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Essays on Education and Family Planning

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Résumé

Le capital humain d'un pays est un facteur important de sa croissance et de son développement à long terme. Selon l'Unicef, ce capital humain est constitué en donnant à chaque enfant un bon départ dans la vie : non seulement la possibilité de survivre, mais aussi les conditions nécessaires pour se développer et réaliser tout son potentiel. Malheureusement, cet état de fait est loin d'être une réalité en Afrique Subsaharienne. En effet, selon toujours l'Unicef et sur la base d'enquêtes ménages dans 21 pays d'Afrique de l'Ouest et du Centre, c'est près de 32 millions d'enfants qui ont l'âge officiel d'être scolarisés, mais qui ne le sont pas. A ces chiffres, il faut ajouter 17 millions d'enfants scolarisés qui risquent fortement l'exclusion. De son Côté, l'OMS pointe du doigt la mauvaise santé des enfants dans cette région. Ainsi, les décès d'enfants sont de plus en plus concentrés en Afrique subsaharienne où les enfants ont plus de 15 fois plus de risques de mourir avant l'âge de cinq ans que les enfants des régions développées.

Les difficultés économiques apparaissent comme la première explication des obstacles à l'amélioration du bien être des enfants aussi bien du côté de l'offre que de la demande. Cette thèse relie trois essais sur d'une part le lien entre conflit armés, l'éducation et la mortalité des enfants et d'autre part sur le lien entre fertilité et éducation des enfants en milieu urbain.

Le premier chapitre identifie l'impact de la crise politico-militaire de la Côte d'Ivoire sur le bien être des enfants, en particulier sur l'éducation et la mortalité infanto-juvénile en exploitant la variation temporelle et géographique de la crise. Il ressort de cette analyse que les individus qui vivaient dans les régions de conflit et qui ont atteint durant la crise, l'âge officiel d'entrer à l'école ont 10% moins de chance d'être inscrits à l'école. Les élèves qui habitaient dans des régions de conflit pendant la crise ont subit une diminution du nombre d'années scolaire d'au moins une année. Les élèves les plus

âgés et qui sont susceptibles d'être au secondaire ont connu une décroissance du nombre d'année scolaire d'au moins deux années. Il ressort également que la crise ivoirienne a accru la mortalité infanto-juvénile d'au moins 3%. Mes résultats suggèrent également que la détérioration des conditions de vie et la limitation de l'utilisation des services de santé au cours du conflit contribuent à expliquer ces effets négatifs. Des tests de robustesse incluant un test de placebo suggèrent que les résultats ne sont pas dus à des différences préexistantes entre les régions affectées par le conflit et celles non affectées.

Le deuxième chapitre étudie les disparités intra-urbaines en matière d'arbitrage entre le nombre d'enfant et la scolarisation des enfants en se focalisant sur le cas de Ouagadougou (Capitale du Burkina Faso). Dans cette ville, au moins 33% des deux millions d'habitants vivent dans des zones informelles (appelées localement des zones non-loties). Cette sous-population manque d'infrastructures socioéconomiques de base et a un niveau d'éducation très bas. Dans ce chapitre, prenant en compte la possible endogénéité du nombre d'enfants et en utilisant une approche "two-step control function" avec des modèles Probit, nous investiguons les différences de comportement des ménages en matière de scolarisation entre zones formelles et zones informelles. Nous nous focalisons en particulier sur l'arbitrage entre la "quantité" et la "qualité" des enfants. Compte tenu de l'hétérogénéité des deux types de zones, nous utilisons les probabilités prédites pour les comparer. Nos principales conclusions sont les suivantes. Tout d'abord, nous trouvons un impact négatif de la taille de la famille sur le niveau de scolarisation dans les deux types de zone. Cependant, nous constatons que l'impact est plus aigu dans les zones informelles. Deuxièmement, si nous supposons que le caractère endogène du nombre d'enfants est essentiellement due à la causalité inverse, les résultats suggèrent que dans les zones formelles les parents tiennent compte de la scolarisation des enfants dans la décision de leur nombre d'enfants, mais ce ne est pas le cas dans les zones informelles. Enfin, nous constatons que, pour des familles avec les mêmes caractéristiques observables, la probabilité d'atteindre le niveau post-primaire est plus élevée dans les zones formelles que dans les zones informelles. En terme d'implications politique, selon ces résultats, les efforts pour améliorer la scolarisation des enfants ne doivent pas être dirigées uniquement vers les zones rurales. En plus de réduire les frais de scolarité dans certaines zones urbaines, en particulier les zones informelles, un accent particulier devrait être mis sur la sensibilisation sur les avantages de l'éducation pour le bien-être des enfants et leur famille. Enfin, du point

de vue méthodologique, nos résultats montrent l'importance de tenir compte de l'hétérogénéité non observée entre les sous-populations dans l'explication des phénomènes socio-économiques.

Compte tenu du lien négatif entre la taille de la famille et la scolarisation des enfants d'une part et les différences intra-urbaines de comportement des ménages en matière de scolarisation, le trosième chapitre étudie le rôle des types de méthodes contraceptives dans l'espacement des naissances en milieu urbain. Ainsi, en distinguant les méthodes modernes et traditionnelles et en utilisant l'histoire génétique des femmes, ce chapitre fait ressortir des différences de comportement en matière de contraception entre les femmes des zones formelles et informelles à Ouagadougou (capitale du Burkina Faso). Les résultats montrent que les deux types de méthodes contraceptives augmentent l'écart des naissances et diminuent la probabilité qu'une naissance se produise moins de 24 mois après la précédente. Prendre en compte les caractéristiques non observées mais invariants avec le temps ne modifie pas significativement l'amplitude du coefficient de l'utilisation de la contraception moderne dans les deux types de zone. Toutefois, dans la zone informelle, la prise en compte les effets fixes des femmes augmentent significativement l'effet des méthodes traditionnelles. Les normes sociales, la perception de la planification familiale et le rôle du partenaire de la femme pourraient expliquer ces différences de comportement entre les zones formelles et informelles. Par conséquent, pour améliorer l'utilisation de la contraception et de leur efficacité, il est essentiel de hiérarchiser les actions en fonction du type de sous-population, même dans les zones urbaines.

Mots-clés : Scolarisation, taille de la famille, disparités intra-urbaines, planification familiale, contraception, espacement des naissances, hétérogénéité, conflits, enfants, mortalité infanto-juvénile, Côte d'Ivoire, Burkina Faso.

Abstract

Human capital is an important factor of growth and development. According to UNICEF, human capital consists in giving to each child the opportunity not only to survive, but also the necessary conditions to develop and realize its potential. Based on household surveys in 21 countries in West and Central Africa, UNICEF estimate that nearly 32 millions children who have the official school age are not enrolled in school. Further, 17 millions school children are at high risk of exclusion. Regarding child Health, poor indicators also characterize this region. Indeed, according to WHO, the child death is increasingly concentrated in sub-Saharan Africa where children are over 15 times more chance to die before age five than children in developed regions.

Economic difficulties appear as the first explanation of the obstacles to improving the well being of children both on the supply side and the demand side. This thesis ties together three essays on the link between armed conflict, education and child mortality and also on the relationship between fertility and children's education in urban areas.

The first chapter identifies the link between armed conflict and children outcomes. Using nationally representative household surveys, I exploit temporal and geographical variations of the 1999–2011 Ivorian political instability to identify its causal effect on children's schooling and child mortality. The results show that individuals who lived in conflict areas and who reached the official age to be enrolled in school within the period of the instability have a 10% lower probability of being enrolled in school. Students who spent their school years during the conflict and who lived in an affected area experienced a lag in schooling attainment of more than a year. Older students or those who were likely to be in high school during the conflict underwent a loss in schooling attainment of nearly two years. In addition, results show that the Ivorian armed conflict increased the mortality of children under five by at

least 3%. My results also suggest that the deterioration of living conditions and the limitation of health service use during the conflict contribute to explain these adverse effects. Robustness tests including a placebo tests suggest that the results are not driven by preexisting differences across conflict and non-conflict areas.

The second chapter investigates the intra-urban disparities toward child quantity-quality trade-off by focusing on the case of Ouagadougou (the capital of Burkina Faso). In this city, at least 33% of the 2 million inhabitants live in informal settlements. This subpopulation lacks social infrastructure and has extremely low education attainments. Through a two-step control function approach, we investigate disparities in the Child Quantity Quality trade-off between formal and informal settlements in this city. We focus on differences in families' behavior towards schooling in the two settlement types through children educational attainment. We find evidence of a child quantity and quality tradeoff in both settlements. By adapting long's (2009) group comparisons multiple testing procedures, we find that the trade-off is more acute in informal settlements. Moreover, if we assume that the endogeneity of the number of children is essentially due to the reverse causality, the results suggest some evidence that in the formal settlements parents take into account the children schooling in the decision of their number of children but its not the case in the informal ones. Additional results suggest the existence of settlement-specific unobserved heterogeneity, such as school quality and settlement peer effects. In term of policy recommendations, these results show that efforts to keep children in school should not be directed only toward rural areas. In addition to reducing schooling costs in some urban areas, particularly informal areas, and special emphasis should be put on raising awareness about the benefits of education for children and families$\tilde{O}$ welfare. Finally, from the methodological point of view, our results show the importance of accounting for unobserved heterogeneity among subpopulations in implementing policies, and analyzing the impact of those policies.

Given the negative relationship between family size and children's education, the third chapter explores the role of the types of contraceptive methods in birth spacing in urban areas. By distinguishing women from formal and informal settlements types, it investigate intra-urban disparities in the link between the type of contraceptive method and birth spacing in Ouagadougou

(Capital of Burkina Faso). The results show that both modern and traditional methods increase birth spacing and decrease the probability that a next birth occurs in less than 24 months after the precedent one. Taking into account the unobserved invariant characteristics do not significantly affect the magnitude of the coefficient for modern contraceptive use in both settlement types. However, in the informal settlement type, considering women fixed effect increase significantly the magnitude of the effect of traditional methods. Traditional norms, the perception of family planning and the role of woman partner might contribute to explain this difference of behaviour between the two settlement types. Therefore, to improve contraceptive use and their effectiveness, it is essential to prioritize actions depending to the type of subpopulation even in urban areas.

Keywords : School attainment, family size, intra-urban disparities, family planning, contraception, birth spacing, heterogeneity, control function approach, conflicts, children mortality, Ivory Coast, Burkina Faso.

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Chapter 1

Armed Conflict, Children's Education and Mortality: New Evidence from Ivory Coast.

1.1 Introduction

Africa, the poorest continent in the world, is also the most affected by conflicts and political instabilities. According to the World Bank, among developing countries affected by conflicts, 46% are in Africa [1]. In recent decades, three quarters of African countries have been affected by armed conflicts (Gleditsch et al. 2002). These conflicts often erupt after the seizure of power by civil (Ivory Coast 2000, Central African Republic 2013) or military (Burkina Faso 1966, 1980, 1982, 1983, 1987; Ivory Coast 1999, 2011) factions following disputed elections or coups.

Armed conflicts have dramatic consequences on economic development by destroying private and public infrastructures. The destruction of schools and health infrastructures, along with housing, has a direct effect on schooling and health for exposed populations. Moreover, according to a World Bank report, the economic and social costs of conflict persist for years after the end of the conflict (World Bank 2003).

In peacetime, it is generally accepted that children need special protection because they are considered the most vulnerable sub-population. If this is accepted to be true in peacetime, this should be all the more true during periods of conflict . Armed conflicts affect children's education and health in several ways. First, children are not immune to the killings and mutilations among exposed populations and orphans are more likely to leave school (Evans and Miguel 2007; Kobiané et al. 2005). Second, it is not uncommon to see fighters forcibly recruit children for use as soldiers in conflicts (Honwana 2006; Annan and Blattman 2010). In the same context, girls are often victims of rape and other forms of sexual violence. Under these conditions, even if schools are not officially closed, children may be discouraged from going to school because of personal insecurity. Third, during conflicts, schools and hospitals are often attacked, destroyed, or seized as headquarters by fighters. Children whose schools are destroyed might be forced to interrupt their education. Finally, conflicts have a negative effect on growth (Gupta et al. 2004) and therefore, negatively affect resources of exposed populations. The reduction of families' resources has negative effects on children's schooling and health (Jacoby and Skoufias 1997; Thomas et al. 2004; Thomas 1994). All these events can lead to a marked reduction in the level of schooling, and to an increase in the mortality rate among young children.

1. http://go.worldbank.org/SQ4KUOKGP0 (last accessed April, 2014)

Ivory Coast was recently affected by more than ten years of political instability and absence of peace, beginning with a coup in 1999. This political instability continued until 2011 with civil war, armed militias and rebellions. In this paper, I examine temporal and geographical variations of Ivorian political instability between 1999 to 2011 to identify causal effects on children's outcomes as measured by schooling and mortality. Two school outcomes are used, school enrolment and school attainment. The former is defined as the probability of being enrolled in school for school-age youth, while school attainment is defined by the number of years of schooling for children who have been enrolled in school. Child mortality is defined by the probability that a child dies before reaching the age of five.

Studies on the link between armed conflicts and children's education or health have been conducted at both the macro and the micro levels. Ichino and Winter-Ebmer analyzed the long-run educational cost of World War II. They found that Austrian and German individuals who were 10 years old during the conflict, or were more directly involved in the conflict through their parents, received less education than comparable individuals from Switzerland and Sweden who did not participate directly in the conflict (Ichino and Winter-Ebmer 2004). Using repeated cross-sectional datasets for 43 countries in Africa, Poirier showed that conflict and especially civil war have a strong and negative effect on school attendance and secondary school enrolment (Poirier 2012). Bundervoet using a panel of children during BurundiÕs civil war showed that the effect of the conflict on children education is particularly salient for the older children who were most exposed to violence in their early childhood years (Bundervoet 2012). Oyelere and Wharton by focusing on internally displaced persons during the internal armed conflict in Colombia, found a significant education accumulation gap for children of internally displaced persons compared to non-migrants that extend to approximately half a year at the secondary level (Oyelere and Wharton 2013). More recently Guariso and verpoorten indicate that the conflicts in Rwanda caused on average a 22% drop in schooling attainments, corresponding to about one year less of education, and that the drop was relatively larger for girls (Guariso and verpoorten 2014).

However, in macroeconomic studies, the impact of conflicts might be confused with the effects of other phenomena. Further, these studies can disguise some realities of the impact of conflict. Indeed, according to Akresh and De Walque, while school enrolment trends suggest that the school system recov-

ered quickly after the Rwandan genocide in 1994, a difference-in-difference analysis with micro-data shows that children exposed to the genocide experienced almost a half-year decline in schooling attainment and were 15 percentage points less likely to complete third or fourth grade (Akresh and De Walque 2008). In a more recent study, Shemyakina examined Tajikistan's 1992–1998 armed conflict to show that school-age girls who lived in affected regions were less likely to be enrolled in school and to complete their mandatory schooling than girls of the same age who lived in the regions relatively unaffected by conflict (Shemyakina 2011). The impact of Ivorian conflict on children's education was previously explored by Andrew and Saumik. In their study, they use individuals exposed to Ivorian conflict between 2002 and 2006 by distinguishing the young cohort from the older one within the same survey. Their results indicated that the average number of years of education for a school-going age cohort is .94 of a year lower than an older cohort in war-affected regions (Andrew and Saumik 2012).

The impact of armed conflict on health was addressed by Bundervoet et al. in 2009 in Burundi; Mansour and Rees in 2012 in Palestine; Akresh et al. in 2011 in Rwanda; Akresh et al. in 2012 in Eritrea; Parlow in 2012 in Kashmir; Tranchant et al. in 2014 in India; and Minoiu and Shemyakina in 2014 in Ivory Coast. All these studies use anthropometric measures, particularly child's height-for-age Z-scores or child's weight as health measures. Their results are qualitatively the same. Indeed, these studies arrived at the same conclusion, namely that conflict-exposed children had lower height-for-age Z-scores or lower weight compared to children not exposed to conflict.

Despite the relatively large number of these studies, no study has focused on infant and child mortality. Further, most of the studies on education didn't take into account the probable pre-existence of province-level trends in children's schooling. This study provides several contributions to the literature. First, to the best of my knowledge, this is the first micro-econometric study focused on armed conflict and child mortality. If adult death due to armed conflict is most often directly linked to armed attacks, the deaths of young children, due to their fragility, can also be indirectly driven by the degradation of living conditions during conflicts and thus more difficult to measure. Household micro-data allow the researcher to take into account this indirect effect. Second, previous studies generally use household members' statements to identify individuals affected by the conflict, so their results are highly dependent on the quality of those statements. To avoid this con-

cern, I use information on conflict events drawn from a separate dataset built through several sources (war zones, humanitarian agencies, and research publications). This dataset contains information on the number of conflict events at several administrative levels. Third, unlike previous studies on armed conflicts and children's education, my identification strategy takes into account the probable pre-existence of province-level trends in children's schooling. Not taking into account these probable trends, is to assume that changes between children exposed to the conflict period and those not exposed would have been the same in both conflict and non-conflict areas. This could be a strong assumption in the case of Ivory Coast, because conflict-affected areas are more likely to be urban. FinalIy, in addition to covering the entire period of the political disorder (from 1999 to 2011), the data used in this study allow me to perform a robustness check through a placebo test. Indeed, data from 1994 (four years before disorder), 1998–1999 (just before disorders) and 2011–2012 (just after the end of the conflict) are used. While the two last data are used to estimate the effect of the instability, the first two data allow me to perform a placebo test.

My results show that Ivorian political instability had a strong negative impact on children's education and a positive effect on children's mortality. Indeed, the results show that children who spent at least one of their first five years during the period of instability and lived in affected areas had a 3.5% higher chance of dying before reaching age five. Regarding children's education, children who reached the official age to be enrolled in school within the period of disorders and living in areas affected have a 10 percentage-point lower chance of being enrolled in school. School-age students during the conflict and who lived in affected areas experienced more than a yearÕs drop in average years of schooling. The impact was greater for older students, who experienced almost two years drop of average years of schooling. Regarding mechanisms, my results suggest that the deterioration of living conditions and the limitation of health service use during the conflict contribute to explain these adverse effects.

The remainder of the paper is organized as follows. Section 2 provides a brief historical overview of the 1999–2011 Ivorian political instability. In Section 3, I present the datasets and the empirical estimation strategy. Section 4 presents results and some robustness checks. Section 5 discusses the results while Section 6 concludes.

1.2 History of Conflict in Ivory Coast from 1999 to 2011

A country long considered one of the most stable in West Africa, Ivory Coast experienced political instability between 1999 and 2011marked by coups, civil war and a rebellion. In this study, Ivorian conflict is defined as the political instability that started with the 1999 coup, followed by the rebellion. It take into account all events involving military attacks, civil war, armed militias, and armed groups. Therefore, the Ivorian conflict can be summarized in three phases.

The first phase concerns the period 1999–2001 which was marked by military coups [2]. After the 1993 death of the country's first president, Félix Houphouet-Boigny, Henri Konan Bédié succeeded him as president. Bédié was quickly accused of creating an ethnic division by curbing the political rights of Ivorian people from the north who were assimilated with some immigrants from neighboring countries; and promoting the concept of "ivoirité" or "ivoirity" [3]. The preparations for the 2000 presidential campaign thus took place in an ethnicized context, which caused tensions between people from the north and the south of Ivory Coast. A military mutiny on December 23 1999 became a coup the following day. General Robert Guei, promoted to president, announced the establishment of a national committee of public safety. After the seizure of power by Guei, the concept of Ivorian was further enhanced by the adoption of a new constitution which excluded the possible candidacy of Alassane Ouattara, a northern political leader. This gambit led to heavy fighting throughout the country between Ouattara partisans and those supporting the southerner Laurent Gbagbo. The 2000 presidential election opposed Robert Guei and Laurent Gbagbo. After the election, each candidate declared victory and proclaimed himself president. This led to violence, mainly in Abidjan. The army recognized Laurent Gbagbo as the winner of the election. After organizing legislative and municipal elections without Alassane OuattaraÕs political party, this first step of the crisis ended in 2001 by a forum for national reconciliation designed to end tensions.

The second phase covers 2002–2007 period, which was marked by rebellion in the north (United Nations 2006a; United Nations 2006b) . Despite the

2. http://www.un.org/en/peacekeeping/missions/past/minuci/background.html (last accessed April 2014).

3. "ivoirité" was a concept which distinguishes indigenous people from migrants.

establishment of a Forum for National Reconciliation, questions of nationality and voting rights were not addressed and northerners felt forsaken by the government. In September 2002, a group of soldiers from the largely-Muslim north (mostly populated by Muslims), attempted to seize power in Abidjan. Several rebel attacks took place in Abidjan, but the coup failed and the rebels retreated to the north. The slums of the Ivorian capital, populated mostly by Muslims and immigrants from West Africa, were burned. Several months of fighting followed, and there was violence in several cities including Abidjan in the south, Bouaké in the center and Korhogo in the north of the country. Throughout the conflict period, Ivory Coast was divided in two; the northern part was administered by the rebels with Bouaké as its capital while the southern part remained under the control of the government [4]. Beginning in 2004, an intervention of the international community reduced the attacks from both camps. The country entered a period of neither peace and nor war in which several mediations were undertaken. In 2007, the protagonists signed in Ouagadougou (Burkina Faso) an agreement for the formation of a new government incorporating the main political actors in the country, including the rebels. This agreement also included the participation of all political actors in the next presidential elections. The agreement was intended to bring an end to the war and lead to free and fair elections.

The third phase concerns the 2008–2011 period or presidential election period. It was characterized by the coexistence of the protagonists in the same government with an eye to the 2010 presidential elections. Though country still remained divided in two, until 2010 there was a relatively peaceful climate throughout the country. In December 2010, the presidential election took place and Alassane Ouattara was announced the winner by the electoral commission, but the constitutional council rejected the results and declared Gbagbo the winner. After several failed mediations, the conflict between former rebels and government forces flared up again in the capital and several other cities. The United Nations recognized Alassane Ouattara as the legitimate winner [5]. Faced with the refusal of the former president to recognize his defeat, through a resolution, the United Nations authorized the intervention of international forces. Former President Laurent Gbagbo was arrested in April 2011 and in May 2011 Alassane Ouattara was sworn in

4. http://www.onuci.org/pdf/CONTEXTE.pdf (last accessed April 2014.)

5. http://www.un.org/en/peacekeeping/missions/unoci/background.shtml (last accessed April, 2014).

as the new president of Ivory Coast, marking the official end of the conflict. According to the report of the National Commission of Inquiry, implemented after Ouattara's investiture, the post-election crisis claimed the lives of more than 3,000 citizens (National Commission of Inquiry 2012).

The United States Institute of Peace reported that thousands of stakeholders including students and teachers were barred access to the education system during the conflict and that the education sector itself was seriously damaged (Sany 2010). In 2005, it was estimated that between 800,000 and one million children were not receiving any education [6]. Even university students were not exempt from disruption, as universities were often looted or closed during the conflict (Sany 2010).

It is important to take into account the possible endogeneity of the conflict. If low living conditions or educational inequalities are at the root of the conflict, this causes a reverse causality, which could bias the results. However, for the case of Ivory Coast, this seems not to be the case. The main reason of the conflict seems to be political with the introduction of "Ivoirité", whose initial goal, according to its advocates, was to strengthen national identity. Unfortunately, as this concept gained momentum, it ended up becoming a factor of exclusion from political participation and citizenship for some citizens alleged to be immigrants from neighboring countries. In 2010, Bah in Democracy and Civil War: Citizenship and Peacemaking in Ivory Coast argues that the conflict is largely driven by concrete political and social grievances over citizenship (Bah 2010). Further, the conflict areas appear to have better indicators compared to the non-conflict areas. So, a poor living conditions or adverse educational inequalities did not probably drive the conflict.

1.3 Data and methods

1.3.1 Data

Two types of data are used in this study: household data from the Ivory Coast Demographic and Health Surveys (DHS), and conflict events data from the Armed Conflict Location Events Data (ACLED) [7].

6. http://www.unicef.org/cote_divoire_summary2005.pdf (last accessed April 2014).
7. ACLED data are available on http://www.acleddata.com/

ACLED dataset is used to identify areas affected by conflicts. It is a public collection of political violence data for developing states [8] These data contain information on dates and locations of violence, the event types, the groups involved, fatalities and changes in territorial control. Information is recorded on battles, killings, riots, and recruitment activities of rebels, governments, militias, armed groups, and protesters. The main sources of data are reports from war zones, humanitarian agencies, and research publications. I defined areas affected by Ivorian conflict as those areas for which the ACLED data report at least one conflict event from December 1999 to May 2011. Unlike Minoiu and Shemyakina, who used the same data to investigate the impact of the conflict on children's health, small administrative level at which events occurred rather than the regional level is used. This allows me to focus only on areas affected by events. Figures **??** and **??** show maps maps of Ivory Coast with areas affected by the conflict from December 1999 to May 2011 by small administrative and regional levels, respectively. Darker shades are the most affected areas in term of frequency of conflict events. As Figure 1 demonstrates, many areas in the country were impacted by violence, but the western, central, and to a lesser extent the southern parts of the country were most affected. As the maps make clear, employing the regional level for analysis is misleading because some unaffected areas are counted as affected areas when the administrative level becomes bigger.

The household data come from three surveys: the June-November 1994, September 1998–March 1999, and December 2011–May 2012 Ivory Coast Demographic and Health Surveys. These are cross-sectional surveys with representative data at the national level. The analysis of the impact of conflict is conducted with the 1998Ð1999 and 2011Ð2012 data, while the 1994 data is used for a robustness check. Information on education is collected for each individual aged 6-24 years old, and includes past and current school attendance, current grade if still in school, and the highest grade attained by those no longer in school. Information for children's mortality comes from the birth histories of women 15 to 49 years old. The birth history gives information for all of a womanÕs children, including survival status and date of

8. ACLED is directed by Prof. Clionadh Raleigh and operated by senior research manager Caitriona Dowd, both affiliated with the University of Sussex, while data collection involves several researchers. ACLED was originally hosted by the Peace Research Institute Oslo but now registered as an independent, non-governmental organization in the United States.

death if the child is deceased. Household data were merged with ACLED [9].

1.3.2 Identification and econometric specification

Identification is based on the use of temporal and geographical variations of the Ivorian conflict. For each outcome, It consists of comparing the difference between exposed and unexposed individuals in conflict-affected areas to the difference between exposed and unexposed individuals in unaffected areas. Exposed to the conflict or exposed to the conflict period means that the individual was susceptible to the event in terms of schooling or mortality under five during the conflict period. Thus, exposed individuals come from the post-conflict dataset (2011–2012 survey). Not exposed to the conflict or to the period of the conflict means that the individual was not susceptible to the event in terms of schooling or mortality under five during the period of conflict. These individuals come from the pre-conflict dataset (2008–2009 survey).

1.3.2.1 Empirical strategy

I estimate the following baseline specification with province and birth-cohort fixed effects:

$$Y_{ijt} = \alpha_j + \sigma_t + \beta_1 Conflict_j * Post_t + \epsilon_{ijt}. \quad (1.1)$$

Where Y_{ijt} is children's outcomes, subscripts on the dependent variable denote individual i residing in the area j and born in year t, $Post_t$ is a dummy variable indicating the post-conflict data, $Conflict_j$ is the dummy variable indicating conflict affected areas, α_j is an area fixed effects, σ_t is a cohort of birth fixed effects, and ϵ_{ijt} is a random errors term. When the dependent variable is the number of years of schooling, Y_{ijt} is a discrete variable. However, in the case of school enrolment and children's mortality, Y_{ijt} is a probability that measures the probability of being enrolled in school (for school enrolment) and the probability of death before age five (for children's mortality). For these two outcomes, Equation 1 becomes a Linear Probability Model (LPM). These equations are estimated by OLS with robust standard

9. More information on data availability can be found at http://dhsprogram.com/Who-We-Are/About-Us.cfm (last accessed October 2014).

errors [10].

In Equation 1, the parameter of interest is β_1 which captures the impact on children's outcomes of being exposed to the period of the conflict and residing in an area affected by the conflict. This first specification assumes that changes in children's outcomes between pre-conflict and post-conflict groups in conflict-affected areas would have been the same as changes between pre-conflict and post-conflict groups in non-conflict areas. To account for probable differential time trends in children's outcomes across areas, following Akresh et al. 2012, and Minoiu et al. 2012, an area-specific time trend was added into the previous equations. Further, I integrate individual and family characteristics which could differ between affected and unaffected areas. Therefore, Equation 1 becomes:

$$Y_{ijt} = \alpha_j + \sigma_t + \gamma_{jt} + \beta_2 Conflict_j * Post_t + \beta_3 Conflict_j * Post_t * Female + \lambda X_i + \epsilon_{ijt} \quad (1.2)$$

Where γ_{jt} is an area*year effect that controls for pre-existing trends in children's outcomes and X_i is a vector of individual and family characteristics. In order to capture any possible gender gap in conflict impact the variables of interest ($Conflict_j * Post_t$) has been crossed with a female dummy variable. The identification is based on the common trend assumption meaning that both areas-affected and not affected would have the same trend in the case of non-conflict. This assumption can be assessed with a placebo test. Assume for example that we have two pre-conflict periods. In that case, I could suppose that actually the conflict happened earlier and then measure the outcome after the supposed but before the conflict actually happened. If there is no effect of this artificial conflict one could assume the common trend assumption to be verified. Therefore, because the conflict began in December 1999, the 1994 and 1998–1999 Ivory Coast DHS data are used to perform a placebo test.

10. The Linear Probability Model has two main issues. First, fitted values can be outside the unit interval, although it should predict probabilities. Second, LPM implies that a ceteris paribus unit increase in the same covariate always changes the probability by the same amount. This would be not realistic, particularly with continuous covariates, but less problematic whenever covariates are discrete as in our case. Moreover, since my main purpose is to estimate the average effect of being exposed to the conflict and living in a conflict area on the probability that a child is enrolled in school and the probability that child dies before his fifth birthday, these two issues need not be a serious concern (Wooldridge 2010). Further the results show that of the 17732 fitted probabilities for children's mortality, only 334 are outside the unit interval. According to children's school enrolment 1176 over 19962 predicted probabilities are outside the unit interval. So, I just used OLS with heteroscedasticity robust standard errors for estimation.

1.3.2.2 Definition of the sample for each outcome

I consider three different outcomes. In this section, I define the younger cohort to consider in the post-conflict data for each outcome.
The exposition is referred to the period of the conflict. It identifies individual to be considered in the post-conflict period. The exposition is referred to the period of the conflict. It identifies individual to be considered in the post-conflict period. To define conflict exposure for school enrolment, I considered all individuals likely to be enrolled in school throughout the conflict period. The official age to be enrolled in school is six. According to this definition, a sample of children aged between 6 and 18 years old in 2011 (at the end of the conflict) was used. Children from 6 to 18 years old in 2011 reached the age of six within the conflict period. Therefore, I compared school enrolment for individuals from 6 to 18 years old in 2011 from the 2011–2012 survey to individuals from 6 to 18 years old in 1998 from the 1998–1999 survey. The post-conflict or exposed group is a subset of individuals from 6 to18 years old in 2011 from the 2011–2012 survey. The unexposed group is composed of individuals of the same age in 1998, according to the 1998–1999 survey. For instance, exposed people in unaffected areas are individuals from unaffected areas who reached the official age to be enrolled in school (6 years) within the conflict period. The unexposed people in unaffected areas are individuals from unaffected areas who reached the official age to be enrolled in school outside the conflict period. The identification strategy consists in linking these individuals to the presence of conflict in the areas where they lived.

To analyze the impact of armed conflict on the number of years of schooling for those children enrolled in school, I considered a sample of children who were of school age during the conflict and were enrolled in school. Therefore, from the 2011–2012 survey, individuals from 6 to 24 years old at the beginning of the conflict (1999) and who were enrolled in school are identified as individuals from post-conflict data or exposed to the conflict period. These individuals are thus between 18 and 36 years old in 2011. This age was chosen to take into account all levels of education, including college and university. The subset of individuals from 18 to 36 years old in 1998 (from the 1998–1999 survey) is the unexposed group or pre-conflict group.

Regarding child mortality, the identification strategy consisted of comparing the survival of children at least five years old or who would have been at least five years old if deceased and who lived at least one of their first five years in

the conflict period, to the survival of children at least five years old or who would have been at least five years old if deceased and who did not spend any of their first five years in the period of the conflict. For example, a child who was five years old in 2011 would have been exposed to the conflict period during all five years, whereas children aged 16 in 2011 would have exposed to conflict for only one year of their first five years. So, individuals exposed to the period of the conflict or in the post-conflict group are a subset of children aged 5 to 16 in 2011 (from the 2011–2012 survey) or who would have been between 5 and 16 years in 2011 if deceased. The unexposed or pre-conflict group is, conversely, a subset of children from 5 to 16 years old or who would have been between 5 and 16 years old in 1998 (from the 1998–1999 survey).

1.3.3 Descriptives statistics

Figure 1.3 shows the evolution of the gross enrolment rate in the first grade of primary school from 1996 to 2009. Between 1999 and 2002, enrolment in the first grade decreased by nearly four percentage points for boys and remained almost constant for girls. After a reversal in the trend between 2002 and 2003, the enrolment rate decreased significantly after 2003, particularly for girls, for whom there is a decline of approximately seven percentage points. These declines in enrolment rate have occurred after the beginning of the first and second stages of the conflict, which led to a decrease in the overall primary school enrolment rate during the conflict (Figure 1.5). Using the 2011–2012 survey, I computed children's age at the beginning of the conflict (1999) and plotted the probability to be enroll in school by age at the beginning of the conflict and conflict intensity. Figure 1.4 shows that individuals less than five years old at the beginning of the conflict and lived in conflict affected had less chance to be effectively enrolled in school. Because individual more than six years at the beginning of the conflict are more likely to be already in school at the beginning of the conflict, we see that for these individual the school enrolment rate is greater in conflict areas as shown in the descriptive statistics. This suggests in a descriptive way that the conflict had an impact on school enrolment. Furthermore, Figure 1.6 suggests that the armed conflict had a negative effect on the number of years of schooling for school-age children. It plots by age and intensity of conflict the difference in number of years of schooling between children exposed to conflict and those not exposed. These differences indicate the evolution of the number of years of schooling, because individuals exposed to the conflict come

from the 2011–2012 survey and those not exposed come from the 1998–1999 survey. Figure 1.6 clearly indicates there was an effect in the areas affected by the conflict. The evolution of the number of years of schooling is higher in the areas unaffected by conflict. In affected areas, the number of years of schooling even decreased, mainly for individuals aged approximately 12 to 24 years when the conflict began. This finding suggests that conflict had a greater effect on older school-age individuals.

Table 1.1 shows descriptive statistics by intensity of conflict for each subsample. Conflict areas are defined as areas affected by the conflict. There are statistically significant differences in individuals and families' characteristics between conflict-affected areas and those not affected. Indeed, individuals from affected areas were more likely to be from urban areas and thus likely to be from families with higher standards of living and a head of household with more education. Additional characteristics linked to children's mothers are used for the mortality analysis [11] and also show statistically significant differences between affected and unaffected areas. To perform a robustness check, I included these variables as controls in the regressions for school enrolment and children's mortality. Family characteristics are not included in the specification for the number of years of schooling. The surveys contain only information on the current household in a residence, current conditions might not accurately reflect conditions experienced by individuals during their school years.

Table 1.2 reports average values for each outcome by exposure to the conflict period and residence in conflict-affected areas. In general, for each outcome, as shown in the descriptive statistics, conflict areas had better indicators compared to those not affected by the conflict. Presumably, this reflects the fact that conflict areas are mainly urban areas. However, unaffected areas experienced an improvement. In affected areas, we observed a decrease in the average number of years of schooling and an increase of the proportion of children who die before reaching age five. Furthermore, the overall difference-in-difference suggested that individuals who reached age six during the conflict and lived in conflict-affected areas were 12 percent less likely to be enrolled in school. Those who were aged between 6 and 24 years old at the beginning of the conflict and were enrolled in school experienced an

11. Data for children's mortality come from the birth history module of DHS surveys. This module did not contain information about the childÕs relation to the head of household

average drop of 1.42 years of schooling. Regarding mortality, the descriptive statistics indicated an increase of three percentage points in the probability that a child died before turning five.

1.4 Results

1.4.1 Impact on school enrolment

Table 1.3 presents OLS regression results for school enrolment for both Equations 1 and 2. Each regression controls for child's age fixed effects and area fixed effects. All regressions show that the Ivorian conflict had a significant and negative effect on children's school enrolment. The coefficient of the interaction term between exposure to conflict and residence in conflict-affected areas is negative and statistically significant at the 1% level. Indeed, Column 1, which does not include area-specific trends or child and family characteristics, indicates that children who reached six years old during the conflict period and lived in an affected area had 15 percent lower likelihood of being enrolled in school. The results remain the same area-specific trends are included in Column 2. Controlling for child's characteristics (gender, relation to head, type of residence such as rural or urban) and family characteristics (age of family head, gender, education, and family's standard of living), the coefficient of the interaction term declines from -0.15 to -0.10, which implies a reduction by 10 percent of being enrolled in school for children who reached the official age to be enrolled in school within the period of the to the conflict and living in affected areas. Finally, Column 4 does not show a gender difference in the impact of the conflict. Indeed, the interaction between exposure to the conflict, residence in conflict areas, and the female dummy does not show a significant difference between girls and boys. So, the impact of the conflict is similar for boys and girls. Overall, these results confirm the assumption that conflicts increase non-enrolment in school.

1.4.2 Impact on school attainment

In Ivory Coast, school-age youth are defined as follows: 6-11 years old for primary or basic school, 12-18 years old for high school, and 19-24 years old for college and university level. The impact of the conflict on school attainment is presented in Tables 1.4 and 1.5 for individuals aged 6 to 24

and 12 to 24 years old, respectively, at the beginning of the conflict. Column 1 in Table 1.4 shows the baseline regression results without controlling for area-specific trends. This regression yields a coefficient of -1.14, which is statistically significant at the 1% level, suggesting that students from 6 to 24 years old at the beginning of the conflict who lived in conflict-affected areas experienced more than a one-year drop in average years of schooling. Column 2 in Table 1.4 includes area-specific trends and the type of place of residency. As with school enrolment, results do not show a gender difference Column 3. Table 1.5 presents the results for youth from 12 to 24 years old at the beginning of the conflict. These students, because of their age, had the potential of being directly involved in the conflict. They are also more likely to leave school for the labor market due to deteriorating living conditions during the crisis; for these two reasons, the conflict might affect these school-age students more than all school-age students. As Table 1.5 makes clear, students from 12 to 24 years old at the beginning of the conflict who lived in affected areas experienced a drop in average years of schooling of almost two years. Controlling for area-specific trends, the interaction between exposure to the conflict and residence in the affected areas led to a coefficient of -1.81, which is statistically significant at the level of 1%. Again, this drop affected boys as well as girls.

1.4.3 Impact on child mortality

Studies on the effects of shocks on children's health are documented in both the public health and development economics literatures. Shocks such as famines, recessions, pandemics, and conflicts reduce childhood health and affect work productivity later in life. Strauss and Thomas in 2008; Victora et al. in 2008 and Almond and Currie in 2011 provided more detailed studies on the effects of shocks on children's health. In the specific case of conflicts, children's health is both directly and indirectly affected. In the presence of a conflict, the access to health care services such as vaccinations and other elements of prenatal care, is limited, despite its importance during pregnancy and after childbirth. Furthermore, the deterioration in family families' living conditions makes it difficult to supply nutrients essential for fetal development and early in the life of the child. Another channel through which conflict affects child's health is maternal stress during pregnancy (Camacho 2008), which can reduce the gestation period. These factors make children exposed to conflicts, either in the womb or during infancy and earliest childhood,

more vulnerable than those not exposed; they can result in higher mortality during the first years of life.

In this section, I estimated the impact of the Ivorian armed conflict on child mortality. The regression results are presented in Table 1.6. Child mortality is measured by the probability that a child died before reaching age five. Column 1 indicates that children who spent at least one year in the period of the conflict and lived in a conflict-affected area had a 3.5% higher chance of dying before reaching age five. The estimated coefficient increases to almost 4% and is statistically significant at the 5% level when controlled for area-specific time trends (Column 2). The regression in Column 3 also controls for the child and family characteristics previously used in Table 1.3, but also integrates maternal characteristics such as motherÕs age, education, and total number of children ever born. Controlling for such characteristics leads to a coefficient of 3.3%, which is statistically significant only at the 10% level. Therefore, the Ivorian armed conflict led to an increase of at least 3% of under-five children's mortality. Column 4 suggests that girls and boys were not differently affected by the conflict in term of mortality.

1.4.4 Mechanisms

1.4.4.1 Deterioration in families' living conditions

In addition to the general feeling of insecurity, the mechanism driving lower school enrolment and school attainment during the conflict could be linked to the deterioration in families' living conditions and the higher number of orphans in conflict-affected areas. In Table 1.7, I compared the standard of living of families in affected and non-affected areas between 1998–1999 and 2011–2012. The standard of living index is a combination of a number of socioeconomic resource factors such as housing characteristics and assets owned by the family. In contrast to non-affected areas, families' standard of living decreased in conflict areas. In fact, between 1998 and 2011, the proportion of families with low or very low standard of living increased in conflict-affected areas, while the proportion of families with high or very high standard of living decreased. However, in areas not affected by the conflict, these proportions remained approximately the same. Regressions 1 and 2 in Table 1.8 shows the impact of the conflict on the probability that an individual from six to 18 years old belongs to a family with low standard of living. As the above statistics seemed to show, the conflict had a

negative impact on conditions of living. Indeed, individual from 2011–2012 DHS survey (so, who were exposed to the period of the conflict) and lived in affected areas have 15% more chance to belong to a family with low standard of living compared to individual from the same age but not exposed to the period of the conflict or not lived in a area affected by the conflict. Family economic needs arise in research as a contributing factor to school dropout in general (Rumberger and Lim 2008). The degradation of familial living conditions following the reduction of resources during conflicts negatively affects the demand for schooling. In addition to increasing the inability of households to pay school fees and other costs associated with education, the lack of resources is also associated with a higher opportunity cost of schooling for children. This opportunity cost becomes larger as children age, and increases the pressure for children to work and earn income for family needs.

1.4.4.2 limitation of health service use

The deterioration of family living conditions, mentioned above, could also explain the increase of children's mortality. Maternal depression caused by conflict can decreased pediatric visits (Valluri et al. 2015). To explore other mechanisms that drive higher mortality among children under five years old in conflict-affected areas, I used information on prenatal visits during pregnancies and children's vaccinations, which reduce the risk of pregnancy complications and ensure the infantÕs health and development. Good prenatal care is essential to both maternal and fetal health. A lack of prenatal visits is associated with low birth weight babies, premature births, and babies that do not survive (WHO 2003). As noted, armed conflicts can negatively impact children's vaccination and prenatal care through the limitation of access to health care services and thus increase children's mortality. To determine if such effects occurred during the Ivorian conflict, I compared evolution of prenatal visits and children's vaccination between areas affected by the conflict and those not affected. Table 1.7 shows the evolution of prenatal visits and children's vaccination in both area types. The number of prenatal visits is defined the number of prenatal consultations during the womenÕs most recent pregnancy. From 1998 to 2011, unlike in areas not affected by the conflict, the average number of prenatal visits decreases in affected areas by 0.75. With the slight increase of 0.09 in non-affected areas, this suggests a reduction of the number of prenatal visits by 0.84 during the conflict. The

data also suggest that vaccination of children was is affected by conflict. The proportion of children under five who received their first vaccine (BCG) decreased in conflict areas from 0.87 to 0.80. In areas not affected by the conflict, this proportion increased from 0.71 to 0.74, suggesting an overall decrease of 10% in BCG vaccinations during the conflict. Regressions 3 and 4 in Table 1.8 confirm the decrease in immunization of children under 5 against BCG. Indeed, children under five from 2011–2012 DHS survey (so exposed to the period of the conflict) and lived in conflict-affected area experienced a decline of at least 10% immunization against BCG.

1.4.4.3 Other mechanisms

According to Honwana children are often used as soldiers in conflicts (Honwana 2006). This use of children as soldiers can also drive the negative effect on schooling. Since this phenomenon is typically for boys, the gender difference in the impact of the conflict can be used to check whether this phenomenon occurred in the case of Ivory Coast. Sections 1.4.1 and 1.4.2 did not show a gender difference in the impact of the conflict on school enrolment or school attainment. This suggests that the decreasing of schooling rate did not driven by the use of children as soldiers during the conflict.

Parental Involvement affects childhood behavioral outcomes (Neymotin 2014; Stacer et al. 2013). Comparing the proportion of orphans from the 2011–2012 survey between affected and non-affected areas, we notice that 14% of children 6-16 years old were orphans in conflict-affected areas compared to 12% in unaffected areas [12]. Regression 5 in Table 1.8 shows the correlation between living in conflict-affected and the probability to be orphan for children under 18 years old. This regress confirm a positive correlation between living in conflict-affected area and being orphan. This is another factor which could contribute to a lower school enrolment and school attainment rate in conflict-affected areas.

1.4.5 Robustness check: Migration

The results presented so far could be biased by selective migration and so, not accurately capture the true causal effects of the conflict. For example, due to

12. Results not included here, as the 1998–1999 survey does not contain information on parental survival.

the conflict, if families with healthier children or families wishing to continue the education of their children migrated from conflict to non-conflict areas, my results would overestimate the impact of the conflict. On the other hand, if children from poorer families or from families with a low propensity of children's schooling fled the conflict and moved from conflict to non-conflict areas, my results would underestimate the impact of the conflict. In this section, I examined this probable selection issue and presented evidence that the main results are unlikely to be influenced by migration. To do so, Equation 2 is estimated for school enrolment and school attainment restricted to individuals at least 35 years old in both pre and post conflict datasets. Individuals at least 35 years old in 2011 was likely to have children and thus moved to non conflict areas for better conditions for their children [13]. Table 1.9 compares pre and post conflict difference in the level of education for individual aged at least 35 years in conflict-affected areas to the pre and post conflict difference in unaffected areas. As we can see, Table 1.9 suggests that the difference of the level of adult education between conflict and non-conflict areas has not changed after the conflict. This means that it is unlikely that parent with high or low educational level moved to non-conflict areas during the conflict.

In addition, I compared the religion and ethnic group distribution between conflict and non-conflict areas in 1998 and 2011. As we can see, Table 1.10 shows that the distribution of religion and ethnic group at the beginning and the end of the conflict does not change significantly for conflict and non-conflict areas. This results suggests that migration during the conflict did not significantly affect population distribution.

1.4.6 Robustness check: distinguishing urban and rural areas

The most affected areas are urban areas. So, how can we then distinguish, in the difference in differences approach used, the impact of conflict from a story of developing rural areas catching up to stagnant urban areas? This could be a concern about the potential endogeneity of the conflict. In this section, I attempt to deal with this potential endogeneity of the conflict by distinguishing urban and rural areas. Table 1.11 shows the impact of the conflict on schooling by the type of place of residency. The results are in

13. Results do not change if I consider individuals aged at least 25 or 30 years old.

line with the fact that urban areas are most affected by the conflict. Indeed, for school enrolment and school attainment (for which the number of observations allows to distinguish urban and rural areas) the impact of the conflict is higher in the urban areas. This difference is more sever for school attainment. This fact could be explained by the fact that the effect of the conflict on school enrolment would be temporary. Children may be enrolled in school when conflict events become comparatively rare.

1.4.7 Robustness check: distinguishing more and less affected areas

The intensity of conflict varied widely across the country. Some regions were more affected than others in terms of occurrence of armed attacks. In this section, I estimated the impact of the political instability by distinguishing between more and less affected areas. Following the definition in Figure 1, areas more affected are those with at least five conflict events. They are represented in dark shading in Figure 1, while, the less affected areas are represented in gray shading. Taking into account this heterogeneity, Equation 2 can be rewritten as:

$$Y_{ijt} = \alpha_j + \sigma_t + \gamma_{jt} + \beta_{21}(Conflict_{1j} * Post_t) + \beta_{22}(Conflict_{2j} * Post_t) + \lambda X_i + \epsilon_{ijt} \quad (1.3)$$

Where $Conflict_{1j}$ and $Conflict_{2j}$ are dummy variables indicating whether an individual lived in a more or less affected area respectively. In terms of magnitude, for each outcome, β_{21} is expected to be greater than β_{22} (in absolute values).

Table 1.12 presents estimation results of Equation 3. The difference between more and less affected areas is not significant for children's education. However, in the most affected areas the magnitude of the conflict impact is greater compared to the less affected areas. According to child mortality, the impact of the conflict is mostly driven by children who lived in the more affected areas.

1.4.8 Robustness check: using 2011–2012 survey only

Using 2011–2012 survey only, the exposure to the conflict is defined by the age at the beginning of the conflict (1999). Since the official age to be enrolled in school is six, each child less than seven years old at the beginning of the conflict is exposed to the conflict regarding school enrolment. Children at least seven years old exceeded the official age to be enrolled in school. If

a child were not enrolled in school after seven years, I assumed that the likelihood that this child be enrolled in school after is low [14]. Doing so, the identification strategy in Equation 2 is to compare in both conflict affected and non-affected areas the 2011 school enrolment rate of children less than seven years at the beginning of the conflict to those aged seven years or more. The upper bound is limited to 14 years old. Table 1.13 shows the results of the regression of Equation 2 using this new definition of conflict-exposure. Without controlling by household fixed effect the results suggest a decrease of school enrolment by 10%. Adding household fixed effect to compare sibling before and after the conflict, the coefficient falls to 0.6 but stay significant.

1.4.9 Robustness check: placebo test

Because political instability in Ivory Coast began in December 1999, using the 1994 and 1998–1999 DHS data allows me to perform a placebo test. The data collection process is similar for the three DHS datasets. Therefore, if there are no pre-existing differences in children's outcomes between conflict and non-conflict areas, using Equation 2 with 1994 and 1998–1998 DHS data should not lead to a significant coefficient of β_2. which would then confirm that the results obtained above are driven by the conflict. Following the definition of exposure to the conflict in Section 3, I defined, for each outcome, a placebo exposure to the conflict period. For school enrolment, the subset of individuals from 6 to18 years old in 1998 is considered as those exposed to the conflict period (post-conflict group). These individuals come from the 1998–1999 survey. Individuals of the same age from the 1994 survey are likewise considered the unexposed group (pre-conflict group). For school attainment, from the 1998–1999 survey, individuals from 18 to 36 years old in 1998 and who were enrolled in school are considered individuals exposed to the period of the conflict (post-conflict group). The subset of individuals from 18 to 36 years in 1994 (from the 1994 survey) is the pre-conflict group. Similarly, for children's mortality, the post-conflict group is a subset of children from 5 to 16 years old in 1998, dead or alive (from the 1998–1999 survey), while the pre-conflict group is a subset of children in the same age range from the 1994 survey. To perform the test, I also considered the conflict-affected areas as placebo-conflict areas.

14. I did a sensibility test by changing the threshold from six to seven, six to eight and six to nine and the results did not change.

Table 1.14 presents the test results using these data. As we can see, in all cases, the coefficient of the interaction between exposure to conflict and residence in a conflict area is not significant. The results indicate that individuals who lived in placebo-conflict areas and exposed to the conflict period, according to the placebo-exposure definition, did not experience either lower school enrolment or less school attainment or more mortality. The placebo test suggests that the increase in children's mortality, and the decrease in school enrolment and school attainment, are not driven by preexisting differences across conflict and non-conflict areas.

1.5 Discussion

The empirical strategy is based on the difference-in-difference approach, combining the temporal and geographical variation of the conflict to identify its causal effect on children's schooling and children's mortality. The strength of the difference-in-difference strategy lies in the combination of regional and time-varying exposure to the conflict. The results suggest that the political instability between 1999 and 2011 in Ivory Coast had adverse effects on school enrolment, school attainment, and children's mortality.

The exposure to the conflict for school enrolment takes into account the official age for being enrolled in school. Therefore, all individuals who reached their sixth birthday during the conflict period were exposed to the conflict. According to this definition, the subset of individuals from 6 to 18 years old in 2011 are exposed. Among them, those who lived in conflict areas have a 10% lower likelihood of being enrolled in school. School enrolment is a specific event that takes place in a defined period each year, generally between August and October. The intensity of the conflict was not uniform throughout the conflict, so, if some children were not enrolled in school in a given year due to the occurrence of conflict events, they could be enrolled in succeeding years, if there were a lull in the fighting. The impact of the conflict on school enrolment would be higher in the short term, especially in the period following conflict events. Children may be enrolled in school when conflict events become comparatively rare. Similar results were found by Shemyakina 2011 for TajikistanÕs 1992-1998 armed conflict. Indeed, her results indicate that in 1999, girls from 7 to 15 were about 11 percentage points significantly less likely to be enrolled in school if their householdÕs dwelling was damaged during the war. In absolute terms, this adverse effect

includes many children who need specific treatment. After the conflict, while younger children aged 6 to 8 could be enrolled in school, older children were less likely to still attend formal schooling. Therefore, the development and implementation of specific programs such as vocational and technical training becomes essential for them.

It is generally recognized that education is a powerful driver of development and one of the strongest instruments for reducing poverty and improving health. To consider education as an engine of development, requires a minimum level of education. According to UNESCO, formal secondary schooling is the most effective way to develop the skills needed to improved personal development (UNESCO 2012). To identify the causal effect of Ivorian conflict on school attainment, I consider the exposed group to be the subset of individuals aged 6 to 24 at the beginning of the conflict. This group corresponds to school-age people, including the post-secondary level. The results show that students exposed to the conflict who lived in conflict areas experienced more than a one year drop in average years of schooling. Older students, especially those who were supposed to be at high school at the beginning of the conflict (at least 12 years old in 1999), were the most acutely affected, with almost a two year drop. The regressions results can be viewed as a permanent effect of the conflict on education, because students aged 6 to 24 years in 1999 were 18 to 36 years old in 2011.

The last dependent variable used in my estimation is children's mortality. The results indicate that children who spent at least one year in the period of the conflict have at least a 3% greater chance of dying before reaching age five. Because of younger children's fragility, armed conflict can indirectly affect children's health through the deterioration of family resources. Limiting access to health care services during the conflict directly affects children's health. In the Ivorian conflict, the decrease in children's vaccination rate and the deterioration of families$\tilde{O}$ living condition might have contributed to the increase in children's mortality.

However, some limitations of this study must be noted. First, the data used in this study might suffer from selection bias due to the potential non-coverage of internally-displaced individuals, who were likely most affected by the conflict. Therefore, the results might underestimate the impact of the conflict. Moreover, the data do not include information on individuals who died during the conflict. If these individuals were less likely to be enrolled in school or more likely to leave school early, the results on schooling would

be underestimated. The results on children's mortality might also be underestimated if among individuals who died, there were under five years old. In other words, the results only apply to individuals who stayed in the country after the conflict. The second limitation of this study is considering actual residence as the residence in which events occurred. My estimation strategy assumes that individuals have not migrated since the beginning of the conflict. So, selective migration of individuals affected by the conflict might bias the results. Individuals' current location might differ from the ones where conflict events occurred. If enough households affected by the conflict moved to non-affected areas, then the estimated results underestimate the current impact of the conflict. Unfortunately, data used in this study do not contain information on individuals' migration history. Therefore, the estimates should be considered the lower bound of the true parameters. Finally, data on children's mortality concerns only women from 15 to 49 years old, which could lead to selection bias. However, women over 49 years old and under 15 years old are substantially less likely to have children, so one can assume that this bias is not an important concern.

1.6 Conclusion

This paper investigates the impact of the 1999–2011 Ivorian political instability on children's outcomes defined by schooling and children's mortality. I compare the differences between affected and non-affected individuals in children's schooling and children's mortality for exposed cohorts identified in one nationally representative cross-sectional survey conducted prior to the beginning of the instability (in 1998–1999), with the difference between those affected and non-affected for unexposed cohorts in another nationally representative cross-sectional survey conducted at the end of the conflict (in 2011–2012). The two surveys used the same methodology for data collection. Therefore, the empirical identification strategy uses both pre-conflict and post-conflict data to exploit geographical variation of the conflict.

The results show that Ivorian political instability caused a decrease in schooling and an the increase of children's mortality under five years of age. Individuals who lived in conflict areas and who reached the official age for being enrolled in school within the period of the instability had a 10% lower chance of being enrolled in school. Students exposed to the conflict during their school-age years and who lived in an affected area experienced a decline

in schooling attainment of more than one year (1.14). Older students or those who were likely to be in high school at the outset experienced a decline in schooling attainment of close to two years (1.81). With respect to children's mortality, the results show that Ivorian armed conflict increased under-five children's mortality by 3%.

To confirm that these results can be attributed to the conflict rather than other events occurring between 1999 and 2011, a placebo test using another pre-conflict dataset was performed. These data were collected in 1994 using the same methodology as the other data. To perform the test, I applied the previous empirical strategy to the two pre-conflict datasets by defining placebo-conflict areas and placebo-exposure to the conflict. The test results confirm that the adverse effects of the conflict were not driven by pre-existing differences across conflict and non-conflict areas. The degradation of family living conditions and the limitations on the use of health services during the conflict might explain these adverse effects.

Education is seen as an important component of human capital. By promoting adoption of new modes of behaviour in terms of human reproduction and health life management and improves productivity education is seen as an engine of economic growth. Ivorian armed conflict by affecting children's education and child mortality could hamper the long-term economic development of the country. The reduction in school attainment might have negative welfare consequences by reducing future adult wages and productivity. The development and implementation of specific programs such as vocational and technical training are essential to mitigate this impact. Especially for the older students for whom the likelihood of returning to school are low. Family living condition appears to be a channel associated with the increase of school dropout and child mortality in the case of Ivory Coast. It's therefore essential to promote interventions targeting conflict affected areas to restore economic well-being. This study also confirms the need for special protection of children during conflicts.

However, my research also shows that the socioeconomic costs of political instability are likely to be underestimated because of the unavailability of migration history. Future research could use variation in residency to define exposure to the conflict more fully and accurately and therefore identify conflict impacts better.

1.7 Tables

Table 1.1 – Summary statistics

	School enrolment (6-18 years old)				Children's Mortality (5-16 years old)				Number of years of schooling (18-36 years old)			
Child's variables	OC (1)	IC (2)	Diff. (1) - (2)	N	OC (1)	IC (2)	Diff. (1) - (2)	N	OC (1)	IC (2)	Diff. (1) - (2)	N
Age	10.89	11.27	-0.38***	19962	10.28	10.33	-0.05	17732	27.03	26.84	0.19	11275
Child is a girl	0.49	0.50	-0.01	19962	0.50	0.49	0.01	17732	0.40	0.44	-0.04***	11275
Lives in a rural areas	0.77	0.49	0.28***	19962	0.82	0.59	0.23***	17732	0.66	0.32	0.34***	11275
Child of head	0.58	0.58	0.00	19962	-	-	-	-	-	-	-	-
Head of household												
Head's age	49.25	48.99	0.26	19962	47.53	47.23	0.3	17732	-	-	-	-
Head is a woman	0.10	0.18	-0.08***	19962	0.10	0.15	-0.05***	17732	-	-	-	-
Head's education												
Not educated	0.65	0.57	0.08***	19962	0.67	0.6	0.07***	17732	-	-	-	-
Primary level	0.17	0.18	-0.01	19962	0.21	0.20	0.01	17732	-	-	-	-
Secondary or more	0.18	0.25	-0.07***	19962	0.12	0.19	-0.07***	17732	-	-	-	-
Family's standard of living												
Very low	0.22	0.16	0.06***	19962	0.25	0.21	0.04***	17732	-	-	-	-
Low	0.27	0.17	0.10***	19962	0.26	0.19	0.07***	17732	-	-	-	-
Middle	0.26	0.19	0.07***	19962	0.28	0.21	0.07***	17732	-	-	-	-
High	0.15	0.23	-0.08***	19962	0.13	0.22	-0.09***	17732	-	-	-	-
Very high	0.10	0.25	-0.15***	19962	0.07	0.17	-0.10***	17732	-	-	-	-
Child's mother												
Age	-	-	-	-	34.85	35.23	-0.38***	17732	-	-	-	-
Total children ever born	-	-	-	-	5.47	5.61	-0.14***	17732	-	-	-	-
Not educated	-	-	-	-	0.78	0.70	0.08***	17732	-	-	-	-
Primary level	-	-	-	-	0.17	0.21	-0.04***	17732	-	-	-	-
Secondary or more	-	-	-	-	0.04	0.08	-0.04***	17732	-	-	-	-

OC Outside conflict areas; IC inside conflict areas; N number of individuals
***p<0.01 **p<0.05 *p<0.1

Table 1.2 – Children's outcomes by exposure to conflict and conflict intensity

	Pre-conflict	Post-conflict	Diff.	Double Diff.
School enrolment				
In conflict areas	0.66	0.70	0.04	-0.12***
Outside conflict areas	0.47	0.63	0.16	
Observations	4482	15480		
Number of years of schooling				
In conflict areas	9.23	8.38	-0.85	-1.42***
Outside conflict areas	6.63	7.20	0.57	
Observations	2820	8455		
Children's mortality				
In conflict areas	0.14	0.15	0.01	0.03***
Outside conflict areas	0.15	0.13	-0.02	
Observations	3939	13793		

***p<0.01 **p<0.05 *p<0.1

Table 1.3 – Impact of the conflict on school enrolment

	[1]	[2]	[3]	[4]
Conflict area and Post-conflict	-0.15***	-0.15***	-0.10***	-0.11***
	[0.02]	[0.02]	[0.02]	[0.03]
Conflict area and Post-conflict and Female				0.03
				[0.04]
Child is female				-0.12***
				[0.04]
Child's age fixed effects	Yes	Yes	Yes	Yes
Area fixed effects	Yes	Yes	Yes	Yes
Area-specific trends	No	Yes	Yes	Yes
Child and families' characteristics	No	No	Yes	Yes
Observations	19962	19962	19962	19962

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1.
"Conflict area and Post-conflict" indicates a child living in an area affected by the conflict who reached his sixth year within the conflict period. "Conflict area and Post-conflict and Female" indicates a girl living in an area affected by the conflict and who reached his sixth year within the conflict period.
Source: 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys.
Dependent variable: provability to be enroll in school.

Table 1.4 – Impact of the conflict on the number of years of schooling.

	[1]	[2]	[3]
Conflict areas and Post-conflict	-1.14***	-1.13***	-1.77***
	[0.39]	[0.39]	[0.59]
Conflict areas and Post-conflict and Female			1.18
			[0.75]
Child is female			-1.40***
			[0.43]
Child's age fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Region-specific trends	No	Yes	Yes
Observations	11275	11275	11275

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1.
"Conflict area and Post-conflict" indicates a child living in an area affected by the conflict who were of school age during the conflict period and were enrolled in school. "Conflict area and Post-conflict and Female" indicates a girl living in an area affected by the conflict who were of school age during the conflict period and were enrolled in school.
Source: 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys.
Dependent variable: number of years of schooling.

Table 1.5 – Impact of the conflict on the number of years of schooling for older students.

	[1]	[2]	[3]
Conflict areas and Post-conflict	-1.84***	-1.81***	-2.61***
	[0.56]	[0.56]	[0.82]
Conflict areas and Post-conflict and Female			1.55
			[1.05]
Child is female			-1.74***
			[0.54]
Child's age fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Region-specific trends	No	Yes	Yes
Observations	6977	6977	6977

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1.
"Conflict area and Post-conflict" indicates a child living in an area affected by the conflict who were of school age during the conflict period and were enrolled in school. "Conflict area and Post-conflict and Female" indicates a girl living in an area affected by the conflict who were of school age during the conflict period and were enrolled in school.
Source: 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys.
Dependent variable: number of years of schooling.

Table 1.6 – Impact of the conflict on children's mortality.

	[1]	[2]	[3]	[4]
Conflict area and Post-conflict	0.035*	0.039**	0.033*	0.021
	[0.018]	[0.018]	[0.018]	[0.027]
Conflict area and Post-conflict and Female				0.024
				[0.037]
Child is female				-0.01
				[0.031]
Child's age fixed effects	Yes	Yes	Yes	Yes
Area fixed effects	Yes	Yes	Yes	Yes
Area-specific trends	No	Yes	Yes	Yes
Child and families' characteristics	No	No	Yes	Yes
Observations	17732	17732	17732	17732

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1
"Conflict area and Post-conflict" indicates a child living in an area affected by the conflict who aged at least five years old or would be aged at least five years old (if deceased) and who spent at least one of their first five years during the conflict period. "Conflict area and Post-conflict and Female" indicates a girl living in an area affected by the conflict who aged at least five years old or would be aged at least five years old (if deceased) and who spent at least one of their first five years during the conflict period.
Source: 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys.
Dependent variable: provability to die before 5 years old.

Table 1.7 – Evolution of family standard of living, prenatal visits, and children's vaccinations

	Pre-conflict (1998/1999)	Post-conflict (2011/2012)	Diff.	Double Diff.
Very low standard of living				
In conflict areas	0.09	0.22	0.13	0.06**
Outside conflict areas	0.22	0.29	0.07	
Low standard of living				
In conflict areas	0.10	0.19	0.09	0.15***
Outside conflict areas	0.32	0.26	-0.06	
Middle standard of living				
In conflict areas	0.17	0.21	0.04	0.01
Outside conflict areas	0.20	0.23	0.03	
High standard of living				
In conflict areas	0.32	0.20	-0.12	-0.09***
Outside conflict areas	0.17	0.14	-0.03	
Very high standard of living				
In conflict areas	0.32	0.18	-0.14	-0.13***
Outside conflict areas	0.09	0.08	-0.01	
Numuber of prenatal visits				
In conflict areas	4.94	4.19	-0.75	-0.84**
Outside conflict areas	2.79	2.88	0.09	
Child has not health card				
In conflict areas	0.90	0.90	0.00	-0.07
Outside conflict areas	0.82	0.89	0.07	
Child received BCG vacine				
In conflict areas	0.87	0.80	-0.07	-0.10**
Outside conflict areas	0.71	0.74	0.03	
Child received Polio1 vacine				
In conflict areas	0.85	0.86	0.01	-0.02
Outside conflict areas	0.78	0.81	0.03	
Child received Polio2 vacine				
In conflict areas	0.74	0.78	0.04	0.02
Outside conflict areas	0.68	0.70	0.02	
Child received Polio3 vacine				
In conflict areas	0.59	0.63	0.04	0.01
Outside conflict areas	0.51	0.54	0.03	

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1
Source: 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys

Table 1.8 – Conflict, family condition of living and children vaccine

	Low standard of living		BCG		Orphan
	[1]	[2]	[3]	[4]	[5]
Conflict areas and Post-conflict	0.20***	0.15***	-0.13**	-0.10*	
	[0.03]	[0.02]	[0.06]	[0.06]	
Conflict region					0.007*
Child's age fixed effects	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes
Child and families characteristics	No	Yes	No	Yes	Yes
Observations	19962	19962	19962	19962	14668

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1.
"Conflict area and Post-conflict" indicates an individual from 2011–2012 DHS survey and lived in an area affected by the conflict. "Low standard of living" indicates the probability that an individual belongs to the quintile 1 or 2. "BCG" indicates the probability that a child under five were vaccinated agains BCG. "Orphan" indicates the probability that a child is a orphan.
Source: 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys.

Table 1.9 – Pre and post conflict education level for individual at least 35 years

	Ever enrolled in school		Number of years of schooling	
	[1]	[2]	[1]	[2]
Conflict areas and Post conflict	-0.002	-0.001	-0.15	-0.09
	[0.02]	[0.02]	[0.30]	[0.23]
Child and families characteristics	Yes	Yes	Yes	Yes
Cohort region fixed effect	No	Yes	No	Yes
Observations	2814	2814	2814	2814

Notes:
Robust standard errors in brackets.
"Conflict area and Post-conflict" indicates an individual from 2011–2012 DHS survey and lived in an area affected by the conflict.
Source: 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys.

Table 1.10 – Distribution of religion and ethnic group

	Conflict areas		Non-conflict areas	
	1998	2011	1998	2011
Religion				
Muslim	37.03	44.10	36.99	42.21
Christian	39.98	40.45	44.71	43.86
Other	22.99	15.46	18.30	13.93
Ethnic group				
Akan	27.11	28.43	33.14	32.33
Krou	10.90	12.11	12.12	11.64
Mandé	27.80	26.42	18.40	16.97
Voltaic	13.30	12.10	11.89	13.17
Other	23.05	20.95	22.30	25.89

Notes:
Source: 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys.

Table 1.11 – Impact by type of place of residency

	Urban		Rural	
	School enrolment	School attainment	School enrolment	School attainment
Conflict areas and Post-conflict	-0.14***	-2.42***	-0.08***	-0.60
	[0.04]	[0.72]	[0.03]	[0.49]
Child's age fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Region-specific trends	No	Yes	Yes	Yes
Child and families characteristics	No	No	Yes	Yes
Observations	9390	7261	10572	4014

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1
"Conflict area and Post-conflict" indicates a child living in an area affected by the conflict and who was exposed to the conflict period depending to the outcome.
Source: 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys.

Table 1.12 – Impact by intensity of the conflict

	School enrolment (6-18 years)	School attainment (6-24 years in school)	School attainment (12-24 years in school)	Child's mortality
Most affected conflict area and Post-conflict	-0.104***	-1.300***	-1.982***	0.037**
	[0.023]	[0.421]	[0.611]	[0.018]
Less affected conflict area and Post-conflict	-0.095***	-1.033**	-1.689**	0.030
	[0.026]	[0.495]	[0.696]	[0.021]
Child's age fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Region-specific trends	Yes	Yes	Yes	Yes
Families characteristics	Yes	No	No	Yes
Observations	19962	11275	6977	17732

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1
"Most affected area and Post-conflict" indicates a child living in most affected area and who was exposed to the conflict period depending to the outcome. "Less affected area and Post-conflict" indicates a child living in less affected area and who was exposed to the conflict period depending to the outcome.
Source: 1998–1999 and 2011–2012 Ivory Coast Demographic and Health surveys

Table 1.13 – Impact of the conflict on school enrolment using 2011–2012 survey only

	School enrolment	
	[1]	[2]
Conflict area and Post-conflict	-0.10***	-0.06**
	[0.03]	[0.03]
Child's age fixed effects	Yes	Yes
Region fixed effects	Yes	Yes
Child and families characteristics	Yes	Yes
household fixed effect	No	Yes
Observations	17898	

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1.
"Conflict area and Post-conflict" indicates a child living in a conflict-affected area who were less than 7 years in 1999 (beginning of the conflict).
Source: 2011–2012 Ivory Coast Demographic and Health surveys

Table 1.14 – Placebo test

	School enrolment (6-18 years)	School attainment (6-24 years in school)	School attainment (12-24 years in school)	Child's mortality
Conflict area and Post-conflict	0.008 [0.022]	0.169 [0.842]	0.351 [1.466]	-0.005 [0.019]
Child's age fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Region-specific trends	Yes	Yes	Yes	Yes
Families' characteristics	Yes	No	No	Yes
Observations	17809	8084	4584	17321

Notes:
Robust standard errors in brackets.
"Conflict area and Post-conflict" indicates a child living in conflict affected area and who was exposed to the conflict period depending to the outcome.
Source: 1994 and 1998–1999 Ivory Coast Demographic and Health surveys.

1.8 Figures

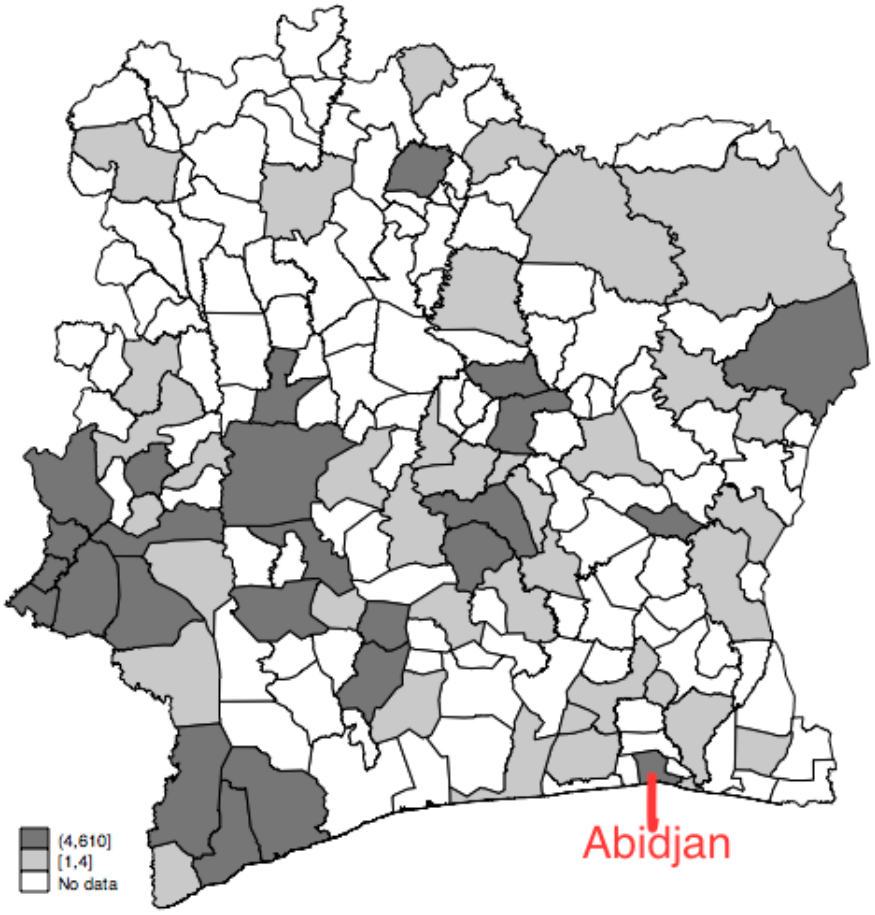

Figure 1.1 – Map of conflict events from 1999 to 2011 in Ivory Coast (subregion level)

Source: Armed Conflict Location Events Data, 2013

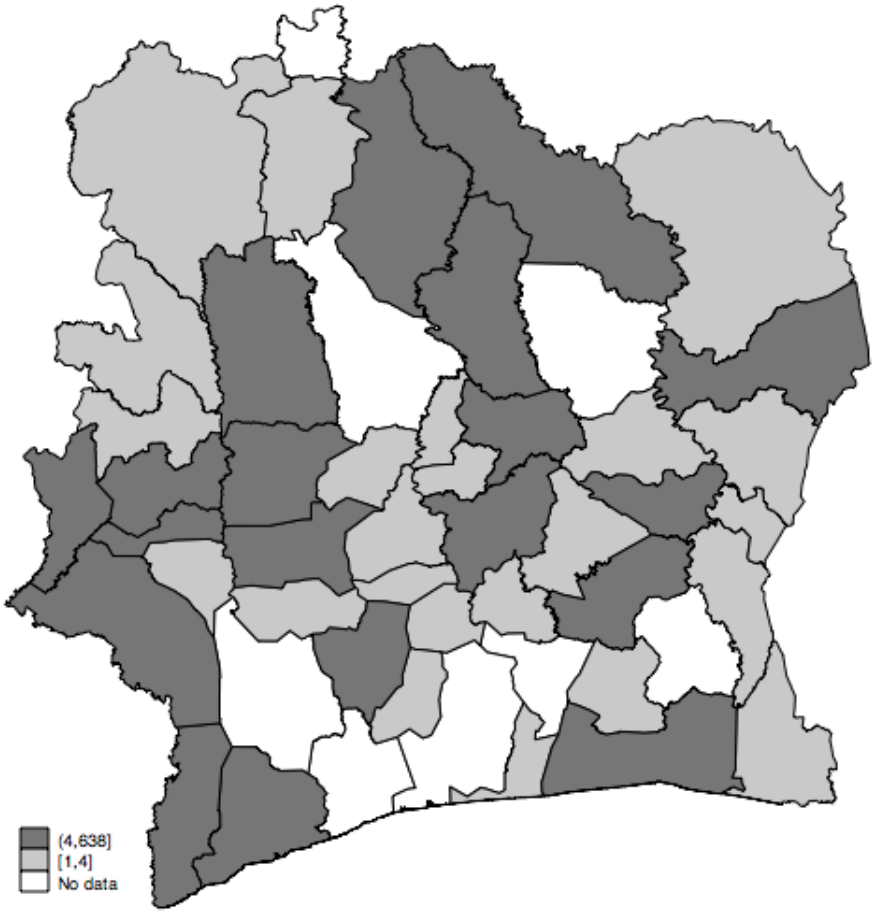

Figure 1.2 – Map of Conflict events from 1999 to 2011 in Ivory Coast (region level)

Source: Armed Conflict Location Events Data, 2013

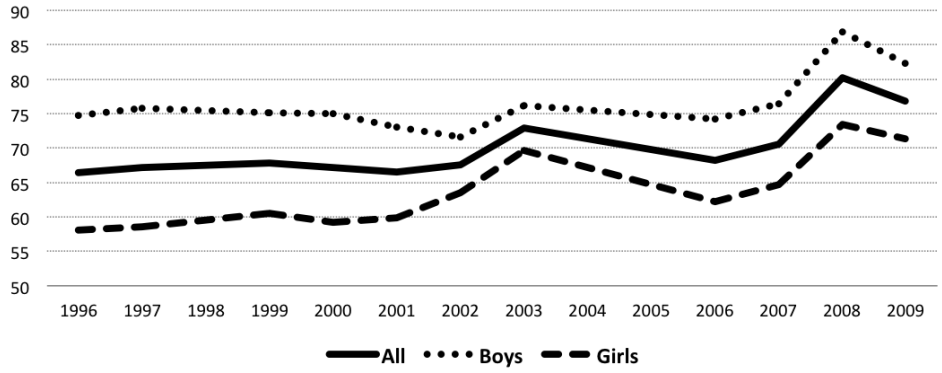

Figure 1.3 – Evolution of first-grade enrolment rate

Source: UN data, 2012 (http://data.un.org/Default.aspx)

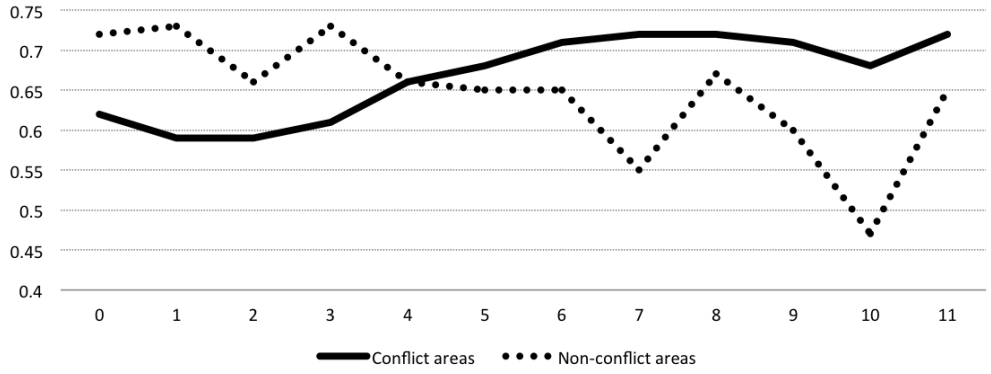

Figure 1.4 – Enrolment in school and age at the beginning of the conflict in each area

Source: Ivory Coast DHS 2011–2012

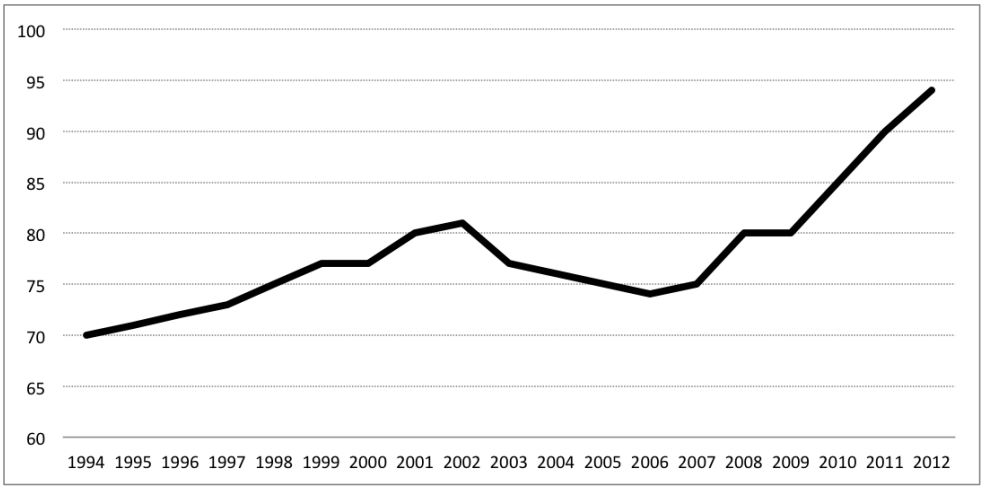

Figure 1.5 – Primary school enrolment rate

Source: UN data, 2012 (http://data.un.org/Default.aspx)

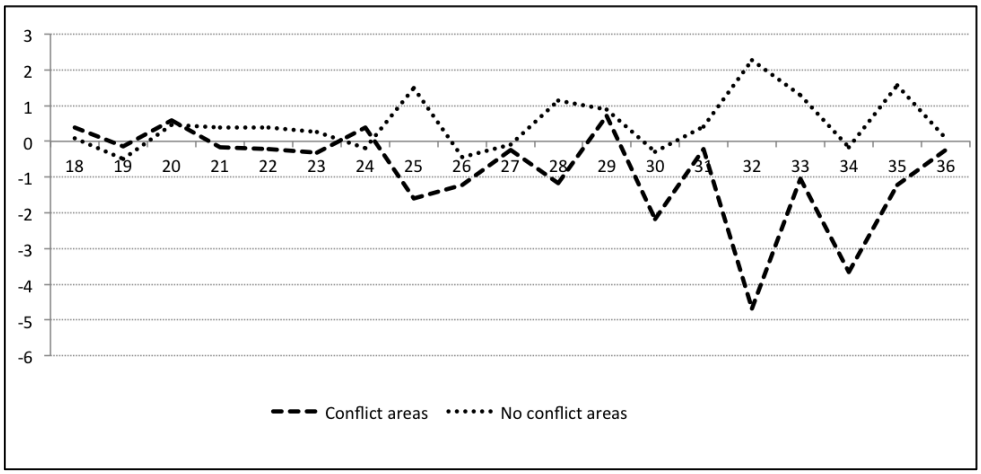

Figure 1.6 – Difference in number of years of schooling between Post-conflict and Pre-conflict by conflict areas and age

Source: Ivory Coast DHS 1998–1999 and 2011–2012

Chapter 2

Child Quantity-Quality Trade-Off: Intra-Urban Disparities.

2.1 Introduction

In developing countries, economic and population growth are concentrated within urban areas (United Nations 2012). This trend results in relatively better socio-economic indicators in urban areas than in the rest of the country; however, those relatively good indicators hide important inequalities in education between subpopulations within the capital. A broad review conducted by the National Research Council (2003) demonstrated that the urban poor in developing countries often face worse socio-economic conditions than the rural poor. Indeed, urban poverty is concentrated in slums, so the health risks faced by the urban poor might even exceed those in rural areas (see for instance African Population and Health Research Center (APHRC) 2002, Montgomery and Hewett, 2005). At least 33% of Ouagadougou's population of 2 million lives in informal settlements (Boyer and Delaunay 2009). These settlements lack social infrastructures such as health offices, electricity, and drinking water networks. Further, literacy and educational rates are very low in informal settlements relative to formal ones and parents' occupation are very different in the two settlement types. These fundamental differences can lead to differences in household behavior toward children's schooling between the two types of settlements.

In this paper, we study disparities in schooling between formal and informal settlements in Ouagadougou. We are interested in differences in families' behavior toward education between the two types of settlements. In particular, we investigate a trade-off between child quantity and quality (Becker and Lewis 1973) in both settlement types.

Despite the sizeable literature on economic models of child quantity and quality in the US and developed countries, much less is known on this link in developing countries, as argued in Glewwe (2002, 2008) about children educational attainment, and, in particular in African countries. Further, studies on intra urban differences on fertility behavior in Africa are rare. In the case of Burkina Faso, the existing lack of data and a suitable methodology to deal with the endogeneity of family size is particularly relevant. Moreover, to the best of our knowledge, the few existing works on educational attainment in Burkina Faso neglected the presence of unobserved heterogeneity and variability among subpopulations and regions.

This paper contributes to filling this gap in the literature. First, we use a recent (2012) database (more than 80,000 individuals) collected by the

Ouagadougou Health and Demographic Surveillance System (OHDSS). The objective of the OHDSS is to understand the problems of the urban poor and to test innovative programs that promote the well-being of this population. Therefore, the dataset gathers information on the subpopulations in the two types of settlements in Ouagadougou.

Our second contribution is methodological. In fact, testing the trade-off between child quantity and quality within a family is already complicated by the endogeneity of family size. Moreover, comparing the effect of family size between two different subpopulations can be more complicated because of the presence of unobserved heterogeneity and variability among subpopulations, especially whenever the outcomes of interest are discrete. As pointed out by Long (2009), traditional tests of the equality of coefficients across groups confound the magnitude of the regression coefficients with residual variations. To deal with those issues, we first, use a two-stage control function approach, which allows testing the endogeneity of family size in both settlements and estimating all the structural parameters of interest, which we need for subsequent analysis. The empirical specification takes into account the existence of settlement-specific, unobserved heterogeneity, and we use the presence of twins as an instrument to deal with the endogeneity of family size. In addition to presenting suggestive evidence of the validity of the twin instrument in this study, we apply a more formal test of instrument validity, recently proposed by Mourifié and Wan (2014), which does not invalidate the relevance of the twin instrument in our context. Second, to compare household behavior toward children's schooling on educational attainment between the two types of settlements, we adapt Long's (2009) method. His method consists of estimating two separate probit models for each settlement type and performing a test based on the predicted probabilities to compare the two settlement types. This method assumes a probit model in which all the covariates are exogenous. Here, since we have a potential endogenous variable (family size), our constructed control variable allows us to have a valid probit in the second step and then to compare the two settlement types using Long's multiple testing method.

Our main findings are as follows. First, we find a negative causal impact of family size on primary school attainment in both settlement types. Indeed, we find evidence of a child quantity and quality trade-off in both settlements. However, we find that the trade-off is more acute in informal settlements. This result seems to confirm the usual view that the trade-off is more pro-

nounced in poorer and more credit-constrained regions, (see Li, Zhang and Zhu (2005)). Although, to the best of my knowledge, it is the first time such evidence is found using African data. It is worth noting that whenever the presence of specific unobserved heterogeneity is neglected, a naive comparison of the regression coefficient in both groups suggest that the trade-off is more acute in formal settlements. This shows the importance of accounting for unobserved heterogeneity among subpopulations in explaining a variety of phenomena and providing suitable method to tackle this issue. Second, we observe that, for families with the same observable characteristics, the probability of reaching the post-primary school level is higher in formal settlements than in informal ones. These differences can be explained mainly by the existence of settlement-specific, unobserved heterogeneity, such as school quality, for which we do not have any information in our data, and the existence of settlement peer effects. This result suggests that there is a comparative advantage to living in formal settlement for children's post-primary school attainment.

The remainder of this paper is organized as follows. In the following section, we present our empirical specification. Sections 3 describes the data. In section 4, we develop suggestive evidence that the presence of twins in a family is an appropriate instrument to determine the causal effect of family size on children's educational attainment. Section 5 presents our results, and the last section concludes.

2.2 An empirical specification

In this section, we present an empirical specification of primary school enrolment and post-primary school attainment in the presence of endogeneity of family's size, which is based on a two-step control function approach and uses a probit model in the second step.

2.2.1 Formal vs informal: Settlement-specific, unobserved heterogeneity.

As described in the next section, our database covers two types of settlements in Ouagadougou namely, formal and informal settlements. In order to measure and compare the impact of the family size and other characteristics such

as gender on school enrolment and post-primary attainment in the two settlement types, we could estimate a single probit model for the two settlements combined, with interactions between dummy (indicator) variables for the settlements and the variables of interest. Significant interactions would indicate significant differences in coefficients across groups. However, by doing so, we would assume that the unobserved variables between the two settlements have the same variability. Indeed, our outcome of interest is binary, so the model does not allow for different residual variation across settlements; see Allison (1999) for a formal justification of this argument.

A simple analysis of the data shows differences in observable characteristics between the formal and informal settlements, (see Table 2.1). If the types of settlement differ in observable characteristics, it is unlikely that they do not differ on unobserved dimensions as well (see Altonji et al. (2005) for a formal justification of this argument). Moreover, in Table 2.2, we perform a test of the standard deviations difference, which shows that, for several observable characteristics used in our estimation, the standard deviations are statistically different in the formal and informal settlements. This suggests that potentially, the standard deviations of unobservable characteristics are different. If so, even if we perform two separate models in each settlement, we could not directly compare the coefficients of interest between the two settlement types because, in a probit model, coefficients are identified only up to scale (see Allison (1999)).

To tackle this issue, several methodologies have been proposed in the literature, including those by Allison (1999), Williams (2010), and Long (2009). Each of those proposals has some advantages and disadvantages; see Williams, (2010) survey. The first two methods depend heavily on the assumption that the effects of at least one variable in both settlement types is equal. Unfortunately, we have not found such a possible variable in our case. Therefore, we propose to follow the Long (2009) method. This method consists of estimating two separate probit models for each settlement type and performing a test based on the predicted probabilities to compare the two settlement types. This method assumes a probit model in which all the covariates are exogenous. Here, we have a possible endogenous variable (family size), so we propose to use, for each settlement a two-step control function approach, in which the second step is a probit model, and then to compare the two settlement types using Long's method.

2.2.2 Identification and econometric specification

2.2.2.1 Empirical strategy 1: school enrolment

The model for school enrolment is specified as follows:

$$N_i = x'_{in}\beta_n^d + \sigma_n^d e_{in}^d \tag{2.1}$$

$$S_i = 1\{N_i\gamma_s^d + x'_{is}\beta_s^d + e_{is}^d \geq 0\}, \tag{2.2}$$

with the following distributional assumption

$$(e_s^d, e_n^d|w) \backsim N(0, \sum(e_s^d e_n^d)),$$

with $w = (x_s, x_n)$ and

$$\sum(e_s^d e_n^d) = \begin{pmatrix} 1 & \sigma_{sn}^d \\ \sigma_{sn}^d & 1 \end{pmatrix}.$$

The first component of the model (1) is a function governing the endogenous variable N (number of children in the family). N_i represents the number of children in the family of child i. We assume that this function is linear, as in similar works [1], although the number of children is a discrete process. However, in our data, as seen in section 2.3, the average number of children is more than 5. It, therefore, is easier to justify the approximation of this discrete process by a continuous distribution than by the similar works on developed countries in which the average number of children is around 2. We consider N potentially endogenous because the number of children decisions would be based on the desired education level. The causal effect of the number of children on educational attainment could be identified with the use of an instrument. Two instruments are widely used in the literature to tackle the endogeneity of family size: mixed sibling-sex composition and twin births (see for instance Black-Devereux-Salvanes (2010); Angrist, Lavy, and Schlosser (2005); and Caceres-Delpiano (2006) for studies on developed countries and Rosenzweig and Wolpin (1980), Knodel and Wongsith (1991), Anh et al. (1998), Lee (2004), Li et al. (2007), and Ponczec and Souza (2012) for studies on developing countries). Here, we consider twin births to be the most appropriate instrument for this study; Indeed, since the average

1. See for instance Black-Devereux-Salvanes (2010); Angrist, Lavy and Schlosser (2005); and Caceres-Delpiano (2006).

number of children is five in our database the mixed sibling-sex argument seems not really relevant and even if it was the probability to have the first five children from the same sex is very low therefore the instrument would be probably weak. Moreover, in a recent study, Smits and Monden (2011) pointed out that West Africa has one of the highest twinning rates in the world, more than 15 twins per 1,000 birth while the lowest rate of twinning is observed in South America and East Asia with less than 9 twins per 1,000 birth. The vector x_{in} represents the set of all observable determinants of N, including the instrument; e_n is the unobserved characteristics which affect decisions about the number of children. This variable will mainly capture the unobserved expected level of education desired by the family. $d \in \{0, 1\}$ represents the settlement type.

The second component of the model (2) represents children's enrolment in primary school. This function is considered to be an index function governing the parents' decision to enrol their child in school or not. Therefore, $S_i \in \{0, 1\}$, which is an indicator function for each child i, takes the value 1 if the child is enrolled in school. It depends on exogenous and endogenous observable and unobservable variables. Many other factors can determine child school enrolment, and we must control for all the observable determinants namely x_{is}. These factors have been widely discussed in the literature, and can be grouped into three groups: children's individual characteristics, family characteristics, and school characteristics. The vector x_{is} contains all observable child and family characteristics for the child i, such as the child's age and gender, the parents' literacy and labor-force participation, and many others (see Table 2.2). Following Hill and Duncan, (1987), Krein and Beller, (1988) and, Brooks-Gunn et al., (1993), we construct a proxy variable for family income using an index to summarize the combined effect of a certain number of socioeconomic resource factors. e_{si} is an unobservable variable which mainly captures the opportunity cost to the family of enrolling their children in school.

2.2.2.2 Empirical strategy 2: Post-primary school level attainment

Similarly for the post-primary school level attainment, we have:

$$N_i = x'_{in}\beta^d_n + \sigma^d_n e^d_{in} \tag{2.3}$$

$$Y_i = 1\{N_i\gamma^d_y + x'_{iy}\beta^d_y + e^d_{iy} \geq 0\}, \tag{2.4}$$

with the following distributional assumption

$$(e_y^d, e_n^d|w) \backsim N(0, \sum(e_y^d e_n^d)),$$

with $w = (x_y, x_n)$ and

$$\sum(e_y^d e_n^d) = \begin{pmatrix} 1 & \sigma_{yn}^d \\ \sigma_{yn}^d & 1 \end{pmatrix},$$

where N_i, e_{in}, and d have the same definition as in the first model. $Y_i \in \{0, 1\}$ models the post-primary school level attainment for every child i who has already been enrolled in school. It takes the value 1 if the child reached the post-primary school level. e_{yi} is an unobservable variable which could contain the school characteristics that we unfortunately do not observe, and the unobserved child ability and the level of parental support. In some recent works, Cunha and Heckman (2007, 2008); Cunha, Heckman, and Schennach (2006) and Heckman, Stixrud and Urzua (2006) found that both cognitive and non-cognitive abilities are important factors in schooling decisions (level of education). In the data on developed countries, it is possible to control for a child's ability using IQ tests as a proxy variable, but this is rarely the case with data from developing countries as argued in Glewwe (2002). As in the school enrolment equation, the vector x_{iy} contains all the observable child and family characteristics which can determine child school attainment (see Table 2.2).

2.2.2.3 Identification and estimation: Control function approach

To estimate each model, we performed three steps. For the sake of simplicity, we drop the indices d and i in the following formulations and restrict ourselves to Y. We likewise estimate the model for S (school enrolment).
First Step: *From (3) obtain the Ordinary Least Squares (OLS) estimates* $(\hat{\beta}_n, \hat{\sigma}_n)$ *of the first-stage equation and the standard residuals* $\hat{e}_n = (N - x_n'\hat{\beta}_n)/\hat{\sigma}_n$*, where* $\hat{\sigma}_n$ *is a household's clustered standard errors.*
Then, rewrite (4) as:

$$Y = 1\{x_y'\beta_y^* + N\gamma_y^* + \hat{e}_n\zeta_y^* + \tilde{e}_y \geq 0\}, \tag{2.5}$$

where

$$(\tilde{e}_y|w) \equiv (\frac{e_y - \sigma_{yn}e_n}{\sqrt{1 - \sigma_{yn}^2}}|w) \backsim N(0, 1).$$

Second step: *Perform a simple probit model to consistently estimate* (β_y^*, γ_y^*, *and* ζ_y^*) *and to obtain all the standard deviations from all parameters.* After the second step of the control function approach, a third step is necessary to recover the structural parameters from equation (4).

Third step: *Applying the control function approach provides the following relation:* $\sigma_{yn} = \dfrac{\zeta_y^*}{\sqrt{1+\zeta_y^{*2}}}$, $\beta_y = \dfrac{\beta_y^*}{\sqrt{1+\zeta_y^{*2}}}$ *and* $\gamma_y = \dfrac{\gamma_y^*}{\sqrt{1+\zeta_y^{*2}}}$. *We calculate the confidence interval of our structural parameters by bootstrapping the structural model to obtain the distribution of the parameters and then, compute the corresponding percentiles.*

Fhourth step: *Applying group comparisons with predicted probabilities.* Let $\pi(z_d) \equiv \mathbb{P}(Y = 1|Z_d = z_d)$ for $d \in \{0, 1\}$ the school attainment predicted probability at a given value of z_d in the settlement d, where z_d is used to specify the realizations of the vector of covariates $(p_y, x_y, N, \hat{e}_n)$ for each settlement. Then test $H_0 : \pi^{Formal}(z_1) - \pi^{Informal}(z_0) = 0$ using the z-statistics:

$$z = \frac{\pi^{Formal}(z_1) - \pi^{Informal}(z_0)}{\sqrt{Var\Big[\pi^{Formal}(z_1) - \pi^{Informal}(z_0)\Big]}}.$$

The confidence region for the z-statistics can be computed using the STATA package proposed by Xu and Long (2009).

If we use the fitted values approach, which consists of estimating an OLS to get $\hat{N}$ in the first stage and a probit estimation in a second using the following equation: $Y = 1\{x_y'\beta_y + \hat{N}\gamma_y + e_y \geq 0\}$, these two steps will provide only these parameters: $\overline{\beta}_y = \dfrac{\beta_y}{\sigma}, \overline{\gamma}_y = \dfrac{\gamma_y}{\sigma}$, where $\sigma^2 = 1 + \gamma_y^2\sigma_n^2 + 2\gamma_y\sigma_n\sigma_{yn}$. Note that from $\overline{\alpha}_y, \overline{\beta}_y, \overline{\gamma}_y$, and σ_n, we cannot back up estimates of α_y, β_y, and γ_y because we do not know σ_{yn}. Therefore, estimation of the parameters of interest through this method is problematic.

2.3 Data

Data for this analysis was drawn from the Ouagadougou Health and Demographic Surveillance System (OHDSS). Launched in 2008, OHDSS is a research platform implemented in five neighbourhoods in the northern periphery of Ouagadougou. In Figure 2.1, a map of the city of Ouagadougou

shows areas monitored by OHDSS, which are outlined in black. The first two from the bottom are the formal settlements, and the three above them are the informal settlements. The OHDSS areas were chosen to target the most vulnerable populations of the city. The main objectives are to understand the problems of the urban poor and to test innovative programs that promote the well-being of this population. The demographic surveillance consists of regularly updating data on vital events (births, deaths, unions) and migration events. This platform is constructed to contrast the two types of settlements in Ouagadougou, namely formal and informal settlements. Since 2008, OHDSS has covered more than 80,000 individual, half from each type of settlement. OHDSS data contain considerable information on individual and family characteristics. Individual data are about age, school attendance, literacy, labour-force participation, migrations, and unions. The family characteristics concern family's physical assets and living conditions [2].

Data on education were collected in 2012 for all individuals aged 6 or older. Information collected were about past and current school attendance (2011-2012 school year), current grade if still in school, and the highest grade attained by those no longer in school. This study focuses on two measures of educational attainment: the proportion of children who have ever been enrolled in school and those who attended the post-primary level.

Several exclusion criteria were applied to the sample. First, we restricted our sample to children aged at least 15 years old. This limitation avoided including individuals still in primary school in post-primary analysis. Second, we limited children's age to 30 to avoid having cohorts with too much difference. The exclusion criteria resulted in to a sample of 3,553 children from 15 to 30 years old [3].

2.3.1 Formal vs informal settlement: Summary statistics of the overall OHDSS sample

Table 2.1 presents the differences between the two settlements through descriptive statistics of the entire population monitored by the OHDSS in 2011. The inhabitants of the informal settlements seem to be younger than those in the formal settlements, with a greater share of children under 5 years old.

2. For more details on OHDSS, see Rossier et al.(2012).
3. We obtained similar results if we restricted the sample to those 15-25 years old.

Indeed, more than 20% of the population in informal areas is aged less than 5 years old compared to 15% in formal ones. The informal settlements are also characterized by a less educated population. More than 40% of this population has never been enrolled in school while 37% of the population in formal settlements has a secondary or higher level of education. In term of families' characteristics, we note that informal settlements lack of baseline socio-economic conditions. For instance, there is not an electricity network in the informal settlements, and almost all families use oil lamps or flash-lights as sources of light. The national network for water does not exist in these settlements and nearly three quarters of the population uses a public fountains. The other quarter uses drilling or wells as a source of drinking water. In the formal settlements, more than half of the population is served by the national domestic water network. Regarding the material used for the wall of houses, we notice that, in the informal settlements, nearly all houses (99%) are constructed of mud bricks while more than three quarters of the houses in the formal settlements are constructed of cement bricks. Even if in both settlements, families use mainly wood for cooking, in the formal settlements, more than 30% also use gas as source of energy for cooking. The main means of transportation in the informal settlement is the bike (used by 47% of this population), while the population in the formal settlements uses mainly motorcycles (65%) and cars (12%).

2.3.2 Summary statistics of the 15-30-year-old sample

Table 2.2 presents the descriptive statistics of the 15-30-year-old sample by settlement type. We notice that the school enrolment rate is higher in the formal settlements than the informal ones. Indeed, only 6% of the 15-30 year olds in the formal settlements have never enrolled in school compared to 18% in the informal ones. Even if there is a relatively strong enrolment in school, the school dropout rate seems to be high. For instance, among individuals enrolled in school, only 53% reached the post-primary level in the informal settlements. In the formal settlements, this percentage is approximately 72%. The average number of children per family (family corresponding to those of the 15-30-year-old sample) is around 5 in the two settlement types, with a slight higher average in the informal settlements (5.41 versus 5.26). We notice that, in the formal settlements, 14% of children come from a family in which there are twins. In informal settlements, this proportion is approximately 10%.

2.4 Creating an Instrument from the presence of twins in the family

A direct comparison of school enrolment or post-primary school attainment between families of different sizes is unlikely to yield the causal effects of family size on school enrolment or post-primary school attainment. Even if a full set of controls were included in the analysis, the results would be unconvincing. If families of different sizes differ in so many observed dimensions, it is unlikely that they do not differ in unobserved dimensions as well. Table 2.3 shows the characteristics of the 15-30-year-old sample depending on whether individuals come from a family with more than 5 children (average number of children in the family). As we can see, individuals in the two types of families differ in several characteristics in both formal and informal settlements. Therefore, we can posit that families of different sizes also differ in unobservable characteristics, and we have to take into account the possible endogeneity of the number of children.

We can observe that this difference in observed dimensions of families with different sizes is more pronounced in the formal settlements than in the formal ones. Therefore, we would expect to have a stronger endogenous effect in the formal settlements than in the informal ones.

In this section, following Angrist, Lavy, and Schlosser (2005) and more recently Ponczec and Souza (2012), we develop suggestive evidence that the presence of twins in the family is an appropriate instrument to determine the causal effect of family size on children's school enrolment and post-primary school attainment. To be a "good exclusion" variable for the number of children, the presence of twins in the family must be correlated with the number of children in the family and uncorrelated with the unobservable variables which could affect school enrolment and post-primary school attainment.

2.4.1 Presence of twins predicts family size

To justify the correlation of the presence of twins and the number of children in the family, we first establish that the number of children is positively correlated with the presence of twins in the family. The first column (1) in Table 2.4 shows that the average number of children is higher in families with twins: 6.06 vs 5.13 in the formal settlements and 6.21 vs 5.32 in the informal settlements. The presence of twins in the family leads to around 1

more child in the family. A t-test of the difference in the mean of the number of children shows that the difference between the two types of families is statistically significant at the level of 1%.

Further, we perform two types of regressions of the number of children on the instrument. The first is a linear regression on the instrument only, and in the second, we control by adding a set of family characteristics (ethnic group; religion; father and mother age, activities, level of education; and family standard of living). In Table 2.4, the second column (2) shows the results without the family characteristics control and the third column (3) the results whenever controlling for family characteristics. The results of the two equations show a positive and significant effect of the presence of twins on the number of children in the family in both settlement types. The results are almost the same in both cases. The F-statistic from a test of the null hypothesis that the coefficient of the instrument in regression (1) is 0 is 111.55 in the formal settlements and 33.66 in the informal ones, which suggests that the instrument is not "weak" in either settlement by conventional standards. Even if controlled by family characteristics, results still suggest that the instrument is not "weak".

2.4.2 School enrolment, post-primary school attainment, and the presence of twins in the family

If individuals from a family with twins differed systematically from individuals in which there are no twins, then the presence of twins would be a poor instrument because it would be correlated with unobserved determinants of school enrolment or unobserved determinants of post-primary level attainment. We now present suggestive evidence that there is no such correlation. First, we examine the possibility of differences between the two groups by regressing the instrument on individuals and family characteristics. Equation (1) in Table 2.5 shows the results of this regression for formal and informal settlements. We observe that all the characteristics are not significant in both settlements. Indeed, we do not reject the null hypothesis that the coefficients on all of these variables are 0. The corresponding Wald statistic is 13.59 with a p-value of 0.33 in the formal settlements, and 12.60 with a p-value of 0.40 in the informal ones.

We further examine the possibility of a direct and significant effect of the instrument on school enrolment and post-primary level attainment. Equations

(2) and (3) in Table 2.5 show the results for a probit regression of school enrolment and post-primary level attainment respectively, controlled by individual and family characteristics. The presence of twins in the family does not produce a significant coefficient in either formal or informal settlements. One would think that having twins or not is not random if the family could increase the probability of twins, especially through artificial insemination. However, these practices are not common in the context of Burkina Faso because they are highly expensive and not culturally accepted.

2.4.3 Mourifié and Wan (2014) LATE's Test

Based on some insight in Heckman and Vytlacil (2005), Kitagawa (2014) and Mourifié and Wan (2014, MW) proposed two formal testing procedure to assess the validity of an instrument. Those two testing procedures have the advantage of being the most powerful tests available to screen the violation of the instrumental variable assumption whenever the treatment response is heterogeneous. Indeed, in addition of being a "good exclusion" variable if the potential number of children is a monotone function of the instrument, Imbens and Angrist (1994) show that the IV estimand can consistently estimate the average treatment effect (ATE) for the subpopulation of compliers, namely, the local average treatment effect (LATE). MW proposes an easily implementable test to verify the validity of those two conditions. Please see MW for more details. Although MW's test can also be implemented for a discrete non-binary treatment, we dichotomize the number of children in order to avoid having few observations in every subgroup. The model can therefore be written as follows: Let $Y_i = Y_{i1}D_i + Y_{i0}(1 - D_i)$, where $D_i \in \{0, 1\}$ is the observed treatment indicator of the individual i, and D_i takes the value 1 if the child is in a family with more than k children. (Y_{i1}, Y_{i0}) are potential outcomes, in other terms, Y_{id} is the school attainment level of a child i if she had been externally assigned to a family where $D_i = d$, $d \in \{0, 1\}$. Let $Z \in \{0, 1\}$ denote the twin instrument; it takes the value 1 if twins are present between the k first children. For each $z \in \{0, 1\}$, let D_z be the potential treatment had the Z been exogenously set to z. With this notation, we can also write the observed treatment $D = D_1Z + D_0(1 - Z)$.

The two well-known identification assumptions for LATE as introduced by Imbens and Angrist (1994) are restated as the following:

1. (Independence) $Z \perp (Y_1, Y_0, D_0, D_1)$ and $\mathbb{P}(D = 1|Z = 0) \neq \mathbb{P}(D =$

$1|Z = 1)$.

2. (Monotonicity) $D_0 \leq D_1$ almost surely.

We perform MW's test to assess the validity of those assumptions for $k \in \{3, 4, 5, 6\}$. We perform the test with and without controlling for the covariates. As can be seen in Table 2.6 the tests do not reject the latter two assumptions in both cases.

2.5 Results

The first variable of interest is family size. This section presents the impact of the number of children on school enrolment and post-primary school attainment for the 15-30-year-old sample in formal and informal settlements. The 95% confidence interval is computed by doing 1500 bootstrap replications. Table 2.7 shows the results for school enrolment and post-primary level attainment for both formal and informal settlements.

2.5.1 Formal settlements

In the formal settlements, the results suggest that the number of children is endogenous with respect to children's school enrolment. Indeed, the covariance between e_n and e_s is 0.46, within the 95% confidence interval [0.21 0.86] (see Table 2.7). This result suggests that in the formal settlement, children school enrolment is part of the parent fertility decisison. We note a negative causal impact of the number of children on the school enrolment for the compliers. Indeed, the point estimate of -0.37 with a confidence interval of [-0.63 -0.21] reflects the negative effect of family size on children's primary school enrolment for families who have had more children than they otherwise would have because of twinning.

Similarly, the results suggest that, the number of children is endogenous with children's post-primary level attainment. Indeed, the covariance between e_n and e_y is 0.40 with a confidence interval of [0.23 0.75] (see Table 2.7). The positive sign of the correlation indicates a positive correlation between parental support and the level of education desired by parents in this settlements. We also note a negative causal impact of the number of children on the post-primary school attainment. The point estimate is approximately -0.32 with a confidence interval of [-0.55 -0.15]. In this case, these results

reflect the effect of family size on post-primary school attainment for the compliers.
This endogeneity of the number of children in both primary school enrolment and post-primary school attainment suggests that in the formal settlement, parents consider children's education when deciding on the number of children. This behavior can be explained by the relatively high-level of parents who are educated. Indeed, 36% of mothers have at least a primary-school level education, increasing to 46% for their husbands (see Table 2.2).

Basically, we observe the existence of a tradeoff between the quantity and quality of children (Becker and Lewis 1973) in the formal settlements.

2.5.2 Informal settlements

Unlike in the formal settlements, the results indicate that there is no endogeneity in the number of children on both primary school enrolment and post-primary level attainment in the informal settlements. (see Table 2.7). This result would indicate that the children's education is not a significant determinant of the family size in the informal settlements.

This behavior can be explained by the relatively low proportion of parents who are educated in the informal settlements. Indeed, only 19% of mothers and 27% of their husbands have at least a primary school level education (see Table 2.2).

It is important to note that the effect of the number of children on school enrolment for the "compliers" is negative (-0.14) but not significant ([-0.49 0.17]), while it is negative (-0.25) and significant ([-0.57 -0.04]) for post-primary school attainment. (see Tables 2.7). These results can be explained by the fact that enrolment in public primary schools is almost free and that the opportunity cost to enrol children in primary school is not high because they are too young to be used in the labor force. However, enrolling them in post-primary school is more costly (direct cost and opportunity cost). First, the fees are higher than for primary school, and the transport costs increase because there are significantly fewer post primary schools than primary schools. Second, regarding opportunity cost, children are physically able (from the point of view of their parents) to help their parents in their employment activity.

2.5.3 Settlement comparison

In this section, we compare the impact of the family size on educational attainment in the two settlements. Notice that a naive comparison of the regression coefficients of the family size variable suggest that the trade-off quantity quality is more pronounced in the formal settlement. However, as explained previously, we cannot compare this impact by merely looking at the point estimate reported in Table 2.7 due to the settlement-specific unobserved heterogeneity.

Therefore, in this section, we compare predicted probabilities to reach the post-primary educational attainment by settlements. Predicted probabilities are calculated employing the child and household characteristics used in the post-primary school attainment analysis. Adapting Long's (2009) method, we make settlement comparisons for some fixed characteristics. We have multiple covariates, so we could estimate and compare multiple counterfactual probabilities. To be parsimonious, we focus on those that are more relevant to policy makers. We define two groups of individuals. First, children with a favourable background are defined as those with characteristics which have a significant, positive effect on post-primary school attainment. In this category, we include non-Muslim individuals with the highest standard of living index, whose parents have at least a primary-school education and work in an activity in which children can not participate. Children with unfavourable background are defined as individuals with characteristics which have a negative effect on post-primary school attainment. In this category, we include Muslim individuals with the lowest standard of living index, whose parents gave never been enrolled in school and work in an activity in which a child could participate. We hold continuous variables at their mean.

Figure 2.2 shows the predicted probabilities to reach the post-primary school level by gender and by settlement type. Above are individuals with an unfavourable background, and below are individuals with a favorable background. As expected, we observe that the probability of reaching the post-primary school level decreases with the number of children. The adverse effect of family size is more severe for children with an unfavourable background. We observe that, for families with the same observable characteristics, the probability of reaching post-primary school is higher in the formal settlements than in the informal settlements. Figures 2.3 and 2.4 provide more detailed information on this trend. In Figures 2.3 and 2.4, we calculate

the difference of the probability of reaching the post-primary school level between the two settlements, for every standard of living index [4]. Therefore, Figures 2.3 and 2.4 present information on how families standard of living and number of children affect the difference in post-primary educational attainments between the two settlement types. The solid line indicates that the difference between formal and informal settlements is significant at the 95% level (Figure 2.3) or 90% level (Figure 2.4), while the dashes indicate that the difference is not significant. The main result is that this difference is consistently positive and significant at the 90% confidence level for families with high and middle standards of living (see Figure 2.4). This suggest that the trade-off quantity quality is more pronounced in the informal settlement. In terms of magnitude, we do not notice any significant gender differences in both favourable and unfavourable backgrounds. Overall, the settlement differences are low when the number of children in the family is low or high. These differences become larger around the average number of children per family, at which point the difference ranges from 0.15 to more than 0.30, depending on the family's standard of living. When the number of children in the family is low (less than 3), settlement differences are similar whatever the family's standard of living. When the number of children is high (more than 3), we observe that the higher the standard of living, the greater the difference between formal and informal settlements. At the 90% confidence level (see Figure 2.4), these differences become significant, especially for children from families with middle and high standards of living and an unfavourable background. One can ask why there are significant differences between formal and informal settlements even the family and children have the same observable characteristics. These differences can be explained mainly by a potential specific-settlement, unobserved heterogeneity. Indeed, the school quality may be extremely different in the two settlement types. The differences might also be explained by settlement peer effect. Indeed, informal settlements are composed mostly of households with low standard of living (see Tables 2.1 and 2.2), so there could be a spillover effect of educational behaviorby poor families on the small number of wealthy families.

4. The standard of living is not included in the definition of favourable and unfavourable backgrounds.

2.6 Conclusion

In this paper, we investigate disparities in educational attainment between formal and informal settlements in Ouagadougou. We focus on differences in families' behavior towards schooling in the two settlement types, in particular the trade-off between child quantity and quality. Our first main result suggests evidence of a quantity-quality tradeoff in both settlements, with more pronounced effect within the informal ones. The results also suggest that, the number of children is endogenous with children's education in the formal settlement but not in the informal one. Additional results suggest the existence of settlement-specific unobserved heterogeneity, such as school quality and settlement peer effects, which creates a comparative advantage from living in formal settlements. Therefore, to reduce such disparities, we recommend prioritizing actions to improve school quality in the urban informal settlements. Also, these results show that efforts to keep children in school should not be directed only toward rural areas. In addition to reducing schooling costs in some urban areas, particularly informal areas, special emphasis should be put on raising awareness about the benefits of education for children's and families' welfare. Finally, from the methodological point of view, our results show the importance of accounting for unobserved heterogeneity among subpopulations in explaining family behavior toward fertility and children's schooling.

2.7 Tables

Table 2.1 – Settlement characteristics

	Formal settlements		Informal settlements		All	
	Mean	SD	Mean	SD	Mean	SD
Variables						
Individual characteristics						
Age	24.79	17.07	21.82	16.2	23.26	16.69
Child under 5 years old	0.15	0.35	0.23	0.42	0.19	0.39
Education level (for people age 7 and older)						
Never enrolled in school	0.27	0.44	0.44	0.5	0.35	0.48
Primary level	0.36	0.48	0.4	0.49	0.38	0.48
Secondary level or higher	0.37	0.48	0.16	0.36	0.27	0.44
Number of individuals	40,584		42,933		83,517	
Family characteristics						
Age of the head of the household	42.33	13.36	36.97	11.72	38.99	12.63
Main means of transportation						
Bike	0.19	0.39	0.47	0.5	0.36	0.48
Motorcycle	0.65	0.48	0.42	0.49	0.51	0.5
Car	0.12	0.32	0.01	0.12	0.05	0.22
Main source of energy for cooking						
Wood	0.57	0.5	0.82	0.46	0.65	0.48
Coal	0.07	0.26	0.08	0.28	0.08	0.27
Gas	0.31	0.46	0.09	0.29	0.18	0.38
Main source of light						
Lamp	0.35	0.48	0.92	0.27	0.7	0.46
Electricity	0.65	0.48	0.07	0.25	0.29	0.45
Domestic water source						
Drilling\well	0.07	0.25	0.24	0.42	0.17	0.38
Collective public fountain	0.38	0.49	0.73	0.44	0.6	0.49
Individual subscription to the national network	0.55	0.5	0.03	0.18	0.23	0.42
Material used for walls of house						
Bricks made with mud	0.24	0.43	0.99	0.11	0.7	0.46
Bricks made with cement	0.76	0.43	0.01	0.11	0.3	0.6
Number of families	6,661		10,823		17,484	

Table 2.2 – Descriptive statistics (15-30 year old group)

Variables	Formal settlements Mean	SD	Informal settlements Mean	SD	SD difference
Child's age	21.15	4.13	20.30	3.88	**
Child is a girl	0.51	0.50	0.51	0.50	NS
Child is Muslim	0.61	0.49	0.56	0.50	NS
Child belongings to the Mossi ethnic group	0.90	0.30	0.92	0.27	***
Enrolled in school at least once	0.94	0.24	0.82	0.38	***
Child reached post-primary level	0.72	0.45	0.53	0.50	***
Number of children in the family	5.26	1.69	5.41	1.60	**
Presence of twins in the family	0.14	0.35	0.10	0.30	***
Child's mother's age	45.21	4.01	43.75	3.85	*
Mother's husband age	54.59	7.58	52.52	8.46	***
Child's mother's has an economic activity in which a child could participate	0.90	0.30	0.95	0.21	***
Mother's husband has an economic activity in which a child could participate	0.70	0.46	0.74	0.44	NS
Child's mother's has at least a primary-school level	0.36	0.48	0.19	0.40	***
Husband has at least a primary-school level	0.46	0.50	0.27	0.44	***
Standard of living					
Low	0.08	0.27	0.47	0.50	***
Middle	0.19	0.39	0.43	0.49	***
High	0.72	0.45	0.09	0.29	***
Observations	3,024		1,207		

***p<0.01 **p<0.05 *p<0.1 NS not significant

Table 2.3 – Individual characteristics by number of children in the family

	Formal settlements			Informal settlements		
	5 & -	6 & +	Difference	5 & -	6 & +	Difference
Variables						
Child's age	20.74	21.73	***	19.74	20.74	***
Child is a girl	0.50	0.53	NS	0.50	0.52	NS
Child belongings to the Mossi ethnic group	0.89	0.91	NS	0.92	0.93	NS
Child is Muslim	0.58	0.67	***	0.59	0.53	**
Enrolled in school at least once	0.96	0.92	***	0.85	0.80	***
Reached post-primary school level	0.78	0.64	***	0.60	0.45	***
Child's mother's age	44.48	46.24	***	0.43	0.45	***
Mother's husband's age	52.99	56.82	***	0.51	0.54	***
Child's mother has an economic activity in which a child could participate	0.87	0.95	***	0.95	0.96	NS
Mother's husband has an economic activity in which a child could participate	0.63	0.80	***	0.70	0.78	***
Child's mother has at least a primary-school level	0.47	0.22	***	0.24	0.14	***
Mother's husband has at least a primary-school level	0.54	0.34	***	0.29	0.24	*
Standard of living						
Low	0.08	0.08	NS	0.46	0.49	NS
Middle	0.16	0.24	***	0.42	0.43	NS
High	0.76	0.66	***	0.11	0.07	***
Observations	1,763	1,261		645	562	

***p<0.01 **p<0.05 *p<0.1 NS not significant

Table 2.4 – Presence of twins and the number of children in the family

	(1)		(2)		(3)	
	Formal	Informal	Formal	Informal	Formal	Informal
Twin in the family	6.06	6.21	0.93***	0.89***	0.78***	0.92***
No twin in the family	5.13	5.32	-	-	-	-
T-test p value	0.000	0.000	-	-	-	-
F-stat	-	-	111.55	33.66	16	74.17
Family characteristics	-	-	No	No	Yes	Yes
Observations	3,024	1,207	3,024	1,207	3,024	1,207

***p<0.01 **p<0.05 *p<0.1 NS not significant
(1) Average number of children in the family
(2) Linear regression of the number of children
(3) Linear regression of the number of children
Family characteristics : ethnic group; religion; father's and mother's age economic activities, level of education; and family standard of living

Table 2.5 – Presence of twins, school enrolment, and post-primary school attainment

Variables	Formal settlement (1)	(2)	(3)	Informal settlement (1)	(2)	(3)
Twins in the family	-	-0.073	0.106	-	0.002	-0.004
		(0.141)	(0.102)		(0.219)	(0.178)
Child's age	-0.006	-	-	0.007	-	-
	(0.007)			(0.015)		
Child is a girl	0.012	-	-	-0.23	-	-
	(0.061)			(0.121)		
Household belongings to the Mossi ethnic group	-0.255	-	-	0.200	-	-
	(0.194)			(0.397)		
Main religion is Islam	-0.163	-	-	0.166	-	-
	(0.125)			(0.207)		
Child's mother's age	0.004	-	-	-0.003	-	-
	(0.016)			(0.028)		
Mother's husband's age	-0.001	-	-	-0.008	-	-
	(0.008)	-	-	(0.014)	-	-
Child's mother has an economic activity in which a child could participate	0.211	-	-	-0.296	-	-
		-	-		-	-
	(0.232)			(0.340)		
		-	-		-	-
Mother's husband has an economic activity in which a child could participate	0.333	-	-	0.075	-	-
		-	-		-	-
	(0.136)			(0.227)		
		-	-		-	-
Child's mother has at least a primary-school level	-0.127	-	-	-0.004	-	-
		-	-		-	-
	(0.143)			(0.227)		
		-	-		-	-
Mother's husband has at least a primary-school level	-0.077	-	-	-0.012	-	-
		-	-		-	-
	(0.136)			(0.229)		
		-	-		-	-
Standard of living		-	-		-	-
Middle	-0.194	-	-	-0.258	-	-
	(0.218)			(0.182)		
High	-0.158	-	-	-0.476	-	-
	(0.193)			(0.414)		
Cons	-0.966	-	-	-0.708	-	-
	(0.718)			(1.430)		
Wald chi2(12)	13.59	-	-	12.60	-	-
Prob > chi2(12)	0.33	-	-	0.40	-	-
N	3,024	3,024	2,834	1,207	1,207	992

(1) Probit regression of the presence of twins in the family
(2) Probit regression of school enrolment
(3) Probit regression of post-primary school level of attainment
Robust standard error in bracket

Table 2.6 – Testing the validity of the instrument: Mourifié and Wan's Test

	School enrolment						Post primary attainment					
	I_n>4		I_n>5		I_n>6		I_n>4		I_n>5		I_n>6	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
Testing results	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Control variables	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

NR: Non Rejected at 95% level
I_n>4 is a dummy variable indicates if the number of children is greater than 4.
I_n>5 is a dummy variable indicates if the number of children is greater than 5.
I_n>6 is a dummy variable indicates if the number of children is greater than 6.

Table 2.7 – Family size, school enrolment and post primary attainment

Enrolment

	Formal settlement		Informal settlement	
	Coeff	95% C I	Coeff	95% C I
σ_{sn}	0.46***	[0.21 0.86]	0.12	[-0.35 0.58]
Number of children	-0.37***	[-0.63 -0.21]	-0.14	[-0.49 0.17]
N	3024		1207	

Post primary

	Formal settlemet		Informal settlement	
	Coeff	95% C I	Coeff	95% C I
σ_{yn}	0.40***	[0.23 0.75]	0.22	[-0.16 0.68]
Number of children	-0.32***	[-0.55 -0.15]	-0.25**	[-0.57 -0.04]
N	2834		992	

***p<0.01 **p<0.05 *p<0.1
All regressions are controlled for family and child characteristics.
Child's age, religion, ethnic group
Child's parent's age, education level, and economic activity
Family standard of living level dependent variables: School enrolment: Probability to be enroll in school
School attainment: Probability to reach the post-primary school level

2.8 Figures

Figure 2.1 – Location of areas monitored by OHDSS

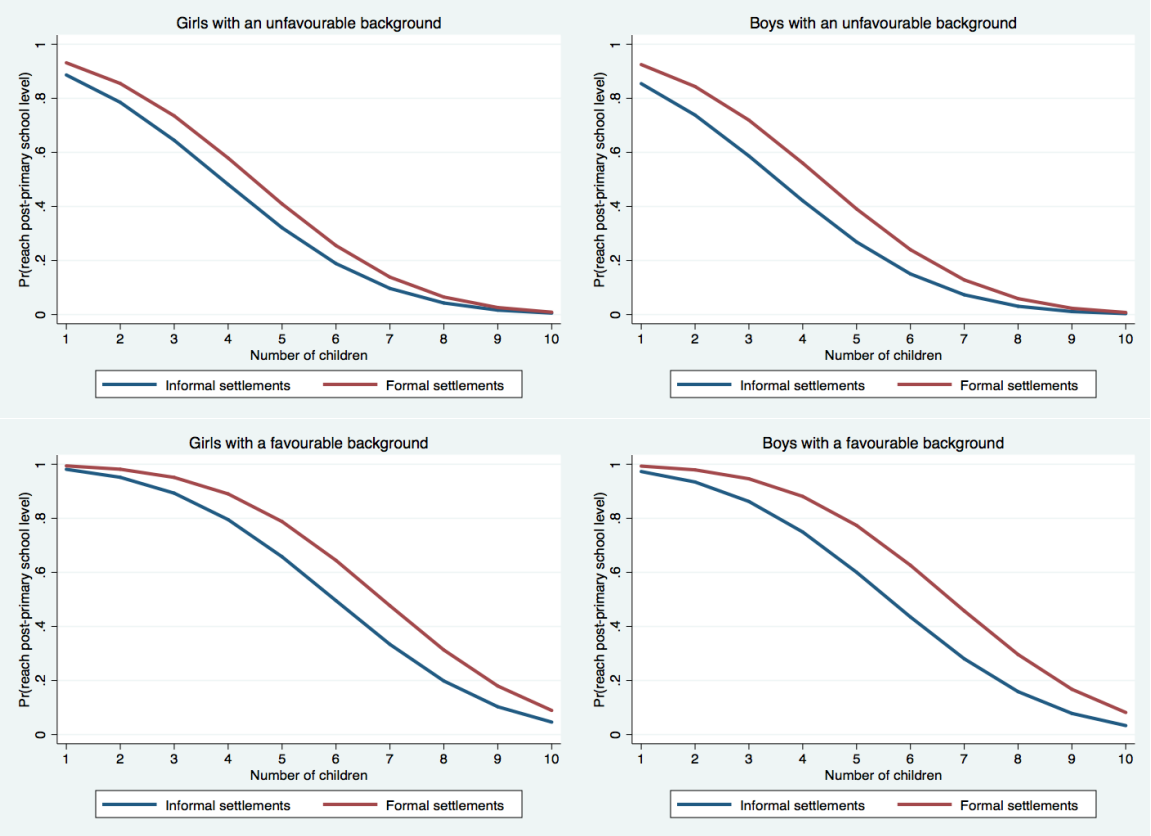

Figure 2.2 – Probability of post-primary school attainment by settlement and number of children

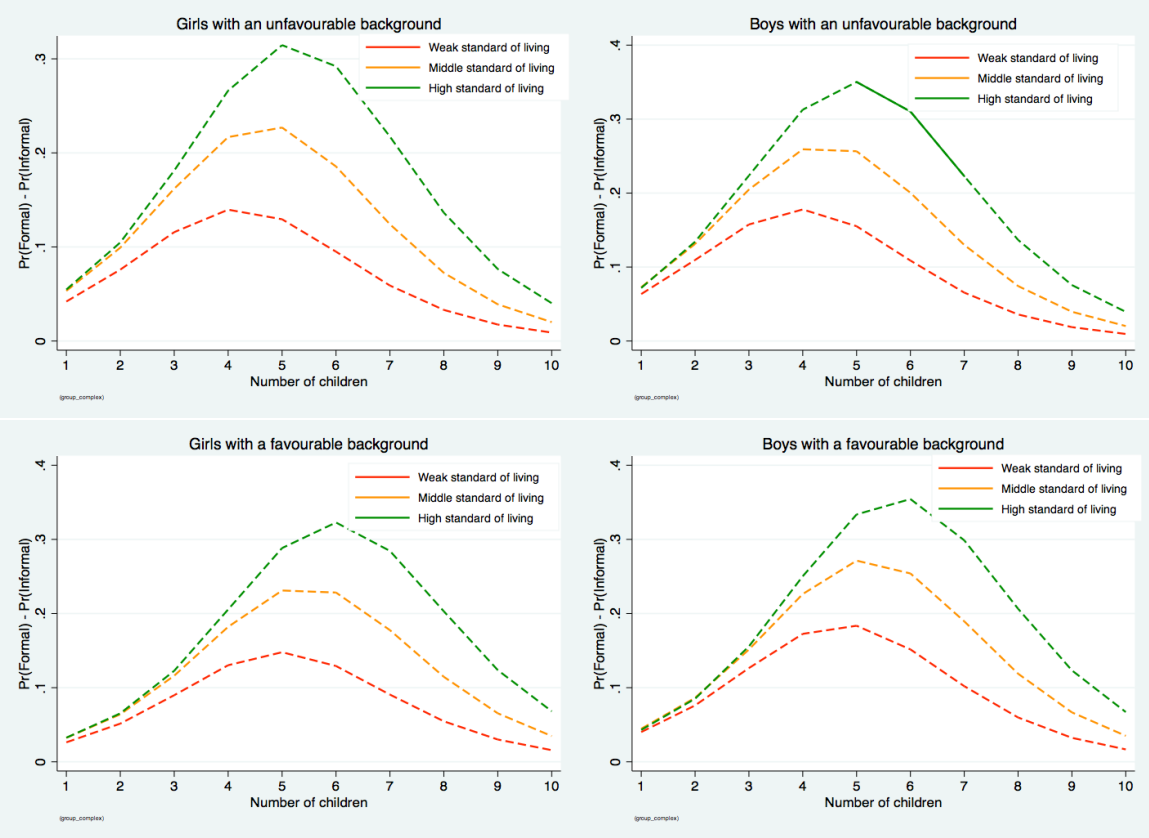

Figure 2.3 – Settlement difference in probability of reaching the post-primary school level by standard of living and number of children in the family (95% confidence interval)

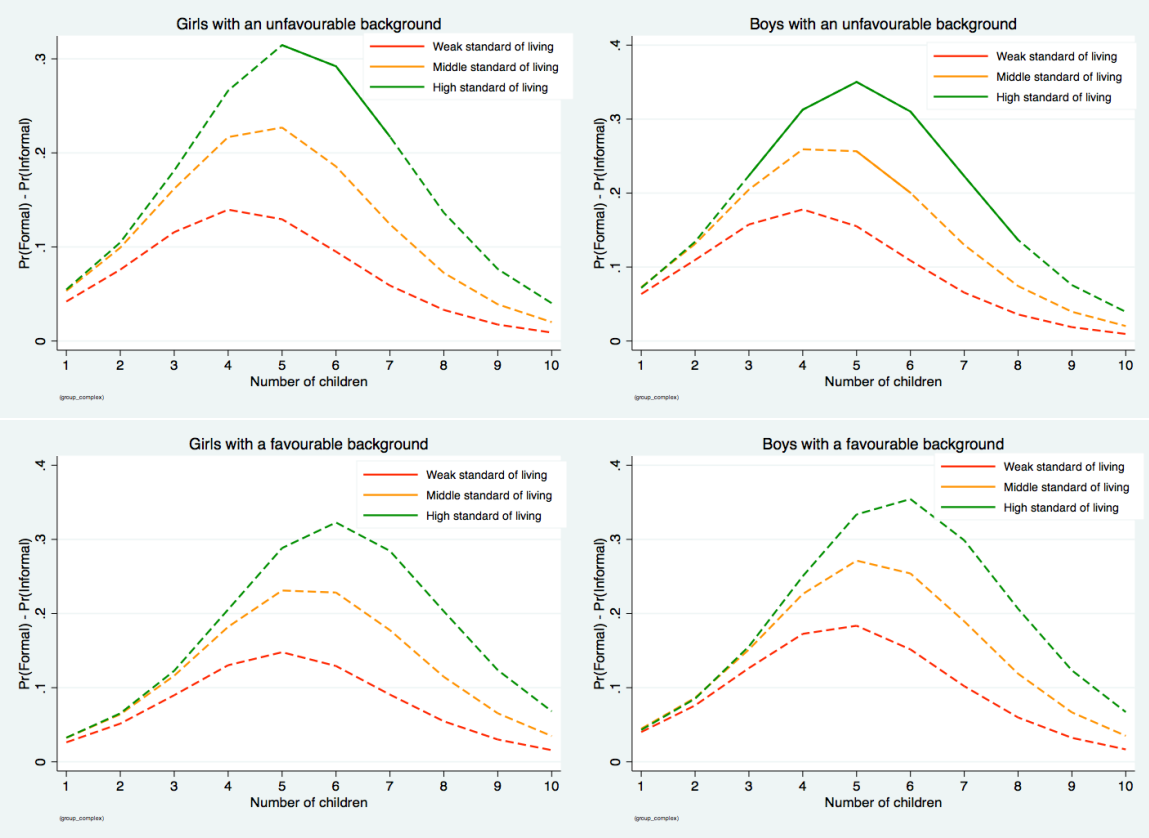

Figure 2.4 – Settlement difference in probability of reaching the post-primary school level by standard of living and number of children in the family (90% confidence interval)

Chapter 3

Contraceptive Use in Africa: Do Traditional Methods Matter in urban areas?

3.1 Introduction

The inter births interval (birth spacing) which is the time between a new birth and a previous one negatively affects child and maternal health. By increasing low birthweight or preterm delivery, closely spaced births or pregnancies can adversely affect child's outcomes in the short and long term. It also increases maternal nutrient depletion which in turn may contribute to increase risk of maternal mortality and morbidity. In 1984, Trussell and Pebly estimated that if all non-first-order births were spaced by at least two years, this would be associated with a reduction by 10% of infant mortality and by 21% of child mortality. By analyzing in several countries the relationships between the length of the preceding birth interval and the risk of neonatal, infant and child mortality, Rutstein showed that chance of child survival increases with increasing birth interval lengths up to 36 months (Rutstein, 2005). More recently, a review by Conde-Agudelo et al. 2006, confirmed that short birth intervals lead to increased risks of preterm birth and low birth weight which are likewise associated with fetal and early neonatal deaths.
In this context, family planning plays a central role. The goal of family planning is to assist families in achieving the number of children desired, with appropriate spacing and timing to ensure optimal growth and development of each family member [1]. So, increase the use of family planning would lead to an improvement in mother's and children's health, which in turn contribute to economic development. Unfortunately, despite that the fertility rate and maternal mortality are much higher in sub-Saharan Africa than in any other region of the world, few sexually active women use contraceptive methods (Population Reference Bureau, 2014). In some countries like Benin, Somalia, Chad, or Democratic republic of Congo, women use more traditional methods than modern ones. In a general view, according to the United Nation, in 2013, traditional methods are commonly used in Middle Africa and Western Africa. Indeed, in these regions, 57% and 29%, respectively, of married women of reproductive age are currently using a method of contraception rely on a traditional method. Thus, the question of whether the use of traditional methods is associated with more birth spacing is a concern.

In traditional society sub-Saharan Africa families have social gains increasing with the size of the family. So, women have traditionally practiced fertility regulation not for the family size limitation but for birth spacing (Caldwell,

1. $(WHO)http://www.who.int/topics/family_planning/en/AccessedJune2015$

1977; Dow, 1977; Lamptey et al., 1978; Rehan and Abashiya, 1981). Traditionally, birth spacing was linked with the fact that postpartum sexual relations were a taboo in Africa. This period of abstinence varied in length from few weeks after birth to two to three years in different societies (Lesthaeghe et al., 1981). Avoid pregnancy during breastfeeding period was the main reason for abstinence. Today, the ways of achieving birth spacing by traditional methods are changing. Urban living conditions and women education gradually eroded the taboo on postpartum sexual relations. The popular traditional methods are now based on fertility awareness which, include all methods based on the identification of the fertile phase of the menstrual cycle; withdrawal which is also known as coitus interrupts; and breastfeeding.

It is generally accepted that traditional methods are not as effective as modern methods (Trussell 2011). However, most of the available studies do not explicitly address or quantify the contribution of contraceptive methods types to birth spacing. In the literature of family planning, the effectiveness is mostly define by the percentage of women experiencing an unintended pregnancy during the first year of typical perfect use of a contraceptive method (Trussell et al., 2009; Trussell, 2011). In addition, data used in previous studies were not designed to answer questions specifically related contraceptive practice. The use of contraceptive in these studies was defined by the ever-use versus never-use of contraceptives, which is not time-specific to births. Evaluate contraceptive efficiency in a static context can be misleading. To analyze fertility decision, at least two essential features must be taken into account, such as: the dynamic dimension of fertility choices and women individual unobserved heterogeneity. Indeed, the motivation of contraceptive choice or the ability of efficiency use can vary across women and women's environment. Further, fertility choices are made in a life-cycle context, meaning that women or couples make decision about fertility each period until sterilization or when menopause occurs. So, time should be necessarily considered when analyzing contraceptive efficiency. In addition, in developing countries, economic and population growth are concentrated within urban areas (United Nations 2012). This trend results in relatively better socio-economic indicators in urban areas than in the rest of the country; however, those relatively good indicators hide important inequalities between subpopulations. A broad review conducted by the National Research Council in 2003 demonstrated that the urban poor in developing countries often face worse socio-economic conditions than the rural poor (see for instance Mont-

gomery and Hewett, 2005). So, unobserved heterogeneity can also occurs through differences across subpopulations within urban areas. For instance, fertility behaviour could differ from formal and informal settlements types or from poor and wealthy areas in the cities. These fundamental differences can lead to differences in contraceptive effectiveness across women from different subpopulations.

To assist policymakers, it is essential on the one hand to ascertain whether the difference of births spacing across contraception methods types are the result of socioeconomic and demographic disparity among women or couples, or whether such differences reflect the values, norms, beliefs, ideals and doctrines, and the other hand to investigate if such differences vary accros different subpopulations. If differences in contraceptive use can be attributed to socioeconomic and demographic characteristics rather than to norms and beliefs, then family planning programmes can be targeted to compensate for the differences between groups in characteristics such as education, employment and age at marriage, poverty etc. If, however, norms or beliefs is an obstacle to contraceptive use, this means that a cultural barrier may exist. So only expand availability of modern contraceptive use may do little towards increasing effectiveness of contraceptive methods.

In this paper, I investigate the link between the type of contraceptive method (modern and traditional) and birth spacing in Ouagadougou (Capital of Burkina Faso) by distinguishing women from formal and informal settlements types. Traditional contraceptive methods include the identification of the fertile phase of the menstrual cycle, withdrawal and folk methods such as strings and herbs. Modern methods include pills, the intrauterine device (IUD), injectables, implants, male condoms, female condoms, the diaphragm, foam/jelly, the lactational amenorrhoea method (LAM), and emergency contraception. The effectiveness is measured by birth spacing defined by the number of months between two consecutive births by considering all pregnancies of women.

The remainder of the paper is organized as follows. In the following section, I present the data and the empirical estimation strategy. Section 3 presents results while section 4 discusses these results and conclude.

3.2 Method and data

3.2.1 Econometrics specification

Study the relationship between the type of contraceptive method used and birth spacing is complicated to the extent that the method choice is potentially endogenous (Steele and Curtis 2003). Indeed, method choice is determined by number of factors linked to the women, including risk of failure, ease of continuation, intended length of use, ability of efficient use, and other unobserved characteristics of women that might also affect birth spacing. In particular, in Africa, partner's or husband's approval is a key factor of contraceptive choice. According to Magadi and Curtis 2003, women whose partners disapprove of family planning are highly likely to use traditional methods of family planning. Not taking into account theses factors can lead to the selection of women with high propensity of birth spacing. This, in turn, would lead to bias in the relationships between birth spacing and contraceptive choice.

To deal with some of the possible causes of endogeneity, I analyze the relationship between the type of contraceptive and birth spacing using women reproductive history. The reproductive history contains information of all births for each woman and the use of contraceptive before each pregnancy. This allows me to control for unobserved time invariant heterogeneity among women. The design allows for the assessment of whether women adopting natural or modern contraceptives experienced different pattern in birth spacing by analyzing within woman changes in birth spacing over time depending of the type of method used. To carry out this analysis, I estimate fixed-effects ordinary least squares regression models, in which the number of months between two consecutive births is the dependent variable. The model directly accounts for dynamic factors which affect birth spacing, as well as those constant unmeasured factors that differ between women. In addition, I also include year of birth fixed-effects, which capture any national policy that are not captured in any of the time-varying explanatory variables. Thus, the fixed effects basic model can be written as:

$$BSpace_{it} = \alpha_i + BYear_t + \beta_1 Tradi_{it} + \beta_2 Modern_{it} + \gamma NbChild_{it-1} + \alpha_1 Want_{it} + \alpha_2 HWant_{it} + \beta X_{it} + \epsilon_{it} \quad (3.1)$$

In this specification, i denotes women, t denotes birth order [2], BSpace is the time in months between birth t and birth t-1, BYear is the year of birth, NbChild is the number of children of the woman [3], X is a vector of various control variables. I have written the error term as composed of fixed woman (α_i) and time component ($BYear_t$) and a residual error (ϵ_{it}). Data I used contain information about whether child was wanted or not. I control for these information for woman (Want) and for woman partner (HWant). The parameters of interest are β_1 and β_2 which show the relation between the use of respectively traditional and modern contraceptive methods and birth spacing. However, even if this specification can allow to identify possible differences in women behavior between the formal and the informal settlement, the results cannot be interpreted as causal, because of the probable existence of time varying unobservables.

3.2.2 Data

In Burkina Faso, the family planning policy began to take shape in the 1980s following the recommendation of African and international and conferences on population (1971 Accra, Arusha and Mexica in 1984). The country's first action plan on family planning was developed in 1985 and involved the integration of family planning into health policy in order to control women's fertility. Despite the involvement of policies in family planning, and, even if this led to the increase of contraceptives use, Burkina Faso stay among countries with high fertility rate and low contraceptive use. According to the Demographic and Health Surveys between 1993 and 2010 modern contraceptive use increased from 2% to 11% and 17% to 31% in respectively rural and urban areas. At the same time the use of traditional method decreased from 3% to less than 1% in rural areas and from 9% to 4% in urban areas. Despite the increase of the modern contraceptive use, the fertility rate remained high. The fertility rate only decreased from 5.0 to 3.9 and form 7.3 to 6.7 in respectively urban and rural areas. This study focused on the role of the type of contraceptive on urban areas by distinguishing women living in formal and informal settlement types.

Data for this analysis was drawn from the Ouagadougou Health and Demo-

2. t is greater than one; meaning that we observe women from their second birth.

3. The specification assume that birth spacing at t is affected by the number of children at t-1.

graphic Surveillance System (OHDSS, a research platform implemented in five neighborhoods in the northern periphery of Ouagadougou.

Data on fertility and contraceptive use come from women retrospective history collected in 2012 and refer to women from 27 to 59 years old with at least one child. These data are about the use or not of contraceptive before each pregnancy, the type of contraceptive if used, the outcome of the pregnancy and information about whether the child was wanted or not. Contraceptive and fertility data are completed by observed socioeconomic, cultural, and demographic characteristics.

The analysis presented here is based on a sample of 2936 women with 1889 from the formal settlement. Table 3.1 presents the descriptive statistics for women sample by settlement type. We notice that the average age is about 40 in both types of settlement. As shown in the overall OHDSS sample in chapter 2, women in the formal settlement are more educated than those in the informal one. Indeed, in the formal settlement 45% have at least the primary education level compared to 25% in the informal settlements. Most of women are muslim belonging to the Mossi ethnic group and in union. Again, women from informal settlements are most poor than those in formal ones.

The average number of living children for each woman is around 4 in both types of settlements. This resulted in 15770 women-children observations (including the first birth of each woman). I removed pregnancies which resulted in miscarriage or abortion. The second part of the Table 3.1 presents some statistics about woman fertility and contraceptive use. A large fraction of women didn't use contraceptive before becoming pregnant. Indeed, in informal settlements, for 82% of pregnancies women didn't use any contraceptive method before, in 10% of cases, a modern method has been used and in 8% a traditional method has been used. In informal settlement, Contraceptive are less used compared to the formal settlement. Indeed, traditional and modern contraceptive have been used in only 4% and 7% of pregnancies respectively. Most of the pregnancies were wanted by both women and there partners.

Studies have shown that birth intervals less than two years are associated with adverse perinatal and maternal outcomes (Zhu et al. 2001, Fuentes-Afflick and Hessol 2000). According to these studies, when births are spaced from three to five years, this is associated with the lowest risks for fetal death, pre-term delivery, neonatal death, low birth weight and lower ma-

ternal morbidity and mortality. Figure 3.1 shows the distribution of birth spacing (aggregated into years) depending of the use of contraceptive methods. Two observations stand out. First, birth spacing of less than a year is low whatever the contraceptive method. In informal settlement, around 10% of the living children are born with less than a year apart from their predecessor. In this type of settlement, it seems to have no difference according to the use of contraception. In the formal settlement, this proportion is about 5% for women who used modern contraceptive before having pregnancy and between 10% and 15% for those who didn't use any method or traditional methods. However, according to birth spacing of less than two years, we observe a gap between on the one hand the use of traditional methods or the non-use of contraceptives and the other hand the use of modern contraceptives. The gap is observed mainly in the informal settlement. The second characteristic of this figure is related to the non-difference between the use of traditional method and the non-use of contraceptive. Indeed, in Figure 3.1 the distribution of birth spacing between pregnancies preceded by traditional contraceptive use and those preceded by the non-use of contraceptive is quite similar. These characteristic are confirmed by Table 3.2 which presents the average birth spacing by contraceptive use and the proportion of birth spaced with less than two years in both settlement types.

One of the central determinants of fertility is the opportunity cost of women's time in raising the children, which is higher for higher income women (Becker and Lewis 1973). So, one can think that women have closely spaced births to quickly reach there desired number of children and go back to their economics activities. If this is the case, the average number of children for women with closely spaced births would probably be low compared to the rest of women. The data show that the average number of children for women at least 39 years old and who experienced spaced birth of less than two years is five compared to four for women of the same age for who the minimum birth spacing is two years. So, the closely spaced births is not probably due to the desire to quickly limit the number of children.

3.3 Results

3.3.1 Contraceptive use and birth spacing

In this section, I present evidence of settlement differences about the link between the type of contraceptive use and the inter-birth interval. Table 3.3 shows the results of the random effects (RE) and fixed effects (FE) regressions of the inter-birth interval on the type of contraceptive used. Considering the whole sample, and in line with what is generally accepted, Table 3.3 shows that the inter-birth interval more increase with the use of modern contraceptive methods than the traditional ones. Indeed, both fixed effects and random effects regressions lead to an increase of nearly seven months of birth interval when the pregnancy is preceded by a use of modern contraceptive. When a traditional method is used, this lead to an increase of the birth interval by around four. Taking into a count the time invariant unobserved characteristics for women doesn't change the coefficient of the moderne contraceptive use. Indeed, the RE and the FE regressions led to an increase of inter-births interval of respectively 6.75 and 6.72. However, taking into a count these time invariant unobserved characteristics moves the coefficient of the use of traditional methods from 1.70 to 4.23 which, becomes significant. Fertility decisions and contraceptive choices in African countries occur in a social context in which, norms and practices are important. So, women who choose to use traditional method does not necessarily means that they are less motivated to birth spacing. This can be explained by a social motivation to provide evidence of the virtues of self-restrain and discipline (Johnson-Hanks, 2005). Traditional methods are also easier to use by women without the knowledge of their partner when he disapproves the use of contraception. Not controlling by such women time invariant unobserved characteristics my understate the effect of the traditional methods.

When we take into account the heterogeneity of the population, the importance of women unobserved characteristics regarding to traditional methods is more pronounced in the informal settlement. The use of modern contraceptive is associated with an increase of birth spacing of around seven months in the formal settlements type and five in the informal ones; this is associated with a little difference between the random effects and fixed effects regressions. However, regarding traditional methods, we observe a big difference between the random effects and fixed effects regressions in the informal settlements type. Indeed, in this type of settlements, while with the random

effects regression the results don't show a difference between the non-use of contraceptive and the use of traditional methods on birth spacing, the control of the women time invariant unobserved characteristics lead the a strong and significant increase of birth spacing. This means that traditional norms, the perception of family planning play an important role in this settlement. Particularly, when a path forward is accepted following intra-couple discussion about fertility choices, couples are more likely to better space and limit their family size. Couple communication about fertility has shown to be significantly associated with family planning use in sub-Saharan Africa (Lasee and Becker ,1997; Salway, 2014)). In particular when woman's partner supports the family planning, this is associated with the use of modern methods. In informal settlement due to the very low education level intra-couple discussion is not common. According to Burkina Faso 2003 Demographic and Health Survey only 40% of women with disadvantaged backgrounds said that their partner approves the family planning. So the possible non-acceptation of family planning could encourage women who wanted to space or limited the number of their children to use methods, which can easily be used without the knowledge of their partner. I performed the same analysis by restraining the sample to women aged up to 49 years. As shown in Table 3.5 the results is quite similar to the results obtained with the whole sample.

The results seem to show a significant women unobserved behaviour about traditional contraceptive use particularly in the informal settlement type. To see if this observed results depend to women parity, I performed the fixed effect regression by woman parity. In other words, I compare women with low number of pregnancies to those with high number of pregnancies. For a chance to only retain women who are near of the end of their maternity, I consider women with at least 40 years old. Table 3.6 shows the link between the type of contraceptive use by number of pregnancies. We notice that the large effect of the use of traditional methods occurs among women with a lower number of pregnancies (3 or 4 pregnancies). Notice that among those women with four pregnancies or less, 80% declared no longer want a child. This could suggest that women who voluntarily want to have a limited number of children and decided to use traditional methods pay more attention about its effectiveness. However, regarding the use of modern methods, the results don't show a big difference across women parities.

The main requirements for modern contraceptives are high efficiency, minimum side effects affecting a woman's body, simplicity, accessibility. Accord-

ing to this, and due to their heterogeneity, even the effects of the type of modern contraceptive can differ between the two types of settlements. In table 3.7, I perform both random effect and fixed effect regression by distinguishing the type of modern contraceptive using the most modern contraceptive used by women. Indeed, among pregnancies preceded by a modern contraceptive use, pills, injectable and norplant are used for more than 90%. I distinguished on the one hand Injectable or Norplant which are more easy to use and the other hand pills which require a daily tracking. Table 3.7 shows that the difference in the effect of modern contraceptives between the two settlements types comes mainly from the use of pills. Indeed, while we don't observe a significant difference between the formal and informal settlement types regarding to the injectable or norplant, the use of pills does not necessarily increase birth spacing in the informal settlement type. Women in the formal settlement type who used pills as contraceptive before the next birth significantly increase their birth spacing by around seven months. There differences might come from the differences in women characteristics in the two types of settlements. Better efficiency of pills requires a rigorous follow of the instructions which is not which easily feasible by illiterate women.

Due to the low contraceptive use presented in the descriptive statistics, I also compute the bootstrap percentile confidence intervals. Table 3.4 shows that the estimated parameters stay statistically significant with bootstrap standard error.

Data used in this study contain information on the survival status of the previous birth. According to Table 3.3, previous birth survival status affect birth spacing. After miscarriage (nonliving previous birth) or early death of the previous birth (death before reaching one year old), parents anxiously await a new birth. This tend to narrow the inter-birth spacing. When the previous birth dies before reaching one year old, this is associated with a reduction of the birth spacing by around 5 months in both type of settlement. The reduction is more pronounced when the pregnancy does not end with a live birth. In this case, birth spacing is reduced by around one year, particularly in the informal settlement. It is shown that women who have a miscarriage are more likely to give birth prematurely in their next pregnancy. Associated with a short inter-birth interval could increase the risk of complications for the next birth. The fact that pregnancy is wanted or not does not affect birth spacing. This is not surprising since the proportion of women or women's partner who declared ex post that the child was not

wanted is extremely low (See Table 3.1).

3.3.2 Contraceptive use and closely spaced births

With the adverse birth outcomes associated with closely birth intervals, the WHO recommends an interval of at least 24 months from a live birth to the next pregnancy. In the following, I analyze the relation between the short birth intervals and the type of contraceptive used before the pregnancy. Closely birth interval is define by a birth interval less than 24 months. In the two types of settlements. around 15% (15.9% and 14.3% in respectively the formal and the informal settlement types) of birth interval are less than 24 months. Table 3.8 shows the RE and FE regressions of the probability that a birth interval is less than 24 months. The loss of a previous birth is a important determinant of a closely birth interval. Indeed, the fact that a pregnancy ends with a nonliving birth or a early death of the previous living birth is associated with an strong increase of the probability that the next birth interval is less than 24 months. This confirms the decrease of the birth interval with a nonliving previous birth or an early death of a living previous birth seen in the previous section. Regarding contraceptive Table 3.8 shows that the use of both traditional and modern contraceptive decreases the risk of closely inter birth interval. In the formal settlement type the use of modern contraceptive appears to be more significant than traditional methods. In the informal settlement type, the reverse happens. Further, in this settlement type, as shown in the previous section, the control with women unobserved invariant characteristics increases the effect of the traditional methods.

3.3.3 Taking into account the heterogeneity within the settlement

In the previous sections, the estimations are made with the assumption that the link between the contraceptive use and birth spacing are constant in each settlement type. In this section, I analyse this link depending of the probability that a women use traditional or modern method before the pregnancy. Doing so, this allow me to also compare women behavior toward contraceptive use within and across settlements.

This analysis is done by using the Propensity Matching Score with heterogenous effects. This approach use the propensity score stratification to estimate

treatment effects at various points over the range of the propensity score. These strata-specific effects are then analyzed to determine whether there is a trend in treatment effects (in our case the effect of traditional method or the effect of modern method). The algorithm consists of four basic steps:

1. Estimation of the propensity score (i.e. the conditional probability to receive treatment) by probit model.
2. Construction of balanced propensity score strata.
3. Estimation of strata-specific average treatment effects.
4. Estimation of the trend of treatment effects across propensity score strata.

The results in Figure 3.2 show how the effect of each type of contraceptive varies depending of the probability to use such type of contraceptive. This effect is not constant as a function of the propensity score. In most case, greater the propensity score, higher is the effect. Only the traditional method in the formal settlement presents a negative trend. But one can see that only three strata are computed in this case. The positive trend means that women who have a high propensity to use a type of contraceptive leads to a greater birth spacing. This also confirms that the use of a type of contraceptive is not random. In general women have a individual idea of the "gain" of the contraceptive when they decide to choose the type. As we noted in section 3.3.1, this behaviour seems to be more pronounced in the informal settlement with the traditional method for which the Figure 3.2 shows a steeper slope.

3.4 Discussion and Conclusion

This paper investigate the role of traditional methods on birth spacing in a urban context by taking into account subpopulation unobserved heterogeneity. It focuses on the Capital of Burkina Faso by distinguishing women living in formal and informal settlement types. The results show that both modern and traditional methods increase birth spacing and decrease the probability that a next birth occurs in less than 24 months after the precedent one. But the results highlight the importance of women unobserved invariant characteristics and the heterogeneity of the two types of settlement. Tacking into account the unobserved invariant characteristics do not significantly affect the magnitude of the coefficient for modern contraceptive use in both settlement types. However, in the informal settlement type, considering women

fixed effect increase significantly the magnitude of the effect of traditional methods.

So, it is not clear that women who use traditional methods do have an unmet need, nor less motivation to avoid pregnancy. Also, it is not clear that they have less aware of modern contraception. For instance, in Cameroon, women have a social motivation of using traditional method and perceive it use as "honorable", as it provides evidence of the virtues of self-restraint and discipline, while not compromising future fertility (Johnson-Hanks, 2005). Further, birth interval is affected by breastfeeding duration (Huffman and Martin, 1994) and traditionally birth spacing have been achieved through a combination of prolonged breastfeeding and postpartum abstinence. The difference of the duration of breastfeeding between the formal and the informal settlement type might also contribute to explain the difference of the effect of traditional method on birth spacing. Indeed, it is shown that the breastfeeding duration in rural areas or disadvantaged areas is longer compared to urban areas (Perez-Escamilla, Rafael, 1994). Finally the non-approval of contraceptive use by women partner is higher in the disadvantaged environment and for less educated couples. So the possible non-acceptation of family planning by women partner in the informal settlement type could encourage these women to use methods, which can easily be used without the knowledge of their partner, particularly the traditional methods.

Therefore, to improve contraceptive use and their effectiveness, I recommend prioritizing actions depending to the type of subpopulation. The results show that efforts to promote contraceptive use should not be directed only toward modern methods, particularly in the informal settlement type. The place of traditional methods in family planning counseling and service provision should be reviewed. For example, in informal settlement, in addition to improve the accessibility of modern contraceptive methods, family planning policy might integrated information about the use of traditional methods. Indeed, for couples or women who opt to use traditional methods, it seems important even essential to sensitize them for a better knowledge and understanding of the menstrual cycle which is the most traditional method used. In Burkina Faso, only 39% of women are considered having clear awareness of the period when they are most fertile (EDS-BF, 2010). If only modern methods is promoted in such areas, a substitution effect might occur. In fact, the increasing of the use of modern contraceptive combined with urban living conditions might gradually erode the taboo on postpartum sexual relations

and modern contraceptive can then replace the effect of traditional practices of prolonged breastfeeding and postpartum abstinence.

The fact that the average of birth spacing is high in the two types of settlement while the number of children by women is relatively high means that a number of women use contraceptive for birth spacing but not for a purpose of birth limitation. So, this suggest a need to reexamine the purpose of family planning by also integrating explicite messages about birth limitation. It is also important to integrate messages encouraging the delay of the entry into union or early motherhood among teens.

If the analysis suggests a difference in women behaviour toward contraceptive use between the two types of settlement, it is essential to point out some limitations. The first one is inherent in the choice of family planning method used by woman. Several types of methods could be used before the beginning of the pregnancy. But for this study, only the main method is available. So I consider that the main method is the most used before the pregnancy. Second, the low contraceptive use in the sample can also be an issue, particularly for the traditional method. So it will be useful to replicate this study in countries with high traditional contraceptive use. Third, if the fixed effect allow to control for time invariant characteristics, the analysis do not take into account the time variant characteristics which could lead to a learning by doing process. So, even if results suggest a link between the type of contraceptive use and birth spacing which varies depending to the type of settlement, one cannot rigorously interpret the result as causal. The way to do is to use a dynamic structural model in which one could investigate whether the main features of the data can be rationalized in a dynamic stochastic optimization framework and quantify the impact on fertility or birth spacing of the variation in the use of each type of method and other technologies. This could be an extension of this paper.

3.5 Tables

Table 3.1 – Descriptive Statistics

	Formal settlement		Informal settlement	
Variables	Mean	SD	Mean	SD
Socio economic characteristics				
Age	43.01	4.60	41.70	4.25
Has at leat primary education level	0.45	0.48	0.25	0.43
Belonging to Mossi Ethnic group	0.87	0.33	0.91	0.28
Muslim	0.59	0.50	0.56	0.50
Christian	0.39	0.49	0.42	0.50
In union	0.85	0.35	0.82	0.38
Low standard of living	0.20	0.40	0.60	0.49
Middle standard of living	0.16	0.36	0.16	0.37
High standard of living	0.64	0.48	0.24	0.43
Nomber of living children	4.33	1.80	4.48	1.76
N	1889		1047	
Fertility and contraceptive use				
Traditional method before pregnancy	0.08	0.27	0.04	0.12
Modern method before pregnancy	0.10	0.30	0.07	0.26
No method before pregnancy	0.82	0.38	0.89	0.28
birth spacing (months)	40.37	24.76	38.67	20.92
Child wanted by woman	0.92	0.28	0.96	0.18
Child wanted by the partner	0.92	0.28	0.96	0.20
N	9820		5950	

Notes:
Source: Ouagadougou Health and Demographic Surveillance System, 2012.

Table 3.2 – Mean of birth spacing and proportion of births spaced less than two years

	Formal settlement		Informal settlement	
	Mean	95% Conf. Interval	Mean	95% Conf. Interval
Birth spacing: modern method	54.02	52.03 - 56.02	50.86	48.36 - 53.36
Birth spacing: traditional method	39.80	38.08 - 41.53	40.51	35.23 - 45.78
Birth spacing: no method	38.39	37.84 - 38.95	37.50	36.88 - 38.12
Less than 2 years: modern method	0.08	0.07 - 0.10	0.12	0.08 - 0.15
Less than 2 years: traditional method	0.16	0.13 - 0.19	0.12	0.04 - 0.19
Less than 2 years: no method	0.17	0.16 - 0.18	0.15	0.14 - 0.16

Notes:
Source: Ouagadougou Health and Demographic Surveillance System, 2012.

Table 3.3 – Contraceptive use and birth spacing

	Formal settlement		Informal settlement		All	
	RE	FE	RE	FE	RE	FE
Traditional method	2.29**	3.28*	0.22	11.54**	1.70	4.23**
	(1.15)	(1.92)	(2.80)	(4.50)	(1.04)	(1.75)
Modern method	7.77***	8.36***	5.59***	4.34***	6.75***	6.72***
	(0.83)	(0.98)	(1.06)	(1.20)	(0.66)	(0.76)
Nonliving previous birth	-10.92***	-7.69***	-13.55***	-12.12***	-12.00***	-9.51***
	(0.82)	(0.80)	(0.97)	(0.97)	(0.63)	(0.61)
Early death of previous child	-6.76***	-4.95***	-6.86***	-5.62***	-6.70***	-5.15***
	(0.89)	(0.87)	(0.98)	(0.97)	(0.66)	(0.65)
Child desired by woman	0.50	0.74	3.35	3.37	1.18	1.46
	(1.54)	(2.04)	(2.30)	(2.64)	(1.27)	(1.60)
Child desired by the partner	0.37	0.06	0.05	-1.30	0.08	-0.62
	(1.54)	(2.13)	(2.11)	(2.58)	(1.24)	(1.64)
R-squared	0.28	0.20	0.24	0.20	0.26	18.00
N	7931	7931	4903	4903	12834	12834

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1.
"Traditional method" indicates that a traditional method is used before the beginning of the pregnancy.
"Modern method" indicates that a modern method is used before the beginning of the pregnancy.
Source: Ouagadougou Health and Demographic Surveillance System, 2012.
Dependent variable: time in months between birth t and birth t-1.

Table 3.4 – Contraceptive use and birth spacing: Bootstrap percentile confidence intervals

	Formal settlement		Informal settlement	
	RE	FE	RE	FE
Traditional method	2.29**	3.28	0.22	11.54**
	[0.59 4.90]	[-0.89 7.09]	[-0.22 5.56]	[5.23 20.44]
Modern method	7.77***	8.36***	5.59***	4.34***
	[6.17 - 9.94]	[5.95 - 10.57]	[3.09 7.81]	[2.76 7.33]
N	7931	7931	4903	4903

Table 3.5 – Contraceptive use and birth spacing for women less than 49 years old

	Formal settlement		Informal settlement		All	
	RE	FE	RE	FE	RE	FE
Traditional method	3.48**	3.70*	0.56	11.50**	2.65**	4.86***
	(1.24)	(2.02)	(2.82)	(4.56)	(1.12)	(1.86)
Modern method	7.74***	7.95***	5.46***	4.28***	6.68***	6.35***
	(0.88)	(1.03)	(1.10)	(1.26)	(0.69)	(0.80)
Nonliving previous birth	-10.93***	-7.24***	-14.01***	-12.53***	-12.21***	-9.44***
	(0.87)	(0.84)	(1.03)	(1.04)	(0.66)	(0.65)
Early death of previous child	-8.41***	-6.58***	-6.66***	-5.34***	-7.45***	-5.87***
	(0.96)	(0.93)	(1.04)	(1.04)	(0.71)	(0.69)
Child desired by woman	0.86	1.97	3.83	3.87	1.68	2.44
	(1.63)	(2.09)	(2.35)	(2.72)	(1.32)	(1.65)
Child desired by the partner	1.00	0.15	-0.20	-1.65	0.35	-0.57
	(1.65)	(2.24)	(2.15)	(2.68)	(1.30)	(1.71)
R-squared	0.29	0.21	0.25	0.20	0.27	0.19
N	6816	6816	4432	4432	11248	11248

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1.
"Traditional method" indicates that a traditional method is used before the beginning of the pregnancy.
"Modern method" indicates that a modern method is used before the beginning of the pregnancy.
Source: Ouagadougou Health and Demographic Surveillance System, 2012.
Dependent variable: time in months between birth t and birth t-1.

Table 3.6 – Contraceptive use and birth spacing for woman at least 40 years old by parity

	Nb. Child.≤3	Nb. Child.>3	Nb. Child.≤4	Nb. Child.>4	Nb. Child.≤5	Nb. Child.>5
Traditional method	18.43*	2.85	16.98**	1.97	5.55	2.72
	(10.98)	(1.95)	(7.20)	(1.93)	(3.79)	(2.17)
Modern method	4.23	6.25***	6.60***	6.46***	4.52***	7.89***
	(4.14)	(0.88)	(2.16)	(0.94)	(1.44)	(1.08)
N	794	9520	2012	8302	3859	6455

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1.
"Traditional method" indicates that a traditional method is used before the beginning of the pregnancy.
"Modern method" indicates that a modern method is used before the beginning of the pregnancy.
Source: Ouagadougou Health and Demographic Surveillance System, 2012.
Dependent variable: time in months between birth t and birth t-1.

Table 3.7 – Contraceptive use and birth spacing by distinguishing modern methods

	Formal settlement		Informal settlement	
	RE	FE	RE	FE
Traditional method	2.19*	2.54	0.09	11.94***
	(1.15)	(1.91)	(2.80)	(4.51)
Pilule	6.11***	7.13***	2.46*	2.47
	(1.02)	(1.22)	(1.42)	(1.59)
Injectable or Norplant	8.16***	8.47***	9.54***	6.98***
	(2.30)	(1.54)	(1.54)	(1.68)
R-squared	0.28	0.19	0.24	0.20
N	7931	7931	4903	4903

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1.
"Traditional method" indicates that a traditional method is used before the beginning of the pregnancy.
"Pilule" indicates that a pill is used as contraceptive before the beginning of the pregnancy.
Injectable or Norplant" indicates that a Injectable or a Norplant method is used as contraceptive before the beginning of the pregnancy.
Source: Ouagadougou Health and Demographic Surveillance System, 2012.
Dependent variable: time in months between birth t and birth t-1.

Table 3.8 – Contraceptive use and closely births

	Formal settlement		Informal settlement	
	RE	FE	RE	FE
Traditional method	-0.07	-0.30	-0.32*	-0.60**
	(0.13)	(0.35)	(0.19)	(0.28)
Modern method	-0.58***	-0.83***	-0.14	-0.35*
	(0.15)	(0.23)	(0.20)	(0.21)
Nonliving previous birth	2.39***	1.79***	2.71***	2.28***
	(0.10)	(0.13)	(0.13)	(0.17)
Early death of previous child	1.76	1.53***	1.78***	1.57***
	(0.11)	(0.14)	(0.14)	(0.16)
N	7931	4203	4903	2555

Notes:
Robust standard errors in brackets. ***p<0.01 **p<0.05 *p<0.1.
"Traditional method" indicates that a traditional method is used before the beginning of the pregnancy.
"Modern method" indicates that a modern method is used before the beginning of the pregnancy.
Source: Ouagadougou Health and Demographic Surveillance System, 2012.
Dependent variable: Probability of birth interval less than 24 month.

3.6 Figures

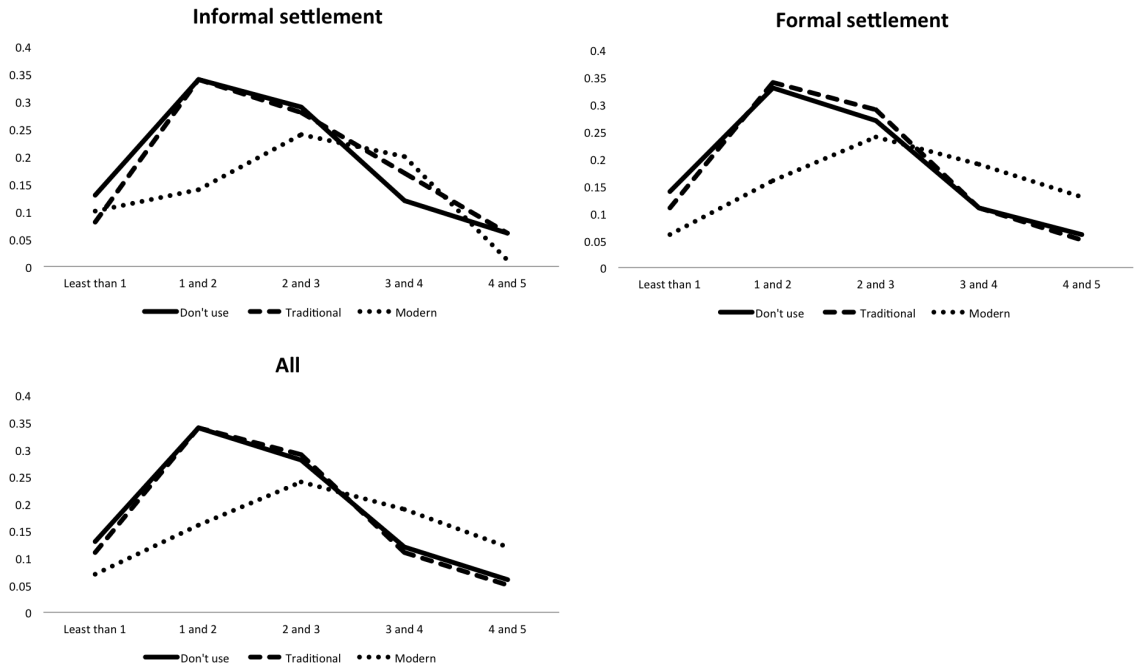

Figure 3.1 – Distribution of birth spacing by settlement type

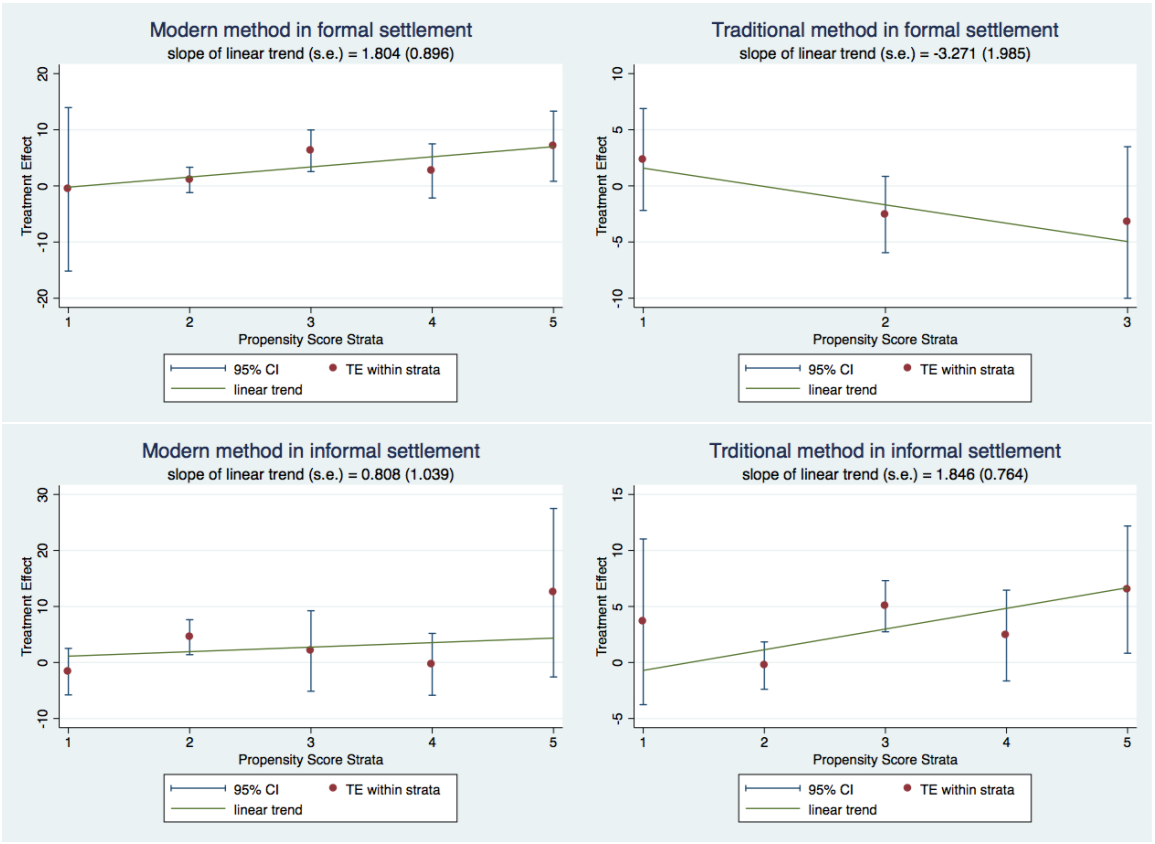

Figure 3.2 – Effect of the type of contraceptive by propensity score

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