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CONFLICT IN YEMEN AND CHILD MALNUTRITION

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ABSTRACT

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The paper tries to understand how the conflict in Yemen up to 2013 contributed to the deterioration of the situation in the country, in particular the malnutrition status for children less than five years old. It measures the Yemeni armed conflict's impact on children's nutritional status from birth to 59 months of age.

The impact of conflict on one specific type of malnutrition – stunting or chronic malnutrition – is measured by calculating height-for-age z-scores (HAZ). Two surveys are used in order to measure the anthropometric indicators for children less than five years old: the Household Budget Survey (HBS) conducted by the Central Statistics Office (CSO) in Yemen in 2006 and the most recent wave of the Demographic and Health Survey (DHS) for Yemen 2013. The difference-in-differences technique is applied as an econometric methodology. It compares children's HAZ scores before (2006) and during the conflict (2013) between two types of governorates: a group of governorates, the control group, which do not experience conflict during the whole period, and another group of governorates, the treatment group, which does experience severe conflict at a certain point between 2009 and 2013.

The empirical findings show that the malnutrition status of children has deteriorated after the start of the armed conflict in Yemen compared to 2006. Conflict has had negative but statistically insignificant impacts on the young cohort of children. Those between 0 and 33 months of age experiencing conflict while in utero are more stunted by 2% and have lower height-for-age z-scores by 0.06-0.09 standard deviations than young cohort children in control governorates. These results measured by the difference-in-differences estimator are the additional impact of conflict on the malnutrition status of children less than 59 months of age without evaluating any positive or negative spillover effects.

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CHAPTER I

INTRODUCTION

A wave of protests demanding political reforms, sometimes collapsing into civil wars, has been occurring in the Arab region starting December 2010. The demonstrations followed by conflicts spread also in Yemen, one of the world's poorest countries, in the beginning of 2011. The conflict in Yemen has had high costs at various levels. Its negative effects have included the internal displacement of people, the injuries, the casualties, and the battle deaths. Besides the social and the environmental detrimental impacts, conflicts have negatively affected the economy of the country and the neighboring region. Yemenis have been facing the impacts of protracted internal violence which can have detrimental long-term effects in terms of development and in particular a more drastic effect on the most vulnerable populations, such as children.

Children under 5 years of age are affected by conflicts, physically and emotionally: they do not attend school as frequently as during peaceful times, they often drop out, they are more prone to illness, and their level of malnutrition increases (Ogwo 2010, Verwimp 2012). Human capital investments, such as nutrition, are crucial in early life. A vast literature describes the importance of health and nutrition at the early stages of life for outcomes in adulthood in health, education, the labor market, and socioeconomic status (Victora et al. 2008, Currie 2009). Children exposed to health shocks might not be able to catch up even if they receive better and suitable health care (Barker 1998). They might be shorter and thinner when they grow up, have lower educational attainment and lower wages compared to children who were not exposed to health shocks (Strauss and Thomas 1998). This trend will most probably be transmitted

to their children (Currie 2009). Accordingly, wars and conflicts causing health shocks such as child malnutrition could lead to long-term damage resulting in intergenerational poverty traps.

Little is understood about the long-term impacts of conflict, especially in the Arab region. Conflicts affect children, and early childhood nutritional status appears to be a crucial indicator of lifelong achievement. Thus understanding the impacts of armed conflict on child nutritional status is extremely relevant, an issue which has not been studied thus far as a cost of Yemeni conflict.

The thesis is organized as follows: chapter II defines malnutrition, discusses the impact of child nutrition on health, education, and economic outcomes, and provides a review of the literature on conflict and child malnutrition. Chapter III gives an overview of the conflict in Yemen. Conflict and nutritional indicators, surveys providing data on child malnutrition and information on children's households are described in chapter IV. Then, chapter V explains the applied econometric methodology, its main assumption, and its major limitations. Chapter VI discusses the empirical results. Finally, chapter VII concludes.

CHAPTER II

LITERATURE REVIEW

Nutrition is one of the major determinants of child health, and early childhood health is important for future educational and labor market outcomes. Child malnutrition affects health negatively, which in turn has impacts on the individual's future cognitive outcomes. Subsequently, health affects education: poor conditions of health among children weaken the ability and the returns to learning and acquiring skills and lead to low educational attainments in the future. Moreover, poor child health may lead to poor health conditions in the long term. Adult health is correlated to adult labor supply, to productivity, and consequently to economic status. Therefore, child nutrition may be linked to adult educational and socio-economic status through its effect on the individual's health status. This is why childhood health is referred as one of the important mechanisms for intergenerational transmission of education and economic status.

Section A of chapter II defines the term "malnutrition." Then, section B gives the literature review on the impacts of child nutrition on health, education, and economic status in order to show how child malnutrition triggers an intergenerational cycle that hinders socio-economic development. The last part of chapter II focuses on the correlations between conflict in developing countries and child nutrition as one of the costs of armed conflicts can be the short- and long-term impacts of child malnutrition due to conflict.

A. Definition of Malnutrition

World Food Programme (WFP) defines malnutrition as “a state in which the physical function of an individual is impaired to the point where he or she can no longer maintain adequate bodily performance process such as growth, pregnancy, lactation, physical work and resisting and recovering from disease.” Malnutrition includes undernutrition and overnutrition. The thesis focuses on the former, henceforth referred to as malnutrition. It is the inadequate intake of macronutrients (carbohydrates, protein, and fat), or micronutrients (vitamins and minerals), or both. Malnourished individuals can be shorter and/or thinner compared to healthy individuals of the same age.

B. The Impacts of Child Nutrition

1. The Impact of Child Nutrition on Health

The immunity of malnourished children is weak. That is why the probability of contracting a disease, becoming ill, and dying is high among these children. Diseases reduce children’s immunity, appetite, and they change their metabolism, and become responsible for insufficient nutritional intake and absorption.

Onis et al. (2008) study the short-term consequences of child undernutrition in terms of deaths and disease burden. The latter is measured by disability-adjusted life years (DALY). DALY measures the total loss of health by including the years lost attributed to premature death and years of life lived with disabilities. This means that 1 DALY is the loss of one healthy-life-year. They show that the percentage of global deaths in children under 5 years of age due to undernutrition and low birth weight is the highest one among death risk factors for this age group. Child undernutrition and low birth weight are responsible for 21% of global deaths in children under 5 and 21% of

global DALYs for the same cohort of children. These figures are very high in south-central Asia and in eastern, middle and western Africa. The latest report of World Health Organization (WHO) in September 2014 shows that children under 5 in sub-Saharan Africa are more than 15 times more likely to die than the ones in developed areas. Forty-five percent of deaths in children under 5 years of age are associated with nutrition-related factors, such as malnutrition, low birth weight, the absence of breastfeeding, and poor hygiene conditions. The main reasons of death in children under 5 are pneumonia, diarrhoea and malaria. In fact, Onis et al. (2008) associate risk of mortality due to specific diseases – diarrhoea, pneumonia, malaria, and measles – to childhood undernutrition in low-income and middle-income countries, such as Ghana, Senegal, Guinea Bissau, Philippines, India, Nepal, Bangladesh, and Pakistan. They show that the risk of death increases as the level of undernourishment becomes more severe.

Adair et al. (2008) study the long-term impacts of child malnutrition in low-income and middle-income countries. They look at the association between child undernutrition and adult health outcomes such as height and risk of diseases. They find that differences in height due to poor nutrition during the first two years of life stay on average until adulthood. This means that 2-year-old boys and girls who are shorter relative to the standard height for age defined by WHO remain on average short in their adulthood too. Moreover, Adair et al. (2008) show that the effects of undernutrition may be transmitted to future generations. Given that undernourished girls most likely become short adults, it is more probable that they will have shorter children: 1 centimeter of maternal height is correlated with an increase of 0.5 centimeter in her offspring's adult height. In high-income countries, children who are short and

undernourished in their first 2 years of life and who rapidly gain weight later in their childhood or adolescence become at high risk of cardiovascular diseases. However, Adair et al. (2008) state that there is still no such evidence in middle- and low-income countries.

2. The Impact of Child Nutrition on Education

Malnutrition can damage the structure and the function of the brain which affects the cognitive development of the child. If these cerebral deficits are not remedied, malnutrition can affect the individual's educational outcomes in the long term. In fact, Filipino children suffering from malnutrition at the age of 2 are associated with entering school late during their adolescence, lower school performance, repeating grades more often, and having higher dropout rates and lower graduation rates from primary and secondary school (Daniels and Adair 2004).

Researchers conclude that poor mental development in malnourished children may be partially attributable to undernutrition. Pollitt and Gorman (1993) study the effect of a random nutritional program on cognition which was implemented among children between 0 and 7 years old in Guatemala between 1969 and 1977. They compare the differences in the performance on psycho-educational and information-processing tests between treated and control groups. They show that the random intervention of the supplementary feeding has positive impacts among treated children: they score higher on tests of knowledge, numeracy, reading, and vocabulary and have faster reaction time in information-processing tasks compared to children of control groups. Maluccio et al. (2009) study the long-term effects of the same nutritional supplementation program. They interview the individuals in both control and treated

groups a quarter of a century after its implementation. They show that individuals who were exposed to the nutritional intervention between 0 and 36 months of age now have higher levels of grades completion and score higher on reading comprehension and non-verbal cognitive ability tests compared to non-treated ones. The results control for parental characteristics such as age, education, and wealth. Grantham-McGregor et al. (1991) study the effect of a similar nutritional supplementation on mental development among Jamaican malnourished children aged between 9 and 24 months. They show that treated children have better mental development scales than untreated ones. The nutritional intervention programs are implemented in developing countries in order to improve the health of pre-school children as short-term goals and ensure better health, educational, and socio-economic outcomes in the long term. That is why the effects of such nutritional programs are less evident in developed countries. There is a special supplemental food program for Women, Infants, and Children (WIC) in the United States. It consists of giving specific food coupons to women, infants, and children who are nutritionally at risk. Rush et al. (1988) study the effect of this nutritional program on cognitive outcomes. They compare WIC participants to control groups composed of pregnant women who are able to receive prenatal care in clinics. Control group women are wealthier and more educated than those of WIC. Surprisingly, Rush et al. (1988) show that 4- and 5-year-old children whose mothers were WIC participants score higher on vocabulary tests compared to children of control group mothers.

3. The Impact of Child Nutrition on Economic Status

Child malnutrition affects human capital because it is associated with adult health, adult height, education, and therefore labor supply, productivity, and economic

status. There is a vast literature about the positive correlation between height and earnings starting from Robert W. Fogel and about the increasing economic returns to schooling.

Height appears to be a significant determinant of wages. In urban areas of Brazil, adult height and income are positively associated even after controlling for education (Thomas and Strauss 1997). Adair et al.'s (2008) study encompasses similar results regarding the relationship between height and income. Differences in men's height for the same age are linked to higher incomes in Brazil and Guatemala and to higher household assets in India. Chen and Zhou (2007) study the long-term effects of China's great famine in 1959-1961. They show that children who were exposed to the famine in their first years of life became shorter and had lower levels of income. Additionally, 2-year-old children in 1961 would have been taller by 3.35 centimeter in the absence of famine; their total labor supply and agrarian income per capita would have increased by 28 and 38% respectively.

Hoddinott et al. (2008) evaluate the impact of nutrition on economic outcomes in Guatemala. There exists a positive correlation between male children's exposure to the nutritional supplementary program up to 24-month-old and hourly wages in adulthood. The increase is US$ 0.67 per hour which represents 46% increase in average wages in the sample.

C. Conflict and Child Nutrition

The level of malnutrition in children under 5 increases during armed conflict due to several reasons such as a decrease in food production level, the contamination of water, increases in the rates of poverty, disease, and displacement. If the mother is

physically or psychologically affected by the intensity of the conflict, the latter may even have impact on child birth weight which is an indicator of health later in life. Those who breastfeed their infants may not be able to take care of them and provide sufficient breastmilk. All these factors worsen children's health and contribute to the risk of infant mortality.

Camacho (2008) measures the influence of prenatal psychological stress due to terrorist attacks in Colombia on child birth outcomes. She finds that they are very sensitive to maternal stress, especially in the initial periods of pregnancy. In fact, children who experienced stress in utero because of the explosions in Colombia have lower birth weight by 8.7 grams than their siblings who were not exposed to attacks.

Cliff and Noormahomed (1993) discuss the impacts of the Mozambican civil conflict in the 1980s on socio-economic indicators, women and children's health, and access to health. The rate of child malnutrition increased intensely to a level where it became the main cause of infant mortality in hospitals by 1990. Sixteen per cent of children suffering from malnutrition and admitted to hospitals were from displaced families. The situation in rural areas was even worse: 53% of children aged between 0 and 59 months were stunted and 7% were wasted.

Research has used anthropometric measures in order to study the impact of conflicts on children's health. The Angolan armed conflict started in 1975 and lasted around 27 years. Arcand and Wouabe (2009) find that the intensity of the Angolan conflict severely affected children's health and growth. Using the same type of anthropometric indicator, Bundervoet et al. (2009) quantify the effect of armed conflicts in Burundi from 1994 to 1998 on children's health. They compare the difference in health status of children exposed or not exposed to conflict. One month of exposure to

civil conflict decreases a child's height for age z-score by 0.047 standard deviations, a result that is robust to various controls. Akresh et al. (2012) measure the impact of the 1998-2000 Eritrean-Ethiopian conflict on children of both countries involved in the war. Children born during the war and living in conflict-affected regions of both the winner and the loser countries have lower height for age z-scores. For the case of Côte d'Ivoire, the armed conflict between 2002 and 2007 is associated with the deterioration in the health of children aged between 6 and 60 months (Minoiu and Shemyakina 2012). Children who had parents victimized by the civil conflict, who were born during the war, and who lived in conflict-affected areas suffered the most: their height for age z-score is lower by 0.489 standard deviations compared to children who were born during the conflict but lived in less-affected areas. Finally, Guerrero-Serdán (2009) is the first one who analyzes the impact of conflict in a Middle Eastern country on nutrition and health. She finds that the Iraqi war which started in 2003 is correlated with large negative impacts on the physical growth of children who were born in areas where the intensity of the conflict was high. In fact, children aged 6 months are 0.76 centimeter shorter than the ones who were born in less-affected regions. Their health status may deteriorate and the impacts may become irreversible after age of 2 if no suitable action is taken.

CHAPTER III

THE CONFLICT IN YEMEN

Yemen is geographically a strategic country because it connects the Red Sea with the Gulf of Aden and the Arabian Sea by the Bab Al Mandab water channel. The strait connects the Horn of Africa with the Middle East and it is a strategic link between the Mediterranean Sea and the Indian Ocean. Much of the world's oil shipments are transferred through the Bab Al Mandab toward Europe, the United States, and Asia. Closure of this water channel implies that oil and natural gas exporters from the Arabian Gulf will not be able to reach the Suez Canal through the Bab Al Mandab. In order to do so, they will have to go around the African continent which increases transfer time and cost. Moreover, trade and commerce between Northern African/European and Asian markets will not take place through the Suez Canal and Bab Al Mandab. Besides its economic significance, the strait has considerable political and military importance. In other words, the security of this region's countries, including Yemen, depends to a great extent on the geopolitical status of the Bab el Mandab.

Yemen has been the scene of clashes between the Al Houthis and the government forces since 2004. The conflict has mostly taken the violent and armed aspect starting 2009 as indicated by the Uppsala Conflict Data Program (UCDP), the most widely used database for armed conflict, which defines the armed conflict as:

"a contested incompatibility that concerns government and/or territory over which the use of armed force between two parties, of which at least one is the government of a state, has resulted in at least 25 battle-related deaths in one calendar year."

The conflict dataset of the paper covers the 2009-2013 period and the surveys regarding the malnutrition indicators are conducted in 2006 and 2013. All of them are described in detail in the following chapter. Whereas this chapter gives a brief chronology of the conflict in Yemen in the first section and mentions its major impacts in the second one.

A. Chronology of the Conflict

Before 1990, the Republic of Yemen was split between two separate countries: the Yemen Arab Republic in the north and the People's Democratic Republic of Yemen in the south. In 1990, the two countries unite with Ali Abdallah Saleh as president. However, southern citizens feel that they are marginalized by the government because political and economic powers are centralized in Sana'a which is in North Yemen. They try to separate the southern area from the northern region of the country in 1994 but they fail.

Today's armed civil conflict in Yemen involves more than two opposing groups: the government versus Al Houthis in the north, the government versus the pro-autonomist supporters in the south, the government versus Al Qaeda in the Arabian Peninsula (AQAP), Al Houthis versus AQAP in the south and south-east, and other tribal forces versus the national army. The situation gets more problematical by the emergence of the Islamic State which carries out two suicidal attacks in Sana'a in March 2015.

Besides the main cities of Yemen, there are regions governed by local tribes which have their own traditions and laws – different than the national ones. This is why

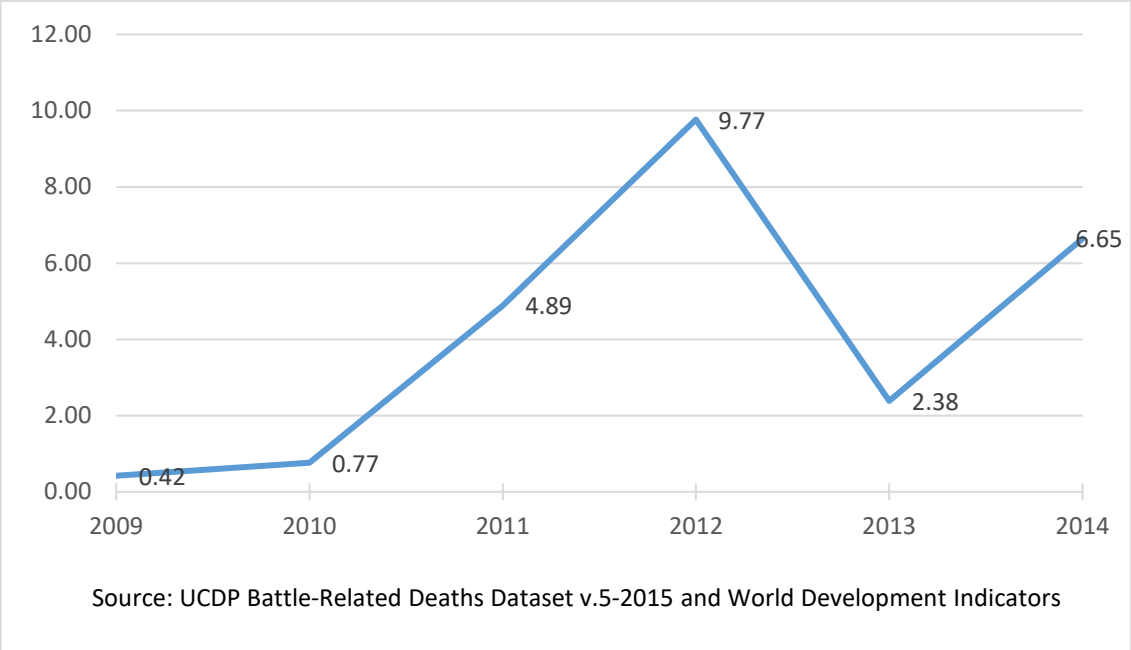
the tribes oppose the Yemeni government and are regularly in conflict with the national army.

In June 2004, Hussein Al Houthi starts to rebel against the Yemeni government. The opposition between the supporters of Al Houthi and Yemeni security forces lasts two months. In September 2004, the Yemeni government declares that it has killed Hussein Al Houthi. The period between 2004 and 2008 witnesses five series of grievances by the followers of Al Houthi, known as Al Houthis, against the Yemeni government. At the end of 2009, Saudi Arabia launches airstrikes against Al Houthis in the northern Sa'adah governorate at the border separating the two countries. Al Houthis charge Saudi Arabia for supporting the Yemeni government and attacking them. Although the Yemeni government and Al Houthis sign a ceasefire at the beginning of 2010, another round of conflict takes place at the end of the same year. Yemeni internal conflict escalates in 2011 as the number of battle deaths per 100,000 population increases from 0.77 to 4.89 between 2010 and 2011 (Figure 3.1).[1] The beginning of 2011 is marked by the diffusion of protests, stimulated by other Arab regions, demanding political reform in Yemen. Government forces respond violently to the demonstrations. At the end of the year, President Saleh passes his responsibility to Abd Rabbuh Mansour Hadi and leaves the country in the following months. A unity government is formed in 2012 with Hadi appointed as president and a prime minister appointed from the opposition. The National Dialogue conference that starts in 2013 fails to reach an agreement amongst all Yemeni tribes in 2014. Meanwhile, Al Houthis take control of the governorate of Sana'a, the capital of the country. The intensity of Yemeni armed conflict increases in 2015. President Hadi resigns and leaves the country

[1] UCDP Battle-Related Deaths Dataset v.5-2015 and World Development Indicators

in February 2015. In the following month in response to the request of President Hadi's government, Saudi Arabia, leading a coalition of 9 Arab countries, carries out a military intervention against Al Houthis in Yemen. The intervention, named the "Operation Decisive Storm" and backed by the United States, is launched through attacks, such as aerial bombardments and air/naval blockades. In April 2015, Saudi Arabia declares to put an end to the Operation Decisive Storm and to carry out a new campaign and new political interventions, named "Operation Restoring Hope," in order to fight the terrorism and ensure the security of civilians in Yemen.

Figure 3.1 Battle deaths per 100,000 population



Source: UCDP Battle-Related Deaths Dataset v.5-2015 and World Development Indicators

B. Major Impacts of the Conflict

The incessant armed conflict creates a humanitarian crisis in Yemen. In 2015, 80% of the population is in need of some form of assistance according to the United Nations Office for the Coordination of Human Affairs (OCHA) in Yemen.[2] The number of internally displaced persons exceeds 2 million.[3]

The young generation of Yemen is exposed to a major risk. Children are not able to attend school because schools are destroyed by the armed conflict or occupied by the internally displaced persons or the armed groups. An estimated 140 schools are completely damaged and 390 partly damaged across Yemen.[4] 47% of the school-age population in Yemen is out of school.[5]

The country is politically insecure and unsafe. Civilians are poor and do not have access to water, to food, nor to health care. In fact, 80% people are in need of water and sanitation assistance.[6] Moreover, 50% of the population is food insecure and around 25% is severely food insecure.[7,8] Conflict exacerbates food insecurity in the country, potentially leading to detrimental health consequences in the population, in particular malnutrition in children. Yemen has one of the highest global levels of child malnutrition: 1.3 million children less than five years old suffer from malnutrition compared to 690,000 prior to the crisis.[9]

[2] OCHA, Yemen Humanitarian Needs Overview 2015, June 2015
[3] OCHA, Yemen Humanitarian Dashboard 2015, October 2015
[4] OCHA, Yemen Humanitarian Snapshot 2015, September 2015
[5] OCHA, Yemen Humanitarian Needs Overview 2015, June 2015
[6] Ibid.
[7] OCHA, Yemen Humanitarian Response Plane 2015, June 2015
[8] OCHA, Yemen Humanitarian Needs Overview 2015, June 2015
[9] OCHA, Yemen Humanitarian Snapshot 2015, October 2015

CHAPTER IV

DATA

A. Conflict Indicators

1. Measurement of Conflict

In this paper, conflict is measured and quantified by the number of casualties and fatalities due to the armed conflict. The adopted source of battle deaths for the period 2009-2013 is the Reuters news agency which regularly reports the progress of Yemeni civil conflict and covers information on the date and region of each battle. It gives concise description of the fighting and specifies the number of all battle deaths by region.

2. Summary Statistics

Table 4.1 shows the battle deaths at the governorate level for 5 consecutive years – 2009, 2010, 2011, 2012, and 2013 – during which Yemen was experiencing civil conflict.

Table 4.1 Battle deaths per governorate, 2009- 2013

	2009	2010	2011	2012	2013
Abyan	1	3	502	1078	56
Aden	0	4	28	35	10
Al-Baida	0	0	0	50	35
Al-Daleh	0	0	0	18	0
Al-Hodeidah	0	0	0	0	0
Al-Jawf	0	23	27	12	7
Al-Maharah	0	0	0	0	0
Al-Mahweet	0	0	0	0	0
Amran	0	0	0	8	0
Dhamar	0	0	0	0	1
Hadramout	0	0	3	87	61
Hajjah	0	0	4	24	0
Ibb	0	0	5	0	32
Laheg	0	0	11	6	9
Mareb	0	1	0	46	27
Reymah	0	0	0	0	0
Sa'adah	70	87	25	16	103
Sana'a	0	1	0	4	0
Sana'a City	0	0	444	143	115
Shabwah	34	0	26	14	56
Taiz	0	19	155	1	2

In 2009, the conflict is at a low level given that deaths related to battles are mainly concentrated in only 2 governorates, Sa’adah and Shabwah. The latter does not suffer from civil conflict measured by battle deaths in the following year, whereas 4 more governorates do in addition to Sa’adah: Abyan, Aden, Al-Jawf, and Taiz. In 2011, 10 out of 21 governorates in Yemen do not experience conflict in terms of battle deaths. The conflict is the most intense in Abyan and Sana’a City where the number of battle deaths reaches 502 and 444 respectively. Both governorates remain the regions with the highest intensity of conflict in 2012. Whereas the number of battle deaths more than doubles in Abyan in 2012, it decreases by about 68% in Sana’a City. The conflict is

more spread in the country in 2012 than in 2011 because only 6 governorates are reported as not having any battle deaths. 2013 is marked by a decrease in conflict intensity. In almost all governorates the number of battle deaths is lower than that of 2012. Sa'adah is the major exception with 103 battle deaths compared to 25 and 16 in 2011 and 2012 respectively. Sa'adah is the governorate with the highest intensity of conflict in 2013 after Sana'a City.

3. Conflict Level Classification

There are 21 governorates in the Republic of Yemen. The governorates must be classified into two groups – a group with low intensity of conflict and another one with high intensity of conflict – in order to specify if the child lives in a region going through conflict.

In this paper, a conflict region (or a region with high intensity of conflict) is defined as a governorate for which the Reuters news agency reports at least 10 battle deaths per year in any of the 5 consecutive years – 2009, 2010, 2011, 2012, 2013. Therefore, there are 14 governorates which experience high level of conflict during the period 2009-2013: Abyan, Aden, Al-Baida, Al-Daleh, Al-Jawf, Hadramout, Hajjah, Ibb, Laheg, Mareb, Sa'adah, Sana'a City, Shabwah, and Taiz. The remaining 7 governorates belong to the group of low intensity of conflict.

B. Overview of Surveys

Two surveys will be used in order to measure the nutritional indicators for children less than five years old: the Household Budget Survey (HBS) in 2006 and the most recent wave of the Demographic and Health Survey (DHS) for Yemen in 2014.

They are both representative at the governorate level and provide detailed anthropometric measures, such as weight and height/length, for 13,581 and 15,320 children less than five years old respectively.

1. Household Budget Survey 2006

The HBS is carried out by the Central Statistical Organization (CSO) of Yemen. The data collection of the cross-sectional survey took place over a year period, from April 1, 2005 through March 31, 2006. The main purposes of the HBS include poverty estimation and the production of aggregates of socio-economic indicators at the governorate level which can be used in socio-economic policy making and development plans.

The HBS 2006 is composed of 3 questionnaires: general questionnaire, local community services questionnaire, and prices questionnaire. The first one is used to collect information on the members of the household. The second questionnaire aims at collecting data about the availability and quality of community services. The third one collects data on prices in the rural areas. The multipurpose survey of the Yemeni population provides comprehensive information on social, economic, and demographic indicators, e.g., education, health conditions including reproductive health for ever-married women, anthropometric measures for children less than 6 years of age, income and expenses, loans and credit, and housing conditions.

The sample is designed using the 2004 General Housing and Establishment Census sampling frame. The following steps are applied in order to construct the sample:

- Yemen has 21 governorates. Each governorate is divided into districts, each district is subdivided into sections, each section into sectors, and each sector into smaller areas called enumeration areas (EU), thus forming 12,000 EUs in total.
- On the basis of the EUs on urban and rural levels, primary sampling units (PSU), referred to as clusters, are defined. In total, 1,200 clusters are selected from 1,200 different EUs.
- 12 households are selected from each cluster after listing all households. The result is 14,400 households at the national level.

2. Demographic Health Survey 2013

The DHS is conducted by the Ministry of Public Health and Population (MOPHP) of Yemen in collaboration with the country's Central Statistical Organization (CSO). Its fieldwork is carried out between September and November 2013. It aims at giving comprehensive data and information to policy makers and decision makers. The latter use the survey as a tool to study the Yemeni population and evaluate country's health policies and programs. Then, they make evidence-based decisions and pertinent interventions in the country.

The DHS 2013 has 4 questionnaires: household questionnaire, ever married woman questionnaire, single woman questionnaire, and maternal mortality questionnaire. The first questionnaire includes all the members of and visitors to the household. It is used to report the basic characteristics of each individual such as gender, age, marital status, height, weight, and education. Moreover, this questionnaire reports each household's dwelling unit characteristics such as sanitation facilities and source of water. The second and the third questionnaires are individual questionnaires;

they collect data on ever-married women aged between 15 and 49 and on never-married women for the same age range. They provide information on family planning, partner's characteristics, fertility preferences, breastfeeding practices, and other health issues. The maternal mortality questionnaire is used to identify the number of deaths of women between ages 12 to 49 years old over the two previous years of the survey.

The sampling frame of the DHS is similarly based on the 2004 General Population Housing and Establishment Census. The total number of the EUs is 35,000 and that of the clusters is 800, 213 rural and 587 urban. Selecting 25 households from each cluster yields a sample of 20,000 households at the national level.

18,027 occupied households are selected. 17,351 are successfully interviewed – representing a response rate of 96.3%. A woman in a selected household is considered eligible for the interview if she's between 15 and 49 years old and she is present in the household the night before the interview. 17,318 ever-married women are identified and 16,656 are successfully interviewed – representing a response rate of 96.2%.

C. Nutritional Indicators

1. Types of Malnutrition

The World Health Organization (WHO) and the World Food Programme (WFP) define three major types of malnutrition for children up to 5 years old:

- Stunting or chronic malnutrition (shortness): it is the result of insufficient nutrition over a long period of time. Poor maternal nutrition or poor feeding practices may yield chronic malnutrition. A child may be stunted if he or she is short compared to the standard height of a child of the same age defined by WHO international growth reference.

- Wasting or acute malnutrition (thinness): it is defined as a rapid weight loss or a failure to gain weight. It is evaluated by comparing the child weight to a standard weight of a child of the same age. There are two degrees of acute malnutrition: moderate and severe.
- Underweight: it is a combination of both stunting and wasting. It can occur as a result of stunting, wasting, or both.

2. Measurement of Malnutrition

WHO and WFP provide specific health indicators to evaluate the malnutrition status for children up to 5 years old by comparing the child with an international standard population defined by the WHO. The latter is known as the Growth Standards (GS); it is a reference for healthy children who have similar growth patterns and distributions of height and weight for a certain age in all populations. Child malnutrition indicators are expressed by z-scores, which are standard deviation units from the median value of the reference population. A z-score is calculated by dividing the difference between the value for a child and the median value of the reference population for the same age or height by the standard deviation of the reference population:

$$z - score = \frac{measured\ value - median\ of\ reference\ population}{standard\ deviation\ of\ the\ reference\ population}$$

A positive z-score means that the child's measurement is higher than the average value of an individual of the same age or height in the GS and a negative z-score means the opposite. Larger negative scores indicate worse cases of malnutrition.

There are 3 different z-scores, one for each type of malnutrition defined in the previous section:

- Height-for-age z-score (HAZ) is the indicator used for stunting or chronic malnutrition (shortness). If the child's HAZ is 2 standard deviation units below the reference median of HAZ, he/she suffers from chronic malnutrition.
- Weight-for-height z-score (WHZ) is calculated in order to diagnose a case of wasting or acute malnutrition (thinness). A WHZ that is 2 standard deviations less than the reference median implies a case of moderate acute malnutrition. A child suffers from severe acute malnutrition if his/her weight-for-age z-score is below -3. In other words, a z-score indicates how far a child's weight (or height) is from the median weight (or height) of a child at the same height (or age) in the reference value.
- The composite index weight-for-age z-score (WAZ) is the indicator used to classify a child with underweight. It is the case when the child's WAZ is 2 standard deviations below the reference median of the indicator.

The thesis will focus on measuring the impact of conflict on stunting by calculating height-for-age z-scores because it is the most dangerous form of malnutrition. It has irreversible consequences even if children are remedied with proper nutrition, as opposed to wasting.

3. Summary Statistics

Table 4.2 shows the mean values of the three malnutrition indicators in both surveys. The height-for-age z-score increases between 2006 and 2013 for boys and girls. In 2006, the mean value of HAZ indicates a case of chronic malnutrition on average because it is around -2. However, it is not the case in 2013 as it becomes higher than -2. Whereas weight-for-height and weight-for-age z-scores show deterioration in nutritional status of children up to 5 years old because their values decrease and become

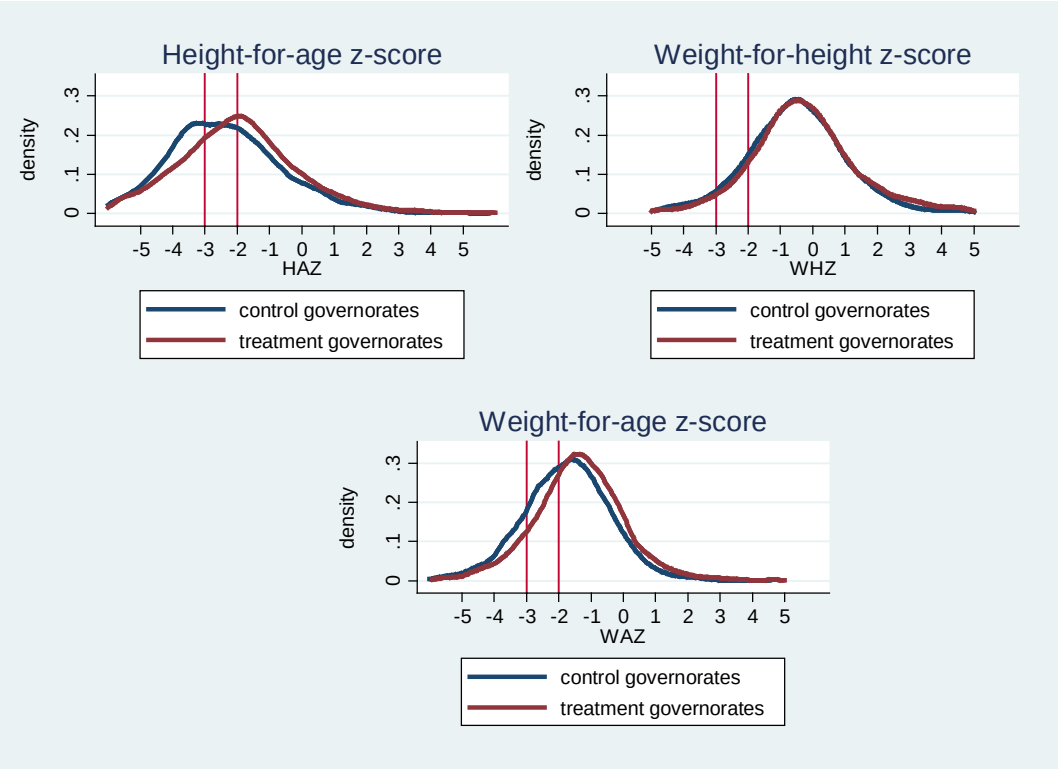
more negative over the period 2006-2013. It is worthwhile to note that male children have poorer status because they score lower for the 3 indicators in both years.

Table 4.2 Mean values of malnutrition indicators

	All children		Boys		Girls	
	HBS 2006	DHS 2013	HBS 2006	DHS 2013	HBS 2006	DHS 2013
HAZ	-2.07	-1.78	-2.16	-1.83	-1.98	-1.74
WHZ	-0.33	-0.82	-0.41	-0.86	-0.24	-0.77
WAZ	-1.49	-1.66	-1.58	-1.68	-1.39	-1.63

Figure 4.1 shows the kernel densities of height-for-age, weight-for-height, and weight-for-age z-scores for the whole sample of children and for the control and treatment governorates before the violent conflict period. Treatment governorates score better on HAZ and WAZ than control governorates in the pre-conflict period because the first and the third graphs show that treatment governorates tend to have higher values of HAZ and WAZ. The second graph shows that there is no difference in WHZ between control and treatment governorates in 2006. However, while the graphs show first order stochastic dominance in the distribution of HAZ and WAZ for the treatment governorates, statistical tests of the difference of sample means show there is no significant difference in mean z-scores between the two types of governorates in the pre-intervention period. T-tests are applied on the control and treatment governorates in the pre-treatment period in order to test whether the differences between the two groups' z-scores means are null. The p-values of the t-statistics are above 10%, i.e. this means that the null hypothesis cannot be rejected (Appendix, Table 8.1).

Figure 4.1 Height-for-age, weight-for-height, and weight-for-age z-score densities



D. Household Members

As mentioned in the second section of chapter IV, HBS 2006 and DHS 2013 provide socio-economic and demographic information about children less than 5 years old and about their parents in addition to the anthropometric indicators. Moreover, they report the characteristics of children's households and those of the household head. Table 4.3 shows the mean values of socio-economic and demographic indicators for the control and treatment governorates in both periods, i.e. pre-treatment and post-treatment periods. These characteristics will serve as controls in the regressions explained in chapter V.

Children in control and treatment areas and in both periods are on average around 28 months old and 49% of them are female. In the pre-treatment period, children under 5 are typically the second born child in the family, whereas in the post-treatment period, they tend to be the third or the fourth born child. In 2013, the probability of being breastfed is higher in both regions compared to those of 2006. The differences in the characteristics of children, except the birth order, between control and treatment governorates in the period preceding the violent conflict are not statistically significant.[10]

The ages of children's mothers and fathers in control and treatment areas are quite similar and do not change between 2006 and 2013: mothers are, on average, 29 years old and fathers 34-35. Mothers' weight and height are greater in treatment governorates compared to control governorates in both periods. However, they decrease in both regions from 2006 to 2013. These three indicators do not statistically differ between control and treatment areas in 2006.[11] Table 4.3 reports the percentage of literate parents who have secondary level of schooling. The fraction of fathers with secondary level of education is higher compared to that of mothers in both types of regions and in both periods. More parents have completed the secondary grades in treatment governorates than in control regions. The educational level of fathers increases between 2006 and 2013 but it remains the same for mothers. The fraction of mothers and fathers who are employed increases from the pre-treatment period to the post-treatment one. In 2013, a higher fraction of mothers and fathers is employed in control areas than in treatment regions; this was not the case in 2006 where the

[10] A t-test for the equality of means is applied on the control and treatment governorates in the pre-treatment period. The p-values of the t-statistics are above 10%. This means that the null hypothesis cannot be rejected, i.e. the differences between the two groups' means are null (Appendix, Table 8.1).
[11] Ibid.

difference in the employment rate for mothers and fathers between the two regions is statistically different.[12]

There are some differences in terms of the urbanization rates. The control regions are more urbanized than the treatment regions in both periods. The two regions are statistically different in terms of urbanization in 2006.[13]

The fraction of female-headed households is very low in all circumstances: it is between 1 and 4%. Household heads are on average between 41 and 44 years old.

Households of treatment governorates have more members than those of control areas in both periods. Household size and number of kids under 5 years old decrease between 2006 and 2013 regardless of governorate type, but the sleeping rooms become more overcrowded. The fraction of middle-wealth household does not change between 2006 and 2013, but the percentage of household having improved water and sanitation facilities decreases drastically in both types of regions, e.g. the fraction of households who have improved sanitation facilities in control governorates decreases by nearly 45% from 2006 to 2013. There is no statistical difference in any of the household indicators between the two types of governorates in the pre-intervention period (Table 8.1).

[12] The p-values of the t-statistics are less than 10%. So, the null hypothesis is rejected, i.e. there is a statistical difference between the mean values of the control and treatment governorates (Appendix, Table 8.1).
[13] Ibid.

Table 4.3 Summary Statistics

	Pre-treatment period (HBS 2006)		Post-treatment period (DHS 2013)	
	Control governorate	Treatment governorate	Control governorate	Treatment governorate
Child characteristics				
age in months	28.79	28.68	28.52	28.52
Sex	0.49	0.49	0.49	0.49
birth order	1.72	1.65	4.15	3.71
ever breastfed	0.81	0.84	0.98	0.97
Mother characteristics				
age in years	29.56	29.87	29.19	29.34
weight in kilograms	53.41	57.05	52.32	55.27
height in centimeters	153.55	154.99	153.17	154.64
education (secondary)	0.19	0.21	0.18	0.21
employment status	0.01	0.03	0.11	0.09
Father characteristics				
age in years	35.28	35.74	34.78	35.14
education (secondary)	0.23	0.27	0.27	0.31
employment status	0.49	0.60	0.98	0.94
Household head characteristics				
age in years	44.18	43.29	41.05	44.26
Sex	0.01	0.03	0.03	0.04
Household characteristics				
household size	9.70	10.13	8.17	9.23
number of kids under 5	2.34	2.31	2.05	2.06
wealth level				
poorest	0.22	0.20	0.31	0.17
poorer	0.16	0.21	0.27	0.20
middle	0.20	0.20	0.21	0.22
richer	0.20	0.20	0.16	0.22
richest	0.22	0.19	0.07	0.20
improved water	0.47	0.55	0.41	0.43
improved sanitation	0.63	0.75	0.35	0.57
overcrowded sleeping rooms	0.22	0.19	0.32	0.29
Area characteristics				
urban/rural	0.61	0.38	0.83	0.70

CHAPTER V

ECONOMETRIC FRAMEWORK

A. Identification Strategy

The ideal identification strategy in order to evaluate the impact of armed conflict on child nutritional status is to observe a child in 2 different situations, each one of them in 2 time periods: a child exposed to conflict before and after conflict and the counterfactual, that is, the same child not exposed to conflict in the same periods of time. Obviously, this identification strategy is impossible because there are 2 kinds of children: a child who is exposed to conflict and another one who is not. Plus, the surveys of Yemen do not contain panel data in order to observe the same children before and after the conflict which mainly escalated in January 2011. Therefore, the identification strategy of the thesis is determined by the timing and the geographical area of the conflict. It exploits differences in data on the Yemeni internal conflict by governorate between 2009 and 2013, when the fieldwork of the second survey, the DHS, was completed.

Conflict and its intensity are measured by conflict casualties. The UCDP armed conflict database records all battle related deaths by conflict year and location. The main sources of the dataset are publicly available, global, regional, and country-specific, printed and electronic, such as journals, news agencies, reports from national and international organizations, and non-governmental organizations (NGO). The UCDP dataset starts reporting deaths related to Yemen's current conflict in 2009. That is why the conflict period considered in this paper starts in 2009. The HBS is carried out before 3 years in 2006 when the intensity of the oppositions was not a high level in terms of

violence. The most recent DHS of Yemen is conducted after 4 years, in 2013. So, it is considered as the survey through which the impact of the civil conflict on various indicators, e.g. anthropometric measures, can be studied.

As stated above, the identification strategy is not only based on the timing of the conflict but also on its geographical area. It may be possible that the governorates which experience high intensity of conflict are different from the others with regard to development and economic indicators. These dissimilarities may be one of the reasons for which conflict had taken place in the governorate; they may even affect child health whether there had been conflict or not. In other words, it is essential to compare the development and the economic status of the governorates before the conflict period. In case of any differences, they must be taken into consideration and included in the econometric methodology to be applied.

B. Econometric Methodology

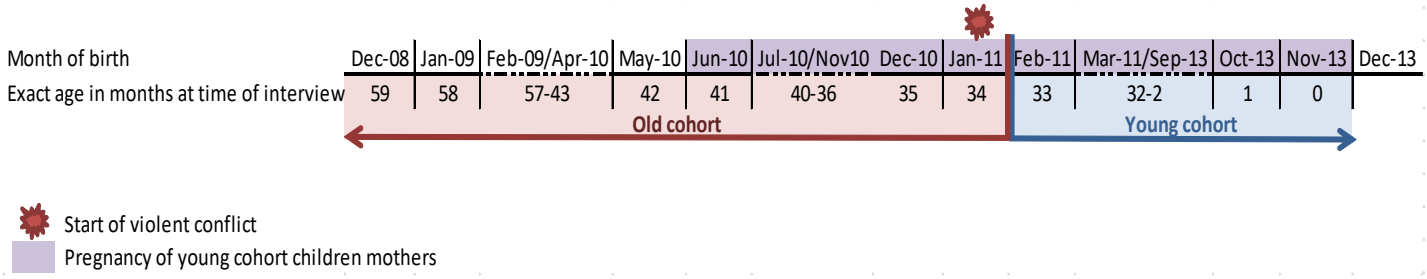
The identification strategy implies that there are 2 periods of time – pre- and post-event, i.e. armed conflict – and 2 groups of individuals – exposed to the conflict and not exposed to the conflict. In econometric terms, the event is referred to as treatment, the exposed group as the treated group, and the unexposed group as the control group.

So, the econometric methodology to be applied is the difference-in-differences approach. It consists of comparing child malnutrition between two types of governorates in 2006 and in 2009-2013 (conflict period). The first group of governorates, the control group, does not experience conflict or experiences it at low

intensity level in 2009-2013, whereas the second group of governorates, the treated group, experiences conflict at high intensity level during the same period of time.

Children under 5 years of age in the Demographic and Health Survey conducted between September and November 2013 can be divided into 2 groups based on the condition whether they are in utero or not during the violent period of conflict. The young group consists of children who experience conflict while in utero at a certain period of time between 2011 and 2013. The mother of the oldest child in this cohort is in her third trimester of pregnancy in January 2011; this means that the child is 33 months old during the survey. So, the children of the young group are between 0 and 33 months of age at the time of the interview; the ones in the treated governorates are exposed to the armed conflict while in utero and after being born. The children of the old cohort are not in utero when they experience conflict, they are already born when the conflict intensifies. The youngest child of this group is born in January 2011 and is 34-month-old during the survey. Therefore, the old group children are between 34 and 59 months of age at the time of the interview; the treated ones are exposed to the armed conflict after being born. Similar age groups can be constructed in the Household Budget Survey 2006 in order to compare the impact of conflict on the nutritional status among treated children while in utero during the conflict or born after it. These two cohorts of children are constructed in a different method than the age groups mentioned by two papers in the third section of chapter II: Minoiu and Shemyakina (2012) and Guerrero-Serdán (2009).

Figure 5.1 Cohorts of children



C. Econometric Model

Control and treatment governorates may differ across some key variables, such as child, mother, father, household head, household, area characteristics as discussed in chapter IV. They may differ in terms of macro and development indicators too. All of these characteristics must be controlled and included in the estimations in order to reduce the bias and the unexplained variance from the difference-in-differences model. The regression model to estimate whether the Yemeni armed conflict has had a detrimental impact on children's nutritional status from birth to 59 months of age is the following:

$$z-score_i = \beta_1 + \beta_2 child_i + \beta_3 post_i + \beta_4 governorate_i + \beta_5 (post * governorate)_i + \beta_6 mother_i + \beta_7 father_i + \beta_8 household\_head_i + \beta_9 household_i + \beta_{10} area_i + \beta_{11} governorate\_controls_i + u_i, \text{ where} \quad (1)$$

$z-score_i$: height for age z-score (HAZ) for individual *i*,

$child_i$: individual *i* characteristics (sex, age, being breastfed, having fever or diarrhea),

$post_i$: a dummy if the observation *i* is in the post-conflict time frame, i.e. in the DHS 2013,

$governorate_i$: a dummy indicating whether the observation *i* is in a governorate affected by high intensity of conflict,

$mother_i$: individual *i*'s mother characteristics (age, weight, height, educational level, and employment status),

$father_i$: individual *i*'s father characteristics (age, educational level, and employment status),

$household\_head_i$: individual *i*'s household head characteristics (age and sex),

$household_i$: individual *i*'s household characteristics (number of members and income class/rank),

$area_i$: residence area of individual *i*,

$governorate\_controls_i$: macro and development indicators of the corresponding governorate,

u_i: an independent and identically distributed (i.i.d.) error term.

Table 1 shows the conditional expectations of $z - score_i$, $E(z - score_i|post_i, governorate_i)$.

Table 5.1: Conditional expectations of $z - score_i$

	$governorate_i = 0$	$governorate_i = 1$
$post_i = 0$	$\beta_1 + \beta_2 X_i$	$\beta_1 + \beta_2 X_i + \beta_4$
$post_i = 1$	$\beta_1 + \beta_2 X_i + \beta_3$	$\beta_1 + \beta_2 X_i + \beta_3 + \beta_4 + \beta_5$

The difference over time in HAZ scores for individuals residing in governorates which experience internal conflict is the following:

$$E(z - score_i|post_i = 1, governorate_i = 1) - E(z - score_i|post_i = 0, governorate_i = 1) = \beta_3 + \beta_5. \quad (2)$$

Similarly, the difference over time in HAZ scores for children living in governorates which do not go through armed conflict or experience at low intensity level is given by:

$$E(z-score_i|post_i=1, governorate_i=0)-E(z-score_i|post_i=0, governorate_i=0)=\beta_3. \quad (3)$$

These two differences include any time trend that exists within each group. Subtracting equation (3) from equation (2) eliminates the time trend insofar that it is common to treatment and control:

$$\{E(z-score_i|post_i=1, governorate_i=1)-E(z-score_i|post_i=0, governorate_i=1)\}-\{E(z-score_i|post_i=1, governorate_i=0)-E(z-score_i|post_i=0, governorate_i=0)\}=\beta_5. \quad (4)$$

So, β_5 is the difference-in-differences estimator. It captures the effect of conflict on child malnutrition because it takes away the time trend affecting the two types of governorates (i.e. affected by conflict or not) and any time-invariant differences between them.

The same regression can be reapplied twice for the 2 groups of children, young and old. The comparison between the estimates of these two regressions allows us to evaluate the impact of conflict on the nutritional indicators of children exposed to and born before the civil conflict and the same impact among exposed children while in utero and therefore born during the violent period of the conflict. Based on the findings of Camacho (2008) as stated in the literature review chapter, this division of age cohorts allows us to study the impact of the prenatal stress due to the conflict on future nutritional status outcomes.

D. Parallel Trends Assumption

The main assumption of the difference-in-differences technique is that, in the absence of conflict, pre- and post-conflict-born children would have had, on average, analogous changes in outcomes, i.e. malnutrition status, in areas affected by conflict and other regions. Moreover, the parallel trends assumption states that macro- and development variables in both types of governorates – with low level and high level of conflict – would have followed a similar trend between 2006 and 2013 in case no conflict had taken place. In other words, it necessitates that the trend in the malnutrition scores and macro-development indicators for both treatment and control governorates in the pre-conflict period to be similar.

A method to test the reliability of the parallel trends assumption is to check whether malnutrition and macro-development indicators in both control and treatment groups are not statistically different from each other in the pre-conflict period at the governorate level. The fact that the two types of regions are statistically similar in terms of nutritional and macro-development indicators gives some credibility to the parallel trends assumption. In other words, since governorates with high or low level of conflict intensity have similar malnutrition and macro-development indicators in the pre-conflict period, the probability that they would be affected differently by the conflict is reduced.

A t-test for the equality of means is applied in order to compare the means of the control and treatment groups for each indicator in the pre-treatment period. The null hypothesis of the t-test is that the difference between the two groups' means is null, i.e. the indicator that is being tested is the same for both areas before the conflict. If the p-value of the t-statistic is greater than 10%, then the null hypothesis cannot be rejected. The t-tests' results for all the malnutrition and macro-development indicators at the

governorate level are reported in the appendix. The results suggest that height-for-age, weight-for-height, and weight-for-age z-scores are the same in both types of governorates in the pre-conflict period. However, 5 out of 54 macro-development indicators are statistically different in control and treatment groups in 2006: percentage enrollment of male and female population (5 years and above) in fundamental schooling, unemployment rate, percentage of governorates as crops area, and percentage of dwellings without any sewage facilities such as public network or closed/open pit. A method in order to take into account these differences between the two groups is to include the 5 macro-development indicators in the main regression as controls.

E. Econometric Issues

The econometric methodology applied in this paper may suffer from certain drawbacks. The major limitations of the difference-in-differences approach explained in the previous sections of this chapter are the following:

- The difference-in-differences technique assumes that conflict is a quasi-natural experiment, i.e. the intervention is quasi-randomly assigned to governorates. However, there is no indicator to verify the random assignment of the conflict to the regions.
- The differences between control and treatment governorates in the pre-intervention period could affect child health. This shortcoming is partially solved by the parallel trends assumption which studies and tests the statistical significance of the differences in macro-development indicators between the control and treatment governorates in the period preceding the violent conflict. Then, these variables are included as controls in the regressions.

- A cross-sectional approach at the child level is applied instead of a panel data methodology at a level of smaller geographical units than governorates. The latter could have been implemented if surveys had had panel data structure and if conflict data had been available at a fine level of aggregation. The difference-in-differences technique with panel data could have allowed to observe the same individuals before and after the conflict and identify the impact of conflict on malnutrition status of children living in the treatment governorates, based on a pre- versus post-conflict comparison with the control governorates.
- Although geographic, macro-development, demographic, and socio-economic indicators are included in the regression, endogeneity bias may still be a problem in the model in case a variable that is correlated to one of the explanatory variables and that affects the malnutrition status of children is omitted.

The main serious challenge of the difference-in-differences methodology remains to justify the aptness and pertinence of the selected control group. The quality of the control group depends on the degree of similarity between the governorates that experience conflict and the ones that do not in the pre-intervention period. An important statistic that may differ between the two types of governorates and may be a cause of conflict is poverty. Table 8.1 in the appendix shows that 3 measures of poverty – headcount index (P_0), poverty gap index (P_1), and poverty severity index (P_2) – are not statistically different between control and treatment governorates before conflict.

However, governorates are diverse in terms of religious, sectarian, and tribal compositions. The predominant religion in the northern areas of the country is Zaydi Shiism, whereas it is Sunnism in the central and southern regions. So, different groups rule different areas of the country. Northern Yemen is mostly controlled by Al Houthis,

and various separatist tribes are in charge of southern regions. Moreover, Al Qaeda in the Arabian Peninsula (AQAP) has emerged recently and has been trying to rule several regions in Yemen.

There are northern, central, and southern governorates in control and treatment groups. This means that both groups may be similar in terms of some macro-development indicators before conflict, but they are not with regard to sectarian and tribal diversities.

Because of the tribal system, conflicts in Yemen are local by nature. Barak Salmoni (2010), an expert in civil conflicts, argues that it is hard to gain "a unitary narrative" about an event related to conflict in Yemen because multiple local sources sometimes report contradicting and biased information. However, all the sources "highlight the complexity, localized nature […] of the conflict itself." Moreover, the United Nations agencies – such as the United Nations Development Programme (UNDP)[14], the United Nations Children's Fund (UNICEF)[15], and the Office for the Coordination of Humanitarian Affairs (OCHA)[16] – have described conflicts in Yemen as multiple localized conflicts: the occurrence of conflicts has intensified but remained localized. Yemenis fear these localized conflicts given the tribal and social differences among communities.

The applied methodology assumes that the Yemeni civil conflict is local, i.e. it does not cross the governorate borders. Spillover effects of the armed conflict across governorate lines are not taken into consideration. However, even if conflicts do not

[14] UNDP, Living in Yemen: Voices of Resilience, October 2015
[15] UNICEF, Children's education, nutrition fall victim to ongoing crisis in Yemen, February 2015
UNICEF, In Yemen, eager to learn, despite the fighting, September 2015
[16] OCHA, Humanitarian Needs Overview 2015, December 2014
OCHA, Humanitarian Response Plan 2014-15, February 2015
OCHA, Yemen: Escalating Conflict – Flash Update 12, April 2015

spread across governorates, their effects may do so. In fact, people start fleeing conflict regions because of the violent conflict and moving to more peaceful regions. Table 5.2 shows the latest figures of internally displaced persons (IDP) in the North and South for the year 2013 reported by OCHA in the Humanitarian Needs Overview of Yemen.[17] The IDPs of the northern governorates are mainly displaced from Sa'adah where the conflict intensity is very high in 2013. So, citizens of Sa'adah are displaced within the governorate itself and to other neighboring ones, mostly to Hajjah where no battle deaths are recorded in 2013. In Southern Yemen, the origin of the majority of IDPs is Abyan. During the same year, about 90% of the southern IDPs have returned to their places of origin as opposed to the 19% of the Northern IDPs due to conflict and insecurity.

Table 5.2: IDPs by Governorates of Destination, 2013

North Governorates	IDPs	South Governorates	IDPs
Sana'a	38,640	Aden	990
Amran	39,780	Laheg	2,291
Hajjah	64,985	Shabwah	444
Al-Jawf	24,700	Hadramout	1,330
Sa'adah	103,014	Al-Baida	301
Other	30,398	Al-Maharah	91
Subtotal	301,517		5,447
Total			306,964

[17] OCHA, Humanitarian Needs Overview 2014, October 2013

Therefore, the governorates observed in 2013 are not exactly the same as the ones observed in 2006. The difference-in-differences method applied in this paper does not distinguish between the direct effect of conflict on child nutrition and such spillover effects of conflict. This means that the technique measures the “reduced form” impact of conflict on the malnutrition status of children less than 5 years of age in the treatment governorates including any positive or negative spillover effects of conflict that in turn affect child nutrition.

CHAPTER VI

EMPIRICAL RESULTS

The chapter discusses and analyzes the results of the regressions at the child level and studies the impact of the conflict on child malnutrition status.

Two sets of regressions are run, each set with a different dependent variable. The dependent variable of the first set is the child's height-for-age z-score, whereas the dependent variable of the second set is the dummy variable "stunted" indicating whether the child is stunted or not. As mentioned in chapter IV, a child is stunted if his/her height-for-age z-score is less than or equal to -2. There are 3 age groups in each set of regressions. First group of regressions is run for all the children, i.e. from 0 to 59 months of age. The regressions of the second group are only for the young cohort (0-33 months of age, as explained in chapter V) and those of the third group for the older cohort (34-59 months of age). Two different regressions are run in each group. All of the regressions include the following:

- characteristics of the child: age, age squared, gender, birth order, and ever-breastfed indicator;
- characteristics of the mother: age, age squared, weight, height, education and employment status;
- characteristics of the father: age, age squared, education and employment status,
- characteristics of the household's head: age, age squared, and gender;

- characteristics of the household: number of members, number of kids under 5-year-old, wealth, having improved water and sanitation facilities, and having overcrowd sleeping rooms;
- characteristics of the area: rural or urban.

Given that the parallel trends assumption is not and cannot be completely tested and verified, the first regression includes the macro and development variables which are statistically different in control and treatment groups in 2006 as explained in the fourth section of chapter V:

- percentage enrollment of male and female population (5 years and above) in fundamental schooling,
- unemployment rate,
- percentage of governorates as crops area, and
- percentage of dwellings with particular sewage facilities such as public network or closed/open pit, and percentage of dwellings without facilities or unspecified ones.

Additional controls at the governorate level may be added in the model in order to account for some of the variation in the response that may not be explained by other covariates at the individual level. These controls may not be related to the treatment, i.e. conflict, but including them helps to identify the treatment effect. The second regression adds further governorate controls:

- population density,
- health outcome: percentage of population with main reported diseases (diarrhea, whooping cough, diphtheria, measles, hepatitis ABC), and
- percentage total enrollment in education.

Table 6.1 shows the results of the regressions for which the dependent variable is the height-for-age z-score. The first two regressions applied on all children have very similar results. First, there is a deterioration of z-scores between 2006 and 2013 given that the coefficient of the period (referred as “post” in the regression and in the table) is negative: height-for-age z-scores decrease by more than 0.37 standard deviations from 2006 to 2013, but this result is not statistically significant. The z-scores do not statistically differ in the control and treatment governorates because the “governorate” dummy’s coefficient is not statistically significant. The difference-in-differences interaction term is negative: violent conflict in treatment governorates worsens the health status of children less than 5 years of age and reduces their HAZ by 0.02 and 0.01 standard deviations as shown in regressions (1) and (2). The estimates remain statistically insignificant in both cases. This is why we cannot conclude that the conflict significantly deteriorates the malnutrition status of children.

The results are very similar when this regression is applied on the young cohort of children: HAZ decrease after the initiation of the violent conflict period; treatment areas score better on these score than control governorates do, but the difference is still not significant; and the interaction term, as shown in table 6.1, becomes more negative in regressions (3) and (4) but remains statistically insignificant: the height-for-age z-score of children in governorates experiencing violent conflict between 2009 and 2013 are lower by around 0.06 and 0.07 standard deviations compared to children of control groups.

Older cohort children in treatment governorates have lower HAZ than those of control areas because the coefficients of the “governorate” term in both regressions (5) and (6) are negative, -0.37 and -0.35 respectively. However, we find no significant

effect of conflict on the height-for-age z-scores of children between 34 and 59 months of age. In fact, regressions (5) and (6) show that the difference-in-differences interaction term is positive but statistically insignificant.

The negative sign of the interaction term for the young cohort versus its positive sign for the old cohort can be due the fact that young children have been suffering the stress of the war from their pre-natal life while in utero and even after being born. Whereas the old cohort children experienced conflict when only after they were born.

Table 6.1: Height-for-age z-score

	(1) z-score	(2) z-score	(3) z-score	(4) z-score	(5) z-score	(6) z-score
Post	-0.37	-0.40	-0.41	-0.41	-0.86	-0.89
	(0.71)	(0.72)	(0.92)	(0.94)	(1.12)	(1.14)
Governorate	0.15	0.13	0.30	0.29	-0.37	-0.35
	(0.32)	(0.32)	(0.41)	(0.42)	(0.52)	(0.52)
post*governorate	-0.02	-0.01	-0.06	-0.07	0.38	0.36
	(0.32)	(0.32)	(0.41)	(0.41)	(0.52)	(0.52)
controls 1	Yes	Yes	Yes	Yes	Yes	Yes
controls 2	No	Yes	No	Yes	No	Yes
age (months)	0-59	0-59	0-33	0-33	34-59	34-59
Cohort	All	all	young	Young	old	Old
Observations	13,052	13,052	7,752	7,752	5,300	5,300
R-squared	0.22	0.22	0.21	0.21	0.16	0.16

***, **, and * refer to 1%, 5%, and 10% significance levels, respectively. Standard errors are reported in parentheses.
Controls 1 include: child, mother, father, household head, household, and area characteristics, and fundamental_schooling_male, fundamental_schooling_female, unemployment_rate, crops_area, sewage_public_network, sewage_closed_pit, sewage_open_pit, sewage_without_facilities, sewage_unspecified_facilities.
Controls 2 include: controls group 1, density, reported_diseases, and total_enrollment.

For the second set and for the regressions applied on all of the children or on the young group, children are less stunted in 2013 than in 2006. Children under 33 months of age are more stunted in control areas than treatment ones. However, all these differences are not significant: the negative coefficients of the “post” term and the negative coefficients of the “governorate” term are not statistically significant as shown in regressions (1), (2), (3), and (4) in table 6.2. The difference-in-differences positive interaction term of the young cohort children suggests that conflict increases the likelihood of being stunted by about 3% in governorates suffering the violent civil war. However, these estimates are also not statistically significant.

However, the results change for the old group of children. First, children are more stunted in 2013 compared to 2006 by about more than 25%: the last 2 regressions in table 6.2 show that the coefficient of the “post” dummy is positive. The sign of the “governorate” coefficient is positive in regressions (5) and (6), suggesting that children in governorates experiencing conflict between 2009 and 2013 are more stunted compared to the ones in control provinces, however the coefficients are not statistically significant. The difference-in-differences interaction term is negative and statistically significant at 10% level of significance in regression (5), i.e. conflict does not have any negative impact on the nutritional status of children between 34 and 59 months of age, and the probability of being stunted decreases by31%. However, the coefficient loses significance when additional controls are added to the regression.

While comparing the interaction terms of young cohort and old cohort children, it is remarkable that kids between 0 and 33 months of age are more subjected to the negative impact of conflict in terms of stunting than older children. In fact, the

difference-in-differences term is positive, i.e. more stunted, in all of the regressions of the young cohort and negative in those of the old group.

Table 6.2: Stunted

	(1) stunted	(2) stunted	(3) stunted	(4) stunted	(5) stunted	(6) stunted
Post	-0.12	-0.18	-0.24	-0.32	0.32	0.26
	(0.21)	(0.22)	(0.25)	(0.26)	(0.39)	(0.40)
Governorate	0.02	0.04	-0.06	-0.04	0.28	0.27
	(0.10)	(0.10)	(0.11)	(0.12)	(0.18)	(0.18)
post*governorate	-0.05	-0.05	0.03	0.03	-0.304*	-0.28
	(0.10)	(0.10)	(0.11)	(0.11)	(0.18)	(0.18)
controls 1	Yes	Yes	Yes	Yes	Yes	Yes
controls 2	No	Yes	No	Yes	No	Yes
age (months)	0-59	0-59	0-33	0-33	34-59	34-59
Cohort	All	all	Young	young	Old	old
Observations	13,052	13,052	7,752	7,752	5,300	5,300
R-squared	0.17	0.17	0.16	0.16	0.14	0.14

***, **, and * refer to 1%, 5%, and 10% significance levels, respectively. Standard errors are reported in parentheses.
Controls 1 include: child, mother, father, household head, household, and area characteristics, and fundamental_schooling_male, fundamental_schooling_female, unemployment_rate, crops_area, sewage_public_network, sewage_closed_pit, sewage_open_pit, sewage_without_facilities, sewage_unspecified_facilities.
Controls 2 include: controls group 1, density, reported_diseases, and total_enrollment.

The regressions show that the malnutrition status of children, measured by height-for-age z-scores, of both cohorts is worse after the start of the violent armed conflict in 2009 compared to 2006. Children between 34 and 59 months of age in treatment governorates have lower height-for-age z-scores and subsequently are more stunted than those in control provinces. The results show that conflict has negative

impacts on children experiencing conflict from their prenatal life: their HAZ are lower by 0.06-0.07 standard deviations and their probability of being stunted is higher by 3% than those of young cohort children in control governorates. However, the negative impact of conflict on child malnutrition remains statistically insignificant.

As mentioned and explained in the previous chapter, the difference-in-differences methodology measures the impact of conflict including any spillover effects.

CHAPTER VII

CONCLUSION

The thesis tries to understand how the conflict in Yemen up to 2013 contributed to the deterioration of the situation in the country, in particular the malnutrition status for children less than five years old. It measures the Yemeni armed conflict's impact on children's nutritional status from birth to 59 months of age.

The thesis measures the impact of conflict on one specific type of malnutrition – stunting or chronic malnutrition – by calculating height-for-age z-scores (HAZ). Two surveys are used in order to measure the anthropometric indicators for children less than five years old: the Household Budget Survey (HBS) conducted by the Central Statistics Office (CSO) in Yemen in 2006 and the most recent wave of the Demographic and Health Survey (DHS) for Yemen 2013. The difference-in-differences technique is applied as an econometric methodology. It compares children's HAZ scores before (2006) and during the conflict (2013) between two types of governorates: a group of governorates, the control group, which do not experience conflict during the whole period, and another group of governorates, the treatment group, which does experience severe conflict at a certain point between 2009 and 2013. However, the methodology may suffer from 2 main limitations. First, the two types of governorates are not exactly similar: they differ in terms of some macro-development indicators and in terms of tribal and sectarian compositions. Second, the governorates in the pre-conflict period may not be totally the same ones in 2013. The difference-in-differences technique assumes that conflict does not spread across governorate lines and does not distinguish between the direct effect of conflict and any positive or negative spillover effects of

conflict, such as the movement of people across governorates in response to conflict. Therefore, the difference-in-differences estimator may under or overestimate the direct impact of conflict on HAZ scores of children.

The empirical findings show that the malnutrition status of children has deteriorated after the start of the armed conflict in Yemen compared to 2006. Conflict has had negative but statistically insignificant impacts on the young cohort of children. Those between 0 and 33 months of age experiencing conflict while in utero are more stunted by 2% and have lower height-for-age z-scores by 0.06-0.09 standard deviations than young cohort children in control governorates. These results measured by the difference-in-differences estimator are the additional impact of conflict on the malnutrition status of children less than 59 months of age without evaluating any positive or negative spillover effects.

APPENDIX

Table 8.1: T-tests applied for the pre-treatment period (HBS 2006)

Variables	Control governorate	Treatment governorate	Difference	t-stat	p-value
_zlen	-2.25	-2.01	-0.24	-0.83	0.42
_zwfl	-0.34	-0.24	-0.10	-0.43	0.67
_zwei	-1.65	-1.41	-0.24	-1.27	0.22
Stunted	0.59	0.51	0.08	0.98	0.34
severely_stunted	0.38	0.29	0.08	1.27	0.22
Agemons	28.79	28.68	0.12	0.24	0.81
Sex	0.49	0.49	0.00	-0.22	0.83
birth_order	1.72	1.65	0.08	1.88	0.07
ever_breastfed	0.81	0.84	-0.03	-0.54	0.59
mother_age	29.56	29.87	-0.31	-0.89	0.39
mother_weight	53.41	57.05	-3.64	-1.66	0.11
mother_height	153.55	154.99	-1.44	-1.36	0.19
mother_employed	0.01	0.03	-0.02	-2.04	0.06
father_age	35.28	35.74	-0.45	-1.05	0.31
father_employed	0.49	0.60	-0.11	-1.86	0.08
head_sex	0.01	0.03	-0.02	-1.18	0.25
head_age	44.18	43.29	0.89	0.77	0.45
hh_size	9.70	10.13	-0.43	-0.73	0.48
kids_under5	2.34	2.31	0.03	0.30	0.76
Wealth	3.15	2.93	0.23	1.16	0.26
improved_water	0.47	0.55	-0.08	-0.73	0.47
improved_sanitation	0.63	0.75	-0.12	-1.70	0.11
Overcrowd	0.22	0.19	0.02	0.47	0.64
urban_rural	0.61	0.38	0.23	2.46	0.02
Population	945,539.20	1,020,126.00	-74,586.43	-0.22	0.83
Density	142.98	504.89	-361.91	-0.72	0.48
Altitude	1,522.38	1,303.20	219.17	0.61	0.55
poverty_p0	31.90	38.42	-6.52	-0.97	0.35
poverty_p1	7.53	10.70	-3.17	-1.35	0.19
poverty_p2	2.55	4.30	-1.75	-1.56	0.13
no_education_male	35.39	32.86	2.53	0.47	0.65
no_education_female	60.53	60.67	-0.14	-0.02	0.98
fundamental_schooling_male	35.43	28.82	6.61	4.11	0.00
fundamental_schooling_female	24.29	18.34	5.96	1.87	0.08
secondary_schooling_male	19.58	24.27	-4.68	-1.23	0.23
secondary_schooling_female	11.16	14.48	-3.33	-1.07	0.30

higher_schooling_male	8.39	13.03	-4.64	-1.60	0.13
higher_schooling_female	2.66	5.20	-2.54	-1.07	0.30
total_enrollment	20.86	21.45	-0.59	-0.30	0.77
unemployment_rate	12.48	19.70	-7.23	-2.30	0.03
participation_rate	46.45	43.36	3.09	1.50	0.15
employees_private_mixed_public	4.58	6.18	-1.60	-1.04	0.31
reported_diseases	0.79	1.11	-0.32	-0.84	0.41
hospitals	1.58	2.12	-0.54	-0.95	0.35
hospital_beds	78.40	102.07	-23.66	-0.52	0.61
social_welfare_beneficiaries	5.61	4.91	0.70	0.72	0.48
social_welfare_subsidies	6.50E+08	7.65E+08	-1.15E+08	-0.51	0.62
agricultural_holders	6.97	5.24	1.73	1.59	0.13
cultivable_area	4.56	2.52	2.04	1.66	0.11
crops_area	4.90	2.25	2.65	2.38	0.03
sewage_public_network	4.65	16.83	-12.17	-1.40	0.18
sewage_closed_pit	23.95	26.09	-2.14	-0.43	0.67
sewage_open_pit	17.30	16.44	0.86	0.20	0.84
sewage_without_facilities	49.82	36.56	13.26	1.72	0.10
sewage_unspecified_facilities	4.27	4.08	0.19	0.25	0.80
water_public_network	14.40	25.85	-11.45	-1.15	0.27
water_private_network	5.10	8.79	-3.69	-1.14	0.27
water_cooperative_network	5.79	4.38	1.41	0.76	0.45
water_tanker	9.49	13.14	-3.65	-0.86	0.40
water_container	58.76	42.13	16.63	1.60	0.13
water_other	2.15	1.72	0.43	0.50	0.63
water_unspecified	4.31	4.00	0.31	0.43	0.67
lighting_public_network	29.98	43.68	-13.71	-1.32	0.20
lighting_private_network	2.46	4.07	-1.61	-1.50	0.15
lighting_cooperative_network	2.48	2.48	0.00	0.00	1.00
lighting_private_generator	2.59	3.10	-0.51	-0.52	0.61
lighting_kerosene	43.03	30.85	12.17	1.26	0.22
lighting_gas	12.57	8.80	3.77	0.95	0.35
lighting_other	2.45	2.83	-0.38	-0.33	0.75
lighting_unspecified	4.45	4.18	0.27	0.37	0.71
communication_call_centers	28.80	58.56	-29.77	-1.08	0.29
communication_internet_cafes	1.28	4.02	-2.75	-1.14	0.27
building_permits	231.40	434.92	-203.52	-0.85	0.41
building_area	64,150.08	132,363.80	-68,213.75	-0.84	0.41
building_cost	2.47E+09	4.50E+09	-2.03E+09	-0.61	0.55
tourism_hotels	36.00	65.29	-29.29	-0.99	0.33
tourism_rooms	405.00	1,380.57	-975.57	-1.29	0.21
Crimes	1,015.29	1,994.07	-978.79	-0.95	0.36
investment_project	16.86	17.36	-0.50	-0.04	0.97
investment_cost	5.27E+09	1.83E+10	-1.30E+10		

investment_created_jobs	523.14	583.86	-60.71	-0.16	0.88
future_investment_project	10.14	8.14	2.00	0.32	0.75
future_investment_cost	2.17E+09	8.11E+09	-5.94E+09	-0.71	0.48
future_investment_workers	383.29	319.93	63.36	0.24	0.82

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