
Population in 1977 (thousand people)	40	50,413	1,260	782	-	3,506
Population in 1978 (thousand people)	40	51,421	1,286	765	87	3,471
Population in 1979 (thousand people)	40	52,462	1,312	793	91	3,397
Population in 1980 (thousand people)	40	53,722	1,343	804	93	3,376
Area of Paddy planted in 1960 (thousand hectares)	40	4,417	110	100	-	412
Area of Paddy planted in 1965 (thousand hectares)	40	4,828	121	98	-	398
Area of Paddy planted in 1968 (thousand hectares)	40	4,468	112	93	-	397
Area of Paddy planted in 1973 (thousand hectares)	40	4,915	123	105	-	483
Paddy productivity in 1960 (thousand tons)	40	8,958	224	204	-	915
Paddy productivity 1965 (thousand tons)	40	9,578	239	208	-	900
Paddy productivity 1968 (thousand tons)	40	8,064	202	177	-	847
Paddy productivity 1973 (thousand tons)	40	11,489	287	276	-	1,361
Number of hospital in 1968	40	390	10	9	-	30
Number of hospital in 1969	40	419	10	9	1	32
Number of hospital in 1970	40	425	11	10	1	32
Number of hospital in 1971	40	419	10	10	1	32
Number of hospital in 1973	40	418	10	10	1	35
Number of hospital beds in 1968	40	37,999	950	755	234	4,163
Number of hospital beds in 1969	40	40,377	1,009	779	225	4,146
Number of hospital beds in 1970	40	44,379	1,109	834	300	4,499
Number of hospital beds in 1971	40	44,848	1,121	761	305	3,770

Number of hospital beds in 1973	40	49,366	1,234	863	320	3,917

4. Framework to measure the short-run impact

4.1 Some basic indicators to measure the variation in regional density

According to the research of Davis and Weinstein (2002), some of the measures of variation in regional density are presented in table 2 and figure 1. Even these measurements are simple but they contain rich information because they are the historical valuable data. The first indicator is the total population in

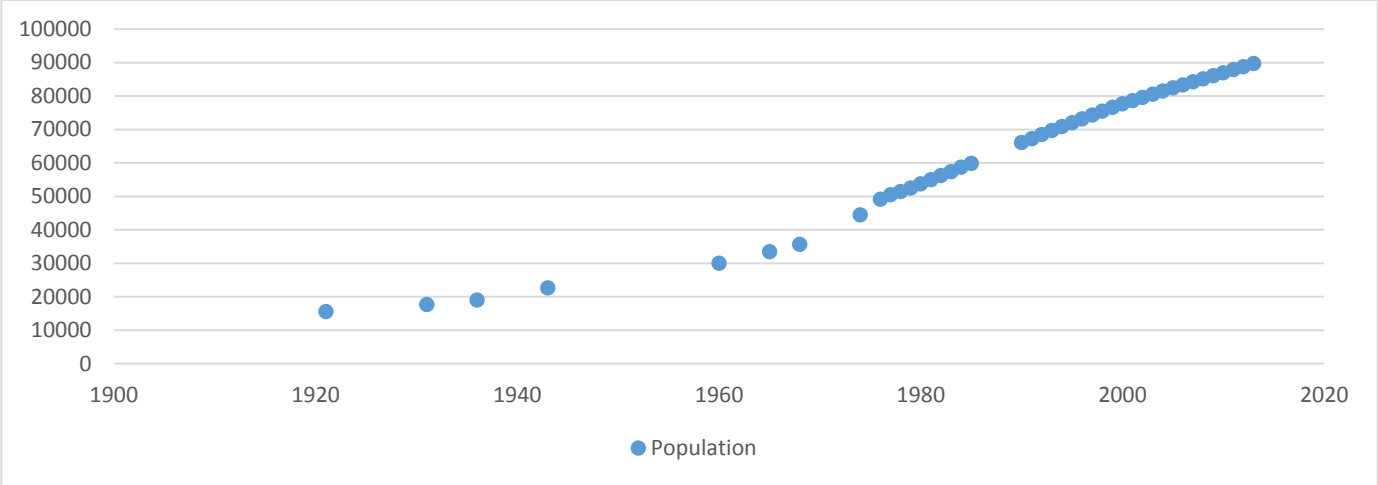


Figure 0.1.Population of Vietnam from 1921 until now (thousand people)

thousand people unit of Vietnam through decades. The earliest year in this data is 1921 when Vietnam has only about 16 million people. The population number increases gradually through years. The growth speed in the peace periods after war 1975 until now is higher than the period before 1975 as showed in the figure 1. In 2013, Vietnam has nearly 90 million people, stands in top 20 biggest countries in the World in terms of total population.

To measure the concentrations of population in some biggest cities, the second information is the percentage of the population of five largest regions to the total population. This number was quite high before the division and in the French Colonial period in Tonkin (North region) and Annam (Center region) and remained the emperors from Nguyen to Bao Dai (1926 to 1945). Before that, French already occupied Cochinchine (South region). The average values are around 35% in the five most populous regions. This number reduced in the division period from 1954-1975 to about 30 percent and reduce more in the reunion periods after 1975 until with about 25%. From 2008 after enlarging of Hanoi, this proportion was bigger to about 29%.

The second indicator to see the variation of population density is the relative variance of log population density which is calculate by the ratio of variance of log of population density in year t and the variance of the log of population density in 2013. If this ratio is bigger than 1, it mean that the population in the past time t varied greater than population in year 2013 and smaller than unity in the reverse case. In the case of Vietnam, all the case has this relative variance ratio greater than unity which means the population in the history change much higher than the modern time. This change can be explained by each period in the history. From 1921 to 1943 in the French Colonial period, the population fluctuated greatly with values are bigger than 2. In the division period, although this number smaller but it still bigger than 1. The biggest numbers is 13.9 in the year 1976 and 1977, this value maybe bias because at that time Vung Tau –Con Dao become one of the region of Dong Nai and population data for this period equal to zero. The variance of population density in the past time still bigger than present time until 1986 when Vietnam has "Doi Moi" program. Since then, these numbers almost are close to unity. This appears to reflect the fact that in the war time the population varied greatly.

One of measurement for regional density is the Zipf coefficient. This measure provides the variation in regional density through its slope. The variation of population density range from zero to minus infinity as the same way with the population were clustered in a single region to many regions. Research of Gabaix (1999) and Rosen and Resnick (1980) and Davis and Weinstein (2002) show most of cities or countries level Zipf slopes that close to minus unity which means the population density varies greatly.

To measure the Zipf coefficient, the cities' population is ranked firstly, then the regression of the log rank minus 0.5 against log population density is hold as the Zipf slope. The table 2 shows the fact that in early years (1921, 1931, 1936, 1943) the population varies greater than in division time or later years except the year 1977 1978 while Vietnam in the big change period. Some of the Zipf lines are described in the figure 2 Hochiminh City remained the position of leading city from division to reunion because it was the new economic and political center of South Vietnam from division 1954 to 1975 and it is the natural economic center after the reunion 1975.

Table 0.2. Variation of the Regional Density

Year	Population (thousand People)	Share of five largest regions	Relative variance of log population density	Zipf coefficient with raw population	Zipf coefficient with population density

1921	15,584	35.5%	2.7	-0.572***	-0.497***
1931	17,681	34.7%	2.3	-0.714***	-0.573***
1936	18,952	34.6%	2.1	-0.750***	-0.600***
1943	22,615	35.1%	2.3	-0.682***	-0.554***
1960	29,989	30.0%	2.3	-0.516***	-0.556***
1965	33,449	30.3%	1.6	-0.987***	-0.728***
1968	35,612	30.5%	1.5	-1.082***	-0.766***
1974	44,476	29.0%	1.5	-1.139***	-0.766***
1976	49,160	28.4%	13.9	-0.0561*	-0.123***
1977	50,413	27.8%	13.9	-0.0554*	-0.123***
1978	51,421	27.3%	1.4	-1.118***	-0.805***
1979	52,462	27.3%	1.4	-1.106***	-0.797***
1980	53,722	27.1%	1.4	-1.107***	-0.800***
1981	54,927	27.0%	1.4	-1.106***	-0.803***
1982	56,170	26.9%	1.4	-1.112***	-0.807***
1983	57,373	26.8%	1.4	-1.099***	-0.807***
1984	58,653	26.7%	1.4	-1.109***	-0.811***
1985	59,872	26.6%	1.4	-1.123***	-0.818***
1990	66,017	25.8%	1.1	-1.576***	-0.885***
1991	67,242	25.7%	1.1	-1.588***	-0.891***
1992	68,450	25.7%	1.1	-1.599***	-0.897***
1993	69,645	25.7%	1.1	-1.610***	-0.904***
1994	70,825	25.6%	1.1	-1.619***	-0.910***
1995	71,996	25.6%	1.1	-1.628***	-0.917***
1996	73,157	25.5%	1.1	-1.637***	-0.924***
1997	74,307	25.5%	1.1	-1.643***	-0.930***
1998	75,456	25.4%	1.0	-1.649***	-0.936***
1999	76,597	25.3%	1.0	-1.657***	-0.941***
2000	77,631	25.3%	1.0	-1.669***	-0.946***
2001	78,621	25.3%	1.0	-1.678***	-0.950***
2002	79,538	25.3%	1.0	-1.686***	-0.954***
2003	80,467	25.3%	1.0	-1.692***	-0.956***
2004	81,436	25.3%	1.0	-1.713***	-0.962***
2005	82,392	25.4%	1.0	-1.715***	-0.964***
2006	83,311	25.4%	1.0	-1.715***	-0.966***
2007	84,219	25.5%	1.0	-1.713***	-0.967***
2008	85,119	28.7%	1.1	-1.638***	-0.934***
2009	86,025	28.7%	1.1	-1.634***	-0.934***
2010	86,933	28.8%	1.1	-1.631***	-0.935***
2011	87,840	28.9%	1.1	-1.629***	-0.935***
2012	88,773	28.9%	1.1	-1.624***	-0.936***
2013	89,709	29.0%	1.1	-1.621***	-0.936***

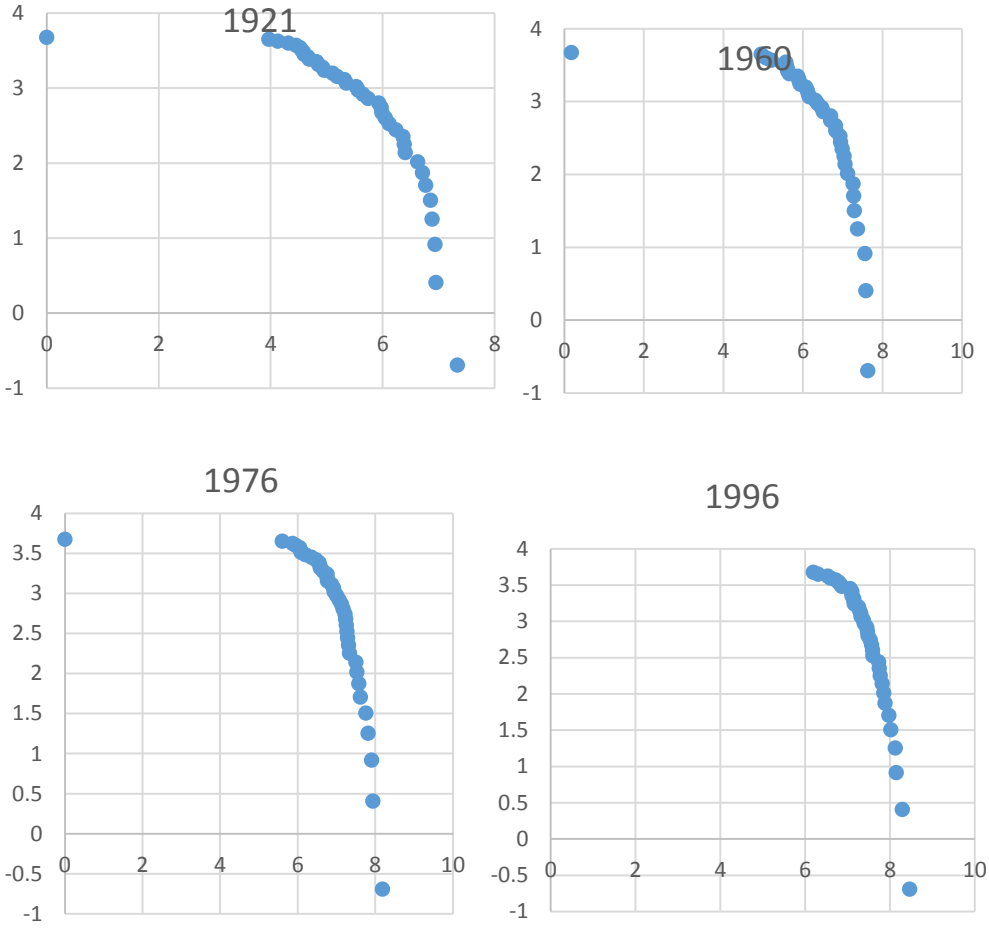


Figure 0.2. Zipf line of some years through 3 periods

The figure 3 show the change of historical population share of some main regions including Ha Noi, Hai Phong, Ha Nam Ninh, Nghe Tinh, Binh Tri Thien, Ho Chi Minh City, Dong Nai. The population share of year t is the ratio of population of each province divided to the total population of that year. We can see the big change of the population share in the division period from 1954 to 1975 for the whole country. The population of Ho Chi Minh increased significantly from 1921 to 1975 then fell very quick after the reunification 1975 when US army withdrew from Sai Gon. Some years later, the population share of Ho Chi Minh City went up with high speed and become the largest city again confirm its role as an economic center of Vietnam. Ha Noi showed the different picture in compare to Ho Chi Minh City because this city has many times of changing the area due to political purpose such as its area is enlarged in several times (1959, 1961, 1978 and 2008), and narrow down in 1991. Therefore, there were big steps of population share change of Ha Noi in these times. While the population share of Hai Phong, a North city near Hanoi, remained the same and the population share of Dong Nai climbed up slightly, the population share of Binh Tri Thien which is the province that has heaviest bomb in the wartime and population share of Nghe Tinh

where is the neighbor of Binh Tri Thien decreased after reunification 1975. The short-term causal effect of bomb amount and all of these changes is tested in the following time series and DID method.

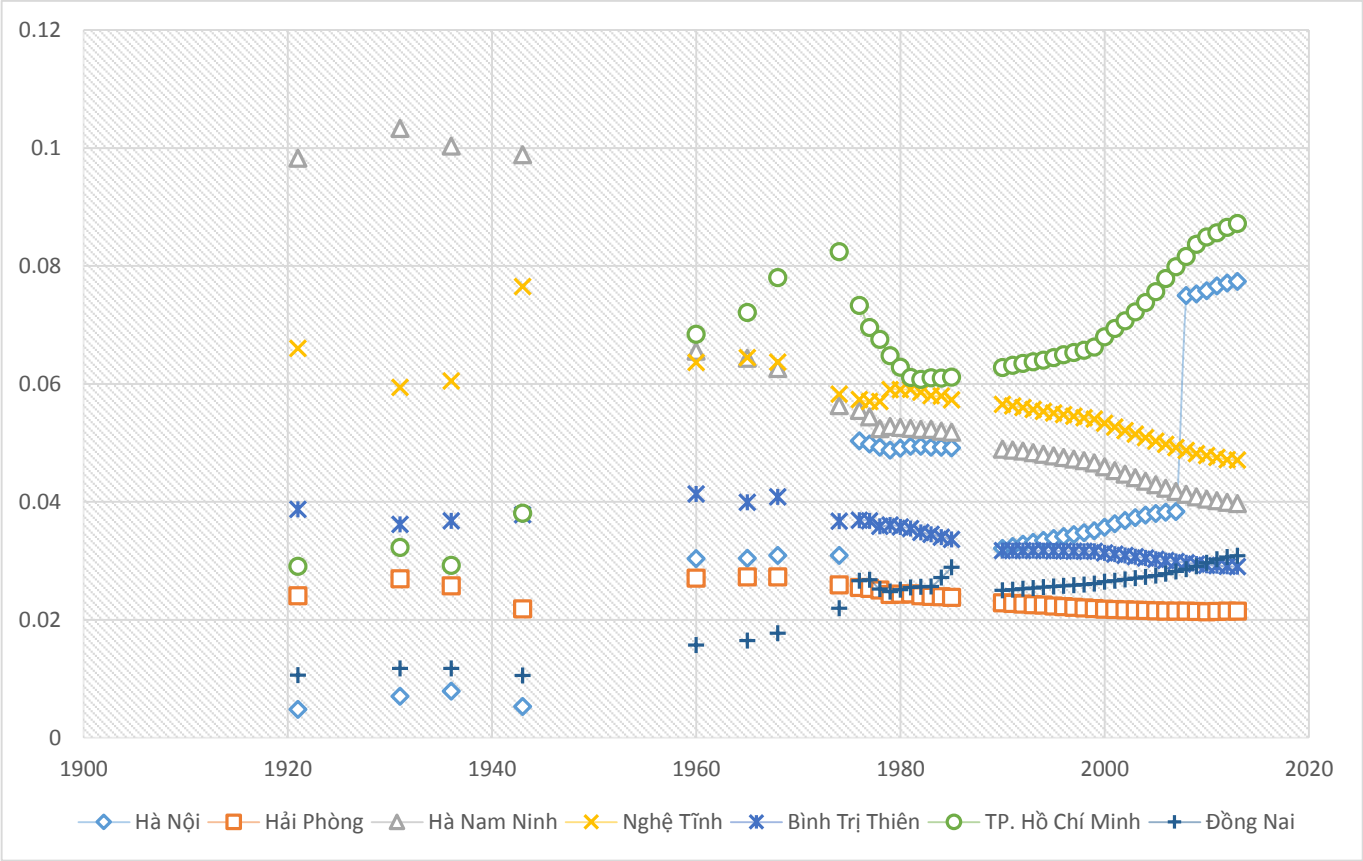


Figure 0.3. Historical population share of some main provinces

4.2 Time series analysis

To test whether the change of population share is significant in three periods union, division and reunification, and test whether there is causal effect of bomb and population change, the model of Redding et al. (2011) is introduced in this paper as followed:

$$\boldsymbol{Popshare_{it}} = \sum_{i=1}^{40} \eta_{ip} + \sum_{i=1}^{40} \boldsymbol{\beta_{ip} year_t} + \boldsymbol{u_{it}} \quad (3)$$

In the model, $Popshare_{it}$ is the share of the population of each province *i* divided to the total population of Vietnam in year *t*, *p* indicates periods (union, division, and reunification). The set of province-period fixed effects is presented in the parameters η_{ip} which allow for changes in mean population shares for each province between union, division and reunification periods. The coefficients $\boldsymbol{\beta_{ip}}$ indicate the trends in population shares for each province and they vary among three periods. u_{it} is a stochastic error.

Beside the population share, other two variables which are log population and population growth also are examined with the similar model. The results of analysis are described in next paragraphs and table 3 as well as in appendix 2 to appendix 4.

The figure 3 shows that in the division time, the population shares of economic centers of North, South and Center such as Ha Noi, Quang Ninh, Quang Nam –Da Nang, and Ho Chi Minh City increases while Binh Tri Thien or Nghe Tinh province decreased significantly. This two provinces are near the border of North and South of Vietnam. In the reunion period, while other regions remain the same time trends, the share of the population of Ha Noi did not show the positive trend and Quang Nam – Da Nang (Center) and Quang Ninh (North) reduced their population share.

The estimated time trends of log population, population share and population growth of some provinces are shown in the table 3. The time trends of North provinces, South provinces and provinces near the border are different. The North provinces and provinces near the Border Binh Tri Thien has more negative significant time trends for population share and population growth than the provinces in the South region. While log population value increases for all of provinces along the country in table 3, the share of population of the provinces in the North area has negatively or not significantly change in the reunion period. It means that the reunion effect attenuates the population density. In the border region Binh Tri Thien, the population share declined significantly in both division and reunion periods and population growth has negative trend in the reunification period. The province which is economic center at the Middle region Quang Nam – Da Nang where belong to the South area presented the positive population share and population growth time trends in the division period but the share of population of this province reduce after 1975. The South provinces such as Ho Chi Minh City and Dong Nai province have positive tendency for population share and population growth at both periods and no negative time trend for their population growths. The more detail tables for whole 40 provinces are described in appendix 2 to appendix 4.

Table 0.3. Estimated time trends of some provinces for union, division and reunion periods

Regions	Provinces	Dependent variables	1921-1953	1954-1975	1976-2013
North	Ha Nam Ninh	ln Population	0.0166***	0.0170***	0.00769***
			(0.000786)	(0.000357)	(0.000674)
		Population Share	1.52e-05	-0.000671***	-0.000405***
			(0.000110)	(0.000115)	(1.08e-05)
		Population Growth	0.0915***	0.171***	-0.0601***
			(0.0154)	(0.0555)	(0.0214)
	Ha Noi (Capital)	ln Population	0.0237**	0.0294***	0.0222***
			(0.0111)	(0.00219)	(0.00463)
		Population Share	4.15e-05	4.02e-05***	0.000421
			(7.90e-05)	(5.97e-06)	(0.000258)
		Population Growth	-0.114	-0.576*	0.145
			(0.207)	(0.328)	(0.329)
	Nghe Tinh	ln Population	0.0220***	0.0215***	0.0102***
			(0.00767)	(0.000332)	(0.000888)
		Population Share	0.000393	-0.000401***	-0.000324***
			(0.000399)	(0.000153)	(2.40e-05)
		Population Growth	0.263***	0.0987**	-0.0841***
			(0.0813)	(0.0413)	(0.0174)
Border	Binh Tri Thien	ln Population	0.0153***	0.0201***	0.0101***
			(0.00319)	(0.000755)	(0.000311)
		Population Share	-4.40e-05	-0.000311***	-0.000203***
			(5.68e-05)	(6.69e-05)	(8.61e-06)
		Population Growth	0.136***	0.00219	-0.0433**
			(0.0173)	(0.0226)	(0.0211)
Middle	Quang Nam-Da Nang	ln Population	0.0103	0.0358***	0.0138***
			(0.00751)	(0.000802)	(0.000181)
		Population Share	-0.000303	0.000285***	-6.99e-05***
			(0.000266)	(7.67e-05)	(8.95e-06)
		Population Growth	0.200***	0.251*	0.0288
			(0.0710)	(0.135)	(0.0403)
South	Ho Chi Minh City	ln Population	0.0266***	0.0418***	0.0242***
			(0.00531)	(0.00204)	(0.00113)
		Population Share	0.000340***	0.00104***	0.000572***
			(0.000127)	(4.47e-05)	(0.000110)
		Population Growth	0.237**	-0.00759	0.109***
			(0.105)	(0.0577)	(0.0245)
	Dong Nai	ln Population	0.0170***	0.0522***	0.0202***
			(0.00178)	(0.00616)	(0.000521)
		Population Share	5.45e-06	0.000450***	0.000105***
			(3.84e-05)	(8.22e-05)	(2.18e-05)
		Population Growth	0.0429	0.269***	-0.0655
			(0.0421)	(0.0996)	(0.0704)

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

4.3 Difference-in-Differences estimates

To examine the statistical significance of the difference in time trends between Ha Noi and Ho Chi Minh city within the prewar and division periods, I next consider the difference-in-differences estimation (DID) for population share of this two provinces. To do this DID method, after estimation for the time trends of population share, the point estimates, standard errors, t or z statistics, p-values and confidence intervals for linear combinations of coefficients are computed by lincom stata command. The third column of panel A (Division) of table 4 compares the time trends between the union and division periods for Ha Noi and Ho Chi Minh city (a difference within provinces across periods) and shows that Ho Chi Minh City's population share increased by 0.0007 percentage point per annum and is statistically significant, while Ha Noi's was not statistically significant change.

Considering the statistical significance of the difference in time trends between Hanoi and Ho Chi Minh city within the union and division periods (a difference within periods across provinces). The final row of panel A (Division) of table 4 presents that within union of division periods, the difference in the population share of Ho Chi Minh is higher than Ha Noi and highly statistically significant. The bottom right-hand cell presents that the DID of population share was 0.0007 percent per annum and statistically significant, it means that the change of Hanoi population share is bigger than the change of Ho Chi Minh city.

Turning to the treatment effect of reunification comparing with division period, (3) column of the panel B of table 4 shows that while population share of Hanoi increased from division to reunion periods, the population share of Ho Chi Minh city decreased significantly. The bottom row of B panel shows that within division time, the population share of Hanoi changes larger than the population share of Ho Chi Minh city. However, within the reunification periods, the population share of this two provinces did not show the difference. The last right-hand side bottom cell shows that the difference in differences of Hanoi is lower than Ho Chi Minh city. Other estimation of DID for population growth and log population is described in the appendix 5 and appendix 6. All analysis of this part show there is short-term impact of division time (which is similar with bomb period) and the population of provinces in Vietnam. To answer the question about the long-run impact of bomb to the economic performance of provinces, I come to the V section.

Table 0.4. Estimated differences in time trends for population share

	(1)	(2)	(3)

	A. Division		
	Period 1921-1953	Period 1954-1975	Between-Period Difference
Ha Noi	4.15e-05	4.02e-05***	0.00000133
	(7.90e-05)	(5.97e-06)	(0000793)
Ho Chi Minh City	0.000340***	0.00104***	-0.0006958***
	(0.000127)	(4.47e-05)	(.0001346)
Within-period difference	-.0002984***	-.0009955***	.0006972***
	(.0001495)	(.0000451)	(.0001562)
	B: Reunification		
	Period 1953-1975	Period 1976-2013	Between-Period Difference
Ha Noi	4.02e-05***	0.000421	-.0003805 *
	(5.97e-06)	(0.000258)	(.0002577)
Ho Chi Minh City	0.00104***	0.000572***	.0004637***
	(4.47e-05)	(0.000110)	(.0001185)
Within-period difference	-.0009955***	-.0001513	-.0008442***
	(.0000451)	(.00028)	(.0002836)

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5. The long-run impact of bombing on economic performance of province

Authors use the following framework to measure the long-run impact of bomb on the economic performance of each province:

$$y_{i2006} = \boldsymbol{\gamma_0} + \boldsymbol{\gamma_1} ln\left(\frac{Bomb_{i,1965-1975}}{Area_i}\right) + \boldsymbol{\gamma_2} ln\left(\frac{Pop_{i,past}}{Area_i}\right) + \boldsymbol{\gamma_3} lnArea_i + \varepsilon_{it} \quad (1)$$

The dependent variable is output *y* of province *i* at the time year 2006. This output can be the number of firms or the number of labors of each province for all types of firm or State-owned enterprises (SOE) of private firm or Foreign Direct Investment Enterprise (FDI) or GDP of each province. While the dependent variable is the value of present time, the independent variables are all in the past time. The first interest parameter is $\boldsymbol{\gamma_1}$ which show how large the density of US bombing $\frac{Bomb_{i,1965-1975}}{Area_i}$ at province i in the period of Vietnam War 1965-1975. $Bomb_i$ is total U.S. bombs, missiles, and rockets into province i and $Area_i$ is acreage of province i. The density of population is presented by $\frac{Pop_{i,past}}{Area_i}$ where the Pop_i is the total population of province i at one year in the past such as 1921, 1943 or until 1978. As common sense, the expected sign of parameter $\boldsymbol{\gamma_1}$ is negative because the bomb should have negative on the economic performance of regions, while the opposite sign is expected for $\boldsymbol{\gamma_2}$ because the population in the past and

population in recent years should change in the same direction. The area variable may have a positive impact on economic performance of each province.

From the first framework, the second equation is the result of the first one.

$$y_{i2006} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1 lnBomb_{i,1965-1975}} + \boldsymbol{\beta_2 lnPop_{i,past}} + \boldsymbol{\beta_3 lnArea_i} + \varepsilon_{it} \quad (2)$$

The formula (2) is the result of formula (1) in which $\boldsymbol{\beta_3 = \gamma_3 - \gamma_1 - \gamma_2}$, $\boldsymbol{\beta_1 = \gamma_1}$, $\boldsymbol{\beta_2 = \gamma_2}$, and the expected signs of both $\boldsymbol{\gamma_2}$ and $\boldsymbol{\gamma_3}$ is positive then I can not predict the sign of $\boldsymbol{\beta_3}$ in the equation (2), it means that this $\boldsymbol{\beta_3}$ parameter may have positive or negative sign.

Table 5 shows the basic result for the impact of bombing on the economic performance of provinces. The upper table is the result of bomb density and population density and the later table is result of the total bomb. Dependent variables are GDP, the number of all firms, the number of SOE, the number of private firm, and the number of FDI firm at province-level all in 2006. From the table, we can see the opposite expected result for bomb density, the higher the bomb density at a province, the higher the GDP of that province. This result also is highly and positively statistically significant for the concentration of firm in that province as well as the total number of labor at each province. When the type of firm is disaggregated into three types including SOE, private and FDI, results for the private firm and FDI firm are consistent with all firm. Not only bomb density has the positive sign but also bomb has the positive sign with the output of provinces as presented in the latter table, and the private firm, as FDI firm are more sensitive with bombing than SOE firm.

Why bombing has the positive sign? Not only this paper shows this result but also the research of Miguel and Roland (2011) and other authors show the positive sign and not significant impact of bombing and economic performance in the long-term. There are multiple reasons for this result according to Miguel and Roland (2011). Firstly, almost bomb is in rural are where little infrastructures are destroyed. Second, Vietnamese government put the most effort in reconstruction after the war from 1976 to 1985 after the labor mobility policy from the 1970s to 1980s. Moreover, from 1960, 1970, school expansion and literacy campaigns were opened and the teachers and students were divided into small groups to avoid the bomb in the foxholes and had helmets that can protect them during U.S. attacked.

Turning to the Area variable, in the upper table, the result shows that in the most cases Area is not statistically significant and it has a positive relationship with only the number of SOE. The latter table shows the negative relationship of area with dependent variable as I have describes that this relationship is unpredictable.

For the both cases, population density or total population in 1968 has a positive relationship with the number of firms. Authors also run separate regressions with other years from 1921 to 2013, and they also have consistent results with 1968 from division period to present years. The appendix 7 describes robust check with other indicators of historical economic output replacing for the historical population such as paddy productivity, the number of hospital and the number of hospital bed, the results for the total bomb, bombing density and area are still consistent with above results.

Table 0.5. Basic result for impact of bomb on the economic performance of provinces

	GDP	Number of all firm	Number of SOE	Number of private firm	Number of FDI firm
Bomb density	0.225***	0.199***	0.0803	0.195***	2.059***
	(0.0509)	(0.0550)	(0.0616)	(0.0540)	(0.570)
Population density 1968	0.144	0.480***	0.345**	0.509***	-0.487
	(0.124)	(0.134)	(0.150)	(0.131)	(1.385)
Area	-0.250	0.218	0.376*	0.240	-0.702
	(0.180)	(0.194)	(0.218)	(0.191)	(2.016)
Number of provinces	40	40	40	40	40
R square	0.520	0.552	0.216	0.572	0.276

	GDP	Number of all firm	Number of SOE	Number of private firm	Number of FDI firm
Total bomb	0.237***	0.206***	0.0836	0.202***	2.087***
	(0.0522)	(0.0568)	(0.0637)	(0.0557)	(0.594)
Population 1968	0.195	0.527***	0.364**	0.555***	0.0229
	(0.119)	(0.130)	(0.146)	(0.127)	(1.358)
Area	-0.571***	-0.417***	-0.0309	-0.421***	-1.769
	(0.123)	(0.134)	(0.151)	(0.132)	(1.404)
Number of provinces	40	40	40	40	40
R square	0.529	0.553	0.216	0.573	0.266

Note: All variables are in logarithms. The constant term are included in all cases. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

Unlike other researches that examine only short-term or long-term impact of war to the economic performance of a country, due to rich dataset of historical population and other historical economic proxy, this research has proved both long-term and contemporary impacts of the war and bomb with the concentration of firm (number of firms) as well as the wealth of a region (GDP at province level). To measure the contemporary impact, some simple indexes has been used in this paper such as Zipf slopes, the simple historical population graph, the relative variance of population density etc… as well as time trends estimation. In addition, the difference-in-differences methods also use to see the differences of the change of population density through periods. The proxy of war in this content is the classification of time into three periods uncluding union, division, and reunification. The results show that there is the short-term effect of division and reunification time on population density, population share or population growth of a city. These impacts are different among provinces in the North, South or close to the division border.

In addition to the calculation of the short-term impact of war on the population of provinces in Vietnam, this paper present the long-run impact of war by bombing proxy on the economic agglomeration or concentration of firm along provinces. With rich historical data from population to agriculture and health data beside the new dependent variables on the left-hand side like number of firms, a number of labors, even the results are not too robust but this research prove no significant or there are positive long-term impacts of the bomb on the economic performance of provinces.

Even the dataset is rich and there are contributions to the empirical study, this research remains some limitations. Firstly, the aggregation methodology does not provide one hundred percent of the accuracy because of the change in the name, the split and the merger of provinces in the long history by many times from 1921. However, authors already put the most effort to make the aggregation. Secondly, the long-term impact can be calculated with more observations instead of only 40 provinces if authors only choose to present results with the population in the year 1968.

The further research should be done with more observations to measure the long-term impact of war on the economic performance. In addition, because of that the data for North and South separately is much more abundant than dataset for the whole country, another research for distinguishing regions can be taken into

consideration. Moreover, the impact of the border 17 parallel should be one of the interesting candidate of a research topic.

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Appendix 1 Aggregation methodology

code1921-1943	**code1954-1975**	***40Provinces (1976-1984)***	**code1985**	**code1990-2003&bombdata**	**code2004-2007&DN2006**	**code2008-2013&GDP**
Ha Giang + Tuyen Quang	Ha Giang + Tuyen Quang	***Ha Tuyen***	Ha Giang + Tuyen Quang	Ha Giang + Tuyen Quang	Ha Giang + Tuyen Quang	Ha Giang + Tuyen Quang
Cao Bang	Cao Bang	***Cao Bang***	Cao Bang	Cao Bang	Cao Bang	Cao Bang
Lang Son	Lang Son	***Lang Son***	Lang Son	Lang Son	Lang Son	Lang Son
Lai Chau+ Dien Bien	Lai Chau	***Lai Chau***	Lai Chau	Lai Chau	Lai Chau+ Dien Bien	Lai Chau+ Dien Bien
Lao Cai + Yen Bai	Lao Cai + Yen Bai+Nghia Lo	***Hoang Lien Son***	Lao Cai + Yen Bai	Lao Cai + Yen Bai	Lao Cai + Yen Bai	Lao Cai + Yen Bai
Son La	Son La	***Son La***	Son La	Son La	Son La	Son La
Bac Can + Thai Nguyen	Bac Thai	***Bac Thai***	Bac Thai	Bac Can + Thai Nguyen	Bac Can + Thai Nguyen	Bac Can + Thai Nguyen
Quang Yen + Hai Ninh	Quang Ninh	***Quang Ninh***	Quang Ninh	Quang Ninh	Quang Ninh	Quang Ninh
Vinh Yen + Phuc Yen + Phu Tho	Vinh Phu	***Vinh Phu***	Vinh Phu	Vinh Phuc + Phu Tho	Vinh Phuc + Phu Tho	Vinh Phuc + Phu Tho
Bac Giang + Bac Ninh	Ha Bac	***Ha Bac***	Ha Bac	Bac Giang + Bac Ninh	Bac Giang + Bac Ninh	Bac Giang + Bac Ninh
Ha Noi	Ha Noi	***Ha Noi***	Ha Noi	Ha Noi	Ha Noi	Ha Noi+Ha Tay
Hai Phong+ Kien An	Hai Phong	***Hai Phong***	Hai Phong	Hai Phong	Hai Phong	Hai Phong
Ha Dong + Son Tay + Hoa Binh	Ha Tay + Hoa Binh	***Ha Son Binh***	Ha Son Binh	Ha Tay + Hoa Binh	Ha Tay + Hoa Binh	Hoa Binh
Hai Duong + Hung Yen	Hai Hung	***Hai Hung***	Hai Hung	Hai Duong + Hung Yen	Hai Duong + Hung Yen	Hai Duong + Hung Yen
Thai Binh	Thai Binh	***Thai Binh***	Thai Binh	Thai Binh	Thai Binh	Thai Binh
Ha Nam + Nam Dinh + Ninh Binh	Nam Ha + Ninh Binh	***Ha Nam Ninh***	Nam Ha + Ninh Binh	Ha Nam + Nam Dinh + Ninh Binh	Ha Nam + Nam Dinh + Ninh Binh	Ha Nam + Nam Dinh + Ninh Binh
Thanh Hoa	Thanh Hoa	***Thanh Hoa***	Thanh Hoa	Thanh Hoa	Thanh Hoa	Thanh Hoa
Nghe An + Ha Tinh	Nghe An + Ha Tinh	***Nghe Tinh***	Nghe An + Ha Tinh	Nghe An + Ha Tinh	Nghe An + Ha Tinh	Nghe An + Ha Tinh
Quang Binh + Quang Tri + TT Hue	Quang Binh + Quang Tri + Thua Thien + Vinh Linh+Hue	***Binh Tri Thien***	Quang Binh + Quang Tri + Thua Thien Hue	Quang Binh + Quang Tri + Thua Thien Hue	Quang Binh + Quang Tri + TT Hue	Quang Binh + Quang Tri + TT Hue
Quang Nam + Da Nang	Quang Nam + Da Nang+Quang Tin	***Quang Nam - Da Nang***	Quang Nam - Da Nang	Quang Nam + Da Nang	Quang Nam + Da Nang	Quang Nam + Da Nang
Quang Ngai + Binh Dinh	Quang Ngai + Binh Dinh	***Nghia Binh***	Quang Ngai + Binh Dinh	Quang Ngai + Binh Dinh	Quang Ngai + Binh Dinh	Quang Ngai + Binh Dinh

Phu Yen + Khanh Hoa	Phu Yen + Khanh Hoa+Cam Ranh	***Phu Khanh***	Phu Yen + Khanh Hoa	Phu Yen + Khanh Hoa	Phu Yen + Khanh Hoa	Phu Yen + Khanh Hoa
Binh Thuan + Ninh Thuan	Binh Thuan + Ninh Thuan+Binh Tuy	***Thuan Hai***	Binh Thuan + Ninh Thuan	Binh Thuan + Ninh Thuan	Binh Thuan + Ninh Thuan	Binh Thuan + Ninh Thuan
Kon Tum	Kon Tum+ Pleiku+ Phu Bon	***Gia Lai - Kon Tum***	Kon Tum + Gia Lai	Kon Tum + Gia Lai	Gia Lai + Kon Tum	Gia Lai + Kon Tum
Dak Lak	Dak Lak+Quang Duc	***Dak Lak***	Dak Lak+Quang Duc	Dak Lak	Dak Lak+Dak Nong	Dak Lak+Dak Nong
Lang Biang/Đà Lạt	Lam Dong + Tuyen Duc + Đà Lạt	***Lam Dong***	Lam Dong	Lam Dong	Lam Dong	Lam Dong
Sai Gon + Gia Dinh + TP Cho Lon	Sai Gon + Gia Dinh	***TP. Ho Chi Minh***	TP Ho Chi Minh	TP Ho Chi Minh	Ho Chi Minh	Ho Chi Minh
Thu Dau Mot	Phuoc Thanh + Binh Duong + Binh Long + Phuoc Long	***Song Be***	Song Be	Binh Duong + Binh Phuoc	Binh Duong + Binh Phuoc	Binh Duong + Binh Phuoc
Tay Ninh	Tay Ninh	***Tay Ninh***	Tay Ninh	Tay Ninh	Tay Ninh	Tay Ninh
Dong Nai + Bien Hoa	Dong Nai + Bien Hoa+Phuoc Tuy+Long Khanh	***Dong Nai***	Dong Nai	Dong Nai	Dong Nai	Dong Nai
Ba Ria + Con Dao +Cap St. Jacques/Vũng Tàu	Vung Tau + Con Son	***Vung Tau - Con Dao***	Vung Tau - Con Dao	Ba Ria - Vung Tau	Ba Ria Vung Tau	Ba Ria Vung Tau
Cho Lon + Tan An	Kien Tuong + Long An+Hau Nghia	***Long An***	Long An	Long An	Long An	Long An
Sa Dec	Kien Phong+ Sa Dec	***Dong Thap***	Dong Thap	Dong Thap	Dong Thap	Dong Thap
Chau Doc + Long Xuyen	An Giang + Chau Doc	***An Giang***	An Giang	An Giang	An Giang	An Giang
Go Cong + My Tho	Dinh Tuong + Go Cong	***Tien Giang***	Tien Giang	Tien Giang	Tien Giang	Tien Giang
Ben Tre	Kien Hoa	***Ben Tre***	Ben Tre	Ben Tre	Ben Tre	Ben Tre
Vinh Long + Tra Vinh	Vinh Long + Vinh Binh	***Cuu Long***	Vinh Long + Tra Vinh	Vinh Long + Tra Vinh	Vinh Long + Tra Vinh	Vinh Long + Tra Vinh
Can Tho + Soc Trang	Ba Xuyen + Chuong Thien + Phong Dinh	***Hau Giang***	Can Tho + Soc Trang	Can Tho + Soc Trang	Hau Giang+Can Tho + Soc Trang	Hau Giang+Can Tho + Soc Trang
Kien Giang	Kien Giang	***Kien Giang***	Kien Giang	Kien Giang	Kien Giang	Kien Giang
Bac Lieu	An Xuyen+Bac Lieu	***Minh Hai***	Minh Hai	Ca Mau + Bac Lieu	Ca Mau + Bac Lieu	Ca Mau + Bac Lieu

Appendix 2. Estimated time trends for log population for three periods

	(1)	(2)	(3)		(1)	(2)	(3)
PROVINCES	lnPopulation	lnPopulation	lnPopulation	PROVINCES	lnPopulation	lnPopulation	lnPopulation
	1921-1953	1954-1975	1976-2013		1921-1953	1954-1975	1976-2013
An Giang	0.0154***	0.0387***	0.0106***	Lam Dong	0.0779***	0.0539***	0.0365***
	(0.000387)	(0.00507)	(0.000843)		(0.0286)	(0.00115)	(0.00150)
Bac Thai	0.0329***	0.0452***	0.0182***	Lang Son	0.0340***	0.0320***	0.0140***
	(0.00381)	(0.00366)	(0.000928)		(0.00305)	(0.00348)	(0.000899)
Ben Tre	0.0126***	0.0187**	0.00626***	Long An	0.0148***	0.0217***	0.0134***
	(0.00149)	(0.00789)	(0.000944)		(0.00149)	(0.00377)	(0.000680)
Binh Tri Thien	0.0153***	0.0201***	0.0101***	Minh Hai	0.0250***	0.0655***	0.0183***
	(0.00319)	(0.000755)	(0.000311)		(0.00162)	(0.00917)	(0.00113)
Cao Bang	0.0270***	0.0248***	0.00155*	Nghe Tinh	0.0220***	0.0215***	0.0102***
	(0.00201)	(0.000410)	(0.000801)		(0.00767)	(0.000332)	(0.000888)
Cuu Long	0.0105***	0.000810	0.0100***	Nghia Binh	0.0144**	0.0233***	0.00900***
	(0.00116)	(0.00710)	(0.000886)		(0.00642)	(0.00761)	(0.000853)
Dak Lak	-0.00531	0.0461***	0.0519***	Phu Khanh	0.0182***	0.0383***	0.0170***
	(0.00368)	(0.00459)	(0.00231)		(0.00131)	(0.00509)	(0.000663)
Dong Nai	0.0170***	0.0522***	0.0202***	Quang Nam - Da Nang	0.0103	0.0358***	0.0138***
	(0.00178)	(0.00616)	(0.000521)		(0.00751)	(0.000802)	(0.000181)
Dong Thap	0.0108***	0.0877***	0.0118***	Quang Ninh	0.0358***	0.0416***	0.0138***
	(0.00148)	(0.00787)	(0.000858)		(0.00136)	(0.00236)	(0.000222)
Gia Lai - Kon Tum	0.0221**	0.0309***	0.0356***	Son La	0.0145***	0.0408***	0.0271***
	(0.0111)	(0.00216)	(0.000976)		(0.00130)	(0.000694)	(0.000807)
Ha Bac	0.0166***	0.0292***	0.0147***	Song Be	0.00713	-0.0103	0.0424***
	(0.000179)	(0.00169)	(0.000778)		(0.00775)	(0.00955)	(0.00105)
Ha Nam Ninh	0.0166***	0.0170***	0.00769***	TP. Ho Chi Minh	0.0266***	0.0418***	0.0242***
	(0.000786)	(0.000357)	(0.000674)		(0.00531)	(0.00204)	(0.00113)
Ha Noi	0.0237**	0.0294***	0.0222***	Tay Ninh	0.0383***	0.0354***	0.0139***
	(0.0111)	(0.00219)	(0.00463)		(0.00846)	(0.0135)	(0.000709)
Ha Son Binh	0.00908***	0.0230***	-0.00301	Thai Binh	0.0123***	0.0114***	0.00508***
	(0.000913)	(0.000792)	(0.00977)		(0.000692)	(0.00126)	(0.000537)
Ha Tuyen	0.0261***	0.0443***	0.0208***	Thanh Hoa	0.0164***	0.0207***	0.0105***
	(0.00604)	(0.00369)	(0.000761)		(0.00372)	(0.000929)	(0.000962)
Hai Hung	0.0155***	0.0182***	0.00913***	Thuan Hai	0.0221***	0.0399***	0.0207***
	(0.000517)	(0.000647)	(0.000647)		(0.00197)	(0.00937)	(0.000803)
Hai Phong	0.0127***	0.0249***	0.0116***	Tien Giang	0.0116***	0.0263***	0.00930***
	(0.00313)	(0.000810)	(0.000211)		(0.000276)	(0.00694)	(0.000629)
Hau Giang	0.0121***	0.0192	0.0130***	Vinh Phu	0.0168***	0.0261***	0.0158***
	(0.00243)	(0.0147)	(0.000914)		(0.00166)	(0.00347)	(0.00141)
Hoang Lien Son	0.0284***	0.0468***	0.0190***	Vung Tau - Con Dao	0.0118***	0.312***	0.0810***
	(0.000104)	(0.00429)	(0.000973)		(0.000425)	(0.0956)	(0.00730)
Kien Giang	0.0221***	0.0149	0.0183***	Constant	6.705***	6.705***	6.705***
	(0.00357)	(0.0158)	(0.000821)		(0.00707)	(0.00707)	(0.00707)

Lai Chau	0.0109***	0.0405***	0.0331***	Observations	1,678	1,678	1,678
	(0.00285)	(0.00192)	(0.000493)	R-squared	0.980	0.980	0.980

Appendix 3. Estimated time trends for population share for three periods

PROVINCES	Population Share	Population Share	Population Share	PROVINCES	Population Share	Population Share	Population Share
	1921-1953	1954-1975	1976-2013		1921-1953	1954-1975	1976-2013
An Giang	-2.74e-05	0.000314***	-0.000156***	Lam Dong	8.64e-06	0.000172***	0.000213***
	(4.63e-05)	(8.40e-05)	(1.24e-05)		(5.76e-06)	(1.02e-05)	(9.98e-06)
Bac Thai	0.000135***	0.000246***	2.95e-05***	Lang Son	0.000135***	3.55e-05	-2.10e-05***
	(2.20e-05)	(8.18e-05)	(9.44e-06)		(1.54e-05)	(5.43e-05)	(4.53e-06)
Ben Tre	-6.21e-05***	-0.000160*	-0.000172***	Long An	-3.30e-05***	-0.000113***	-5.06e-05***
	(2.94e-06)	(9.32e-05)	(7.85e-06)		(9.61e-06)	(3.83e-05)	(5.43e-06)
Binh Tri Thien	-4.40e-05	-0.000311***	-0.000203***	Minh Hai	0.000108***	0.000464***	4.57e-05***
	(5.68e-05)	(6.69e-05)	(8.61e-06)		(7.90e-06)	(0.000124)	(1.63e-05)
Cao Bang	9.42e-05***	-2.92e-05	-0.000109***	Nghe Tinh	0.000393	-0.000401***	-0.000324***
	(8.71e-06)	(2.34e-05)	(6.45e-06)		(0.000399)	(0.000153)	(2.40e-05)
Cuu Long	-0.000142***	-0.000824***	-0.000164***	Nghia Binh	-0.000124	-0.000228	-0.000259***
	(1.31e-05)	(0.000155)	(1.22e-05)		(0.000264)	(0.000244)	(1.77e-05)
Dak Lak	-0.000105***	0.000117***	0.000580***	Phu Khanh	3.13e-05	0.000226***	1.47e-05
	(2.03e-05)	(3.29e-05)	(2.25e-05)		(5.36e-05)	(6.34e-05)	(1.01e-05)
Dong Nai	5.45e-06	0.000450***	0.000105***	Quang Nam - Da Nang	-0.000303	0.000285***	-6.99e-05***
	(3.84e-05)	(8.22e-05)	(2.18e-05)		(0.000266)	(7.67e-05)	(8.95e-06)
Dong Thap	-6.95e-05***	0.000779***	-9.33e-05***	Quang Ninh	0.000211***	0.000184***	-3.47e-05***
	(3.26e-06)	(9.27e-05)	(1.04e-05)		(1.48e-05)	(6.06e-05)	(6.82e-06)
Gia Lai - Kon Tum	0.000104	2.64e-05	0.000291***	Son La	-1.07e-05***	8.53e-05***	0.000116***
	(0.000221)	(3.94e-05)	(6.12e-06)		(2.09e-06)	(1.01e-05)	(3.10e-06)
Ha Bac	3.68e-06	3.49e-05	-5.20e-05***	Song Be	-6.91e-05	-0.000449***	0.000493***
	(6.98e-05)	(0.000124)	(1.07e-05)		(7.71e-05)	(0.000104)	(3.70e-05)
Ha Nam Ninh	1.52e-05	-0.000671***	-0.000405***	TP. Ho Chi Minh	0.000340***	0.00104***	0.000572***
	(0.000110)	(0.000115)	(1.08e-05)		(0.000127)	(4.47e-05)	(0.000110)
Ha Noi	4.15e-05	4.02e-05***	0.000421	Tay Ninh	0.000171***	7.34e-05	-3.23e-05***
	(7.90e-05)	(5.97e-06)	(0.000258)		(5.88e-05)	(0.000102)	(9.22e-06)
Ha Son Binh	-0.000453***	-0.000230***	-0.000242	Thai Binh	-0.000224***	-0.000580***	-0.000278***
	(0.000149)	(7.12e-05)	(0.000216)		(5.20e-05)	(4.38e-05)	(7.42e-06)
Ha Tuyen	7.33e-05**	0.000216***	7.13e-05***	Thanh Hoa	-2.89e-06	-0.000376**	-0.000257***
	(3.27e-05)	(7.98e-05)	(5.06e-06)		(9.93e-05)	(0.000161)	(2.16e-05)
Hai Hung	-6.24e-05	-0.000442***	-0.000265***	Thuan Hai	5.44e-05***	0.000187*	8.22e-05***
	(0.000134)	(7.16e-05)	(1.15e-05)		(1.28e-05)	(0.000107)	(7.22e-06)
Hai Phong	-8.67e-05	-8.40e-05**	-0.000108***	Tien Giang	-0.000126***	-3.79e-05	-0.000152***
	(0.000117)	(3.91e-05)	(7.26e-06)		(4.15e-05)	(9.97e-05)	(4.17e-06)
Hau Giang	-0.000137***	-0.000303	-0.000135***	Vinh Phu	1.27e-05***	-7.13e-05	-1.42e-05
	(2.54e-05)	(0.000393)	(2.19e-05)		(4.90e-06)	(0.000199)	(2.85e-05)
Hoang Lien Son	8.31e-05***	0.000262***	4.11e-05***	Vung Tau - Con Dao	-1.76e-05***	0.000190***	0.000355***
	(1.04e-05)	(8.93e-05)	(9.02e-06)		(5.19e-06)	(2.67e-05)	(2.47e-05)
Kien Giang	9.63e-05	-0.000178	3.63e-05***	Constant	0.0250***	0.0250***	0.0250***
	(9.65e-05)	(0.000168)	(8.07e-06)		(0.000138)	(0.000138)	(0.000138)
Lai Chau	-1.77e-05	6.45e-05***	0.000131***	Observations	1,680	1,680	1,680
	(1.50e-05)	(2.15e-05)	(5.06e-06)	R-squared	0.964	0.964	0.964

Appendix 4.Estimated time trends for population growth for three periods

	(1)	(2)	(3)		(1)	(2)	(3)
	1921-1953	1954-1975	1976-2013		1921-1953	1954-1975	1976-2013
Provinces	Growth	Growth	Growth	PROVINCES	Growth	Growth	Growth
An Giang	0.0686*	0.263***	-0.0763***	Lam Dong	-0.218	-1.122**	-0.0866***
	(0.0376)	(0.101)	(0.0142)		(0.498)	(0.552)	(0.0326)
Bac Thai	0.234***	-0.00198	-0.0603*	Lang Son	0.223***	0.0323	-0.0757*
	(0.0241)	(0.0985)	(0.0314)		(0.0109)	(0.117)	(0.0400)
Ben Tre	0.0887***	0.179	-0.145**	Long An	0.0988***	0.162	-0.0880***
	(0.00423)	(0.240)	(0.0604)		(0.0229)	(0.184)	(0.0212)
Binh Tri Thien	0.136***	0.00219	-0.0433**	Minh Hai	0.148***	0.268	-0.177***
	(0.0173)	(0.0226)	(0.0211)		(0.0266)	(0.312)	(0.0641)
Cao Bang	0.165***	0.0913**	-0.0909**	Nghe Tinh	0.263***	0.0987**	-0.0841***
	(0.0403)	(0.0397)	(0.0400)		(0.0813)	(0.0413)	(0.0174)
Cuu Long	0.0722***	-0.0894	-0.109***	Nghia Binh	0.198***	0.327***	-0.0624*
	(0.0157)	(0.411)	(0.0328)		(0.0564)	(0.0815)	(0.0320)
Dak Lak	-0.0677	0.0107	-0.194*	Phu Khanh	0.0675**	0.266***	-0.0598
	(0.158)	(0.316)	(0.108)		(0.0309)	(0.0668)	(0.0532)
Dong Nai	0.0429	0.269***	-0.0655	Quang Nam - Da Nang	0.200***	0.251*	0.0288
	(0.0421)	(0.0996)	(0.0704)		(0.0710)	(0.135)	(0.0403)
Dong Thap	0.0797***	0.680	-0.132***	Quang Ninh	0.181**	0.133	-0.0253
	(0.00271)	(0.662)	(0.0389)		(0.0839)	(0.111)	(0.0240)
Gia Lai - Kon Tum	-0.114	0.214	-0.130**	Son La	0.0936***	0.126***	-0.119**
	(0.296)	(0.237)	(0.0569)		(0.00301)	(0.0267)	(0.0467)
Ha Bac	0.0747***	0.123	-0.0733***	Song Be	-0.120	-0.257	-0.0479
	(0.0214)	(0.0831)	(0.0139)		(0.0949)	(0.406)	(0.108)
Ha Nam Ninh	0.0915***	0.171***	-0.0601***	TP. Ho Chi Minh	0.237**	-0.00759	0.109***
	(0.0154)	(0.0555)	(0.0214)		(0.105)	(0.0577)	(0.0245)
Ha Noi	-0.114	-0.576*	0.145	Tay Ninh	0.364***	0.556**	-0.126
	(0.207)	(0.328)	(0.329)		(0.138)	(0.243)	(0.113)
Ha Son Binh	0.0253	0.128***	-0.199	Thai Binh	0.0704***	0.0995*	-0.0501*
	(0.0445)	(0.0232)	(0.257)		(0.0108)	(0.0517)	(0.0294)
Ha Tuyen	0.239***	-0.0514	-0.0652***	Thanh Hoa	0.153**	-0.0225	-0.0826***
	(0.0418)	(0.135)	(0.00924)		(0.0718)	(0.0172)	(0.0140)
Hai Hung	0.0640***	0.121***	-0.0612**	Thuan Hai	0.131**	0.296	-0.0830***
	(0.0206)	(0.0244)	(0.0251)		(0.0628)	(0.219)	(0.0204)
Hai Phong	-0.00316	-0.00534	-0.0266	Tien Giang	0.0553***	0.299***	-0.0857**
	(0.0485)	(0.0381)	(0.0180)		(0.0116)	(0.105)	(0.0380)
Hau Giang	0.106***	0.374	-0.137***	Vinh Phu	0.112***	0.0263	-0.0554
	(0.0389)	(0.413)	(0.0531)		(0.0111)	(0.0980)	(0.0408)
Hoang Lien Son	0.133***	-0.0912	-0.0563*	Vung Tau - Con Dao	0.0600**	0.306	0.472
	(0.0382)	(0.0932)	(0.0313)		(0.0233)	(4.072)	(0.567)
Kien Giang	0.0338	0.523*	-0.183*	Constant	2.785***	2.785***	2.785***
	(0.0587)	(0.294)	(0.0972)		(0.408)	(0.408)	(0.408)
Lai Chau	-0.00636	-0.0814**	-0.0474*	Observations	1,678	1,678	1,678
	(0.0461)	(0.0365)	(0.0273)	R-squared	0.168	0.168	0.168

Appendix 5. Estimated differences in time trends for population growth

	(1)	(2)	(3)
	A. Division		
	Period	Period	
	1921-1953	1954-1975	Between-Period Difference
Ha Noi	-0.114	-0.576*	.4617643
	(0.207)	(0.328)	(.3872405)
Ho Chi Minh City	0.237**	-0.00759	.2441174**
	(0.105)	(0.0577)	(.1195674)
Within-period difference	-.3504974	-.5681443*	0.2176469
	(.2315652)	(.3326095)	(.4052796)
	B: Reunification		
	Period	Period	
	1953-1975	1976-2013	Between-Period Difference
Ha Noi	-0.576*	0.145	-.720565
	(0.328)	(0.329)	(.4639531)
Ho Chi Minh City	-0.00759	0.109***	-.1165691*
	(0.0577)	(0.0245)	(.062675)
Within-period difference	-.5681443*	.0358516	-.6039959
	(.3326095)	(.3294715)	(.4681673)

Appendix 6. Estimated differences in time trends for log population

	(1)	(2)	(3)
	A. Division		
	Period	Period	
	1921-1953	1954-1975	Between-Period Difference
Ha Noi	0.0237**	0.0294***	-.0056612
	(0.0111)	(0.00219)	(.0112701)
Ho Chi Minh City	0.0266***	0.0418***	-.0151739***
	(0.00531)	(0.00204)	(.0056901)
Within-period difference	-.0029281	-.0124409***	.0095127
	(.0122662)	(.0029887)	(.012625)
	B: Reunification		
	Period	Period	
	1953-1975	1976-2013	Between-Period Difference
Ha Noi	0.0294***	0.0222***	.0071325
	(0.00219)	(0.00463)	(.0051177)
Ho Chi Minh City	0.0418***	0.0242***	.0175841***
	(0.00204)	(0.00113)	(.002327)
Within-period difference	-.0124409***	-.0019893	-.0104516*
	(.0029887)	(.0047617)	(.005622)

Appendix 7. Impact of some other economic indicators in the past on the present economic performance

	GDP	GDP	GDP	Number of all firms	Number of all firms	Number of all firms
Bomb Density	0.243***	0.244***	0.210***	0.263***	0.262***	0.194***
	(0.0479)	(0.0488)	(0.0469)	(0.0597)	(0.0604)	(0.0488)
Area	-0.387***	-0.408***	-0.356***	-0.345**	-0.316**	-0.211*
	(0.115)	(0.116)	(0.109)	(0.144)	(0.144)	(0.114)
Paddy productivity	-0.0283			0.0294		
	(0.0200)			(0.0250)		
Number of hospital		0.0162			0.0193	
		(0.0225)			(0.0279)	
Number of hospital bed			0.334**			0.657***
			(0.127)			(0.132)
Number of provinces	40	40	40	40	40	40
R square	0.528	0.509	0.582	0.414	0.399	0.639

	GDP	GDP	GDP	Number of all firms	Number of all firms	Number of all firms
Bomb	0.253***	0.255***	0.225***	0.258***	0.258***	0.200***
	(0.0517)	(0.0524)	(0.0482)	(0.0664)	(0.0664)	(0.0511)
Area	-0.586***	-0.605***	-0.524***	-0.515***	-0.515***	-0.359***
	(0.125)	(0.125)	(0.116)	(0.159)	(0.159)	(0.123)
Paddy productivity	-0.0251			0.0182		
	(0.0204)			(0.0289)		
Number of hospital		0.0151			0.0182	
		(0.0228)			(0.0289)	
Number of hospital bed			0.371***			0.695***
			(0.123)			(0.131)
Number of provinces	40	40	40	40	40	40
R square	0.514	0.500	0.596	0.355	0.355	0.635