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Breaking the Waves?

Does Education Mediate the Relationship Between Youth Bulges and Political Violence?

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Abstract

Much of the developing world has experienced a decline in mortality, while fertility often has remained high. This has produced youthful populations in many countries, generally referred to as "youth bulges." Recent empirical research suggests that youth bulges may be associated with increased risks of political violence and conflict. This paper addresses ways that education may serve as a strategy to reduce the risk of political violence, particularly in the context of large cohorts of young males. The authors use a new education dataset measuring educational attainment. The dataset is constructed using demographic back-projection techniques, and offers uninterrupted time-series data for 120 countries. The empirical analysis finds evidence that large, young male population bulges are more likely to increase the risk of conflict in societies where male secondary education is low. The effect on conflict risk by low education and large youth populations is particularly strong in low and middle-income countries. This is especially challenging for Sub-Saharan Africa, the region facing the youngest age structure and the lowest educational attainment levels. Although quantitative studies generally find a strong relationship between indicators of development and conflict risk, the results suggest that poor countries do have some leverage over reducing conflict potential through increased educational opportunities for young people. There is further evidence that the interaction of large youth cohorts and low education levels may be mediated by structural economic factors. The study supports broad policy interventions in education by relaxing concerns about the consequences of rapid educational expansion.

This paper—a product of the Post Conflict & Social Development Unit, Africa Region, with support from the Trust Fund for Environmentally and Socially Sustainable Development and the Norwegian Ministry of Foreign Affairs—is part of a larger effort to build a solid body of theoretical and applied research on the links between youth exclusion and political violence. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at Bilal.Barakat@oeaw.ac.at and henriku@prio.no.

Breaking the Waves? Does Education Mediate the Relationship Between Youth Bulges and Political Violence?[1]

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[1] This paper has previously been presented at a PRIO & World Bank conference on 'Youth Exclusion and Political Violence: Breaking the Link and Engaging Young People Positively in Development', Oslo 4-5 December 2008; at the United Nations Population Fund's (UNFPA) Expert Group Meeting on Age Structural Transitions, Vienna 7-9 October 2008; and at the 49th Annual Meeting of the International Studies Association, San Francisco, CA, 26–29 March 2008. It is part of a larger research project on 'Youth Exclusion and Political Violence', funded by the World Bank Trust Fund for Environmentally and Socially Sustainable Development (TFESSD) with support from the Governments of Finland and Norway, and by The Norwegian Ministry of Foreign Affairs.

1.0 Introduction

Recent quantitative studies have found that large youth cohorts, or 'youth bulges' generally increase the risk of internal armed conflict or civil war (Cincotta et al, 2003; Staveteig 2004; Urdal 2006; 2008). Explanations for this relationship have been sought in the environmental conditions determining economic, social and political opportunities for young people. While young men are undoubtedly the main protagonists of political, as well as criminal, violence, the vast majority of young men do not engage in violent conflict. Nor are countries with very youthful age structures necessarily predestined to experience instability and conflict. In fact, given the right conditions, large youth cohorts may represent a significant resource that can boost development, a so-called 'demographic dividend'. Recent studies in economic demography suggest that countries are better positioned to achieve economic progress if large youth cohorts precede significantly smaller cohorts (Birdsall et al., 2001).

While large youth cohorts may generally increase the risk of conflict, the contextual factors that determine when this is true, and under what conditions large youth cohorts may be a blessing, are not well understood. More generally, the realization of the demographic dividend 'depends upon other features of the social, economic, and political environment' (Williamson, 2001: 108). The conflict potential of large youth cohorts has been linked to the opportunity structure of youth cohorts determined by factors like economic growth, the structure of the economy, unemployment and educational attainment. Addressing the size of the cohorts merely captures limited aspects of the opportunity structure, hence the challenge lies in identifying how environmental factors may systematically influence the youth bulge and conflict nexus.

This article analyzes the potential mediating role of educational attainment and education reform on the relationship between youth bulges and conflict. Our ambition is to test prevailing hypotheses on the relationship between youth bulges, education and different forms of political violence in a global model for the 1970-2000 period. Greater levels of educational attainment are generally perceived as a positive factor, increasing the opportunity cost of young people and hence reducing the likelihood that they are recruited to rebel organizations. Indeed, large public investment in basic education is seen as an important success factor behind the realization of the demographic dividend in East Asian countries such as South Korea and Taiwan, while countries in Latin America have, among other things, invested less in education, and largely failed to take advantage of rapid demographic change (Birdsall & Sinding, 2001: 11).

However, certain forms of pressures in the educational system have been argued to potentially increase frustrations and anger among youth. Specifically, we address claims that conflict may arise due to unmet expectations in the form of low progression ratios between different education levels, as well as following rapid expansions in secondary and tertiary education presumably producing an over-capacity of highly educated youth for which there are limited employment opportunities.

Expanding access to education is a tool that countries may use in order to respond to large youth cohorts. Since, relative to most other factors that are known to affect the risk of civil war (Hegre & Sambanis, 2006), expanding education is a feasible policy-option for most governments, the study of the role of education is particularly pertinent (Thyne, 2006). But as Mack (2002) points out, policy-makers may not take a great interest in general recommendations of policies that are already widely pursued as a broader development agenda, even though

invoking security arguments is often helpful for rallying support behind a specific policy. Rather, identifying more specifically what forms of education and under what conditions educational reform may help break the general adverse relationship between youth bulges and political violence can form the basis for developing better policy instruments for engaging youth in development rather than violence.

The issue of age structure aside, the interaction of schooling and national conflict has attracted increasing interest from educational researchers for at least a decade. Initially attention focused primarily on the detrimental effects of violent conflict on educational development, Education for All (EFA) and educational MDGs (c.f. Machel, 1996; Bensalah et al., 2000). More recently, the ways in which inequitable schooling and discriminatory curricula can actively contribute to violence have been exposed, leading to the notion of 'the two faces of education in conflict' (Bush & Saltarelli, 2000; Davies, 2004). Tomlinson & Benefield (2005) provide a recent review of the field. To date, most of this research has been qualitative, reflecting the fact that the research agenda has been driven by the concerns of practitioners and researchers 'in the field', a lack of comparable international data, and the complexity of the interaction.

Despite the different nature and emphasis of the present study, the body of research on 'education and conflict' offers a warning important to any attempt to study the effect of schooling 'outcomes' (attainment levels) on violent conflict, namely that the educational process and content have been shown to matter. Much variability is to be expected in the effect of high participation in secondary schooling, since 'secondary schooling' can, depending on context, mean either exposure to incitement and a culture and logic of violence, as an examination of textbooks in Afghanistan (Spink, 2005) or pre-genocide Rwanda (Obura, 2003) show, or to civics and peace education.

We are using a newly constructed dataset measuring cohort-specific educational attainment rates. The dataset, developed by researchers at the International Institute for Applied Systems Analysis (IIASA), contains time-series data from 1970-2000 for 120 countries. Based on age-specific education data from national censuses and Demographic Health Surveys (DHS), the project has performed demographic back-projections to arrive at the most consistent and complete education dataset available, representing a vast improvement over existing education datasets that primarily measure educational enrollment. Since it is primarily young men who are the perpetrators of violence, this paper focuses on educational attainment for young men, as well as the size of young male cohorts. Armed conflict refers to low-intensity internal conflict as defined by the Uppsala/PRIO dataset (Gleditsch et al. 2002). We are also employing two different age composition measures, a procedure aimed at discriminating between rival explanations in the youth bulge literature. The Relative Youth Cohort Size (RYCS) measure is more sensitive to reduced employment opportunities arising from a rapid increase in the size of youth cohorts relative to the immediate preceding cohorts (Easterlin, 1987; Korenman & Neumark, 1997; Machunovich, 2000), while the conventional youth bulge measure captures the overall abundance or density of youth in the adult population determining the relative availability of potential rebel soldiers with generally low opportunity cost. We specifically address the role age structure and education in Sub-Saharan Africa. Exploring whether expanding education in Sub-Saharan Africa may contribute to curb conflict in one of the poorest and least stable regions of the world has important policy implications.

2.0 Youth, education and conflict

Youth bulges have been argued to provide both opportunities and motives for political violence. Collier (2000: 94) has suggested that relatively large youth cohorts may be a factor that reduces recruitment costs through the abundant supply of rebel labor with low opportunity cost, increasing the risk of armed conflict. According to the opportunity perspective, rebellion is feasible only when the potential gain from joining is so high and the expected costs so low that rebel recruits will favor joining over alternative income-earning opportunities. Studies in economic demography also suggest that large cohorts are likely to experience a pressure on wages, so that the opportunity cost of a person belonging to a large cohort is on average lower than that of a person belonging to a smaller cohort (Easterlin, 1987; Machunovich, 2000).

Another strain of literature focuses on how youth bulges provide motives for political violence. Frustration and aggression among youth populations arise as a result of pressures in educational institutions or the labor market (Moller, 1968; Choucri, 1974; Braungart, 1984; Huntington 1996; Goldstone, 1991; 2001; Cincotta et al., 2003). Youth unemployment is generally higher among younger than older cohorts, and in some countries youth unemployment is particularly high among educated youths (e.g. McNally et al., 2004: 162; Kabbani & Kothari, 2005). In the following, we discuss how education may relate to these two perspectives, and address youth and education in relation to relevant determinants of conflict motives and opportunities.

2.1 Education as a Factor that Increases Opportunity Cost

Opportunity factors in armed conflict relate to structural conditions that facilitate a rebel group's war against a government. These may either be conditions that provide the rebel group with extraordinary financial means to fight, or factors that reduce the cost of rebellion, such as unusually low recruitment costs for rebel soldiers. The availability of large youth cohorts may be a factor that reduces recruitment costs through the abundant supply of rebel labor with low opportunity cost (Collier, 2000). Rebel recruits join to obtain a private good, weighing the potential gains against the expected costs represented by the risk of being killed or maimed. Relative gains are high either when outside options are poor, or when a rebel group can offer greater rewards through loot-seeking activities (Gates, 2002: 116).

Education is generally expected to increase the opportunity cost of rebel labor, since an educated person on average is expected to have greater income-earning opportunities, although for the relatively small number of 'conflict entrepreneurs', a higher level of education may in fact lead to *higher* rewards on account of more efficient management of illicit trade or similar activities. However, the present study is concerned with *structural* conditions, and the argument that rebel activity is economically less attractive to more highly educated youth refers to mass participation as fighters.

This implies that rebel recruitment is more costly and rebellion less likely the higher the level of education in a society (Collier & Hoeffler, 2004), everything else being equal. In countries with large potential pools of recruits, increasing educational attainment at any level can act to reduce this pool, and we should expect to see that youth bulges primarily are associated with an elevated risk of conflict in low-education societies. Furthermore, we expect that structural economic conditions affect the relative opportunity cost of a young educated person. More

specifically we hypothesize that the income-earning opportunities for educated youth are greater in societies where economic opportunities are good, assuming that among low and middle income countries, large youth cohorts and low educational attainment rates are relevant for explaining the onset of violent conflict. In particular, we expect this to be true for sub-Saharan Africa, a region that generally sees large youth populations and low investments in education, and also generally offers fewer economic opportunities for youth. Studying the social, economic and political determinants for the positive engagement of African youth into development has obvious policy implications.

Although the argument that education increases the opportunity cost of youth takes a general form, we focus here on secondary education for young males since they are the primary target for recruitment and because gender disparities in education are widely observed.

> H_1: Countries that invest less in secondary education for young men are more likely to experience armed conflict in the context of large youth bulges.

> H_2: Large cohorts of young men with low secondary education levels increase the risk of conflict more in low and middle income countries, and in particular in Sub-Saharan Africa.

We further assess the claim by Weinstein (2005) that a rebel group's resource profile determines the socio-demographic make-up of the rebel organization. Rebel organizations that have access to rich natural resources are able to quickly overcome the collective action problem and build a substantial army by offering private economic rewards to new recruits. Rebel groups that do not possess considerable economic endowments instead have to draw on social endowments 'including shared beliefs, common expectations, norms of behavior, and trust with certain members of the population' (ibid. p. 601). While the recruitment processes of such rebel organizations are more incremental, the quality of recruits is generally greater since recruits have to be highly committed to accept that rewards are long-term. Low-commitment recruits, on the other hand, are likely to join only if immediate and significant rewards are credibly offered. Weinstein argues that this represents a rebel 'resource curse', where access to rich resources tends to flood rebel organizations with opportunistic joiners (ibid. p, 599). He observes that both in Mozambique (Renamo) and in Sierra Leone (RUF), where the economic endowments were considerable, rebel organizations consisted mainly of poorly educated individuals. In Mozambique less than three percent of the soldiers had an education at the high school level and above (ibid.: 613). This is contrasted with the National Resistance Army (NRA) in Uganda and the EPLF in Eritrea, both of which had to rely on social endowments, resulting in organizations with a very different educational structure than those of Renamo and RUF (Weinstein, 2005). Similarly, Oyefusi (2008) found that low educational attainment significantly increased the willingness of young people to participate in armed struggle for local resource control in the oil-rich Niger Delta, Nigeria, despite lower levels of grievances among low educated than among better educated youth. Building on these observations we posit that the availability of large and uneducated youth cohorts may be a factor that particularly increases the risk of conflict in countries that possess rich natural resources.

H_3: The presence of large youth cohorts with low education increases the risk of conflict more the higher the country's dependence on rich natural resources.

2.2 Education as a Factor that Produces Frustration and Aggression

Relative deprivation theory posits that grievances and frustration arise when the gap between people's expectations and their actual situation widens (Gurr, 1970). Political violence is seen as a means to redress these grievances (Sambanis, 2002). Although we here treat low education as an opportunity factor, the argument could also be made that a lack of spending on education generally signals low governmental responsiveness vis-à-vis the population, and may produce grievances among segments of the population barred from the educational system (e.g. Thyne, 2006). This interpretation is plausible, and we are not able in the current empirical assessment to distinguish between low education as an opportunity or a motivation factor. In the following, we focus on two factors that arguably more clearly capture grievance, rather than opportunity, aspects: unmet expectations of educational progression, and expansions in education leading to an over-supply of educated youth.

The provision of near universal lower education is assumed to greatly increase expectations of further educational opportunities among young people, and the failure to provide such may increase anti-government grievances. In many countries it has been an explicit focus on first providing primary education to all, giving less priority to providing secondary and higher education. An example from our sample is Namibia, where primary attainment levels among 15-19 year-old men in 2000 were 100%, while only 24 percent of young men aged 20-24 had received secondary or higher education. In Tanzania, the corresponding numbers were roughly 80% primary and 10% secondary male attainment (see Appendix B through E for attainment levels in Sub Sahara Africa). Thyne (2006) argues that primary enrollment rates capture government responsiveness towards the population. We hold that low educational progression ratios, meaning low opportunities for advancing from one level of educational attainment to the next, may be a better indicator of low government responsiveness and more strongly associated with greater risks of conflict.

Second, increasing education leads to increasing expectations of getting employment, and grievances may arise if economic opportunities for educated youth are severely limited compared to the supply. It has been argued that high unemployment among educated youth is one of the most destabilizing and potentially violent socio-political phenomena in any regime (Choucri 1974: 73), and Goldstone notes that rapid increases in the number of educated youth historically have been associated with political upheaval. Lia (2005: 145-146) argues that the expansion of higher education in many countries in the Middle East, producing larger classes of educated youth than the labor market can absorb, has had a radicalizing effect and provided new recruits to militant organizations in the area. Unless there are economic opportunities either in the private sector or through government programs, prevailing unemployment among highly educated youth segments may cause frustrations that could motivate political violence. Although we are unable to measure economic opportunities directly, we assume that labor markets generally are not sufficiently flexible to accommodate rapid increases in the number of highly qualified

youth. Hence, an important policy question is whether countries are best advised to expand educational opportunities gradually in order to avoid increased grievances and instability.

H_4: The lower the educational progression ratios from primary to secondary, the greater the risk of armed conflict.

H_5: Rapid expansions in educational attainment (secondary/tertiary) increase the risk of armed conflict.

3.0 Empirical model and data

The analysis is based on a dataset combined from a number of sources and expanded through the calculation of additional derived variables. The dataset covers 120 countries for the 1970-2000 period, as well as four historical entities. The spatial-temporal domain is determined by the coverage of the education dataset used (Lutz et al., 2007; see Appendix A).

Data on the dependent variable, *domestic armed conflict onset,* is drawn from the Uppsala/PRIO dataset (Gleditsch et al., 2002). The Uppsala/PRIO dataset sets a relatively low violence threshold for conflict, and distinguishes between minor armed conflict (a minimum of 25 battle-related deaths per year), and war (at least 1,000 battle-related deaths per year). Several conflicts in the dataset are inactive for periods before they restart, posing the issue of how to code recurring conflicts. The dependent variable used for this study requires at least two years of inactivity before a new onset is coded.[2] Similarly, conflicts beginning while another conflict in the country is already in progress are excluded. In other words, only transitions from a spell of peace to a state of conflict are analyzed. There are a total of 79 conflict onsets among the countries covered by the IIASA dataset during the 1970-2000 period.[3]

We have used two measures for *young male bulges*, the conventional measure of 15-24 year old males as share of all males aged 15 and above, and a measure that better captures the dynamics in the younger working-age segments measured as the ratio between 15-29 year-olds and 30-44 year-olds, the Relative Youth Cohort Size (RYCS). Both measures are constructed on the basis of the age structure data provided in the education dataset (Lutz et al., 2007), which is consistent with the UN Population Division's *World Population Prospects: The 2004 Revision*. As described above, the RYCS measure should be more sensitive to reduced employment opportunities due to increasing relative cohort size, while the conventional measure more generally captures the abundance of youth in the adult population. Both of these measures were centered on their means.

[2] In a previous study (Urdal, 2006), alternative coding rules were applied by changing the requirement to one year and five year of inactivity, with only marginal impacts on the main results.

[3] The corresponding number of conflict onsets for all countries for the same period is 125.

3.1 IIASA Human Capital Data

Education data originate from a new dataset compiled by researchers at IIASA (Lutz et al. 2007). The dataset contains information from 120 countries for the 1970-2000 period, based on individual-level educational attainment data from Demographic Health Surveys and national censuses, back projected using multi-state demographic modeling. The dataset measures educational attainment as opposed to more commonly used education measures like educational spending or enrollment rates. It covers a great number of developing countries, including many countries with recent conflict experiences.

The IIASA data consists of population estimates by age, gender and highest educational attainment (4 categories: no schooling, some primary, completed lower secondary, completed tertiary), covering the period from 1970 to 2000, for 120 countries/territories (discrepancies between this figure and others below arise from the fact that more countries have been added since the publication of Lutz et al. (2007) and the introduction of splits and mergers during data matching). It is discussed in some detail here because of the novel methodology it is based on and the implications this has for the present analysis.

The dataset corrects a number of deficiencies of existing education statistics for this period that have to this date prevented the kind of analysis conducted in this study. The principal existing source for historical international education statistics has been UNESCO, which has been collating national education statistics since the 1960s. Unfortunately, this database suffers from at least four problems. Firstly, there are many gaps, reflecting years in which no statistics were provided by particular countries. Secondly, not all countries had the capacity to collect reliable data, especially in earlier years. Thirdly, the statistics are not fully consistent across countries due to different definitions. Fourthly they are not consistent over time, as definitions, incl. internationally agreed ones, such as the *International Standard Classification of Education* (ISCED) categories, were modified at various points in time.

The IIASA dataset attempts to overcome these limitations by employing a novel methodology inspired by demographic methods to reconstruct historic attainment data from censuses performed around the year 2000. The central idea is that at any point in time, the education profile of the population reflects its educational history much like its age profile reflects past fertility and mortality. Since the highest education level is typically reached relatively early in life, it can be assumed that the 50-year olds with secondary education in 2000 come from exactly one population group in 1995, namely the 45-year olds with secondary education, rather than a mixture of these and 45-year olds in 1995 who graduated from secondary school between 1995 and 2000. This principle is refined by applying differential mortality rates to different educational attainment groups, by disaggregating the oldest age group and normalizing the figures to the known total population size known for any intermediate years. For a more detailed reference, see (Lutz et al., 2007).

The dataset produced by this method is by design complete in the sense that every combination of country and year within its scope contains a data entry; it can be considered more reliable in that data from recent census results can be assumed to be of higher quality than data collected twenty or thirty years ago, when many developing countries had lower statistical capacity; it is consistent across countries in that the census categories are mapped to the ISCED classification in creating the baseline data; and it is consistent over time in that the entire dataset is with

reference to the definitions valid in 2000, regardless of different conventions at the time.

On the other hand, the IIASA dataset comes with limitations of its own. A significant number of countries is not included, and – especially relevant to the present study – since it is difficult or impossible to conduct an effective census in unstable countries, exclusion from the list is likely to correlate with the occurrence of conflict.

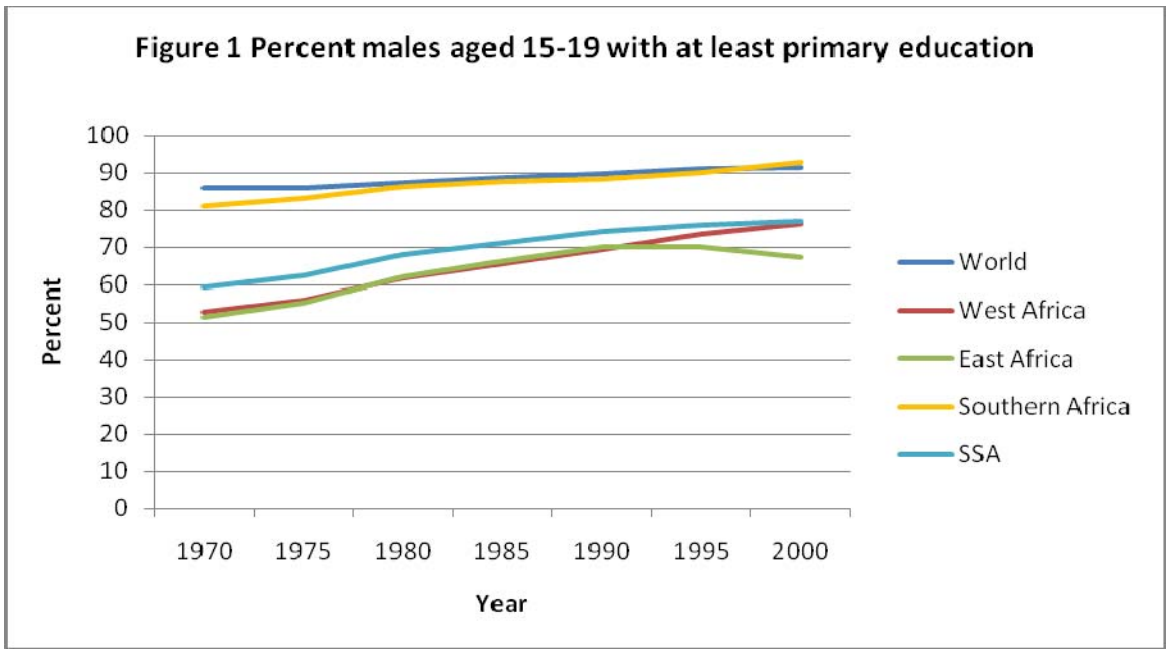
Another limitation lies in the necessity to make more or less well-justified assumptions regarding firstly the education profile of migrants, and secondly the age at which educational transitions occur. While the transition to primary education can be assumed to occur before the age of 15 for the vast majority of those who do make it, the proportion of lower secondary completions occurring before and after the age of 15 must be estimated. The range of ages of transition to tertiary education is even greater, especially in many developing countries.

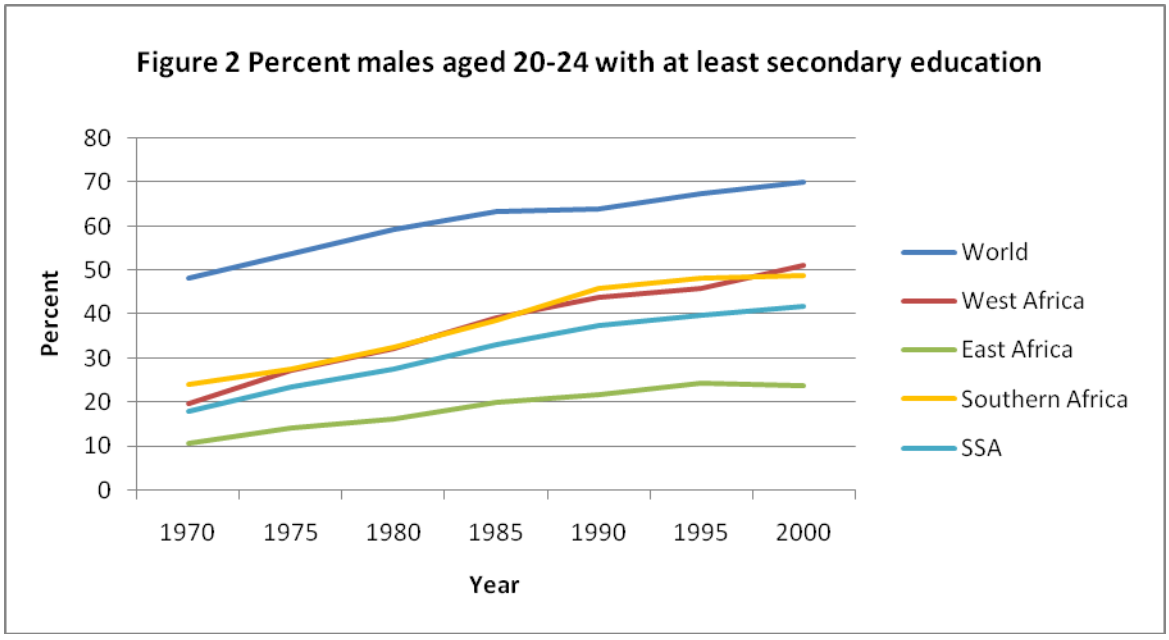
While these assumptions regarding the exact age of transition may not be critical when analyzing the effect of the education profile of the entire labor force on economic growth, say, an analysis dealing with youth, i.e. focusing on the ages at which the transitions tend to occur, is more sensitive to them. An additional complication lies in the definition of the education levels. Mapping all possible educational attainment levels to 4 categories necessarily means some distinctions are blurred. The mapping in the IIASA data means that all those with any primary schooling but who never completed lower secondary school fall into level 2. As a result, individuals can be registered as being at level 2 even if they only attended primary school for a year, and are for all practical purposes (and for the purposes of the present analysis) indistinguishable from the lowest attainment level.

To mitigate the impact of the above, the present study focuses primarily on the effect of secondary schooling. This means it is unaffected by the blurring between the bottom two levels and by the problematic assumptions regarding the age of tertiary completion. The principle education variable analyzed is the proportion of 20-24 year-old males in the two higher attainment categories, i.e. having *at least* completed lower secondary school. Even though the values for males and females are highly correlated (Pearson's correlation coefficient > 0.95), the value for males is chosen on account of reflecting more closely the theoretical considerations that it is specifically young men who contribute to conflict potential. This indicator is robust to the exact timing of the transition from ‘some primary’ to ‘completed lower secondary’, because all of these are assumed to have occurred by age 20.

We have constructed additional education variables to test more specific claims in the youth bulge and conflict literature. *Progression ratios* from primary to secondary education are defined as the percentage of males aged 15-19 with secondary or higher education of all males aged 15-19 with primary or higher education. Similarly, progression ratios from secondary to tertiary education are defined as the percentage of males aged 24-29 with tertiary education as a share of all males aged 24-29 with secondary or higher education. *Expansion in secondary education* among males aged 15-24 is defined as the number of males with secondary education aged 15-24 at time t less the number in the same category in period t-1, normalized over the total male population aged 15-24 at time t. Similarly, expansion in tertiary education among males aged 20-29 is defined as the number of males with tertiary education aged 20-29 at time t less the number in the same category in period t-1, normalized over the total male population aged 20-29 at time t. Figures 1 and 2 illustrate trends in primary and secondary male educational attainment respectively, globally for Sub-Saharan Africa. Sub-Saharan Africa is trailing well below the rest of the world in secondary educational attainment, although there is considerable inter-regional and cross-country variation

(see Appendix B through D for country details).





3.2 Control variables

Level of development is interchangeably proxied by infant mortality rate (IMR) collected from the *World Population Prospects* (UN, 1999) and a logtransformed measurement for PPP adjusted GDP per capita collected from the Penn World Tables (Heston et al., 2002). The Polity IV data (Marshall & Jaggers, 2000) are used to measure regime type, and the variable ranges from -10 (most autocratic) to 10 (most democratic). *Total population* size is drawn from the *World Population Prospects* (UN, 1999) and is log-transformed.

3.3 Combined dataset and model

The above datasets were matched by country and year. In order to do so, the IIASA data, which covers 5-year intervals, was expanded by creating records for the intermediate years. This was done by applying the data for year x to years x-2 through x+2 (e.g. the value for 1975 was assigned to the years 1973 through 1977). As a result, the education variables as well as the age structure variables change step-wise every five years. This approach was chosen over interpolation for reasons of simplicity and because there was no compelling theoretical argument for any particular form of interpolation curve.

The combined dataset covers 124 countries/territories for the years 1970-2000.[4] The key variables used in the analysis are: onset of conflict, years since last conflict, infant mortality rate (IMR), Polity index, dependency ratio, (natural logarithm of) total population, age composition, % of males aged 20-24 years with secondary schooling or higher. Among these variables, the number of missing values is 312 out of a total number of 3,434 observations. All are missing due to lack of information on the Polity index, and for the purpose of this analysis missing values on Polity are set to the sample average ('0') adding a dummy variable controlling for imputed values.

The analysis takes the form of a logistic regression, with the onset of an armed internal conflict (defined above) as the dependent variable. All subsequent observations of the same conflict are omitted and we also apply a control variable for time in peace, counting the number of years in peace since the previous conflict. The variable counts time in peace going all the way back to 1945 which is the first year covered by the PRIO/Uppsala conflict data.

The inclusion of a variable measuring the duration in years of the current spell of peace means this approach can be interpreted as a survival analysis (c.f. Singer and Willett, 2003; see Beck et al., 1998 and Raknerud & Hegre, 1997 for applications in the study of armed conflict). While data points within the same peace spell are not originally independent, they are *conditionally* independent given the inclusion of the 'time since last conflict' variable. Statistical dependence *across* multiple peace spells experienced by the same country is more difficult to

[4] The datasets differed in their handling of country partitions and unifications for the period studied, in particular the demographic and education data were not available for historical states. These were reconciled manually. For historical periods of partitioned states (e.g. the Soviet Union, Yugoslavia), education and population measures were constructed based on data from the successor states for which such information was available (the education dataset lacks information for several former Soviet as well as Former Yugoslavian Republics). For states that have unified (e.g. Germany, Yemen, Vietnam), these variables have been constructed by distributing age- and education-specific populations on the separate historical territories based on historical estimates of total population size, assuming that age structure and educational attainment levels were the same.

account for. Some countries experienced up to four peace spells in the period 1970-2000. Nevertheless, the number of multiple peace spells is small relative to the total number. In the absence of an established method to correct for this dependence, this problem is therefore treated as a nuisance and ignored in the analysis. Geographic interactions between neighboring countries (which are certainly known to exist, e.g. Gleditsch, 2007; Buhaug & Gleditsch, 2008) and other unobserved heterogeneities cannot be accounted for either.

The analysis was performed using the statistical systems STATA (StataCorp, 2007) and R (R Development Core Team, 2007), the latter in combination with a number of specialized packages.[5]

4.0 Analysis and results

The core set of explanatory variables included in the models is determined firstly by standard predictors of conflict commonly used in the literature, and is largely identical with those in Urdal (2006). We principally use the infant mortality rate (IMR) as the indicator of 'general development' in the present analysis, a measure that is both more sensitive to social development beyond material living conditions, and also more sensitive to economic inequalities. GDP per capita is used as an alternative measure to compare results with the seminal study of education and conflict by Thyne (2006). Two different measures of age composition are tested. Measure 1 is the ratio of males 15-24 to the male adult population 15+. This is consistent with the definition previously used. Measure 2, RYCS, is the ratio of males 15-29 to males 30-45, in a slight variation on the measure proposed by Staveteig (2004). The rationale is that this last measure is easy to interpret, namely the increase in young men 15-29 relative to their number 15 years earlier (ignoring mortality, which at these ages is normally fairly low).

Secondary education is found to provide the most suitable discriminator in assessing the role of education. Especially in later years, the proportion of the highest and lowest categories (completed tertiary and no schooling) are small in most countries, while the share of secondary educated youth covers the full range of possible values. Lastly, the measure is theoretically attractive and of particular policy importance. The transition to secondary-level qualification is a threshold for participation in the modern economic sector and as such is likely to mark a significant rise in opportunity costs for participation in violent conflict.

In addition, the effects of secondary schooling are of practical interest for policy formulation in developing countries. While the aim of universal primary schooling is considered a given since the Education for All (EFA) and Millennium Development Goals (MDG) processes, and for many developing countries mass participation at the tertiary level remains in any case far off, there is genuine debate and a wide range of opinions (both within developing countries and international organizations) regarding the appropriate rate of expansion of secondary schooling (Alvarez et al., 2003).

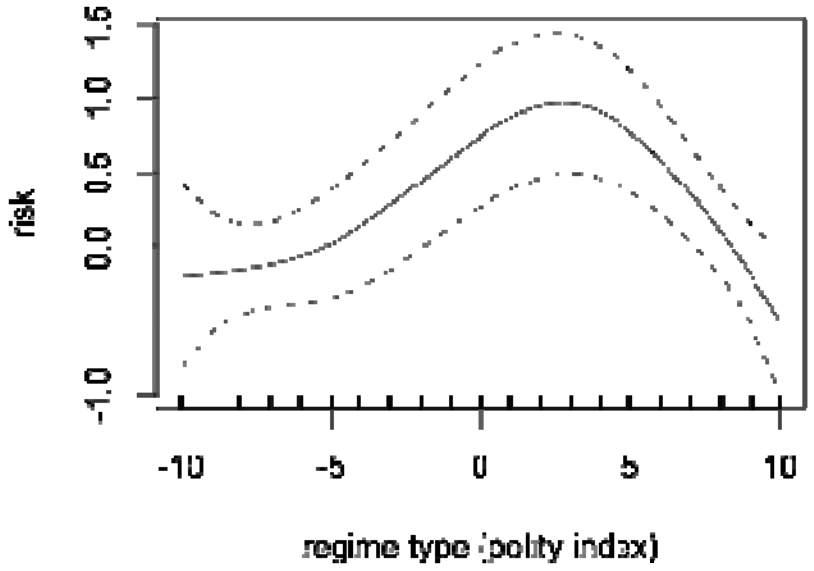
Finally, the use of secondary education or higher in the age group 20-24 helps reduce endogeneity and to disambiguate the direction of causation. Since secondary education is typically obtained at ages 15-19, its spread in the 20-24 age group depends on *past* education trends, and cannot, therefore, be directly influenced by the occurrence of conflict in the year of analysis, only the reverse. The possibility that an unknown third factor affects both education and the occurrence of conflict, but with different time lags, can of course not be excluded.

[5] Cranmer, 2007; Imai, King & Lau, 2007; 2008a; 2008b.

4.1 Without education

As a first step, the set of predictors excluding education were tested. The aim was to establish a baseline by verifying whether the effect found in Urdal (2006) could be replicated on this smaller subset of countries and years. First, all predictors were included as potentially non-linear terms in a logistic Generalized Additive Model (GAM) to establish whether assumptions of linearity were reasonable. With the exception of the Polity measure, all terms show an approximately linear effect. Accordingly, all subsequent models include these predictors as linear terms. The effect of the Polity term is displayed in Figure 3. It confirms previous findings and theoretical arguments (Hegre et al., 2001) in favor of an 'inverted U-shaped' effect, where transitional regimes are most prone to violent conflict. Both repressive totalitarian regimes and democracies are less vulnerable, albeit for different reasons. In all subsequent models, we have included a squared Polity term to account for this relationship.

Figure 3 The effect of regime type on conflict onset



In Table 1, the original model is replicated for the education sub-sample (Model 1), with the exception of 'brevity of peace' in this study being measured linearly in years. The effect of age structure on conflict propensity could be confirmed but is less strong than found previously, as could be expected given the smaller sample (124 countries x 30 years compared to 217 countries x 50 years). Moreover, the model is somewhat sensitive to the precise age structure measure used. The original youth bulge measure (Measure 1, Model 1) overall performs slightly better than the RYCS measure (Model 2), suggesting that overall density of youth in the adult population may be more relevant than a sudden increase (note that Measure 1 and 2 have different scales and their coefficients are not comparable). In

all later models, Measure 1 is used.

Infant Mortality Rates used as the development measure is clearly statistically significant, while a measure of GDP per capita in the same model is insignificant (not shown here). Replacing the development measure with the secondary male educational attainment term reinstates the effect (not shown here), underscoring the high correlation between secondary education and other development measures.

Table 1 Youth bulges, education and internal armed conflict

Explanatory Variables	**Model 1** Measure 1	**Model 2** Measure 2‡	**Model 3** With Education	**Model 4** With GDP	**Model 5** % secondary, all
Young males β	2.058	0.311	1.254	1.468	1.047
Z	(0.72)	(0.66)	(0.38)	(0.44)	(0.31)
Secondary attainment, males			-0.439	-1.531**	
			(-0.52)	(-2.02)	
Secondary attainment, all					-1.703**
					(-2.21)
Infant mortality rate	0.010***	0.011***	0.009**		
	(3.25)	(3.57)	(2.21)		
GDP per capita, ppp (ln)				-0.017	0.033
				(-0.09)	(0.16)
Total population (ln)	0.274***	0.275***	0.275***	-0.276***	-0.273***
	(3.53)	(3.52)	(3.54)	(3.45)	(3.42)
Regime type	0.023	0.023	0.023	0.012	0.014
	(1.16)	(1.15)	(1.15)	(0.63)	(0.73)
Regime type squared	-0.012**	-0.013***	-0.012**	-0.011**	-0.011**
	(-2.52)	(-2.71)	(-2.55)	(-2.39)	(-2.42)
Missing regime data	-0.457	-0.482	-0.461	-0.379	-0.393
	(-0.84)	(-0.90)	(-0.85)	(-0.70)	(-0.73)
Time since conflict	-0.071***	-0.072***	-0.072***	-0.077***	-0.075***
	(-3.17)	(-3.20)	(-3.18)	(-3.46)	(-3.38)
Constant	-3.58***	-3.43***	-2.99*	-1.85	-1.69
	(-3.48)	(-3.81)	(-1.95)	(-1.30)	(-1.18)
N	2,989	2,989	2,989	2,989	2,989
Log likelihood	-329.67	-329.71	-329.53	-331.91	-331.46
Pseudo R^2	0.097	0.097	0.097	0.091	0.092

* p<0.10, ** p<0.05, *** p<0.01. Robust z statistics in parentheses.

‡ The reason for the very different parameter estimates between measures 1 and 2 is the different scales.

4.2 With education

In a next step, the secondary schooling measure defined above was added to the original model as an independent predictor (Model 3). This in itself does not improve the model fit or show a significant effect. However, the education variable is highly correlated with several of the other predictors, in particular the proxy for general development, IMR. Moreover, the aim of the study is to uncover interaction effects (especially with age structure) as much as direct effects of education. When running male secondary attainment in a model using GDP per capita, and not IMR, as development measure (Model 4), male secondary attainment is clearly statistically significant. This is consistent with Thyne's (2006) findings. This underscores that there is more to 'development' than income or state

capacity. Both IMR and education seem to capture aspects of social development that have a pacifying effect.

It is also important to note that when replacing male secondary education with secondary education for both sexes combined (Model 5), the latter measure is slightly more predictive than male attainment, which is the opposite of what Thyne (2006) found. This finding suggests at least that there does not seem to be an added effect on peace from giving priority to male education. Even though females with low education, as opposed to males, are not typically a group suspected of directly engaging in violence, raising female education is likely to have a mitigating effect on indirect risk factors of conflict, economic growth and social cohesion, for example.

4.3 Other education relationships

In Table 2, two additional hypothesized relationships between education and conflict are tested. Model 6 contains the measure for progression from primary to secondary education, which also appears to be unrelated to conflict.[6] Finally, there is no increase in conflict risk associated with massive expansions in the number of youths with secondary or tertiary education (Models 7 and 8),[7] defined as the increase in the number of males with secondary or higher attainment aged 15-24 from period t-1 to period t as a share of all males aged 15-24 with secondary or higher attainment in period t. In fact, expansions in secondary education are statistically significantly associated with lower conflict risk. For tertiary education, the increase is calculated for the cohorts aged 20-29 years. Also expansions in tertiary education is negatively, although insignificantly, associated with conflict onset. This finding suggests that rapid expansions in education are not generally associated with greater conflict risks. Because the argument relating social unrest to large numbers of university students without a prospect for adequate employment has been made particularly with reference to the Middle East (e.g. Lia, 2005: 145-146; Winckler, 2005: 635) the tertiary expansion measure was tested on a sub-sample including only MENA countries. As before, however, no evidence was found that rapid expansion of tertiary education constitutes a risk factor for conflict.

[6] Progression ratios from secondary to tertiary education are also unrelated to conflict risk.
[7] We have also experimented with lagged expansion variables, still yielding insignificant results.

Table 2 Youth bulges, education variables, and internal armed conflict

Explanatory Variables	**Model 6** Progression Ratios	**Model 7** Expansion secondary	**Model 8** Expansion tertiary
Young males β	1.369	7.109*	5.060
Z	(0.42)	(1.73)	(1.34)
% male secondary attainment	0.082	0.616	0.532
	(0.07)	(0.65)	(0.56)
Primary to secondary progression ratio	-0.605		
	(-0.73)		
Expansion in secondary education		-2.404*	
		(-1.75)	
Expansion in tertiary education			-10.55
			(-1.20)
Infant mortality rate	0.010**	0.010**	0.009**
	(2.31)	(2.13)	(2.04)
Total population (ln)	0.287***	0.288***	0.285***
	(3.58)	(3.29)	(3.31)
Regime type	0.024	0.016	0.019
	(1.17)	(0.73)	(0.86)
Regime type squared	-0.012***	-0.008	-0.009*
	(-2.58)	(-1.51)	(-1.66)
Missing regime data	-0.431	-0.604	-0.665
	(-0.79)	(-0.89)	(-0.98)
Time since conflict	-0.072***	-0.090***	-0.094***
	(-3.20)	(-3.67)	(-3.88)
Constant	-3.01***	-5.39***	-4.62***
	(-1.97)	(-2.89)	(-2.63)
N	2,989	2,662	2,662
Log likelihood	-329.28	-274.00	-274.51
Pseudo R^2	0.098	0.114	0.112

* p<0.10, ** p<0.05, *** p<0.01. Robust z statistics in parentheses.

4.4 Stratifications of the sample

There are no compelling theoretical arguments for any specific parametric shape or monotonicity of interaction between education and age structure effects on conflict. A multiplicative interaction terms is more difficult to justify under such circumstances than a discrete interaction in terms of dummy variables. In order to allow for the possibility of non-monotonic interaction, the sample was divided into 4 strata according to the level of the youth education measure. The thresholds were set at 20%, 40% and 80% of men aged 20-24 with secondary or higher education as a percentage of all men aged 20-24, and dummies created for each stratum. The results are shown in Table 3, Model 9.

Table 3 Stratified models of youth bulges and education

Explanatory Variables	**Model 9** Education strata	**Model 10** Sub-Saharan Africa	**Model 11** Low-middle income	**Model 12** High agriculture	**Model 13** High resource dependence
Medium secondary education β Z	1.002 (1.41)				
Low secondary education	-0.331 (-0.34)				
Very low secondary education	-2.234 (-1.34)				
Low and very low secondary education		-0.368 (-0.28)	-1.447** (-2.30)	-0.478 (-0.43)	-0.301 (-0.14)
Infant mortality rate	0.015*** (3.58)	0.011 (1.34)	0.014*** (3.56)	0.003 (0.41)	0.013 (1.09)
Total population (ln)	0.282*** (3.60)	0.088 (0.43)	0.266*** (3.23)	0.176 (1.34)	0.540** (2.29)
Regime type	0.018 (0.88)	0.003 (0.07)	0.028 (1.28)	0.034 (1.13)	0.029 (0.46)
Regime type squared	-0.013** (-2.55)	-0.017* (-1.72)	-0.013** (-2.46)	-0.002 (-0.29)	-0.016 (-1.26)
Missing regime data	-0.395 (-0.71)		-0.151 (-0.27)	0.040 (0.05)	
Time since conflict	-0.060*** (-2.62)	-0.109*** (-3.10)	-0.053** (-2.28)	-0.059* (1.73)	-0.081 (-1.25)
Youth*High secondary education	-6.148 (-0.80)				
Youth*Medium secondary education	-3.423 (-0.81)				
Youth*Low secondary education	12.498 (1.37)				
Youth*Very low secondary education	32.642** (1.97)				
Youth*High-medium secondary education		1.609 (0.11)	-1.965 (-0.59)	11.536 (0.91)	2.952 (0.23)
Youth*Low-very low secondary education		11.670 (1.22)	15.639** (2.10)	15.774* (1.73)	-6.954 (-0.19)
Constant	-3.95*** (-4.95)	-2.77** (-1.98)	-3.08*** (-6.84)	-3.104*** (-2.90)	-2.96*** (-2.61)
N Log likelihood Pseudo R^2	2,989 -324.58 0.111	703 -112.59 0.092	2,084 -293.15 0.073	759 -140.99 0.047	543 -47.18 0.123

* p<0.10, ** p<0.05, *** p<0.01. Robust z statistics in parentheses.

Note that because the education dummies are exhaustive, in other words, not all can be zero at once, no separate youth bulge parameter is required in addition to the interaction terms. One education level always applies and the interaction indicates the youth bulge effect within that education level. The discrete interaction result is strong and consistent: the lower the education level of male youth, the more strongly are large youth cohorts associated with the occurrence of conflict. The youth bulge effect in the two lowest education categories is also significant when these are combined (see Appendix E, Model 9.2). The value of stratified interaction rather than a multiplicative term of

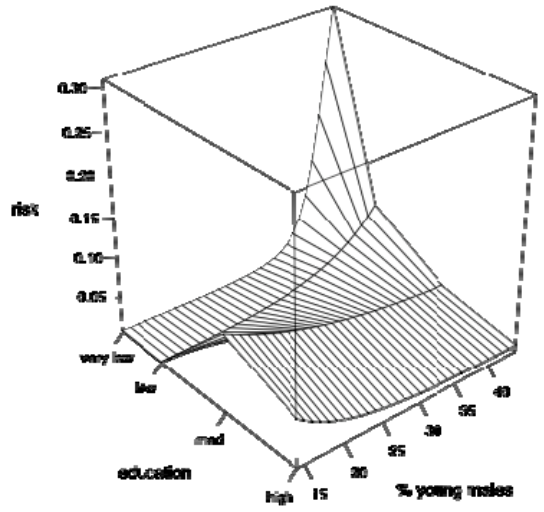
the continuous education variable with the youth bulge measure becomes clear. While the pattern of interaction is consistent, it does not follow a proportional pattern, and would not be captured well by a multiplicative interaction term.

The question needs to be addressed whether the above interaction truly represents an effect of education per se, or whether education merely serves as an indicator of a country's general level of development. In fact, it can be shown that an alternative general development indicator, namely IMR, does not reproduce the effect. Despite the fact that the infant mortality rate and our education measure have a correlation of over 0.8 in our sample, it is possible to disentangle the two to some extent, at least with regard to their interaction effect with youth bulges. In the 'low' and 'very low' education groups combined, the correlation between education and IMR drops to under 0.5. As a result, re-running Model 9 with IMR dummies instead of education dummies represents a stratification that is sufficiently different in the lower categories and that therefore measures a different effect, namely that of extremely high IMR rather than very low education. Doing this shows that the stratification by IMR fails to reproduce the fit of the stratification by education, both with regard to goodness-of-fit measures and with regard to coherence: unlike the education stratification model, which estimates steeper and steeper slopes of consistent sign for the youth bulge effect as the education level decreases, in the IMR stratification model the youth bulge effects change sign and magnitude erratically as one moves to higher and higher levels of IMR (c.f. Appendix E, Model 9.1). This provides even stronger evidence than the inclusion of IMR as a control that in Model 9, education does not simply act as a proxy for the level of 'general development'.

The interpretation of interaction parameters in logistic models (and non-linear models in general) is notoriously difficult. In particular, the intuitive interpretation of the interaction terms as a 'difference of differences' (or, in other words, a mixed second-order partial derivative) applies only to the log-odds-ratio, but *not* to the odds-ratios, much less to the risk. For this reason it is best practice to examine the model implications for the quantities of interest directly, in this case risk levels. One method is to re-estimate the model many times on a set of bootstrap samples of the original sample, and to calculate and compare actual risk levels (not log-odds) associated with certain values of the predictors. The bootstrap approach offers the additional advantage of assessing the fit and robustness of the model, which is discussed further below.

Figure 4 below shows the expected conflict risk as a function of education level and youth cohort size. The interaction is clearly visible: the highest risk is associated with countries that have *both* a large proportion of youth and low education among them. Note that the uncertainty of the model is not evident from the graph, and will be discussed further below.

Figure 4 Conflict risk as a function of education and youth bulges



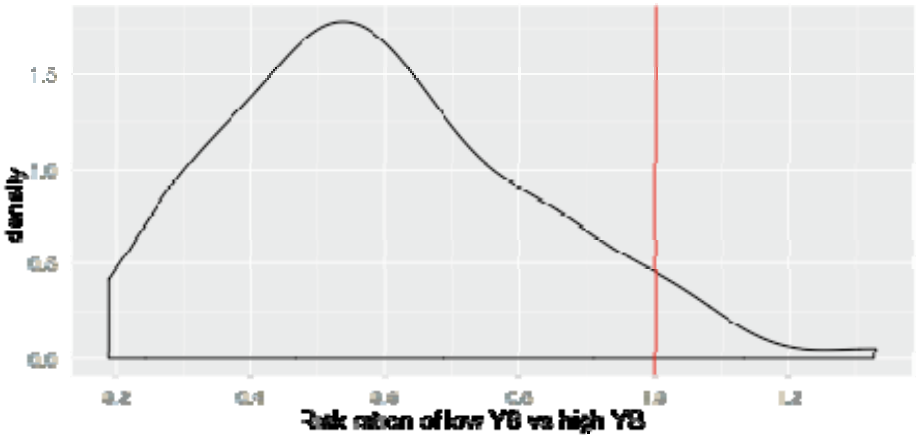
The reliability of the model needs to be carefully assessed. For all models, the values of the Pseudo-R-Square measure should be interpreted with caution. In logistic regression, both the interpretation and scale may differ from the traditional R-Square measure as used in Ordinary Least Squares regression. The measure indicated in Tables 1–3 is McFadden's[8] (see e.g. Williams, 2008). Its theoretical maximum is less than 1 and depends on the probabilistic properties of the 'true' model. It is suggested that values between 0.2 and 0.4 represent an excellent fit (McFadden, 1979: 307). In a model of events that are relatively rare and not deterministically determined, a relatively large amount of residual variance will remain even under perfect information. The highest predicted risk for any individual country in a single year is less than 40% in our Model 9, so even if the high risk group could be identified with great confidence, much uncertainty would remain over *which* of these countries would in fact experience conflict. At the same time, it is clear that in policy terms, being able to disaggregate an overall risk of 2–3% into a low risk group and a high risk group with an elevated average risk level of 10–15%, say, would be extremely useful, even if this represented only a marginal decrease in statistical variance.

The spread of parameter estimates based on the bootstrap samples provides a good alternative indication of goodness-of-fit, since in a perfectly fitting model, all the estimates would be identical. The location of the estimates provides an indication of the strength of the effect. At the same time this approach constitutes a robustness-check: if the inclusion or exclusion of a particular observation has a large effect on the result, this will increase the spread in the simulated distribution, since the observation will sometimes be included in the bootstrap sample and sometimes not. With regard to such robustness to individual outliers, a leverage-Cook's distance plot suggests that no individual or small set of countries has a disproportionate effect on the result.

[8] Although this is not clearly stated in the STATA manuals.

One hundred bootstrap simulations of Model 9 were performed here, and the risk ratio calculated of a theoretical country, ten years into a peace spell with low levels of male youth attainment at secondary level, average values for all other variables, and a youth share among males of about 33%, versus a similar country with 38% young males. The distribution of the risk ratios is shown in Figure 5 below.

Figure 5 Simulated risk ratios



This figure illustrates the remarks above: Despite the fact that substantial uncertainty remains 'unexplained' by the model, it is clear that a smaller youth bulge is very likely to be associated with a reduced level of risk (the vast majority of simulated risk ratios is below 1), typically more than 40% lower. Note that this is a conservative illustration of the effect, as a relatively small change in youth cohort size was simulated, and in a 'low' as opposed to 'very low' education regime.

The interaction is robust to the inclusion of further controls, including urbanization, resource dependence, religious and ethnic polarization, and the share of agricultural production (see Appendix E, Model 9.3). Instead of including other factors as controls, as done above, it is also possible to examine how they mediate the interaction by running the stratified interaction model (Model 9) on different subsets.[9]

For these stratified models, the number of education strata was reduced to two in most cases. First of all, for some of the subsets, the highest education category was in any case very sparsely populated. Secondly, the sample sizes on the subsets were significantly smaller than on the overall sample, and a smaller number of estimation parameters increases the robustness of the results. Where this applies, the top and bottom two categories were merged to form new 'high/med' and 'low/very low' groups. Also, the response curves are only shown for the segment with above-average youth cohort sizes. The reason is that the quadrant of low education - small youth cohorts is virtually empty in most of the subsets. As a result, the shape of the response surface in this quadrant is

[9] In addition to the subsets reported here, we have run the stratified interaction model (Model 9) on the following subsets: pre-1991, post-1990, high agricultural dependence, and high religious and ethnic polarization. For the pre-1991 and the high agricultural dependence subsets, the interaction effect was statistically significant at the 0.05 and 0.1 levels respectively. For the post-1990 period, the interaction between large youth bulges and medium to high education is actually negative and significant at the 0.1 level, possibly indicating a pacifying effect from demographic dividends.

non-empirical. Because the interaction pattern has already been established for the overall sample, in discussing the patterns on subsamples the focus rests on how the shape of the interaction changes, and less on the level of significance. An interaction on a subset that is consistent with the qualitative pattern on the entire sample is credible even if non-significant, since the non-significance may be attributed to the reduced sample size.

The challenge posed by youth bulges is most pronounced in Sub-Saharan Africa, where large youth populations will continue to be a dominating demographic characteristic of the region for decades. In Model 10, we run the basic model with the interaction term for the sub-sample consisting of the 29 Sub-Sahara African countries covered by the education dataset. The results on the whole confirm the pattern above: the interaction of large youth cohorts and low secondary education is positively associated with conflict, but not statistically significant. However, in Model 11, we run the model again for a larger sub-sample of all low and middle-income countries, defined as those countries with a real GDP per capita (adjusted for purchasing power parities) of less than USD 10,000 (1996 as base year). In this segment, the interaction of large youth bulges and low education is positive and clearly statistically significant. This general finding of a relationship in the low and middle income segment has particular relevance for Sub-Saharan Africa, which is the continent with the largest youth cohorts and the lowest levels of male secondary education, scoring on average nearly 30 percentage points lower than the world average.

Figure 6 Response on SSA subsample

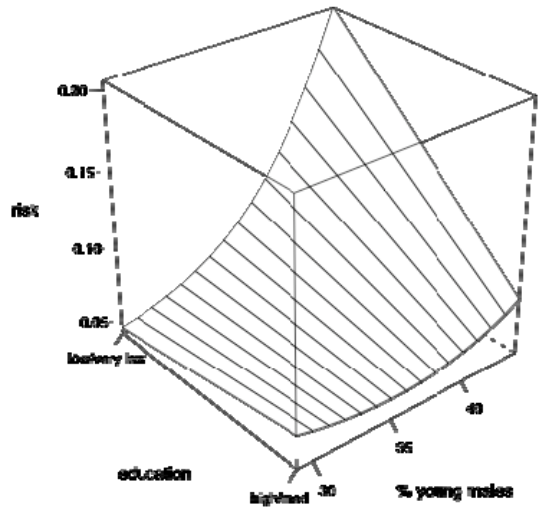
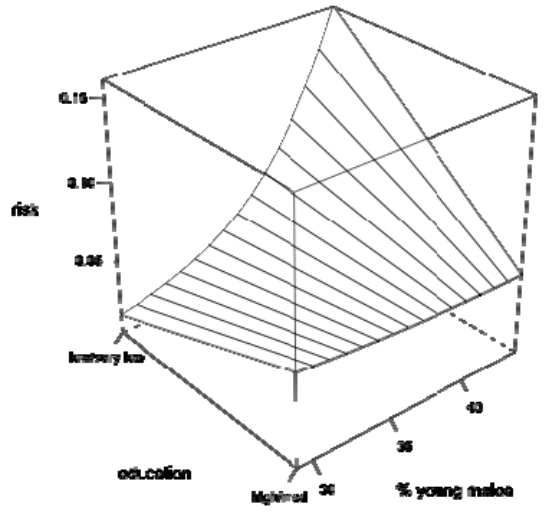


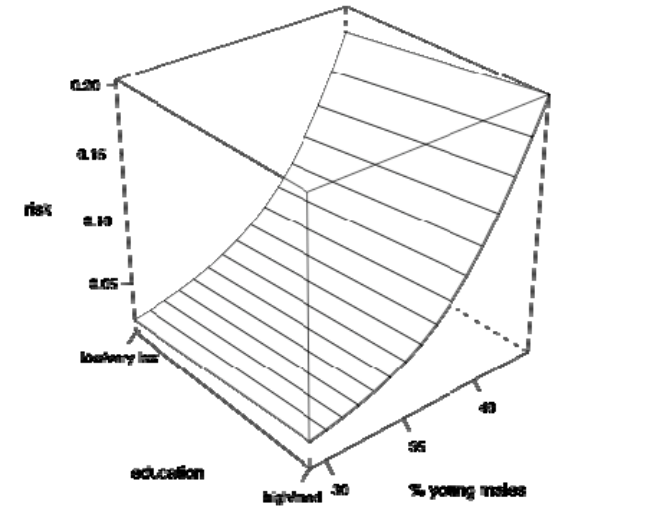
Figure 7 Response on Low-to-Mid-Income subsample



Qualitative changes can only be observed in two cases. Youth bulges have a stronger effect on conflict in countries with low economic opportunities (Model 12, Figure 8), defined here as a high share of income from the agricultural sector[10], but there is no significant effect of the interaction between education and youth.

[10] Data collected from the World Bank's *World Development Indicators*(World Bank, 2003). We have used an alternative measure, *Foreign Direct Investment* as share of total GDP, also producing insignificant results.

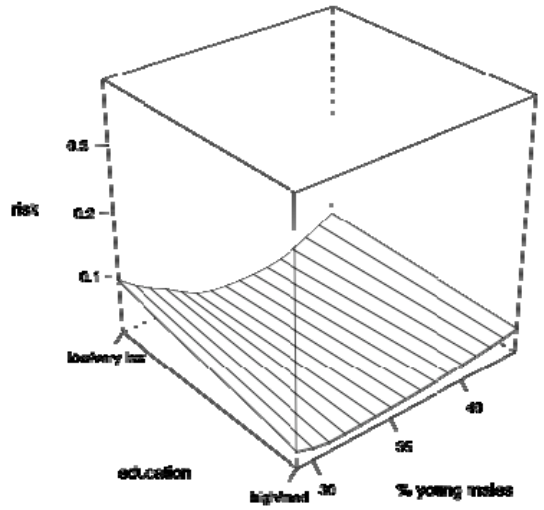
Figure 8 Response on large agricultural sector subsample



Weinstein (2005) suggests that rebel organizations with access to rich natural resources are able to grow faster by recruiting low-cost rebels using resource rents. Our data suggest that in the stratum of countries with high levels of primary commodity exports[11] (Model 13, Figure 9), youth bulge effects are not detectable, and there is no discernable interaction effect between youth and low education.

[11] Data from Fearon & Laitin (2003), we have also used an alternative measure of natural resource rents from de Soysa & Neumayer (2007).

Figure 9 Response on resource-dependent subsample



These last two results, regarding the possible presence of youth effects but no education interaction in countries with large agricultural sectors, and the absence of either in resource-dependent countries, lends credence to the notion that the effect of education and youth on conflict risk is mediated by structural economic factors. This is confirmed further by the fact that those stratifications that confirmed the qualitative shape of the education-youth-conflict interaction found on the overall sample, related either to non-economic factors, or, in the case of low-to-mid-income countries, to the *size* rather than the structural characteristics of the economy.

The inability of education to reduce the contribution of large youth cohorts to conflict risk in highly agricultural societies may indicate that it is the ability to participate in the modern sector that is risk-reducing, rather than education as such. The result in resource-rich economies is more difficult to interpret, but may indicate that access to rich natural resources allows rebel organizations to recruit successfully even in a 'competitive' market where the pool of potential recruits is relatively small and regular livelihood alternatives exist for the more educated.

5.0 Conclusion and further research

The present analysis is constrained on several fronts. Some of the most conflict-affected countries of the last few decades are not included in the IIASA data and therefore absent from the combined dataset. The real-life interactions between education and the other variables are likely to be highly complex, and there is little theory to suggest their functional form. The education data itself is relatively coarse: even the secondary education data is somewhat 'noisy' as a result of estimates of the age of transition. Another constraint is that we are measuring quantity of education rather than quality. In certain cases this may misrepresent the relevance of education for the

opportunities of young people (e.g. Salehi-Isfahani & Dhillon, 2008: 14). Finally, the outcome measure, while standard, captures only one specific aspect of national conflict. Measures of political unrest might in principle produce stronger results, but are of questionable reliability.

Given all these constraints, the stronger age structure effect in the context of low education is surprisingly clear-cut. It indicates that the connection is real and robust. By itself, this result does not conclusively prove that the connection is causal. Even though the level of the specific education variable used here is determined at an earlier point in time than the conflict outcome is measured, it may be the case that both youth education and conflict risk are determined by an even earlier shared cause, but with different lags.

Nevertheless, the results of this study are particularly interesting in that they are easier to explain with reference to some hypotheses concerning the effect of youth education on conflict than with reference to others. The fact that in low youth education contexts there is a strong age structure effect, and particularly so in low and middle income countries, supports an argument based on opportunity costs, namely that the incentive to participate in violent conflict is lower for more highly educated youths. These results support Hypotheses 1 and 2, while Hypothesis 3 relating the risk of youth and low education in particular to countries' dependence on income from primary commodity exports is unsupported. Similarly, there does not appear to be an interaction effect in countries with large agricultural sectors. A different theoretical argument, namely that expanding cohorts of relatively well educated youth are more easily frustrated by lack of opportunities for either further education or jobs, formulated in Hypotheses 4 and 5, is not supported by the present analysis. In this context it is worth re-emphasizing that the dependent variable here is a criterion of deaths due to political violence. It might well be that great expansions in the number of university students are a greater risk factor for political unrest short of mass violence; the present analysis merely suggests they do not increase the risk of fatal organized political violence.

A caveat is required here. Strictly speaking, the conclusion that it is large numbers of under-educated male youths that increase the risk of conflict is unwarranted and represents an instance of the 'ecological fallacy'. The statistical results do not exclude the possibility that in the low education contexts it is in fact the few *highly* educated individuals that contribute to conflict. While consistent with the numbers, this alternative interpretation seems implausible from a theoretical point of view. It is also not supported by recent micro-level studies by Brett & Specht (2004), Humphreys (2005) and Oyefusi (2008), suggesting that low education increases the propensity to recruit as rebels. Our results also suggest that increasing educational levels for females may have an indirect pacifying effect.

Nevertheless this study can only be a first step in improving our understanding of the link between education, demography and conflict. Further research is required. The most obvious next step is to include a greater number of countries/territories and increase coverage in time. The IIASA backprojection methodology cannot robustly be extended further back than 1970, but data for the period 2000-2005, and for additional countries, should become available in the near future. In terms of testing the opportunity cost argument further, the single most useful piece of information would be youth unemployment figures for different levels of education. These are already available for a small subset of countries and years, but not sufficiently many to be statistically useful.

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Appendix A Temporal-spatial coverage of the education data:

120 existing countries
4 historical entities
Total: 124
Time span: 1970-2000

Name	ID number	Observations	Start	End
Americas (24)				
United States of America	2	31	1970	2000
Canada	20	31	1970	2000
Bahamas	31	31	1970	2000
Cuba	40	31	1970	2000
Haiti	41	31	1970	2000
Dominican Republic	42	31	1970	2000
Mexico	70	31	1970	2000
Belize	80	31	1970	2000
Guatemala	90	31	1970	2000
Honduras	91	31	1970	2000
El Salvador	92	31	1970	2000
Nicaragua	93	31	1970	2000
Costa Rica	94	31	1970	2000
Panama	95	31	1970	2000
Colombia	100	31	1970	2000
Guyana	110	31	1970	2000
Ecuador	130	31	1970	2000
Peru	135	31	1970	2000
Brazil	140	31	1970	2000
Bolivia	145	31	1970	2000
Paraguay	150	31	1970	2000
Chile	155	31	1970	2000
Argentina	160	31	1970	2000
Uruguay	165	31	1970	2000
Europe (37)				
United Kingdom	200	31	1970	2000
Ireland	205	31	1970	2000

Netherlands	210	31	1970	2000
Belgium	211	31	1970	2000
Luxemburg	212	31	1970	2000
France	220	31	1970	2000
Switzerland	225	31	1970	2000
Spain	230	31	1970	2000
Portugal	235	31	1970	2000
Germany	255	10	1991	2000
German Federal Republic	260	21	1970	1990
German Democratic Republic	265	21	1970	1990
Poland	290	31	1970	2000
Austria	305	31	1970	2000
Hungary	310	31	1970	2000
Czechoslovakia	315	23	1970	1992
Czech Republic	316	8	1993	2000
Slovakia	317	8	1993	2000
Italy	325	31	1970	2000
Malta	338	31	1970	2000
Macedonia	343	8	1993	2000
Croatia	344	9	1992	2000
Slovenia	349	9	1992	2000
Greece	350	31	1970	2000
Cyprus	352	31	1970	2000
Bulgaria	355	31	1970	2000
Rumania	360	31	1970	2000
Russia (Soviet Union 1970-91)	365	31	1970	2000
Estonia	366	9	1992	2000
Latvia	367	9	1992	2000
Lithuania	368	9	1992	2000
Ukraine	369	9	1992	2000
Armenia	371	9	1992	2000
Finland	375	31	1970	2000
Sweden	380	31	1970	2000
Norway	385	31	1970	2000
Denmark	390	31	1970	2000
Sub-Saharan Africa (29)				
Mali	432	31	1970	2000
Benin	434	31	1970	2000
Mauritania	435	31	1970	2000
Niger	436	31	1970	2000

Ivory Coast	437	31	1970	2000
Guinea	438	31	1970	2000
Burkina Faso	439	31	1970	2000
Ghana	452	31	1970	2000
Togo	461	31	1970	2000
Cameroun	471	31	1970	2000
Nigeria	475	31	1970	2000
Gabon	481	31	1970	2000
Central African Republic	482	31	1970	2000
Chad	483	31	1970	2000
Uganda	500	31	1970	2000
Kenya	501	31	1970	2000
Tanzania	510	31	1970	2000
Rwanda	517	31	1970	2000
Ethiopia	530	31	1970	2000
Eritrea	531	8	1993	2000
Mozambique	541	31	1970	2000
Zambia	551	31	1970	2000
Zimbabwe	552	31	1970	2000
Malawi	553	31	1970	2000
South Africa	560	31	1970	2000
Namibia	565	31	1970	2000
Malagasy Republic	580	31	1970	2000
Comoros	581	31	1970	2000
Mauritius	590	31	1970	2000
Middle East/North Africa (8)				
Morocco	600	31	1970	2000
Iran	630	31	1970	2000
Turkey	640	31	1970	2000
Egypt	651	31	1970	2000
Syria	652	31	1970	2000
Jordan	663	31	1970	2000
Saudi Arabia	670	31	1970	2000
Bahrain	692	31	1970	2000
Asia (24)				
Turkmenistan	701	9	1992	2000
Kyrgyz Republic	703	9	1992	2000
Uzbekistan	704	9	1992	2000
Kazakhstan	705	9	1992	2000

China	710	31	1970	2000
Mongolia	712	31	1970	2000
Korea,South	732	31	1970	2000
Japan	740	31	1970	2000
India	750	31	1970	2000
Pakistan	770	31	1970	2000
Bangladesh	771	29	1972	2000
Sri Lanka	780	31	1970	2000
Maldive Islands	781	31	1970	2000
Nepal	790	31	1970	2000
Thailand	800	31	1970	2000
Cambodia	811	31	1970	2000
Vietnam, Dem. Rep. Of	816	31	1970	2000
Vietnam, Republic of	817	6	1970	1975
Malaysia	820	31	1970	2000
Singapore	830	31	1970	2000
Philippines	840	31	1970	2000
Indonesia	850	31	1970	2000
Macau	1320	31	1970	2000
Hong Kong	1330	31	1970	2000
Oceania (2)				
Australia	900	31	1970	2000
New Zealand	920	31	1970	2000

Appendix B: Educational attainment by level and gender, Sub-Saharan Africa, Year 2000

Country	Male 15-19 primary	Female 15-19 primary	Male 20-24 secondary	Female 20-24 secondary	Gender difference in secondary attainment
Benin	74.1	47.0	34.3	14.3	20.0
Burkina Faso	42.1	31.8	20.8	12.6	8.3
Cameroun	93.7	85.2	55.2	43.9	11.3
Central African Rep.	86.0	64.6	36.8	22.1	14.7
Chad	69.7	40.5	29.1	8.0	21.1
Eritrea	87.7	78.5	48.1	27.9	20.2
Ethiopia	31.8	25.8	20.2	13.8	6.3
Gabon	98.3	96.6	71.4	62.7	8.7
Ghana	90.7	85.3	73.3	60.8	12.5
Guinea	55.9	31.2	32.1	12.5	19.6
Ivory Coast	65.7	50.2	31.9	20.4	11.5
Kenya	94.3	92.2	39.0	32.8	6.2
Malagasy Republic	80.6	79.4	30.6	30.9	-0.3
Malawi	87.7	81.3	27.5	13.4	14.1
Mali	40.8	27.2	21.5	10.2	11.3
Mauritania	68.4	65.9	32.3	19.6	12.7
Mozambique	89.2	76.0	26.9	11.1	15.8
Namibia	100.0	100.0	24.3	25.8	-1.5
Niger	40.0	21.2	18.3	7.7	10.6
Nigeria	84.5	69.6	63.3	48.0	15.3
Rwanda	85.1	85.4	16.1	14.6	1.5
South Africa	97.0	96.9	62.1	66.3	-4.2
Tanzania	80.7	76.0	10.5	7.7	2.8
Togo	89.1	69.9	48.8	20.8	28.0
Uganda	96.8	90.1	31.0	21.0	10.1
Zambia	93.7	91.1	47.0	35.1	11.9
Zimbabwe	98.7	98.0	72.6	67.2	5.4

Appendix C: Sub-Sahara African Countries Ranked by Percentage of Males Aged 15-19 with at Least Primary Education, Year 2000

Country	Primary male attainment, ages 15-19
Ethiopia	31.8
Niger	40.0
Mali	40.8
Burkina Faso	42.1
Guinea	55.9
Ivory Coast	65.7
Mauritania	68.4
Chad	69.7
Benin	74.1
Malagasy Republic	80.6
Tanzania	80.7
Nigeria	84.5
Rwanda	85.1
Central African Republic	86.0
Eritrea	87.7
Malawi	87.7
Togo	89.1
Mozambique	89.2
Ghana	90.7
Zambia	93.7
Cameroun	93.7
Kenya	94.3
Uganda	96.8
South Africa	97.0
Gabon	98.3
Zimbabwe	98.7
Namibia	100.0

Appendix D: Sub-Sahara African Countries Ranked by Percentage of Males Aged 20-24 with at Least Secondary Education, Year 2000

Country	Secondary male attainment, ages 20-24
Tanzania	10.5
Rwanda	16.1
Niger	18.3
Ethiopia	20.2
Burkina Faso	20.8
Mali	21.5
Namibia	24.3
Mozambique	26.9
Malawi	27.5
Chad	29.1
Malagasy Republic	30.6
Uganda	31.0
Ivory Coast	31.9
Guinea	32.1
Mauritania	32.3
Benin	34.3
Central African Republic	36.8
Kenya	39.0
Zambia	47.0
Eritrea	48.1
Togo	48.8
Cameroun	55.2
South Africa	62.1
Nigeria	63.3
Gabon	71.4
Zimbabwe	72.6
Ghana	73.3

Appendix E Alternative stratifications of Model 9

Explanatory Variables	**Model 9.1** IMR Strata	**Model 9.2** Collapsed low education	**Model 9.3** Additional controls
Medium secondary education dummy β Z		1.006 (1.41)	3.264 (1.34)
Low and very low secondary education dummy		-0.548 (-0.59)	2.035 (0.80)
Medium IMR	0. 913 (0.52)		
High IMR	0.132 (0.13)		
Very high IMR	1.581 (1.39)		
% male secondary attainment	-1.031 (-1.26)		
Infant mortality rate		0.014*** (3.52)	0.007 (1.26)
Ethnic polarization			0.440 (0.62)
Religious polarization			-0.863 (-1.57)
Resource dependence			0.949 (0.71)
Agricultural share of GDP			0.025* (1.93)
Urban growth			-0.134 (-1.22)
Total population (ln)	0. 288*** (3.63)	0.295*** (3.77)	0.320*** (2.90)
Regime type	0.014 (0.66)	0.020 (0.98)	0.012 (0.49)
Regime type squared	-0.011** (-2.28)	-0.013*** (-2.58)	-0.009 (-1.45)
Missing regime data	-0.288 (-0.53)	-0.381 (-0.69)	0.091 (0.14)
Time since conflict	-0.066*** (-2.90)	-0.064*** (-2.83)	-0.059** (-2.24)
Youth*Low IMR	-6.374 (-0.80)		
Youth*Medium IMR	-0.500 (-0.12)		
Youth*High IMR	18.049** (2.21)		
Youth*Very high IMR	-11.196 (-0.73)		
Youth*High secondary education		-5.840 (-0.75)	-16.414 (-0.74)
Youth*Medium secondary education		-3.107 (-0.73)	-1.183 (-0.23)
Youth*Low and very low secondary education		15.467** (2.10)	16.541** (1.96)
Constant	-2.77** (-2.57)	-3.87*** (-4.87)	-6.15** (-2.43)
N Log likelihood Pseudo R^2	2,989 -327.49 0.103	2,989 -325.52 0.108	2,141 -236.87 0.123

* p<0.10, ** p<0.05, *** p<0.01. Robust z statistics in parentheses.