Erasmus School of Economics
Master Thesis International Economics

Youth, Mining, and Their Impact on Conflict

Abstract

Regions with valuable minerals can attract conflict. In addition, the people participating in such conflicts are often argued not to be very old, sometimes even younger than eighteen. Therefore, this thesis aims to discover whether large youth populations, both relative and absolute, impact the likelihood of mining-induced violence. This thesis focuses on Africa over the period 1997-2010. By exploiting provincial youth population statistics for 13 African countries and changes in world mineral prices, this thesis shows that provincial youth populations are negatively correlated with the onset of mining-induced conflict. This could be explained by the fact that decreased mineral prices lower the youth's opportunity costs and increase their grievances, making them more likely to engage in conflict. Lastly, this thesis suggests that youth and mining-induced conflict are most strongly negatively correlated for small-scale and less violent conflicts, being riots and protest.

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1. Introduction

This thesis aims to investigate the effect of youth bulges on mining-induced violence in Africa. Regions that are home to valuable minerals are often argued to be prone to conflict (Grossman, 1999; Ross, 2002; Lulaja et al., 2005). Furthermore, when those minerals actually do lead to (violent) conflict, the people taking up arms in those conflicts are usually not very old (Richard & Peters, 2006). Especially in the African civil wars in the late the 20th century, forces have become increasingly youthful (Richard & Peters, 1998). In extreme cases, rebels and soldiers are as young as 8-12, far below the internationally agreed minimum to bear arms (Richard & Peters, 1998). The youthfulness of these forces is partly caused by the demographics of the continent. Besides the fact that Africa is the world's poorest continent, its high fertility rates combined with an average life expectancy of 50 also makes it the youngest continent (World Population Review, 2017). Linking this to mining-induced conflict, in areas with little job opportunities and high poverty, militia activities involving profitable minerals can offer young people a livelihood (Richard & Peters, 1998). For the initiators of rebel movements on the other hand, the sale of minerals can be a means to finance and sustain conflict (Berman et al., 2017).

An increasing number of empirical research has been done to discover whether and how minerals fuel conflict (e.g. Collier and Hoeffler, 2004; Dube and Vargas (2013); Berman et al. (2017)), and in general find a positive relationship between the two. Another strand of literature (e.g. Cincotta et al., 2003; Urdal, 2006; Yair and Miodownik, 2016) looks at whether the presence of youth bulges (i.e. exceptionally large youth cohorts in the 15-to-24 age group (Urdal, 2006)) are good predictors of conflict and instability (Hvistendahl, 2011). There is no real consensus on whether youth bulges increase the risk of conflict (Yair and Miodownik, 2016). While both natural resources and youth bulges as causes of conflict have been researched separately, no empirical research exists yet that investigates whether the combination of minerals in areas with youth bulges increases the risk of conflict. Following Berman et al.'s (2017) strategy on mining-induced conflict, this thesis contributes to the literature by researching whether youth bulges increase the likelihood of mining-induced violence. This relationship is not so straightforward. On the one hand, a booming mining sector can offer jobs, and thus a livelihood to people (Mining Weekly, 2016). A large youth population in these areas might be a sign of large job opportunities that subsequently increase the opportunity costs of these youth. Engaging in conflict might then be less attractive. One the other hand, minerals can be a source of conflict (Berman et al., 2017). Large youth populations in turn could for example make it easier for rebel groups to get new recruits, or have low incomes and find an alternative way to prosperity by engaging in illegal mining activities and conflict, increasing the likelihood of mining-induced conflict. Furthermore, to my knowledge, empirical research on youth bulges and conflict so far either looks at national population statistics or national urbanisation rates, but no regional youth statistics are used yet. Therefore this thesis also contributes to the literature by using provincial-level data instead of only using country-level data.

A well-known case of a civil war that is fuelled by minerals and large youth populations is that of Sierra Leone and its so-called “blood diamonds”. In 1991, the rebel movement called Revolutionary United Front of Sierra Leone (RUF) started the civil war in Sierra Leone, proclaiming to aim to overthrow the regime of the then President Momoh. Soon after its establishment, the RUF’s rebel forces increased quickly, predominantly through the recruitment of young people, many under the age of 18 (Peters, 2006). Most young people recruited had dropped out of school or were recruited through illegal small-scale mining (Peters, 2006). In January 1994, the RUF invaded a small town located near an important diamond mine in Tongo. The RUF took control of Tongo for two days. These two days were full of looting, killing, and voluntary and forced recruitment. After having gathered the loot, the RUF established a new base-camp 10 kilometres each of Tongo (Peters, 2006), allowing them to rebuild forces and continue fighting later on. In the following years of the civil war, Tongo and its diamond fields have been under changed hands (Peters, 2006).

Following Berman et al. (2017), this paper uses geolocalized data on conflict events and mining extraction of 14 minerals for all African countries over the 1997–2010 period. Complementing their data with national statistics of youth populations for all 54 African countries, and provincial data on youth populations for 13 countries, this thesis aims to shed light on the role of youth bulges in conflict in mining areas. Berman et al.’s (2017) dataset contains data on the type and location of conflicts and its corresponding actors from the Armed Conflict Location Event Dataset (ACLED), and information on the location and types of minerals and mines from the original dataset Raw Material Data (RMD). The data is georeferenced at cells of 0.5 x 0.5 degree latitude and longitude (i.e. 55km x 55km at the equator), covering the whole African surface. By exploiting variations in violence because of world mineral price changes, the disaggregated units of analysis combined with year-country and cell fixed effects allow for causal identification of mining-induced violence. Note that this thesis combines their dataset with national and provincial youth population data, introducing new endogeneity issues. Lagging the explanatory variable and adding time-varying cell-level controls should mitigate these issues.

The results based on country-level youth data suggest that youth bulges increase the likelihood of, and might even be the main driver behind mining-induced violence. However, because of their level of aggregation, the country-level results are expected to be less precise. The results based on provincial youth data indicate that youth bulges and areas with higher youth densities are negatively correlated with the likelihood of mining-induced conflict. This shows that areas with large youth bulges and youth population density are less likely to onset mining-induced conflict. Considering that identification for variation in mining-induced violence comes from changes in mineral prices, this negative correlation seems to provide evidence for the onset of mining-induced conflict being fuelled by low opportunity costs and increased grievances. In addition, youth bulges are most strongly negatively correlated with the onset of mining-induced small-scale conflicts, being riots and protest.

The next chapter contains the literature review, followed by the theoretical framework. Chapter IV elaborates on the data used, chapter V explains the methodology, chapter VI presents the results and chapter VII discusses and concludes.

2. Literature Review

This section discusses the methodology and findings of previous literature on natural resources and youth bulges, and how they separately may impact conflict. In addition, it discusses how this thesis contributes to the existing literature.

2.1 Literature findings natural resources and conflict

Berman et al. (2017) provide an extensive literature review on natural resources and conflict, which is described here as well. In the first decade of the 21st century, the relationship between natural resources and conflict has gained increased interest from economic scholars. The first strand of literature that researches this link empirically mostly consists of pooled cross-country regressions (Berman et al., 2017). Such papers (e.g. Collier and Hoeffler (2004) on primary commodities, Ross (2004) on oil, minerals and agricultural products, Humphreys (2005) on oil and diamond) typically find a positive correlation between natural resources and the likelihood of civil war onset and incidence. However, causal interpretation in these papers can be questioned because of endogeneity issues. Such papers do not perfectly account for the fact that resource-rich countries can substantially differ from resource-poor countries in various dimensions (e.g. demographic and economic), and especially the existence of unobservable cross-country differences makes causal interpretations more difficult. Consecutive literature tries to solve this issue via panel data, enabling the use of country fixed effects, typically by looking for variations in prices, new discoveries of resources or other instrumental variables that could isolate the effect of natural resources on conflict (Berman et al, 2017). For example, Bazzi and Blattman (2014) find that export price shocks have no effect on the onset of wars, but that they do lead to weaker and less deadly wars. This finding supports the idea that higher revenues raise the opportunity costs of individuals to fight in conflicts and that revenues increase the state's counter-insurgency capacity. Lei and Michaels (2014) on the other hand find that new oil discoveries in crease oil production and exports, and that these oil discoveries increase the incidence of conflict. However, both these papers use data on the country level, and as noted by authors such as Collier and Hoeffler (2005), Dube and Vargas (2013), and Michalopoulos and Papaioannou (2016), conflicts are regional, not per se national, events, causing within-country heterogeneity. This heterogeneity can explain the different outcomes of these papers (Berman et al., 2017). A paper that solves this issue by using disaggregated data is that of Dube and Vargas (2013), who use the variation of exogenous price shocks to find whether municipalities in Colombia that produce more of these commodities are disproportionally more affected by violence. Berman et al.'s (2017) paper uses a comparable method, however, it consists of a panel of disaggregated cells that cover conflicts and minerals of the whole continent of Africa, adding a lot to external validity compared to earlier papers that apply similar methods.

2.2 Literature findings youth bulges and conflict

While scholars generally agree that the people taking up arms in civil conflict are mostly young men, there is still no consensus in the empirical literature whether relatively large youth cohorts actually increase the risk of civil conflict (Yair and Miodownik, 2016).

An author who has studied this relationship multiple times is Henrik Urdal. By making use of Uppsala-PRIO conflict data sets and national youth population data, he has performed a panel study over the years 1950-2000 including 217 countries, testing the effect of youth bulges on internal armed conflict. His results confirm his hypotheses that youth bulges increase the risk of conflict through the large supply of youths with low opportunity costs. In addition, Urdal

(2006) finds that particularly youth bulges in strong autocratic and highly democratic countries face a larger risk to experience internal armed conflict. The same holds for youth bulges interacted with dependency rates. In a later paper on social disorder in major cities in Sub-Saharan Africa and Asian, however, Urdal (2009) finds no relationship between large male youth bulges between 15 and 24 and violent or non-violent social disturbances.

Yair and Miodownik's (2016) extensive literature review shows that there are various other studies that consider youth bulges and its impact on civil conflict. In a panel study with demographic and conflict data covering 180 countries from 1970-2000, Cincotta et al. (2003) find that during the 1990s youth bulges and a rapid rate of urban population growth are the demographic factors most closely related to the onset of civil conflict. Their results indicate that countries with youth cohorts that make up for more than 40% of the total population are than twice likely to experience the outbreak of a civil conflict than populations with smaller youth cohorts. Just as (Urdal, 2004; Staveteig, 2005; Urdal, 2006), they find that this relationship mostly holds for low-intensity internal armed conflict, being conflicts with at least 25 battle-related deaths per year (Gleditsch et al., 2002). In contrast, for civil wars, that are, high-intensity intra-state conflicts that led to at least 1000 battle-related deaths (Sambanis, 2004), others find no proof that youth bulges increase the risk of civil war incidence and/or onset (Fearon and Laitin, 2003; Collier and Hoeffler, 2004; Urdal, 2006; Collier et al., 2009; Fearon, 2011) (Yair and Miodownik, 2016). Furthermore, their own study researches the link between youth bulges and the onset of violent, armed intra-state conflict (Yair and Miodownik, 2016). By using the relative abundance of youth in a country as their youth bulge measure, they test whether youth bulges affect the onset of ethnic and non-ethnic wars. They theoretically argue that youth bulges negatively affect the economic conditions of youth cohorts in a country, and therefore affect the onset of non-ethnic wars, but not the onset of ethnic wars.

2.3 Contribution to the literature

Berman et al., (2017) test whether their results are altered by various country characteristics, such as governance, ethnic cleavages and property rights, but they do not test whether demographic structures alter their results. Because their paper contains such rich data on Africa, which has the world's most young population and makes a good case for youth bulges and conflict, this thesis builds its analysis on their dataset, and extends it to researching the impact of youth bulges on mining-induced violence. They make convincing causal claims on the increased likelihood of conflict because of minerals, relieving the worry of endogeneity problems related to the link between minerals and conflict.

Furthermore, the findings from the youth bulge literature above show that there is indeed no consensus on whether youth bulges amplify the risk of conflict, but they also show that findings can vary across different dimensions of conflict intensity, conflict occurrence, and social, politic, and economic conditions. Therefore, this thesis looks at conflict onset, and tests for different types of conflict events (e.g. riots, protest, civil wars, etc.). In addition, social, politic, and economic conditions per country or province will be controlled for, so that cross-country differences in these variables do not drive the results. Furthermore, all these studies have in common that they only have national data on youth populations, and therefore do not distinguish between very dense or less dense provinces. However, as especially relevant for this mining-induced violence focused thesis, conflicts are often regional and mines are likely to be found in rural areas. These areas can differ substantially in their youth population structure, both in absolute and relative numbers. Therefore, this thesis considers provincial youth populations, and does not only look at youth bulges (the 15-24 youth population relative to the adult population), but also considers absolute population numbers weighted by area surface, to account for density differences between provinces.

3. Theoretical Framework

This section describes the channels through which natural resources and youth bulges separately can increase the likelihood of conflict. The last paragraph combines the two and aims to provide a clear conceptual overview of how youth bulges can alter the risk of mining-induced conflict.

3.1 Channels of natural resources and conflict

Berman et al. (2017) have, based on a survey by Bazzi and Blattman (2014), summarized the major channels identified by theoretical literature, through which natural resources amplify the risk of conflict. This thesis sticks to their channels, as it gives a clear and complete overview of the different channels highlighted in most of the natural resources and conflict literature. Firstly, natural resources improve rebellion *feasibility*. Extortion and looting of minerals can provide the necessary financial means to sustain rebellion. Secondly, if a territory is for example situated in a mining area, conquering this territory becomes more attractive. This practice is identified as *greed* or *rent seeking*. Thirdly, natural resources may lead to *weak state capacity* and *extractive institutions*. Richly endowed states may be inclined to rely on rents from their resources instead of developing good institutions, making them more ineffective in counter-revolution and counter-guerrilla measures and consequently less stable. Fourthly, production of natural resources such as minerals is *capital intensive*. An increase in mineral prices increases the amount of capital-intensive production, decreasing production in labour intensive sectors. The substituted labour intensive sector free up labour for rebellion. Fifthly, *grievances* as a result from environmental degradation due to extractions from mines and banned access to lucrative mining jobs may increase the likelihood of conflict. Sixthly, mining booms attract migrants from other parts of or outside the country, leading to changes in the demographics (e.g. age, gender, and ethnicity) of a mining area. Such *migration* could lead to clashes between for example different ethnicities. Lastly, there is the *opportunity cost* channel. Higher local incomes increase the opportunity costs of joining a rebel group, reducing the risk of conflict.

3.2 Channels of youth bulges and conflict

In contrast to natural resources, the presence of youth bulges alone are unlikely to directly cause conflict (Urdal, 2011), otherwise there would have been a lot more violent youth revolts throughout history. While Braungart (1984), Feuer (1969), and Goldstone (1990) propose that the possible development of a general consciousness by youth cohorts can enable them to act collectively, resulting from an awareness of belonging to a generation of extraordinary size and strength, this does not necessarily mean that youth bulges holding a general consciousness always leads to conflict. The literature listed in the next paragraph has proposed several conditions that provide youth bulges with the necessary motives and opportunities to start an- or engage in armed conflict. According to Urdal (2011), the literature can be divided in the *opportunity* and motive (i.e. *grievances*) channels, which are, based on his paper, described below. However, he also states that these channels often work together.

The opportunity perspective on the one hand is based on economic theory and focuses on conditions that provide the rebel group with opportunities to fight against a government, being either financial means or unusually low rebel recruitment costs (Collier 2000; Collier and Hoeffler, 2004). Collier (2000) suggests that in case of youth bulges, rebel costs might be reduced because of the abundant supply of rebel labour. However, according to this perspective, youth bulges will only increase the risk of armed conflict if the potential gain of joining is high and costs low enough such that joining a rebel organisation is preferred over alternative income earning opportunities (Urdal, 2011). On the other hand, the motive perspective has its roots in relative deprivation theory and sees the eruption of civil conflict as a result of redressing economic or political grievances (Gurr, 1970; Sambanis, 2002). These grievances can be economic; for example because of poverty, economic inequality, or because of an economic recession – or they can be politic; caused by a lack of democracy, restriction of self-governance or absence of representation of minority groups. According to Urdal (2011), most literature investigating the relationship between youth bulges and civil conflict reasons from the *grievances* perspective, focussing on how the absence of political openness, institutional crowding in educational systems or the labour market may pave the way for political violence (Braungart, 1984; Choucri, 1974; Goldstone, 1991, 2001).

3.3 Channels of youth bulges and mining-induced violence

Based on previous literature and the channels through which natural resources and youth bulges may amplify or reduce the risk of conflict, I have listed several combinations of the natural resource and youth channels that could impact the likelihood of conflict. First of all, increased returns on minerals improve rebellion *feasibility*, hence it is easier to sustain rebellion, because among other things, higher returns from conquered mining areas also allow for more paid recruits. A higher youth population makes it easier to find new recruits and may thus amplify the risk of conflict. Secondly, conquering a territory with natural resources present may lead to *greed / rent seeking*. Especially if unemployed and opportunity costs are low, youth might be more susceptible to temptations of higher income. Thirdly, g*rievances* as a result from environmental degradation due to extractions from mines and banned access to lucrative mining jobs are most likely to be present among youth (Mining Weekly, 2016), as they are most affected. In contrast, the last channel are most likely to mitigate the risk of conflict in mining areas with large youth populations. Higher *opportunity costs* as a result of increased mining prices might make it more attractive to work or keep working in the mining sector, lowering the likelihood of conflict in those areas. To better understand how these channels can interact, consider this example in the mining sector in South Africa (Mining Weekly, 2016). In the, mostly rural, mining areas in South Africa where the mining sector offers the only viable job opportunities, a deteriorating mining sector because of decreased mining prices and low entrepreneurship activity causes high youth unemployment rates. A combination of *grievances* resulting from unemployment and the search for income via alternative, perhaps extra-legal ways because of low *opportunity costs* in turn increase the likelihood of violence. African

National Congress (ANC) general, dr, Zweli Mkhize says during a youth mining summit in 2016 that this is one of the main reasons why community protests near mines are often led by young people. He also believes that a revived mining sector in anticipation of increased mineral prices can turn around the situation, because it will lead to more mining jobs, less youth unemployment, and therefore less *grievances* and higher *opportunity costs*, that lower the likelihood of conflict (Mining Weekly, 2016).

It is interesting to see what channels dominate and whether youth bulges amplify or decrease mining-induced conflict. However, disentangling the various channels and their effect on conflict is difficult. This thesis therefore does not try to find the magnitude of the separate channels, but rather aims to find the aggregate effect of youth bulges on mining-induced conflict. Nevertheless, considering that identification of mining-induced violence depends on variations in world mineral prices, the sign of the results might hint towards some channels above others (e.g. feasibility channel would require a positive correlation between youth and mining-induced violence, while the opportunity cost explanation better fits a negative correlation).

4. Data

Just as in Berman et al. (2017) this thesis uses the PRIO-GRID[1] dataset as basis for each observational unit. The datasets cover the whole continent of Africa and is divided in units of 0.5 x 0.5 degrees latitude and longitude (equal to 55 x 55 kilometres at the equator). This geographical approach is used to ensure that each unit of observation is exogenous to conflict events, as these often occur at the regional level and are heterogeneous within administrative borders. This section elaborates on the main data sets and variables used in the paper and provides some descriptive statistics.

4.1 Data

Conflict data- The conflict data in Berman et al.'s (2017) dataset comes from the Armed Conflict Location and Event dataset[2] (ACLED), which covers conflict events in all African countries. To conform to the mines data, events from 1997-2007 are included in the sample.

[1] Available at: https://www.prio.org/Data/PRIO-GRID/
[2] Available at: https://www.acleddata.com/

Each event reported contains information on the day an event occurred, its geolocation in latitudinal and longitudinal degrees, and the designated actors. The ACLED dataset distinguishes between eight types of events[3], which for this thesis will be summarized to three types of violent events (Berman et al., 2017): violence against civilians, battles between fighting groups, and riots/protests, which allows for testing whether youth bulges have a different impact on different types of (mining-induced) violent events. An advantage of the ACLED that makes it more attractive for the analyses of this thesis compared to the UCDP-GED dataset (Berman et al., 2017), is that reported events are not bound to a minimum death threshold, so all events involving political violence are included.

One potential worry that may arise when using this dataset is that it contains (systematic) measurement errors. For example, the events reported come from different sources, including humanitarian agencies, regional and local news reports, or publications from researchers. However, in countries with less objective reporters and for example biased reports from the local press may suffer from over- or underreporting of certain events. The way of reporting can also vary per country, which could systematically bias the data. However, Berman et al. (2017) explain that this worry is unlikely to affect the results, as cell and country-year fixed effects should remove systematic differences in the reporting of events across countries and cells. Non-systematic measurement error would only bias the estimates towards zero, meaning that the actual effect is even bigger, so this does not pose a threat to the analysis.

Youth data- Country-level youth data are retrieved from the World Bank database[4], that contains information on the countries' youth population and the percentage of unemployment youth per country, for the ages 15 to 24 and available per gender. Provincial data on youth populations from the age of 15 to 24 are gathered from national statistic reports that report on provincial demographics[5]. Country-level statistics are gathered for the complete sample period; from 1997-2010.

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[3] The ACLED dataset distinguishes between eight types of events, which in alphabetical order are categorized as follows: battle with no changes in territory; battle with territory gains for rebels; battle with territory gains for the government; establishment of a headquarters; nonviolent activity by rebels; rioting; violence against civilians; and nonviolent acquisition of territory.

[4] World Bank country-level youth variables can be found in their World Development Indicators database: http://databank.worldbank.org/data/source/world-development-indicators

[5] Benin: http://www.insae-bj.org/annuare-statistique.html; Burundi: http://www.isteebu.bi/index.php/publications/annuaires-statistiques/annuaires-statistiques; Congo, Dem. Rep.: http://www.ins-rdc.org/sites/default/files/Montage%20AnnuStat%20FINAL%202%20From%20VEROUILLE%20_0.pdf; Congo, Rep.: http://www.cnsee.org/index.php?view=category&id=83%3Aannuaire-statistique&option=com_content&Itemid=110; Cote D'Ivoire:

Provincial data however, have been gathered and compiled for the period 2000-2010. The latter period is chosen because the data of these reports is not always complete. More specifically, some countries only report on a few years, only have total provincial population data and / or do not report provincial demographic statistics at all. Based on these reports I have included the provincial data of countries that conform to a minimum precision level for the data to be a good proxy of the actual youth population in the provinces in a given year. In total, the provincial data covers 13 out of 54 countries and 31,988 out of 144,690 observations. The provincial data is ranked either precision level 1 or 2. Precision level 1, the most precise level, requires that there is data available on provincial population numbers by age for more than five years between 2000 and 2010. Precision level 2 requires that there is data available on provincial population numbers and country-wide age structures for more than five years between 2000 and 2010. By multiplying provincial population numbers with country-wide youth shares, proxied provincial youth populations can be calculated. The latter precision level is believed to provide a good proxy of a provinces' youth population, because when looking at country reports that have complete data, the provincial youth structures seem to be similar to the country's youth structure, generally not varying from the country youth percentage averages for more than one percentage point. Furthermore, provinces seem to differ from each other mostly in size and density, therefore available provincial population statistics are a minimum requirement. For years that are missing provincial and or youth structure data, province youth structures from the previous (next) year are applied to total population statistics of the next (previous) year(s), providing a proxy of provincial population numbers by age.

Still, even complete data from national statistics bureaus can consists of estimates, as provincial population reports are often based on census data that are acquired for example only once in five or ten years. In case of systematic measurement errors, this might pose a threat to the analyses. For example, countries that experience more conflict might less often collect population data, and if conflicts lead to fatalities, but reported numbers are estimates based on population statistics from previous years, populations might be overestimated. Again, cell,

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http://www.ins.ci/n/index.php?option=com_content&view=article&id=118&Itemid=99; Egypt, Arab Rep.: "Egypt statistical yearbook,2015" with population data from 2003-2010, C.A.P.M.A.S. http://www.capmas.gov.eg/; Ethiopia: http://www.csa.gov.et/national-statistics-abstract-2003-15; Mauritius: http://statsmauritius.govmu.org/English/Publications/Pages/all_esi.aspx; Mozambique: http://www.ine.gov.mz/estatisticas/estatisticas-demograficas-e-indicadores-sociais/populacao/projeccoes-da-populacao; Namibia: https://nsa.org.na/page/publications/; Senegal: http://www.ansd.sn/index.php?option=com_sess&view=sess&Itemid=398; South Africa: http://www.statssa.gov.za/publications/SAStatistics/SAStatistics2001.pdf (similar links are available for the years 2001-2010); Tunisia: http://www.ins.tn/fr/search-stat?text=annuaire&page=1.

country-year and provincial-year fixed effects should remove at least part of the systematic differences in the reporting of population statistics across countries, provinces and cells.

Finally, to be able to combine the provincial data with cell-data, polygons of each African province have been gathered from the GADM database[6] (version 3.6), where provinces are ranked as administrative boundaries level-1. These administrative boundaries can have different names based on the country's division (e.g. provinces, regions, departments etc.), but for simplicity I refer to them as provinces throughout this thesis. The geographical programme ArcGIS (Esri, 2018) allows for the merging of polygons and longitudinal and latitudinal event data, so that each 0.5 x 0.5 degree-cell is assigned its corresponding province.

Youth variables – The main explanatory variables of this thesis are youth variables interacted with mining variables. Two types of variables are considered for the youth analyses. First, following Urdal (2006), youth bulges are defined as the population aged 15-24 divided by the total adult population (i.e. the population aged 15 or older). The total adult population is considered instead of the total population to account for under- and overestimation of youth bulges. Theories on youth revolt are explained to arise from, amongst other reasons, competition between youth and the older population. If youth bulges are measured based on the total population, countries with high fertility rates, the youth bulge is underestimated. Similarly, populations with low fertility rates are expected to experience more growth opportunities, called the "demographic dividend" (Kelley, 2001). But, populations with low fertility rates also lead to an underestimation of youth bulges (which in turn might decrease the likelihood of conflict), therefore weighing the effect of the demographic dividend "upwards". The youth bulge variable is created for both country-level and province-level population data.

Secondly, because the youth data in this thesis is more disaggregated than in previous youth bulge literature mentioned in the literature review, it might make sense to also look at the absolute number of youth populations, as they provide a more locally accurate image. High absolute youth populations could for example increase competition for jobs among youth (Urdal, 2006). In addition, to account for differences in provincial area sizes, absolute provincial youth populations are divided by the number of cells within a given province. I will refer to this variable as provincial youth density. The rest of the variables used in this thesis are for practical reasons explained in the methodology section.

[6] Available at: https://gadm.org/data.html

Mines data- The data on active mining areas and their corresponding produces minerals is retrieved from Raw Material Data (RMD, IntierraRMG[7]). There is price data available for 14 out of 25 minerals identified on the African continent. These 14 minerals[8] cover 92 percent of the mining cells in this study. For each one of the 237 active mines, Berman et al. (2017) have defined the main mineral produced, that on average amounts to 96 percent of total production value and about 70 percent of cells with active mines produce only one mineral. In the baseline regressions, mineral prices correspond to the main mineral produced in a given cell-year.

Again there is the worry of measurement error, because the RMD dataset mainly contains data on large-scale mines, excluding illegal or small-scale mines. For example, cells with illegal mines could attract more conflict, small-scale mines perhaps attract less conflict, but this information is not included. However, cell fixed effects should alleviate this worry, as only within-cell variation of world mineral prices are estimated. In addition, Berman et al. (2017) argue that instead of only indicating the presence of a mine identified by the RMD dataset, the dummy M_{kt} can be interpreted as a proxy for the extraction area of a given mineral. If a certain mineral is present in a given cell, it is plausible to assume that small-scale or illegal mines are also active in that area, and thus captured by the data.

Lastly, the baseline regressions exclude cells in which the main mineral is either diamonds or coltan. This is because diamonds can greatly differ in quality and thus in price across mines, and because the RMD does not distinguish between different diamond qualities, diamonds are not included. For coltan no world prices are available, so following Berman et al. (2017), my regressions also do not contain these minerals.

4.2 Descriptive Statistics

Table 1 shows the descriptive statistics of the variables used. The first thing to note is that the average provincial youth bulge is 27.75% compared to a youth bulge of 20.16% of that of the country youth bulge. This difference could be due to the different sample sizes, meaning that the countries for which there is provincial data, youth bulges are larger on average compared to the average youth bulge number covering the whole African continent. Moreover,

[7] More information available at http://www.snl.com/Sectors/metalsmining/Default.aspx
[8] The minerals included are: Bauxite (aluminium), Coal, Copper, Diamond, Gold, Iron, Lead, Nickel, Platinum (and Palladium, being Platinum Group Metals), Phosphate, Silver, Tantalum (Coltan), Tin, and Zinc.

there is higher variation in the provincial youth figures because of the disaggregation, allowing for more precise estimates.

Table 1 – Descriptive statistics youth, mines, and conflict

Variable	Observations	Unit of obs.	Mean	Std. Dev.	Min.	Max
Country youth bulges	144,690	country-year	20.16	1.33	15.60	24.34
Provincial youth bulges	31,988	province-year	27.75	2.74	9.63	36.07
Provincial youth density	31,570	province divided by # province cells-year	20176.68	45849.18	188.08	1119204
Pr(Conflict onset > 0)						
all cells	136,709	cell-year	0.03	0.18	0	1
if mines > 0	2,207	cell-year	0.08	0.27	0	1
battles	140,577	cell-year	0.02	0.17	0	1
viol. against civ.	140,547	cell-year	0.02	0.14	0	1
riots and protests	142,472	cell-year	0.01	0.10	0	1
Pr(Mine > 0)	144,594	cell-year	0.02	0.14	0	1
Number of mines						
all cells	144,594	cell-year	0.05	0.60	0	49
if > 0	144,594	cell-year	2.57	3.55	1	49
Ln(precipitation)	144,647	cell-year	4.16	1.94	-5.99	7.30
Mean lights at night	144,690	cell-year	0.34	1.82	0	59.57
temperature	144,620	cell-year	24.71	3.94	9.45	39.53

	(1)	(2)
Correlation with conflict onset	All cells	If mines>0
Country youth bulges	-0.0165	0.1076
Observations	*136,709*	*2,207*
Provincial youth bulges	0.0269	-0.0174
Provincial youth density	0.1024	0.2016
Observations	*30,368*	*977*

Notes: the total sample consists of around 10,000 cells over 14 years. *Source:* 'Pr(Conflict > 0)' but calculated for conflict onset, 'Pr(Mine > 0)' and 'number of mines' from Berman et al. (2017) page 1572, table 1. '

Looking at the other explanatory variables, some statistics are worth highlighting. The probability of the onset of conflict in a given cell-year is low, only 3%. For mining cells however, this probability (having not accounted for any (un)observable cell characteristics) is more than twice as large, namely 8%. Moreover, the probability that a cell contains an active mine is also low, only 2%. Mines seem to be spatially clustered, as the average number of mines across all cells is 0.05, but for cells with active mines the average number of mines is 2.57. Finally, not shown in the table, but mineral prices more than doubled on average over the sample period, known as the *2000s commodity boom* (Berman et al., 2017)

In addition, the table displays the basic correlations (without any control variables, fixed-effects etc.) between youth variables and conflict onset. When considering all cells, i.e. including cells with and without active mines, youth bulges at the country level seems to be slightly negatively correlated with conflict onset. This indicates that at face value, countries with larger youth bulges experience less conflict. For the provincial youth variables however, youth bulges and the youth population per cell are positively correlated with conflict. Meaning that areas with a higher (both relatively and absolutely) population aged between 14 and 25 are more positively correlated with the onset of conflict. Furthermore, for both country-level youth bulges and provincial youth densities, conflict is stronger and more positively related with conflict onset in areas with mines present. But, this is the opposite for provincial-level youth bulges. Overall, the sign of the relationship between youth populations and conflict onset from these basic correlations remains ambiguous.

5. Methodology

This thesis applies methodological techniques used in Berman et al.'s (2017) study on mining-induced conflict. The methodology section first explains their methods on the impact of mining on conflict at the local level and subsequently describes how their method can be extended to test for the impact of youth bulges on mining-induced conflict.

5.1 The local impact of an exogenous change in world mineral prices

All three endogeneity issues, reverse causality, omitted variable bias, and measurement error arise when researching the relationship between minerals and conflict. First, reverse causality is expected to mainly negatively bias the results. For example, when a conflict occurs, it might decrease the likelihood of a mine being active. This relationship works in the opposite direction as the one that is expected to be found, i.e. mines leading to more conflict, and would thus only imply that the actual effect is bigger than the estimated effect found. Nevertheless, a positive bias from reverse causality could occur (Berman et al., 2017) if the state finances counter-insurgency with mine production. Second, cells with mines might systematically differ in (un)observable characteristics besides being in a mining area that both impact mineral prices and local conflict. Third, as explained in the data section, biased reporting of mines and/or conflict events might cause (systematic) measurement error.

To alleviate these problems, this thesis follows Berman et al. (2017) and focusses on the local impact of exogenous changes in the value of mines (Dube & Vergas, 2013). The main idea behind this identification strategy is that an increase in the value of mines increases regional rent seeking and subsequently the risk of violence. The regression method used for all models in this thesis is a linear probability model (LPM). The estimated regression including control variables is:

$$CONFLICT_{kt} = \beta_0 + \beta_1 M_{kt} + \beta_2 lnp_{kt}^{W} + \beta_3\left(M_{kt} \times lnp_{kt}^{W}\right) + FE_k + FE_{it} + \varepsilon_{kt} \qquad (1)$$

Where *k* is the given cell, *t* is a given year, and *it* is the given year-country combination. The dependent variable $CONFLICT_{kt}$ indicates whether there was a cell-specific conflict incidence, the variable takes value 1 if a conflict happened in that cell in a given year and takes on value 0 otherwise. Because the dependent variable is a binary variable, the coefficients of the explanatory variables indicate the effect of that variable ceteris paribus on the likelihood of a conflict. The main explanatory variable is M_{kt}, and takes value 1 when at least one mine is active in that cell in that year. The variable p_{kt}^{W} denotes the world price in year t of the main mineral produced present in the cell *k*. The main mineral produced is defined as the mineral with the highest total production value over the entire 1997-2010 period, evaluated at 1997 prices. It is equal to zero for cells where no mine of the respective mineral is active at all between 1997 and 2010. It is nonzero for cells where mines are only temporarily inactive. Cell fixed effects that filter out time-invariant factors at the cell-level are denoted by FE_k. Additional fixed effects that can vary depending on the specification (i.e. country x year or province x year) are denoted by FE_{it}.

The coefficient of interest in eq. (1) is β_3, and corresponds to the interaction term of the world price and mining activity dummy. The estimation of β_3 captures the impact on local conflict of an exogenous increase in the world price of a given mineral, in cells where the extraction of the corresponding main mineral takes place. Crucial for the identification strategy is the exogeneity to local determinants of conflict of the corresponding interaction term, $(M_{kt} \times lnp_{kt}^{W})$. The sample might contain countries with mines big enough so that they impact world prices, which would violate the exogeneity assumption. Berman et al. (2017) show that their results are robust to excluding countries that belong to the top ten producers of a certain mineral. In addition, the country x year fixed effects should account for most of the time-varying omitted variables that affect both local conflict in mining areas and mineral world prices.

Endogenous mining activity- Considering the problems of reverse causation mentioned above (opening & closing of mines), Berman et al. (2017) consider an alternative estimation. β_4 could be influenced by shifts in M_{kt}, due to (ending of) conflicts inducing the opening or closing of mines. By restricting the sample to a subsample where only mines are considered whose activity is permanent, being mines that either stay open or closed during the sample period, (V(M_{kt}) = 0 for a given k), this issue is avoided. Given that M_{kt} is either always equal to one or equal to zero and now absorbed by the cell fixed effects, lnp_{kt}^{W} and the interaction term become identical, leaving only β_3 for interpretation.

$$CONFLICT_{kt} = \beta_0 + \beta_3\left(M_k \times lnp_{kt}^{W}\right) + FE_k + FE_{it} + \varepsilon_{kt} \qquad (2)$$

Two high dimensional fixed effects - The unit of observation is highly disaggregated which leads to two high dimensional fixed effects, being cells of 0.5x0.5 degrees of longitude and latitude, and a combination of the given year and country. Using Guimaraes and Portugal's (2010) algorithm for high dimensional OLS regressions removes high dimensional fixed effects from the data and leaves transformed regression variables that impose minimum memory requirements and allow for alternative specifications. The Linear Probability Model is therefore used throughout this thesis, to be able to apply Guimaraes and Portugal's (2010) algorithm.

Furthermore, Berman et al., (2017) prefer keeping the cells with no mines ($M_{kt} = 0$), because of estimations with more than 900 country x year fixed effects, these cells contain valuable information when estimating the fixed effect dummies. For the cells without active mines, the world prices are coded as zero. Berman et al. (2017, Table 2, column 4) therefore also includes a specification of equation (2) for which the definition of the mining activity dummy becomes time in-variant (M_k) and now equals 1 for cells that had an active mine in at least one period. The variation in the identification of the coefficient of interest β_3 keeps on only depending on changes in world mineral prices. The benefit of this approach is, is that the estimator is not restricted to the subsample of mines with permanent activity, but it allows for the whole sample to be included. The downside is that some cells are regarded as a mining cell, even when there is no mining activity in that cell in a given year. For all the baseline specifications, Berman et al. (2017) find that a spike in world mineral prices increases the likelihood of conflict.

In conclusion, this thesis builds on Berman et al.'s (2017) two preferred specifications of equation (2). The first one only considers a sub-sample of mines with permanent activity to avoid endogeneity issues, while the second one considers mines that change activity (open/close) during the sample period, and allows for inclusion of the whole sample.

5.2 Adding youth variables to the equation

Now that the methodology for testing for mining-induced violence is set, the next step is to add youth variables to the equation. This can be done via a triple interaction term between the main explanatory variable ($M_{kt} \times lnp_{kt}^{W}$) (Berman et al., 2017) and youth variables, to research how youth variables might alter the average effect of variations in world mineral prices on local conflict events. The estimated equation then changes to:

$$ONSET_{kt} = \beta_0 + \beta_2(M_{kt} \times lnp_{kt}^{W}) + \beta_3(M_{kt} \times lnp_{kt}^{W} \times youth_{it}) + X_{kt} + FE_k + FE_{it} + \varepsilon_{kt} \quad (3)$$

The above equation (3) is similar to equation (2), but now a triple interaction term with the $youth_{it}$ term is added, where *i* stands for either country or province and *t* denotes the year. This means that the fixed effects term FE_{it} also changes definition based on the type of youth variable used. If the youth variable is on the provincial level, the fixed effects will control for both time-invariant and time-varying provincial trends. The triple interaction term indicates that if a cell has an active mine and world mineral prices change, whether (relatively) larger youth populations alter the likelihood of conflict.

Furthermore, the dependent variable used for the analyses of this thesis is conflict onset, to mitigate temporal correlation of conflict (Collier and Hoeffler, 2004; Urdal, 2006; Yair & Miodownik, 2016). For example, if a country experiences conflict in the first year, it might be more likely to experience conflict in the next year, because of conflict continuation or high social tension because of past wounds (Urdal, 2006). In this light, this thesis follows Collier and Hoeffler's (2004) measure of conflict onset that in the first year of conflict takes value one and zero otherwise (Flückiger and Ludwig, 2017). The cell-years of continued conflict are kept as missing values. Nevertheless, conflict in the analyses of this thesis suffer less from temporal persistence, because of the highly spatially disaggregated data. For example, for more than 75% of conflict events, the conflict does not last longer than two years (Berman et al., 2017).

However, adding country or provincial time-varying youth variables does introduce reverse causality. For example, if conflicts lead to fatalities, it could decrease the youth population in that year, biasing the relationship between conflict and youth populations downwards. I expect this to be a problem mostly for the youth density measure, as this measure contains absolute youth figures. For the relative measures (country and provincial youth bulges) this should be less of a problem, because when fatalities occur it should be unlikely that people between the age of 15 and 24 are mostly affected. This can be the case when rebel groups mainly consisting of youth fight each other isolated from the rest of the population. Though, I expect that in such cases the conflict and fatalities are not large enough to substantially affect the youth bulge shares in a country or province. Following literature on youth bulges (Urdal, 2006; Yair & Miodownik, 2016; Fluckiger and Ludwig, 2017), the youth bulges measures are not lagged in the baseline regressions.

Nevertheless, the provincial youth density variable is lagged and included in two different specifications. Firstly, density is lagged for one year, to keep the youth population growth over time (as the sample period is rather short). In case of a conflict, the youth population corresponds to the year before the conflict onset, and as most conflicts do not last longer than two years, this should at least partly mitigate reverse causality. However, sudden decreases in the population are obviously unlikely to be restored in the short-term. Therefore, following Berman et al.'s (2017) analyses on heterogeneous country characteristics, an additional specification is run for the years 2001-2010, with provincial youth density numbers corresponding to values of the year 2000. This specification loses the variation in population growth over time, but accounts more strictly for reverse causality.

In addition, even though the fixed effects control for time-invariant and time-varying (un)observable trends on the country and provincial level, and time-invariant trends at the cell-level, the estimation can still suffer from omitted variable bias from time-varying cell-level trends. To control for such trends, three time-varying cell-level controls are added, denoted as X_{kt} in equation (3). All three variables are retrieved from the dataset in Berman et al. (2017)[9]. Firstly, the log of luminosity at night is added as a proxy for local differences in economic development (Michalopoulos and Papaioannou, 2016). Secondly, yearly mean temperature is added to account for local climate differences. Thirdly, the analyses contain a measure of log

[9] Available at: https://www.aeaweb.org/articles?id=10.1257/aer.20150774

precipitation (rainfall), a proxy to account for local differences in fitness for agriculture that might impact local initial opportunity costs. Moreover, following Berman et al.'s (2017) triple interaction analyses, standard errors are clustered at either the country or provincial level, depending on the spatial-level of the youth variable, to account for unobservable correlations within these levels.

Lastly, as described in the literature review, youth bulges can have different effects on different type of conflicts. This is analyzed for my most preferred youth specification, provincial youth bulges, as it is expected to not suffer from reverse causality, but allows for variation over time and has more detailed population information than the country youth bulge measure. Therefore, equation (3) will be estimated for provincial youth bulges, separated by three types of conflict events: battles between fighting groups, violence against civilians, and riots/protests (Berman et al., 2017).

6. Results

Table 2 shows the results of the baseline regressions. Every two columns (column (1) and (2), columns (3) and (4) etc.) correspond to one youth variable and show the results for cells with mines that do not change activity and cells that also include mines that change activity during the sample period, respectively. Please note that none of the specifications show the direct effect of the youth variables, because they are cancelled out by either the country-year or provincial-year fixed effects. However, the direct effects of youth variables are shown and interpreted in the appendix (see table A1). For all specifications, the direct effect of the youth variables enter with the same sign as the corresponding triple interaction terms. But, none of the direct effects of the youth variables are statistically significant.

The triple interaction term considered for columns (1) and (2) is that of the country-level youth bulges. In this specification, the effect of changes in mineral prices on conflict completely loses its significance. The triple interaction term is positively significant at the 10% level in column (2), indicating that larger country-level youth bulges increase the likelihood of mining-induced conflict. In column (2) this effect is so strong, that the mining-induced conflict coefficient (i.e. the log of world mineral prices interacted with the presence of active mines) becomes negative. This would indicate that bulges are the main driver behind the onset of mining-induced conflict. However, considering the level of aggregation in this specification, and the lower variation in country-level youth bulges (see Table 1), the estimates from this specification are less precise, and the results should be interpreted with caution.

Table 2 – Youth, mines and conflict

	Dependent variable: Conflict onset							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	V(Mkt) = 0	All	V(Mkt) = 0	All	V(Mkt) = 0	All	V(Mkt) = 0	All
ln price x mines > 0	0.0235 (0.0385)		0.1282** (0.0592)		0.0837 (0.1968)		0.1140** (0.0363)	
ln price x mines > 0 (ever)		-0.0012 (0.0225)		0.0778** (0.0366)		0.0948 (0.116)		0.498** (0.0226)
x country youth bulges	0.0029 (0.0023)	0.0022* (0.0012)						
x provincial youth bulges			-0.0028 (0.0019)	-0.0026* (0.0014)				
x ln provincial youth density (lag -1)					-0.0037** (0.0017)	-0.0033** (0.0016)		
x ln provincial youth density (2000)							-0.0006 (0.0217)	-0.087 (0.013)
ln(precipitation)	0.0002 (0.0013)	0.0003 (0.0013)	0.0020 (0.0023)	0.0019 (0.0023)	0.0025 (0.0024)	0.0026 (0.0024)	0.0025 (0.0025)	0.0024 (0.0025)
mean lights at night	0.0008 (0.0051)	0.0011 (0.0050)	0.0168** (0.0076)	0.0166** (0.0073)	0.0083 (0.0077)	0.0076 (0.0075)	0.0239*** (0.0064)	0.0227*** (0.0063)
temperature	-0.0002 (0.0036)	0.0003 (0.0036)	0.0071 (0.0063)	0.0081 (0.0062)	0.0028 (0.0063)	0.0037 (0.0062)	0.0054 (0.0072)	0.0064 (0.0071)
Country x year FE	Yes	Yes	No	No	No	No	No	No
Province x year FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.33	0.33	0.297	0.294	0.301	0.297	0.297	0.295
Observations	134,431	135,828	29,242	29,753	28,670	29,178	26,238	26,699

Notes: LPM estimations. Standard errors in parentheses are adjusted for clustering at the country or province dimension. Variables: 'Ln price' is the world mineral price corresponding to the mineral with the highest production value over the period (based on 1997 prices) for mining cells and zero for non-mining cells. The dummy 'mines > 0' equals one if the cell has at least one active mine in a given year. The dummy 'mines > 0 (ever)' equals 1 for cells that had an active mine in at least one point in time over the 1997-2010 period. Every two columns (column (1) and (2), columns (3) and (4) etc.) correspond to one youth variable, and show the results for cells with mines that do not change activity (V(Mkt) = 0) and cells that also include mines that change activity during the sample period, respectively. Columns (1) and (2) are estimated with the country-level youth bulges and columns (3) and (4) with the province-level youth bulges, columns (5) and (6) with 1-year lagged provincial youth populations divided by the corresponding number of cells in the province (i.e. lagged provincial youth density variable). Columns (7) and (8) are estimated with provincial youth density values of the year 2000, for the sample period 2001-2010. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Moving on to the specifications with provincial-level data, column (3) and column (4) show that provincial youth bulges are negatively linked to mining-induced conflict, with column (4) being statistically significant at the 10% level. These results indicate that mining-induced conflict is less-likely with larger youth bulges. As the identification strategy here depends mostly on changes in mineral prices, this could explain that larger youth bulges (relatively young populations) in mining areas and a booming mining sector are a sign of job opportunities, increasing the opportunity costs of the youth and making them less likely to engage in conflict. Or, that in the case of decreased mineral prices, increasing grievances and lowering opportunity costs, so that areas with relatively younger populations are more likely to experience conflict.

Column (5) to (8) show the results of the impact of provincial youth density per cell on mining-induced conflict. These results also indicate that larger youth populations are negatively correlated with conflict, providing more evidence for the *opportunity cost* channel. The estimates in column (5) and (6) are significant at the 5% level, but the estimates in columns (7) and (8) are highly insignificant. This might be because time-invariant youth density figures used for specifications in columns (7) and (8) could make the estimates less precise. Whether this difference between the results of the two density measures is because of more reverse causality in column (5) and (6) is unclear, as there is no clear under- or overestimation visible. Nevertheless, besides for column (2), the overall effect of increased mineral prices on conflict remains positive.

A naive, but clear quantification of the results is to find out how youth populations alter a one standard deviation increase in mineral prices translates to an increase in probability of conflict (Berman et al., 2017, p. 1584). I will perform this exercise for the most preferred youth variable, provincial youth bulges, and the specification in which it enters significantly, namely column (4). This exercise therefore only considers the sample with provincial youth data. Performing the quantification exercise indicates that a one standard deviation increase in prices from their mean translates into a decrease in probability of conflict onset in mining cells from 0.068 to 0.127, when the effect of the triple interaction term of youth bulges is controlled for.

However, when not controlling for youth bulges, a one standard deviation increase in prices from their mean translates into a decrease in probability of conflict onset from 0.068 to 0.076. Hence, not including the youth bulges underestimates the effect of one standard increase in mineral prices on the probability of conflict onset by 0.051.

Lastly, the mean of lights at night enters positive and significantly in four out of the eight specifications, indicating that either local economic growth increases the likelihood of conflict onset, or mean lights at night is just not a good proxy for economic growth in this case.

Table 3 – Provincial-level youth bulges and types of conflict

	Dependent variable					
	Onset (battle)	Onset (battle)	Onset (violent)	Onset (violent)	Onset (riot)	Onset (riot)
	(1)	(2)	(3)	(4)	(5)	(6)
	Vkt = 0	All	Vkt = 0	All	Vkt = 0	All
ln price x mines > 0	0.0397 (0.0283)		0.0043 (0.0365)		0.1295*** (0.0526)	
ln price x mines > 0 (ever)		-0.0164 (0.0191)		0.0104 (0.0213)		0.0933*** (0.0319)
x provincial youth bulges	-0.0011 (0.0009)	-0.0009 (0.0006)	-0.0002 (0.001)	-0.0006 (0.0007)	-0.0033* (0.0018)	-0.0028** (0.0014)
ln(precipitation)	0.0006 (0.0022)	0.0006 (0.0022)	-0.0018 (0.0014)	-0.0021 (0.0014)	0.0023* (0.0013)	0.0023* (0.0013)
mean lights at night	0.0019 (0.0027)	0.0017 (0.0026)	0.0144*** (0.0053)	0.0135*** (0.0051)	0.0078* (0.0046)	0.0061 (0.0045)
temperature	0.0018 (0.0042)	0.002 (0.0041)	0.0035 (0.0039)	0.0032 (0.0039)	0.0004 (0.0026)	0.0019 (0.0031)
Country x year FE	No	No	No	No	No	No
Province x year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.192	0.189	0.170	0.170	0.213	0.209
Observations	29,948	30,536	30,148	30,722	30,406	30,974

Notes: LPM estimations. Standard errors in parentheses are adjusted for clustering at the country or province dimension. Variables: 'ln price' is the world mineral price corresponding to the mineral with the highest production value over the period (based on 1997 prices) for mining cells and zero for non-mining cells. The dummy 'mines > 0' equals one if the cell has at least one active mine in a given year. The dummy 'mines > 0 (ever)' equals 1 for cells that had an active mine in at least one point in time over the 1997-2010 period. The youth variable considered for all columns are provincial-level youth bulges. Every two columns (column (1) and (2), columns (3) and (4) etc.) correspond to one type of conflict variable, and show the results for cells with mines that do not change activity (V(Mkt) = 0) and cells that also include mines that change activity during the sample period, respectively. Columns (1) and (2) are estimated for battles between fighting groups, columns (3) and (4) for violence against civilians, columns (5) and (6) for riots/protests. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Next, table 3 shows the results of the impact of provincial-level youth bulges on different types of mining-induced conflict onset. For all three types of conflict, violence against civilians, battles between fighting groups, and riots/protests, the triple interaction term with youth bulges is negative, hinting towards confirmation of the *opportunity costs* channel. However, from this table it can be seen that youth bulges only have a statistical significant (at the 10% and 5% level respectively in column (5) and (6)) negative impact on riots and protests. Considering that evidence of both table 2 and table 3 is in favour of the *opportunity cost channel* and perhaps *grievances*, it seems plausible that in the case of conflict the onset of a conflict (e.g. lower mineral prices leading to unemployment among youth), conflict erupts on a small-scale. The lowering of opportunity costs and increased grievances because of no access to mining jobs, may cause people to protest in local areas for more economic opportunities. In contrast, if the sign of the triple interaction term was positive, then it might have been more plausible to assume that an increase in mineral prices and the presence of large youth bulges increases large-scale conflict, for example, to pay for and gain more recruits for (already large) rebel groups, and make diffusion of conflict to other areas possible.

7. Conclusion and Discussion

The results of this thesis differ for the two aggregation levels of the youth data. The estimates based on country-level youth data suggest that larger country-level youth bulges increase the likelihood of mining-induced conflict. But, because the youth data is not as disaggregated, these results are expected to be less precise. On the other hand, the main results, based on provincial data for 13 countries, indicate that youth bulges and areas with higher youth densities are negatively correlated with the likelihood of mining-induced conflict. Considering that identification for variation in mining-induced violence comes from changes in mineral prices, this negative correlation seems to provide some evidence for the onset of mining-induced conflict being fuelled by low opportunity costs and increased grievances. Hence, when mineral prices decrease, there could be less demand for workers, more youth unemployment and therefore these youth have low opportunity costs or hold grievances against the (local) government because of bad economic prospects. On the other hand, when mineral prices increase, there is less reason for youth to start a conflict because of for example more and better job opportunities. Both directions explain how changes in mineral prices can make for a negative correlation between youth bulges, youth population density and conflict onset.

Though, this research has its limitations. Firstly, because of different channels at work (that can have either a positive or negative impact on conflict) through which youth and mines impact conflict, it is not sure whether for example reverse causality problems are solved, and if not, in what direction they are present. Secondly, while lagging the density variables, adding fixed-effects and adding cell time-varying controls should mitigate endogeneity issues between youth and conflict, it is not clear what the causal direction of and mechanism behind the relationship between youth, mineral prices and mines is. Thirdly, the provincial data is only available for 13 countries, lowering the external validity of the results. It is therefore also difficult to compare the country-level and provincial-level results, as they cover a different sample. In addition, it many observations of the youth data are estimates of other years, country-wide age structures etc., which could bias the results.

Nevertheless, the results based on provincial data imply that while overall increased mineral prices still increase the likelihood of conflict, larger youth populations seem not to be the driver behind mining-induced conflict, but actually decrease it. Even though this thesis only provides evidence for the mining sector, it does suggest that the booming of a sector, and perhaps better job opportunities and higher wages for youth, decrease the likelihood of conflict.

For future research it would therefore be interesting to look at whether changes in mineral prices lead to changes in local youth unemployment and wage levels, to find out whether youth populations impact mining-induced conflicts in the way as is explained here. In addition, because it was out of the scope of this research, this thesis provides no causal evidence for the relationship between youth populations and conflict. However, gathering proper controls and while allowing for variations on the province-year level (which were now absorbed by the fixed effects), could provide more insights on the overall relationship between youth populations by using the more disaggregated (provincial) youth data.

8. Appendix

This section sheds light on the direct effect of youth on conflict by estimating the following equation:

$$ONSET_{kt} = \beta_0 + \beta_2(M_{kt} \times lnp_{kt}^{W}) + youth_{it} + \beta_3(M_{kt} \times lnp_{kt}^{W} \times youth_{it}) + X_{kt} + FE_k + FE_t + \varepsilon_{kt} \qquad (4)$$

Equation (4) is similar to equation (3), except that it allows for the direct effect of youth ($youth_{it}$) on conflict to be estimated. This is because in equation (4), the country-year / province-year fixed effects (FE_{it}) are replaced by year fixed effects (FE_t).

Table A1 shows the results for all youth variables except the 2000 provincial youth density values, as they do not vary over time and are absorbed by the cell fixed effects. Overall, the triple interaction terms with the youth variables are similar to that of table 2, but of larger magnitude. Moving on to the direct of youth variables on conflict onset, these coefficients all have the same sign as their corresponding triple interaction terms. But, none of the youth variables are significant. Nevertheless, the coefficients are worth interpreting. Columns (1) and (2) show the direct effect of country-level youth bulges on conflict onset. It shows that for each percentage increase in a country's youth bulge, conflict onset likelihood increases by 0.65%. In column (2) adding youth variables alters the results so much that mining-induced conflict in itself becomes negatively correlated with conflict onset. Again, because the country-level youth variables are very aggregated compared to the locality of conflict, the estimates are less precise. Column (3) and (4) show the direct effect of provincial-level youth bulges on conflict onset. Column (4) for example shows that when considering all cells, a 1% increase in provincial youth bulges decreases the likelihood of conflict by 0.09%.

Table A1 – The direct effect of youth on conflict

	Dependent variable: Conflict onset					
	(1)	(2)	(3)	(4)	(5)	(6)
	V(Mkt) = 0	All	V(Mkt) = 0	All	V(Mkt) = 0	All
country youth bulges	0.0065 (0.0045)	0.0065 (0.0045)				
provincial youth bulges			-0.0011 (0.0024)	-0.0009 (0.0024)		
ln(provincial youth density) (lag -1)					-0.0177 (0.0168)	-0.0182 (0.0172)
ln price x mines > 0	0.0078 (0.0562)		0.1611** (0.0634)		0.4578** (0.2133)	
ln price x mines > 0 (ever)		-0.0312 (0.0410)		0.1136** (0.0458)		0.2178** (0.1064)
x country youth bulges	0.0050 (0.0035)	0.0042 (0.0026)				
x provincial youth bulges			-0.0031 (0.0019)	-0.0030* (0.0016)		
x ln(provincial youth density) (lag -1)					-0.0393** (0.0194)	-0.0187* (0.0016)
ln(precipitation)	-0.0002 (0.0007)	0.0003 (0.0013)	0.0013 (0.0016)	0.0016 (0.0017)	0.0018 (0.0020)	0.0021 (0.0020)
mean lights at night	0.0011 (0.0045)	0.0011 (0.0050)	0.0079 (0.0061)	0.0086 (0.0060)	0.0079 (0.0061)	0.0085 (0.0060)
temperature	0.0042* (0.0025)	0.0045* (0.0025)	0.0058* (0.0032)	0.0057* (0.0031)	0.0037 (0.0034)	0.0040 (0.0034)
Cell FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.307	0.33	0.298	0.295	0.305	0.302
Observations	134,439	135,836	29,523	30,044	28,619	29,174

Notes: LPM estimations. Standard errors in parentheses are adjusted for clustering at the country or province dimension. Variables: 'Ln price' is the world mineral price corresponding to the mineral with the highest production value over the period (based on 1997 prices) for mining cells and zero for non-mining cells. The dummy 'mines > 0' equals one if the cell has at least one active mine in a given year. The dummy 'mines > 0 (ever)' equals 1 for cells that had an active mine in at least one point in time over the 1997-2010 period. Every two columns (column (1) and (2), columns (3) and (4) etc.) correspond to one youth variable, and show the results for cells with mines that do not change activity (V(Mkt) = 0) and cells that also include mines that change activity during the sample period, respectively. Columns (1) and (2) are estimated with the country-level youth bulges and columns (3) and (4) with the province-level youth bulges, columns (5) and (6) with 1-year lagged provincial youth populations divided by the corresponding number of cells in the province (i.e. lagged provincial youth density variable). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Lastly, columns (5) and (6) show the direct effect of the one-year lagged log of provincial youth density (i.e. the provincial youth population per cell) on conflict onset. Column (5) for example shows that a 1% increase in the provincial youth population per cell of the previous year is, decreases the likelihood of conflict by 0.02%. Overall, these direct effects of youth variables do not clarify anything about the channels through which youth bulges affect conflict. Table 2 focuses on the triple interaction terms and provides more insights for such interpretations. All in all, the results show a weak direct effect of youth populations on conflict onset, and the results should be interpreted with caution, as the estimations do not account for time-varying country and provincial trends.

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