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THESIS

‘Whether Armed Conflicts Impact Human Development’

Student: Maksym Liushan
Supervisor: Dr. Ivan Gomza

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ABSTRACT

The principal objective of wars is control over territory, resources, and human capital, either directly or through a proxy government. The majority of wars have ambiguous endings with inevitable future violence. If the situation is so grim when must wars end? In this study the author attempts to find the answer to this question by highlighting what is really crucial for the survival and future development of a country – human capital. Or more precisely the state of development of human capital. The reviewed literature treats armed conflicts as events, describing the negative impact as a result of a conflict. Author insists on treating armed conflict as a process and assessing the impact along the way. Based on the literature review, the author forms a hypothesis that each additional milestone of battle-deaths negatively impacts human development. The author chose the cumulative number of battle-deaths as independent variable and several indicators of human development as dependent variable, including Human Development Index, Maternal Mortality Rate, Infant Mortality Rate and included Official Direct Assistance and Aid as a control variable. The results of the study confirm author's hypothesis of a negative correlation between battle-deaths and human development, highlighting the potential existence of the point of no return in an armed conflict, after which both the winner and loser will be worse off no matter the conflict result.

Keywords: armed conflict, human development, battle-deaths, health, standard of living, expected years of schooling, direct assistance, humanitarian aid, war.

Word count: 8972

ACRONYMS

FAO – Food and Agriculture Organization of the United Nations
GNI – Gross National Income
HDI – Human Development Index
HRW – Human Rights Watch
ICRC – International Committee of Red Cross
IFAD – International Fund for Agricultural Development
IMF – International Monetary Fund
IMR – Infant Mortality Rate
ODA – Official Direct Assistance
MHSB – Maternal Health Seeking Behaviour
MMR – Maternal Mortality Rate
OLS – ordinary least squares
OPEC – Organization of the Petroleum Exporting Countries
PRIO – Peace Research Institute Oslo
Rsq – R square
TB – Tuberculosis
UCDP – Uppsala Conflict Data Program
UNDP – United Nations Development Program
UNFPA – United Nations Population Fund
UNICEF – United Nations International Children's Emergency Fund
WFP – World Food Program
WHO – World Health Organization

INTRODUCTION

The world constantly experiences wars and armed conflicts. According to the data of the Geneva Academy, as of 2023, there are approximately 114 ongoing armed conflicts in the world. They all started with different pretexts – religion, resources, historical justice, geopolitics (Dochartaigh, 2015).

Except for the case of total victory of one side, wars end in some implicit or explicit settlement, because at some point the costs of additional armed activity can no longer be justified by the interests involved (Rummel, 1979). Since total victory and compromise entail territorial change, not all conflict terminations result in long-lasting peace. In one of his research, Jaroslav Tir concludes that only half of the ceased conflicts ended in altering territorial boundaries, lead to the absence of future violence. The other half experienced an enormous rate of future territorial conflicts (2003). If the conflict endings are so ambiguous, and if the future violence is inevitable, when must wars end?

In his book *On War,* Carl von Clausewitz defines war as "a mere continuation of policy by other means" (1918, p.87). This definition can be applied broadly to encompass all armed conflicts. On the one hand, an armed conflict is an ideological and emotional issue, and a purely pragmatic approach to decisions around this issue is not possible. On the other hand, if a conflict is a policy instrument it should be measured, its progress monitored, and its implementation stopped if it serves the interest of the people. Furthermore, per the basic microeconomics principle as the costs that already occurred cannot be recovered, they should not influence future policy-related decisions. Finally, emotions and ideology sooner or later hit the brick wall of practicality, means to continue. Illustratively, in 1982, during the war in Lebanon, driven by ideological political goals, Israel failed to achieve its outspoken goal of eliminating non-state actors as they did not have the military means to achieve it (Casais, 2009). In 2006, Israel once again failed to achieve the principal goal but accepted the ceasefire in a month from the start in comparison with the three years of the first war. The author believes there is an academic approach to making or forcing such a decision.

All armed conflicts have one common consequence – a grave negative impact on all aspects of human development. The longer conflicts continue, the more horrendous impact they make. Furthermore, it is also harder for human capital to bounce back after the truce. The academic literature confirms the thought, providing an in-depth analysis of the negative impact of wars on various aspects of human development, specifically mentioning that the longer war carries on, the graver the impact is. At the same time, literature tends not to focus on the impact of each additional year of hostilities, potentially missing the point of no return in the worsening state of human development and potentially overlooking a trade-off made by the states in their striving to achieve victory.

The existing research tends to treat an armed conflict as an event, describing and analysing the total impact of it. Within this research paper, the author insists on treating an armed conflict as a process. This approach allows to better understand the process of mounting costs of continuing a conflict. In our case, the costs are associated with human development, putting it in the centre of the conflict's negative impact. Having this in mind, the paper advances a question is **what impact the accumulation of battle casualties has on human development?** Answering this question will pave the way to potentially pinpoint the moment when every war must end, the point after which each armed conflict party would be worse off regardless of the outcome.

The thesis is of confirmatory design and consists of six parts: introduction, literature review, analytical framework, methodological design, empirical results, conclusions and discussion. Since the impact of mounting casualties on human development seems obvious, the choice of confirmatory design is dictated by the need find empirical prof for the role of battle-deaths in the state of human development throughout an armed conflict. In the literature review, the author examines the actual discussion on the impact of armed conflicts on human development. The review proves there is a gap in the academic discussion regarding the pace of deteriorating human development, which, in the authors opinion, is tied with deteriorating human capital. In the next part, the author conceptualises two main research notions, namely *an armed conflict* and *human development*, by looking into various existing definitions of war and the most affected and influential dimensions of human development. Afterwards, the author uses the established definitions to select the appropriate datasets containing information on the duration and casualties of armed conflicts disaggregated in time and changes in human development dimensions that follow the same timeline. After selecting the datasets, the author applies the most appropriate method of research. Finally, building on the research results, the author builds a discussion on the damage each additional milestone of an armed conflict inflicts on human development.

LITERATURE REVIEW

Armed conflicts are one of the most horrendous human-caused disasters. The costs of armed conflicts are immense and often incomprehensible. Tens and hundreds of thousands of people die, and other millions suffer from long- and short-term consequences, some of which humanity carries through several generations (Alderman et al., 2006, Akresh et al., 2012, Weldegiargis et al., 2023). Conflicts destroy infrastructure, impact human capital, and set conditions for retarded development for years after the end of hostilities. Illustratively, besides both direct and indirect morbidity, armed conflicts affect populations health and their future ability to contribute to the workforce, decrease access to education, lower the human capital potential, and destroy economic and civil infrastructure, stripping nations of the development base (Chamarbagwala & Morán, 2011, Bernal et al., 2022). Furthermore, while armed conflicts, on average, reduce a state's GDP by 30% and increase inflation by 10 points, they also change focus of public spending. The states at war tend to prioritise the use of scarce resources on military and other spending related to national defence while deprioritising healthcare, education, and social support, resulting in the decrease or complete arrest of human development (Chamarbagwala & Morán, 2011, Mutschler & Schularick, 2024). Summing up, researchers unanimously agree on the devastating impact armed conflicts have on human capital. Furthermore, speaking about inequality, even conflicts do not affect all populations in the same way. Armed hostilities always have a disproportionate effect on women and girls, low-income families and individuals, people with health issues, and other vulnerable population categories (Quinn et al., 2007).

Despite all the negative consequences armed conflicts have on both victim and aggressor parties, neighbouring states, environments, and even global trade, the whooping 114 conflicts are still going on in the world. Moreover, since 2010, the pace of ignition of new wars has been rapidly increasing (Zhang et al., 2023, Dupuy & Rustad, 2018). A puzzle from the first look, the paradox has a very obvious and logical explanation: all aggressors believe that their victory will justify the costs. However, several researchers suggest that parties who lost the war will continue to progress and develop. For instance, Davies & Weinstein (2002), for example, found in their work that Japanese cities that were bombarded and destroyed during World War II do not differ from the ones that stayed relatively intact. Furthermore, Chen et al. (2008) testify that war-ravaged countries show steady social, economic, and political development after the end of hostilities. Interpretations by Davies, Weinstein, Chen, and other similar research prompt the author to the conclusion that the outcome of an armed conflicts potentially less important from the purely utilitarian position of human development. A more important factor is what is left of populations' ability to resist a disaster, bounce back into recovery building back after the end of hostilities, and expand the rebuilding process into progress. Almendom (2005), Landau & Saul (2004) and Omand (2005) define this ability as “resilience”.

The terminology of resilience emerged in the 70s in the field of health studies. During that time, the concept of resilience was primarily used while studying the developmental risks of individuals in the field of psychopathology. In present days, social sciences researchers widely apply the concept in human development research to illustrate the importance of the state of human development in the level of populations’ resilience (Keyes, 2004). Furthermore, Keyes (2004) also defines human development as ‘causes, mechanisms, and consequences of constancy and change in behaviour and functioning’ highlighting the multidimensionality of the concept. While studying resilience, it was determined that the exposure to the violence of war is one of the major risk factors that impacts individual, and, subsequently, collective human development (Mrazek & Haggerty, 1994).

Summing up, while justifying continuously rising costs of war with the potential victory benefits, the states must be vigilant in safeguarding the nation’s resilience to be able to bounce back and recover. The resilience, in its turn, is best measured by the state of human development of the nation. Hence, the author deducts that the state’s ability to bounce back into recovery after the end of an armed conflict, and, therefore, justify the costs of continuing war is enshrined in the state of human development of the nation, which is not limitless. In 2019, UNDP, in its special report ‘Assessing the Impact of War on Development in Yemen’, concluded that the ongoing conflict already caused a setback of 21 years to human development. If it ended in 2022, the setback would be 26 years. Truce in 2030 will result in a 40-year setback (Moyer et al., 2019). The report highlights the notion of ever-rising negative impact on human development: the longer the conflict goes, the more grave the impact is.

The literature is thorough on the overall impact of armed conflicts, and clearly highlights devastations in critically important sectors: health, education, and the economy. The literature also goes beyond an armed conflict, describing the negative impact it causes for generations to come, mainly from the health perspective. At the same time, the reviewed literature fails to look into the change in the mentioned sectors throughout a conflict. Considering that all armed conflicts have various paces, the impact they cause in a given period of time is also uneven. That is why, for example, it is impossible to measure the pace of deteriorating medical infrastructure that leads to decreased access to medical services. However, it is possible to measure the pace of deteriorating human capital, which, according to the literature, also plays an important role in human development. The well-accepted datasets, like the Uppsala Conflict Data Program or Peace Research Institute Oslo, provide data for the measurement of capturing the number of casualties caused by a conflict in a year. However, after conducting the literature review, **the author could not find research that would explain the role of conflict-related casualties in deteriorating human development.**

Considering the identified gap in the literature, it is not possible to state that it builds a comprehensive understanding of all peculiarities of the negative impact of armed conflict on human development. It is evident that armed conflicts decrease the total population of a country, but it is not **what impact the accumulation of battle casualties has on human development?** Taking into account the overall negative impact and described horrific consequences, it is expected that the impact of mounting battle-deaths is harmful as well. The challenge is to find empirical proof that the impact of battle-deaths on human development is negative, how bad it is, and whether the casual relationship exists.

RESEARCH FRAMEWORK

Conceptualisation: Armed Conflict and Battle-Deaths

International law recognises two types of armed conflicts: (1) international armed conflict, where there is an armed confrontation between two states, and (2) non-international, where the confrontation is happening between governments and organised armed groups within or outside the recognised border (ICRC, 2008). Uppsala Conflict Data Program uses a similar approach to defining armed conflicts in their dataset of organised violence. In the UCDP Battle-related Deaths Dataset Codebook v 23.1 (2023, p7), Pettersson also identified conflict types as following: "extrasystemic - between a state and a non-state group outside its own territory, where the government side is fighting to retain control of a territory outside the state system; interstate (both sides are states; intrastate - side A is always a government; side B is always one or more rebel groups; internationalised intrastate - side A is always a government; side B is always one or more rebel groups; there is involvement of foreign governments with troops."

In addition, according to the UCDP, battle-deaths are not limited to the deaths occurred on the battlefield (UCDP, n.d.). The Program relates to all casualties, both civilian and military, that occurred as a result of battle-related actions: artillery strikes, missile attacks, bombardment, explosions, assassinations, and all types of guerrilla warfare.

With the raging interstate armed conflict in Ukraine caused by the Russian full-scale invasion, the author aims to find the relevance of the research findings for the context of the mentioned war.

Conceptualisation: Human Development

There is a common misconception that human development necessarily equals economic growth. While the economic factor is important, health and education are also crucial aspects of human development. (Kosack & Tobin, 2006). Therefore, according to the 1990 Human Development Report, "human development is a process of enlarging people's choices through the formation of human capabilities and the use people make of their acquired capabilities" (UNDP, 1990). These capabilities are longer life through the improved health, knowledge and skills acquired through years of schooling and increased standards of living ensured through the economic means (Miller, 2016, Perfilyeva & Arkhangelskaia, 2023).

The majority of research conducted in the field of the impact of armed conflicts on human development record the immense negative short- and long-term consequences, pointing out the irreversibility of some of them and the impact on the next generations (Weldegiargis et al., 2023). To completely grasp the idea of the horrendous consequences any armed conflict has, both directly and indirectly, the impact linked to combat activities needs to be analysed. The principal and probably obvious consequence of any conflict is increased mortality and disability rates among military personnel and the civilian population (Zhang et al., 2023, Bernal et al., 2022). In addition, scholars point out that of the human development dimensions, armed conflicts, first and foremost, directly affect the population's health, access to education and various aspects of standard of living such as economic well-being, access to food and hygiene (Furst et al, 2010). Indirectly, conflicts have a delayed impact on the above-mentioned dimensions for the current and future generations through the violations of human rights, ecological damage, and impacted child development (Furst et al, 2010). The mentioned list of impacted human development factors is not exhaustive. However, the referred literature mentions them as the principal ones with the gravest and imminent impact.

Impact on healthcare

Armed conflicts negatively impact healthcare from different angles, primarily by reducing access to healthcare services. In the short term, the literature considers three main points of impact: maternal health and childbirth, worsening chronic diseases, and infection-caused emergencies (Zhang et al, 2023, Kreisel, 2001). While chronic diseases are a threatening factor, it is usually lesser affected when an armed conflict starts. While the other two points are really vital for the populations survival.

Besides the direct impact of reduced access to healthcare, armed conflicts also affect maternal health-seeking behaviour (MHSB). He (2022, p2) defines MHSB as "the utilisation of maternal and child health services by women during pregnancy to ensure the wellbeing of both the mother and the foetus throughout pregnancy, delivery and the postpartum period". A strong correlation has been found in conflict environments in Nepal, Afghanistan, Colombia, Burundi, Pakistan, and Nigeria and declining MHSB, namely antenatal care (Zhang et al, 2023). At the same time, several scholars point out the cases of increased MHSB and higher fertility rates as a result of wars. Women tend to reduce contraception and devote more attention to foetal health as a coping mechanism in threatening environments recognising the increased social and economic security of larger families (Chi et al., 2015, Price & Bohara, 2013, Namasivayam et al., 2017). In addition, infant mortality rate (IMR) and maternal mortality rate (MMR) are widely accepted as one of the principal indicators to assess human development as mother's health and childbirth are one of the first healthcare aspects to be affected by any armed conflict. Various research confirmed the strong correlation between IMR and MMR and human development, underlining the possibility of using the latter to make the prognosis for IMR and MMR (Lee et al., 1997). Insecure environment of wars gravely stimulates the IMR and MMR increase. According to WHO (2024), 551 maternal deaths per 100,000 population were recorded in conflict zones in 2020. For comparison, Ukraine's MMR was only 17 in the same year (World Bank, n.d.). Being a Millennium Goal 5, MMR, in combination with IMR, reflects not only on the state of the healthcare but also on the country's potential to reproduce and ameliorate the demographic crisis that always follows an armed conflict (Sajedinejad et al., 2015).

Another aggravating threat to public health during armed conflicts is infectious diseases. The decreased control of the spread, as well as reduced access to treatment, led to horrifying consequences: per one military loss on the battlefield, 14-15 civilians die from preventable infectious diseases such as tuberculosis (TB), for example (MacQueen & Santa-Barbara, 2000). Gale and Bjune (2010) argue that wars exacerbate the situation from two sides: a conflict environment increases the number of cases due to poverty and malnutrition; at the same time, by reducing access to healthcare and willingness to seek medical attention, conflicts increase the length and complexity of the required treatment, and thus, increases the number of people simultaneously having TB. Illustratively, in Iraq, the rising levels of poverty and destroyed medical infrastructure led to the threefold increase of TB cases during the war (Kreisel, 2001). To make the situation worse, Gale and Bjune (2010) found "significantly higher odds" for conflict-zone populations to exercise self-treatment (OR = 3.34, 95% CI: 1.56-7.12). In turn, research finds strong correlation between self-treatment practices and delayed diagnosis with increased morbidity from infectious diseases, including TB (Baker et al., 2006).

In addition, armed conflicts cause long-term health-related consequences. For example, besides the mentioned war-caused disabilities and chronic medical conditions, wars leave a mark on mental health, with the consequences dragging on through an individual's life and, in many cases, passing through to other generations. In 1991, Terr conceptualised the long-term mental health problems caused by "chronic stress and adversities that are part of a daily life" as Type II trauma, different from an experienced one-time traumatic event. Brewin and Holmes (2003), and Quota et al. (2008) argue that in the long term, conflict-affected mental health negatively impacts cognitive abilities, somatic health, and emotional connections with close relatives.

All three parameters – maternal and infant mortality, infectious diseases, long lasting mental health issues – are the lead contributors to the reduced life expectancy.

Impact on the access to education

As well as on health, all armed conflicts have a devastating impact on the state's capacity to provide education and on citizens' willingness to enrol. The impact usually comes from different dimensions. First and foremost, the direct consequence of any conflict is the destruction of infrastructure. Educational infrastructure is being destroyed in deliberative attacks as a tactic, as collateral damage, and as a place of temporary military disposition (Pedersen, 2022). Furthermore, Greenberg (1994), describing Israel-

Palestine conflicts, notes the governments' willingness to close schools as a precaution from students or teachers' death.

On the other hand, access to education suffers from the actions of the home government. A well-known theory, 'guns for butter', describes a phenomenon of decreasing spending on social programmes during times of war (Adeola, 1996). Moreover, Adeola (1996) grounds empirical evidence in his research that the end of conflict rarely means the backtracking of the wartime changes. Even after the end of hostilities, governments usually keep the sector of education underfunded, massively impacting access to education and, subsequently, the years of schooling (Lai & Thyne, 2007).

Lastly, the impact of armed conflicts on human capital founds its reflection in the reduced willingness to enrol. As a consequence, the years of schooling and the quality of education drop. The conscription of teachers and students, enormous migration numbers, and civilian casualties impact the quality of education by reducing the number of students per class (Lai & Thyne, 2007). The impact could be so immense that, for example, in Sudan, Human Rights Watch (1997) described the whole population as 'lost' due to the devastating impact of armed conflict on education. The group has also found the gendered disproportionate effect of wars on enrolment: males are less likely to enrol in secondary education during and immediately after the armed conflict. Lastly, the destruction of private houses also negatively impacts enrolment, decreasing the chances of children, especially girls, to enrol in primary education (Shemyakina, 2006).

Impact on the standard of living

Though in HDI the standard of living parameter is measured through the GNI per capita, the impact of war on it is best illustrated by its various aspects. Encyclopaedia Britannica (n.d.) defines the standard of living in social sciences as "the aspiration of an individual or a group for goods and services … [which] includes privately purchased items and as well as items that lead to an increased sense of well-being but are not under the individual's direct control, such as publicly provided services and the quality of the environment".

The principal privately procured item needed for the survival of an individual is nourishment. Thus, it is fair to assume that food access is the cornerstone aspect of the standard of living. Because of conflicts, affected populations experience food insecurity due to their inability to physically access food and/or the inability to afford it (FAO, 2020). Concerning physical access to food, Makinde et al. (2023) wrote that armed conflicts' occurrence immediately creates barriers in the form of either life danger connected to traveling to food points or the expropriation of nourishment by military elements. However, if the conflict drags on, more populations suffer from the lack of access due to the inability to grow crops or a decrease in drinking water. Illustratively, Weldegiargis et al. (2023) describe the situation in the Tigray region of Ethiopia after the armed conflict broke out in 2020. According to the conducted survey, “63% of the households had to eat food that they found socially or personally undesirable, and almost 72 felt that the amount of food any household member ate in any meal during the past four weeks was smaller than they felt they needed” (Weldegiargis et al., 2023, p4).

Even if an underfed individual, especially at an early age, eventually survives the conflict, the lack of proper nourishment has long-term consequences. Scholars find a correlation between malnutrition among children with faltering growth, disruptions in cognitive development and premature deaths (Victora et al., 2010, Adair et al., 2013). Alderman et al. (2004) confirm the thought finding that war-caused malnutrition among children in Zimbabwe resulted in their growth disruption and affected their lifetime productivity. Makinde et al. (2023), in their study of armed conflicts in Nigeria, even found the supporting evidence that malnutrition is associated with the continuous appearance of new armed conflicts in future.

As for the economic aspect of the reduced access to food, scholars study various factors of the reduced financial well-being. First and foremost, conflicts disproportionately affect the poor and the most vulnerable groups of the population, aggravating the situation for them (Quinn et al., 2007). Chamarbagwala & Morán (2011) also point out that households tend to lose breadwinners to direct combat activities or permanent disabilities. Illustratively, as a result of the Rwandan genocide, approximately 20% of the survived population was pushed into poverty (Justino & Verwimp, 2006). Furthermore, from the public service point of view, conflicts increase military spending, decreasing spending on social, education and healthcare. Overall, governments have less money due to the conscription of workforce, death, displacement, destroyed infrastructure and disturbed supply chains negatively affecting production capacities (Chamarbagwala & Morán, 2011). In addition, Furst et al. (2010) argue that the mentioned declines in human development (affected health and education) put additional long-term economic costs on the states that are hard to calculate.

Overall, the standard of living is an important parameter as it is generally mainstreamed throughout a life of an individual. Though its components are spread through various aspects of life, the primary factor of influence is the economic state of a person.

Human Development and war consequences

In summary, the research considers three abovementioned dimensions of human development as the most critical. **These dimensions – health, education, standard of living -** have the immediate, as well as long-lasting negative impact on the current and future generations. Hence, all three dimensions must be assessed to properly reflect on the state of human development.

Furthermore, the reviewed literature suggests that the negative impact on human development dimensions could be divided into two groups: infrastructural and human capital. While a destroyed hospital or school relates to some reduced access to healthcare or education, the impact of plummeting human capital is more of a cumulative nature and is not felt right away. However, deaths and conscription of doctors with an increase in patients led to a decrease in access to healthcare and inability to cope with the exacerbated effects described earlier. In addition, deaths and conscription of teachers and professors led to reduced access to education, further exacerbating the negative impact. Finally, reduction of workforce due to the death, disability and conscription multiplies the horrific effect of wars on production capabilities, further crimpling the well-being and as a result individual standard of living. In addition, destroyed and damaged infrastructure could be rehabilitated or rebuilt. At the same time, human capital is a resource hard to replenish neither during nor immediately after the end of hostilities.

Hence, considering the above, the author assumes that the increasing battle-deaths number of a protracted armed conflict has a negative impact on human development.

H1: There is negative correlation between the cumulative number of battle-deaths and human development.

Impact of Humanitarian Aid

As previously described, the academic literature widely agrees on the grave impact and negative consequences of armed conflicts on human development without alternative opinions. At the same time, thoughts of researchers sometimes vary when discussing the impact of humanitarian aid.

On the one hand, a growing body of research conducts a closer analysis of humanitarian aid, developing a thought that it not only mitigates the negative impact of atrocities but also increases indicators of various aspects of human development. For example, from the healthcare standpoint, scholars found a positive correlation between wars and mother and child health services - skilled delivery and antenatal care - in Uganda, Somalia, and South Sudan (Namasivayam et al., 2017; Ahmed Z et al., 2000; Sami S et al., 2020). In addition, Zhang (2023) confirms the increase in the quality of reproductive, maternal, newborn, and child-related services due to the humanitarian aid in 2016. Drawing from example from the current war in Ukraine, the United Nations Population Fund in Ukraine (UNFPA) distributed more than 300 tons of pharmaceuticals, supplies and medical equipment for the sexual and reproductive sector only, including 32 ambulances, gynaecological chairs and furniture for more than 100 cabinets, constantly resupplied stock of life-saving and necessary medicine (UNFPA, 2023).

On the other hand, humanitarian aid has an extremely important downside – it bears an ability to prolong the war. Miller (2016) found evidence that by providing governments with humanitarian aid targeting critical sectors, usually health, nutrition, and hygiene, the international community frees up funds from state budgets to prolong the war. While in survival wars the delivery of aid gives defending courtiers a chance for a fight, it also means a higher death toll, which, subsequently, means a higher impact on human development. In addition, after the end of hostilities, the provision of humanitarian aid is happening without consultations with local populations, disregarding their needs, which is leading to a further decline in health and living standards (Murtazashvili, 2024). Furthermore, the OPEC data on net official direct assistance, which also includes humanitarian aid, shows a negative balance for a significant number of countries, even during the conflict years (World Bank, n.d.). The negative balance signifies that the recipient countries are often due to repay their debts, even when the hostilities continue. Illustratively, international creditors are pushing for Ukraine to start repaying its debt in 2025, disregarding the fact of the continuing hostilities at the rate of the First World War (Saeedy, 2024). Hence, while repaying their debts, states might be put into the position of further cutting the expenses on the social sector, aggravating the impact of human development.

H2: The net official direct assistance and aid have negative correlation with human development.

If proven, the first hypothesis will underscore the negative impact of mounting battle-deaths on human development. Furthermore, the chosen quantitative research method will allow to understand not only whether battle-deaths negatively impact human development but also how bad the impact is. The resulting equation will enable calculation of the gradual decrease in human development depending on the increase in battle-deaths. In addition, finding an answer to hypothesis 2 will help understand if the ODA and Aid are actually a mitigating factor of the impact on human development. Proving the hypothesis will mean that the ODA and Aid strengthen the negative impact by either redirecting state funds elsewhere or increasing the battle-deaths count by allowing for prolonging the war.

RESEARCH DESIGN

The empirical part of the research is constructed to test two hypotheses advanced in the research framework section. Considering the expected number of observations, it was decided to use regression analysis as a method to test the existence of a causal relationship between battle-deaths and human development and the role direct assistance and aid plays in it. The unit of analysis for the empirical part is a year of an armed conflict. Due to the data availability restrictions, the research covers the period of 1990 – 2021.

Independent variable

The independent variable is the cumulative number of battle-deaths in the form of a percentage of the total population. The total population percentage will allow to minimise the difference between large and small countries and measure the impact correctly.

The data on armed conflicts is derived from the Uppsala Conflict Data Program (UCDP). The source is well-known and well-credited among scholars. The main UCDP/PRIO Conflict Dataset is frequently cited as the most comprehensive dataset on organised violence and armed conflicts (Le, 2022). The UCDP battle-deaths dataset covers the time period of 1989-2021 and originates from the UCDP/PRIO Conflict Dataset. The dataset contains 1848 observations on 195 conflicts. After filtering against (1) conflicts that lasted 2 years or more and (2) missing values of total population, the dataset ended up with 1056 observations and 139 conflicts. This dataset has also been filtered against missing values of ODA and Aid and development indices for each model. The number of observations and conflicts in each model is specified in the results tables. All available observations that were not filtered out as a result of the above transformations were used for calculations.

The available data on armed conflicts underwent several transformations. The cumulative battle-deaths rate was calculated for each year of armed conflict and is a sum of battle-deaths of prior and the current years of the conflict. Thirdly, for interstate type of armed conflicts, both parties were included in the final dataset, while for intrastate and internationalised intrastate conflicts only the government of the territory of the conflict was included. The decision is justified by the availability of human development data only for states. Furthermore, the non-international conflicts usually hurt only one nation, on whose territory the hostilities occur. Lastly, it is important to mention, the UCPD dataset does not have records of any extrasystemic contract within the observation period.

In addition, a proxy indicator was created to estimate the weight of battle-death with regard to the country’s total population. For this purpose, United Nations Population

Division's World Population Prospects (World Bank, n.d.) was sourced and added to the conflict-related dataset. This comprehensive dataset is based on census reports and demographic statistics sourced from national statistics offices, national government bodies and international organisations. Indicators of percentage of commutative deaths of total population was calculated for each year of conflict.

Dependent variable

The dependent variable is human development, and a larger variety of data was used to best determine the influence of armed conflicts' battle-deaths on human development.

The choice of the datasets was solely based on the literature review outlined in the Research Framework section, with the principal goal of covering all three dimensions of human development. The Human Development Index (HDI), yearly calculated by the United Nations Development Programme, was chosen for its complexity and coverage of three dimensions: health, education, and standard of living. Haq (1995) characterised the dataset as the one that covers many directions and sides of human development. The index includes life expectancy at birth as a health indicator, expected and mean years of schooling as an education indicator and gross national income per capita as a standard of living indicator. Model 1 tests the relationship between battle-deaths in the percentage of the population and HDI.

Considering the fact than HDI includes life expectancy as one of three key parameters there is a probability of multicollinearity occurrence with the battle-deaths indicator, as these two parameters may correlate on their own (Frost, 2019). Hence, three additional models were developed to find empirical proof for the research hypotheses while avoiding the potential multicollinearity. The HDI was decomposed into its three main parameters: life expectancy, years of schooling – both mean and expected – and GNI per capita (UNDP, n.d.). Following the same methodology (see Annex 3), a new index - devi1 - was composed that included only two dimensions, years of schooling and GNI per capita. In addition, considering the postponed effect of armed conflicts on education, a lag of three years in both expected and mean years of schooling was introduced to the dimension. Model 2 tests relationship between battle-deaths in percentage of population and devi1 index.

Models 3 and 4 follow the same calculation logic (see Annex 3) but include different health indicators to find a substitute for life expectancy. Devi2 and devi3 indices use mother mortality rate (MMR) and infant mortality rate (IMR) respectively as health parameters. MMR and IMR are two well-credited indicators of human development, and they are especially relevant in an armed conflict environment as child delivery services are the first affected (Wilmoth et al., 2012, Ross, 2006). The approach to devi2 and devi3 composition follows the already mentioned HDI methodology. The MMR and IMR as a health component are calculated as a reciprocal to the original formula, since the logic of both MMR and IMR is inverse – the higher the indicator the worse human development is. In addition, since the diversity of values for MMR and IMR is significant, following the example of GNI per capita, the natural logarithm was taken from the values. The calculated Model 3 and Model 4 test relationship between battle-deaths in percentage of population and devi2 and devi3 indices respectively.

Furthermore, devi4 index was composed, containing all three parameters of HDI (see Annex 3). However, a lag of three years was introduced to the years of schooling parameter, to better reflect the postponed impact of armed conflicts. Model 5 tests relationship between battle-deaths in percentage of population and devi4 index.

The number of lag years was tested empirically in modelling. The lagged variable with best R squared was chosen.

Lastly, Model 6 and Model 7 test relationship between battle-deaths in percentage of population and MMR and IMR respectively. Both MMR and IMR could be considered as standing alone indicators of human development (Lee et al., 1997, Ross, 2006).

Models with ‘r’ in the name mean TRE models, while the absence of ‘r’ means TFE models.

Control variable

To control the impact of the official direct assistance and aid that also includes humanitarian aid a continuous variable of ‘aid per capita’ was calculated. Aid per capita follows the logic of GNI per capita calculation and includes Net Official Direct Assistance and Aid (ODA) data divided by total population. The variable was further transformed into a percentage of GNI per capita to better reflect of the weight ODA had brought to a state in question. The Net ODA data was sourced from the World Bank. Considering that the effects of the provided ODA are usually visible the next year, a lag of one year was introduced to the variable.

All seven models described above were used with the introduction of the ODA variable in them resulting in Models 1a(r)-7a(r). Models with ‘r’ in the name mean TRE models, while the absence of ‘r’ means TFE models.

Statistical approach

Considering that the available data are a specific form of data, namely the panel data, ordinary least squares (OLS) multiple regressions could not be used, as they would produce a variable bias. According to Stock & Watson (2002) by applying multiple regression to panel data researchers are jeopardising the internal validity of results because of the omitted variable bias. Since the panel data assumes that the coefficients of the measured variables are constant across panels Fixed or Random Effects models are better fit to prevent bias. Furthermore, to control for variables that change in time, time fixed and time random effects are included in the equation (Stock & Watson, 2002). Hausman test will be performed to determine which model is of better fit, TFE or TRE. Afterward, Breusch-Pagan test will be performed for the selected models to determine the existence of heteroscedasticity. In case of the existence, the robust coefficient test will be performed to correctly estimate the statistical significance of a model with heteroscedasticity and its coefficients.

EMPIRICAL RESULTS

The regression test results are presented in Table 1 and Table 2.

While testing the impact of battle-deaths on human development the Hausman test showed the better fit of Time Random Effects (TRE) models in all seven cases. All seven models produced statistically significant correlation with p lower than 0.1. The independent variable coefficients in Models 1r-5r are negative, signifying the existence of the negative correlation relations assumed in the hypothesis 1. At the same time, Models 6r and 7r produced positive coefficients. However, in contrast with HDI and all custom indices (devi1-devi4), higher IMR and MMR signify the worsening human development. Hence, the positive coefficients mean positive relationship between battle-deaths and IMR, but negative relationship between battle-deaths and human development. Hence all the models produced statistically significant results that confirm the hypothesis 1.

Models 1r-5r produced very formidable Chi squared and Adjusted R squared between 0.875 to 0.901, signifying that the models explain the relations within the majority of observations. Models 6r and 7r produced smaller Chi square and R square; however, still at a significant level.

Higher R square of Model 5r with HDI that consists of lagged parameters than in the standard HDI signifies the better fit of the lagged model and confirms the appropriateness to consider the delayed effect of armed conflicts. Statistically significant result of Model 2r – HDI without life expectancy – proves the absence of overlooked relations between battle-deaths and life expectancy. Model 4r – HDI with IMR as the health parameter – demonstrated the highest Chi square and R square, signaling the best fit among the models.

The results of the regression tests produced the following estimated functions:

$$\text{Human Development (HDI)} = 0.454 - 0.048 * \text{Battle-Deaths} + \text{Time Random Effects} \quad (1)$$

$$\text{Human Development (devi1)} = 0.416 - 0.036 * \text{Battle-Deaths} + \text{Time Random Effects} \quad (2)$$

$$\text{Human Development (devi2)} = 0.657 - 0.060 * \text{Battle-Deaths} + \text{Time Random Effects} \quad (3)$$

$$\text{Human Development (devi3)} = 0.624 - 0.045 * \text{Battle-Deaths} + \text{Time Random Effects} \quad (4)$$

$$\text{Human Development (devi4)} = 0.460 - 0.029 * \text{Battle-Deaths} + \text{Time Random Effects} \quad (5)$$

$$\text{Human Development (MMR)} = 5.757 + 0.226 * \text{Battle-Deaths} + \text{Time Random Effects} \quad (6)$$

$$\text{Human Development (IMR)} = 4.12 + 0.099 * \text{Battle-Deaths} + \text{Time Random Effects} \quad (7)$$

All seven models showcase that regardless of the approach of calculating human development, mounting battle-deaths affect it in the same way, negatively.

Table 1. Impact of armed conflicts on human development

	Model 1r HDI	Model 2r HDI w/o LE	Model 3r HDI w/ MMR	Model 4r HDI w/IMR	Model 5r HDI w/ lagged parameters	Model 6r MMR	Model 7r IMR
Cumulative battle-deaths (% of total population)	-0.048* (0.022)	-0.036* (0.018)	-0.060* (0.027)	-0.045* (0.022)	-0.029(.) (0.017)	0.266* (0.119)	0.099(.) (0.057)
Constant	0.454 (0.017)	0.416 (0.017)	0.657 (0.024)	0.624 (0.022)	0.460 (0.017)	5.757 (0.143)	4.12 (0.080)
R sq.	0.881	0.888	0.880	0.906	0.889	0.774	0.857
Adj. R sq.	0.875	0.883	0.874	0.902	0.884	0.764	0.850
Chi sq.	4470.98	4685.57	4282.58	5724.91	4664.03	1791.67	3210.57
N observations	689	659	659	659	658	659	659
N conflicts	103	102	102	102	102	102	102

Note: Robust standard errors in parentheses. ****p* = 0, ***p* < 0.01, **p* < 0.05, (.)p<0.1. r – near the model name indicates TRE model.

The Hausman test for models testing the impact of both battle-deaths and aid, showed the better fit of TRE models in all cases but one. The regression modelling produced statistically significant results in four models (except Model 2ar, 3ar and Model 7a). The independent variable coefficients in Models 1ar, 3ar, 5ar are negative, signifying the existence of the negative correlation relations assumed in the hypothesis 1. At the same time, the regression testing produced statistically significant negative coefficients for the control variable, ODA and Aid, as well, supporting the negative relations hypothesised in the Research Framework section. Adding the control valuable to Models 1ar-5ar increased R squared signaling the better fit of the model.

As in the first iteration of modelling, Models 1ar, 3ar, 5ar produced very robust Chi squared and Adjusted R squared between 0.877 to 0.886, signifying that the models explain the relations within the majority of observations.

Higher R square of Model 5ar with HDI that consists of lagged parameters than in the standard HDI also showed the better fit of the lagged model and confirms the appropriateness to consider the delayed effect of armed conflicts even when accounting for the delivered aid.

Models 6ar and 7a produced inconsistent results. On the one hand, the one hand positive and statistically significant coefficients of the aid variable are in line with the general trend of aid delivery negatively influencing human development. At the same time, the coefficient itself is too high to properly explain the relationship. On the other hand, the model produced negative coefficients for the independent variable, indicating the positive impact of battle-deaths on human development, which is nonsense from both the literature and the common sense. Model 6ar produced relatively low R square and Model 7a produced statistically insignificant results for the independent variable. Hence adding the aid dimension to the models with MMR and IMR does not improve the models, proven by the decreased R squared, due to more complex relations between the variables.

The relationships between human development and battle-deaths accounting for the delivered aid may be explained with the following estimated functions:

Human Development (HDI) = 0. 461 – 0.038 * Battle-Deaths – 0.176 * Aid + Time Random Effects (8)

Human Development (devi2) = 0. 671 – 0.041 * Battle-Deaths – 0.309 * Aid + Time Random Effects (9)

Human Development (devi4) = 0. 469 – 0.017* Battle-Deaths – 0.184 * Aid + Time Random Effects (10)

Judging from the estimated functions the increase in aid delivery in percentage of GNI per capita has stronger negative impact on human development than the increase in battle-deaths in percentage of total population.

Table 2. Impact of armed conflicts on human development x delivered aid

	Model 1ar HDI	Model 2ar HDI w/o LE	Model 3ar HDI w/ MMR	Model 4ar HDI w/IMR	Model 5ar HDI w/ lagged parameters	Model 6ar MMR	Model 7a IMR
Cumulative battle-deaths (% of total population)	-0.038*** (0.008)	-0.022 (0.007)	-0.041(.) (0.023)	-0.027 (-0.009)	-0.017* (0.008)	-224.685** (71.372)	-4.564 (3.928)
Net ODA and aid per capita (% of GNI per capita)	-0.176*** (0.032)	-0.219*** (0.025)	-0.309*** (0.052)	-0.261*** (0.031)	-0.184*** (0.029)	2387.931*** (259.82)	121.881*** (14.315)
Constant	0.461 (0.013)	0.426 (0.014)	0.671 (0.024)	0.635 (0.019)	0.469 (0.013)	457.955 (51.583)	
R sq.	0.883	0.896	0.889	0.913	0.892	0.4	0.752
Adj. R sq.	0.877	0.891	0.885	0.909	0.886	0.37	0.689
Chi sq.	4394.25	4990.55	4626.79	6118.37	4606.47	404.40	

F-stat.							51.486
N observations	689	659	659	659	658	659	659
N conflicts	103	102	102	102	102	102	102

Note: Robust standard errors in parentheses. ***$p = 0$, **$p < 0.01$, *$p < 0.05$, (.)$p<0.1$. Presence of r near the model name indicates TRE model. Absence of r – TFE.

The Hausmann and Breusch-Pagan tests results presented in Table 3.

Table 3. Hausmann and Breusch-Pagan tests results

TFE Model	TRE Model	Hausmann p value	Selected model	Breusch-Pagan p value	Heteroscedasticity
			Battle-deaths only models		
1	1r	1	TRE	0.3615	Yes
2	2r	1	TRE	0.7853	Yes
3	3r	1	TRE	0.9535	Yes
4	4r	1	TRE	0.9801	Yes
5	5r	1	TRE	0.406	Yes
6	6r	1	TRE	0.9672	Yes
7	7r	1	TRE	0.9937	Yes
			Battle-deaths and Aid models		
1a	1ar	1	TRE	7.221e-05	No
2a	2ar	1	TRE	0.02983	Yes
3a	3ar	1	TRE	0.8339	Yes
4a	4ar	1	TRE	0.8812	Yes
5a	5ar	1	TRE	0.001168	No
6a	6ar	0.5664	TRE	1.058e-11	No
7a	7ar	< 2.2e-16	TFE	3.411e-05	No

DISCUSSION

The results of the research follow the existing discussion in the academic literature, further confirming the horrendous impact armed conflicts have on human development. The results of the regression modelling prove the existence of a negative correlation between cumulative battle-deaths and human development, as assumed in hypothesis 1. This relationship was robustly tested with various human development indicators. The strong correlation of the primary model, the unmodified Human Development Index, shows the general impact on human development, considering how balanced is the UNDP's index. In addition, the better fit of the model with HDI with incorporated lagged parameters provides insight into the delayed impact of armed conflict casualties on human development. The statistically significant correlation in the other four models – with MMR and IMR – shows that infant mortality and maternal mortality are also severely impacted by armed conflicts, which aligns with multiple studies cited in the literature review.

To illustrate how bad the impact is, we should dive deeper into the results. From the first look, coefficients are small – from 0.029 in to 0.048 I. In reality, it means a significant drop in human development. For example, in 2022, Ukraine, acknowledged as a high human development country and ranked 86th country in the world by UNDP, scored 0,734 in HDI (UNDP, 2023). The 0.048 drop in HDI caused by the 1% in battle-related casualties is equalled to: a 58% drop in GNI per capita; or an 8-year drop in life expectancy; or a 5-year drop in expected years of schooling. However, in reality, the impact would be widespread through all three parameters. For Ukraine, a 5-year drop in schooling means an average individual will not go to a university. In addition, the 0.048 reduction in HDI will downgrade Ukraine to a medium human development country. All of this impact is made by just 1% of population in casualties.

This discovery puts an additional spotlight on how valuable human capital is for the development of a country. Furthermore, the results might serve as a basis for the re-evaluation of the position of 'winner takes it all' in an armed conflict. Since both parties suffer losses, it is probable that they will be worse off after the end of hostilities, regardless of the outcome.

As for humanitarian aid, the research results confirmed the hypothesis 2 – the delivered ODA and Aid have negative relations with human development. This means that despite its original design, an increase in share of ODA and Aid in GNI per capita is more likely to stimulate the decline of human development. Though sounding counterintuitive, the results received are mentioned by several authors highlighting a side effect of aid in prolonging the war (Miller, 2016). Furthermore, a donor-driven setting of aid delivery may cause an overlook of critical domains due to the imperfect needs assessment (Murtazashvili, 2024). This is an important discovery that needs to be looked into more precisely in the following research. A humanitarian-aid-focused study may further corroborate the hypothesis. If confirmed, the recipient governments need to evaluate their needs more attentively and present them to the donor community more elaborately.

Admittingly, there are some limitations of the research. First and foremost, the Uppsala Conflict Data Program dataset, while being the most credible and cited, is limited to the period of 1989 – 2021. At the same time, the human development data, primarily the human development index and maternal mortality rate, were also available from 1990 onwards. Hence, the datasets matched the period for this research but did not allow the study of the results of previous conflicts. Subject to the availability of human development data, perhaps in the form of other indices, the PRIO battle-deaths dataset that includes conflicts from 1960 might combined with UCDP for further research. In addition, the official credible data on direct assistance is only available for the net ODA and aid combined. This means that data does not distinguish humanitarian aid from other development assistance, as well includes non-cross-border transfers, like donor country consultancy. Subject to the availability of credible estimations of humanitarian aid, preferably separated by sectors, a more in-depth study on the effects of humanitarian aid would be possible.

The proven hypothesis about negative relations between battle-deaths and, as an extension, the duration of an armed conflict with human development could be considered as a contribution of this research to the general academic discussion. The research question was formed from the absence of research on the yearly impact of armed conflicts on human development. The existing literature tends to treat the impact as an event, summarising the consequences after the end of hostilities. These research results may prompt further studies into the impact of casualty milestones on human development and the existence of the point of no return in human development.

POLICY RECOMMENDATION

The main objective of this result-based policy recommendation is to prevent the deprioritisation of public spending on social sectors in the environment of a long interstate war on Ukrainian territory caused by the full-scale Russian invasion. With the recognition of the current and future need to bolster national defence expenditures, a solution must be found to keep the existing level of funding for social sectors: healthcare, education, social support.

The target audience of this policy recommendation is the Ministry of Finance of Ukraine, as a penholder in the process of the state budget formulation. In addition, the Ukrainian members of parliament have a crucial role in the adoption and financial oversight of the state budget. Finally, local authorities empowered by the decentralisation reform mechanisms might also benefit from the recommended priorities for municipal budget allocations.

Starting from the onset of the full-scale Russia's war against Ukraine in 2022, the Ukrainian budget experienced a deficit of more than 50%. Direct international financial assistance currently covers a major part of the deficit, allowing the government of Ukraine to allocate its own financial resources to the national defence sector. In addition, the humanitarian aid provided through UN agencies, international organisations or via local civil society organisations, as well as local business and crowdfunding initiatives, supports the key social sectors, like healthcare, social support, and education. However, the trend in the availability of this support is negative: the international aid is fading, and the local private financial resources are decreasing as well. In addition, with the possible need to start repaying the state debt in 2025, the Ukrainian government needs to already think about financial resources for the years to come.

The status-quo option of this policy issue will lead to a non-covered deficit in the state budget. Under the oversight of the IMF and other international lenders, Ukraine will not be able to emit in order to cover the deficit. Furthermore, the reduction in international reserves might cause economic instability and further aggravate the situation. Hence, the only logical way forward would be the spending cuts. Considering that the war will continue in 2025 and maybe further on, the Ukrainian government will need to hold the level of national defence expenditures or maybe even increase it due to the reduced military support from the allies. As a result, the government of Ukraine will probably start cutting expenditures for social sectors that look less important from the national defence standpoint.

Alternatively, the Ukrainian government may already start preparing for the need to find additional internal resources to cover the budget deficit. Furthermore, specific actions to collect resources might be tied to specific social programs that might suffer from budget cuts in future. The actions could the following:

- Strengthen control of the usage of private entrepreneurs by large companies for tax optimisation.
- Adopt a 'Ukrainian person tax' that would be fixed and tied to Ukrainian nationality rather than to having an income.

These and similar actions will prevent the future budget cuts in social sectors as the tax income for these sectors will be specifically associated with the selected sector or action. Furthermore, the integration of such non-standard creative solutions will support the Ukrainian government in its general attempt to cover the budget deficit in the future years. Most importantly, by upholding the level of public expenditures on the social sector, the government of Ukraine will mitigate the negative impact the war has on human development. In turn, the supported human development will provide benefits for Ukraine, supporting its faster recovery and development.

BIBLIOGRAPHY

(2022). *Estimates developed by the UN Inter-agency Group for Child Mortality Estimation*, 1990-2021. UNICEF, WHO, World Bank, UN DESA Population Division. https://data.worldbank.org/indicator/SP.DYN.IMRT.IN?end=2021&start=1960

(n.d.). *Today's Armed Conflicts*. Geneva Academy. Retrieved September 25, 2023, from https://geneva-academy.ch/galleries/today-s-armed-conflicts

Adair, L. S., Fall, C. H. D., Stein, A. D., Martorell, R., Ramirez-Zea, M., Sachdev, H. S., Dahly, D. L., Bas, I., Norris, S. A., Micklesfield, L., Hallal, P., & Victora, C. G. (2013). Associations of linear growth and relative weight gain during early life with adult health and human capital in countries of low and middle income: Findings from five birth cohort studies. *Lancet*. https://doi.org/DOI: 10.1016/S0140-6736(13)60103-8

Adeola, F. O. (1996). Military Expenditures, Health, and Education: Bedfellows or Antagonists in Third World Development? *Armed Forces & Society*, *22*(3). http://www.jstor.org/stable/45346757

Ahmed, Z., Ataullahjan, A., Gaffey, M.F. et al. (2020). Understanding the factors affecting the humanitarian health and nutrition response for women and children in Somalia since 2000: a case study. *Conflict and Health,* 14 (35). https://doi.org/10.1186/s13031-019-0241-x

Akresh, R., Bhalotra, S., Leone, M., & Okonkwo Osili, U. (2012). War and Stature: Growing Up during the Nigerian Civil War. *American Economic Review*, *102*(3), 273-77. https://doi.org/DOI: 10.1257/aer.102.3.273

Alderman, H., Hoddinott, J., & Kinsey, B. (2006). Long Term Consequences Of Early Childhood Malnutrition. *Oxford Economic Papers*, *58*(3), 450-474. https://doi.org/DOI:10.1093/oep/gpl008

Almedom, A. (2005). Resilience, hardiness, sense of coherence, and posttraumatic growth: All paths leading to "light at the end of the tunnel"? *Journal of Loss and Trauma*, *10*(3), 253-265. https://doi.org/DOI:10.1080/15325020590928216

Barker, R. D., Millard, F. J. C., Malatsi, J., Mkoana, L., Ngoatwana, T., Agarawal, S., & De Valliere, S. (2006). Traditional healers, treatment delay, performance status and death from TB in rural South Africa. *Int J Tuberc Lung Dis*. https://pubmed.ncbi.nlm.nih.gov/16776455

Bernal, O., Garcia-Betancourt, T., León-Giraldo, S. et al. (2022). Impact of The Armed Conflict in Colombia: Consequences in The Health System, Response and Challenges. *Research Square*. https://doi.org/10.21203/rs.3.rs-2356172/v1

Brewin, C. R., & Holmes, E. A. (2003). Psychological theories of posttraumatic stress disorder. *Clinical Psychology Review*, *23*(3), 339-376. https://doi.org/10.1016/S0272-7358(03)00033-3

Brick Murtazashvili, J. (2024, March 7). *Recovery and Reconstruction in Theory* [Lecture]. Kyiv School of Economics. https://youtu.be/Y4SpzxC8VzQ?si=uXQhUmjI1in4a6i8

Britannica, T. Editors of Encyclopaedia (n.d.). *standard of living*. *Encyclopedia Britannica*. Retrieved May 5, 2024 from https://www.britannica.com/money/standard-of-living.

Casais, K. W. (2009). *Israel's Wars in Lebanon, 1982-2006: An Ends/Means Mismatch* [Master's thesis, Defense Technical Information Center]. https://apps.dtic.mil/sti/citations/ADA507993

Chamarbagwala, R., & Morán, H. E. (2011). The human capital consequences of civil war: Evidence from Guatemala. *Journal of Development Economics*, *94*(1), 41-61. https://doi.org/10.1016/j.jdeveco.2010.01.005

Chen, S., Loayza, N., & Reynal-Querol, M. (2008). The Aftermath of Civil War. *The World Bank Economic Review*, *22*(1), 63-85. https://econpapers.repec.org/RePEc:oup:wbecrv:v:22:y:2008:i:1:p:63-85

Chi, P. C., Bulage, P., Urdal, H., & Sundby, J. (2015). A qualitative study exploring the determinants of maternal health service uptake in post-conflict Burundi and Northern Uganda. *BMC Pregnancy Childbirth*. https://doi.org/DOI: 10.1186/s12884-015-0449-8

Davies, S., Pettersson, T., & Öberg, M. (2023). Organized violence 1989-2022, and the return of conflict between states. *Journal of Peace Research*, *60*(4).

Davies, Shawn, Therese Pettersson & Magnus Öberg. (2023). UCDP Battle-Related Deaths Dataset version., v. 23.1. *Uppsala Conflict Data Program*. https://ucdp.uu.se/downloads/index.html#battlerelated

Davis, D. R., & Weinstein, D. E. (2002). Bones, Bombs, and Break Points: The Geography of Economic Activity. *American Economic Review*, *95*(5), 1269-1289. https://doi.org/DOI: 10.1257/000282802762024502

Dochartaigh, N. (2015). Territorial Conflicts. *International Encyclopedia of the Social & Behavioral Sciences*. https://doi.org/10.1016/B978-0-08-097086-8.96039-2

Dupuy, K., & Rustad, S. A. (2018). Trends in Armed Conflict, 1946–2017. *PRIO Conflict Trends*, *5*. https://www.prio.org/publications/11181

FAO, IFAD, UNICEF, WFP, & WHO. The State of Food Security and Nutrition in the World 2020 Transforming food systems for affordable healthy diets. *FAO*. https://doi.org/10.4060/ca9692en

Frost, J. (2019). *Regression analysis. An Intuitive Guide For Using and Interpreting Linear Models*.

Furst, T., Tschannen, A., & Raso, G. (2010). Effect of an armed conflict on relative socioeconomic position of rural households: Case study from western Côte d'Ivoire. *Emerging Themes in Epidemiology*, *7*(6). https://doi.org/10.1186/1742-7622-7-6

Gele, A. A., & Bjune, G. A. (2010). Armed conflicts have an impact on the spread of tuberculosis: The case of the Somali Regional State of Ethiopia. *Confl Health*. https://doi.org/DOI: 10.1186/1752-1505-4-1

Gleditsch, N. P., Wallensteen, P., Eriksson, M., & Sollenberg, M. (2002). Armed Conflict 1946-2001: A New Dataset. *Journal of Peace Research*, *39*(5), 615-637. https://doi.org/DOI:10.1177/0022343302039005007

Greenberg, J. (1994, January 9). Building Peace in Palestinian Schools. *The New York Times*. https://www.nytimes.com/1994/01/09/education/building-peace-in-palestinian-schools.html

Haq, M. U. (1995). *Reflections on Human Development*. Oxford University Press.

He, Q., Abdureyim, M., He, Z., Ma, X., Huang, M., Zhang, T., Qi, X., Hee, J., & Tang, K. (2022). Factors associated with age-specific maternal health-seeking behaviours among women: A Multiple Indicator Cluster Survey-based study in 10 African countries. *J Global Health*. https://doi.org/DOI: 10.7189/jogh.12.04095

HRW (1998, January 1). World Report 1998 - Sudan. *Human Rights Watch*. https://www.refworld.org/reference/annualreport/hrw/1998/en/22743

ICRC (2008, March 17). How is the Term "Armed Conflict" Defined in International Humanitarian Law? *International Committee of Red Cross*. https://www.icrc.org/en/doc/assets/files/other/opinion-paper-armed-conflict.pdf

Ivshina, O., Dale, B., & Brewer, K. (2024, April 17). Russia's meat grinder soldiers - 50,000 confirmed dead. *BBC Russian*. https://www.bbc.co.uk/news/world-68819853

Justino, P., & Verwimp, P. (2006). Poverty Dynamics, Violent Conflict and Convergence in Rwanda. *HiCN Working Papers*. https://doi.org/https://econpapers.repec.org/scripts/redir.pf?u=https%3A%2F%2Fhicn.org%2Fwp-content%2Fuploads%2F2012%2F06%2Fwp16.pdf;h=repec:hic:wpaper:16

Keyes, C. L. M. (2004). Risk and Resilience in Human Development: An Introduction. *Research in Human Development*. https://doi.org/DOI: 10.1207/s15427617rhd0104_1

Kosack, S., & Tobin, J. L. (2006). Funding Self-Sustaining Development: The Role of Aid, FDI and Government in Economic Success. *International Organization*, *60*(1), 205-243. https://doi.org/DOI:10.1017/S0020818306060097

Kreisel, W. (2001). *Health Situation in Iraq* [At the hearing “Iraq and the International Community” of the Committee on Foreign Affairs, Human Rights, Common Security and Defence Policy, World Health Organisation in Brussels].

Lai, B., & Thyne, C. (2007). The Effect of Civil War on Education, 1980—97. *Journal of Peace Research*, *44*(3). https://doi.org/10.1177/0022343307076631

Landau, J., & Saul, J. (2004). Facilitating Family and Community Resilence in Response to Major Disaster. *In F. Walsh & M. McGoldrick (Eds.), Living Beyond Loss: Death in the Family*, *2*, 285-309. https://www.researchgate.net/publication/240626653_Facilitating_Family_and_Community_Resilence_in_Response_to_Major_Disaster

Le, T.H., Bui, M. T., Uddin, G.S., et al. (2022). Economic and social impacts of conflict: A cross-country analysis, *Economic Modelling*, 115. https://doi.org/10.1016/j.econmod.2022.105980

Lee, K. S., Park, S. C., Hsieh, H. L., & Mittendorf, R. (1997). Human development index as a predictor of infant and maternal mortality rates. *J Pediatr*, *190*(3), 430-433. https://doi.org/DOI: 10.1016/s0022-3476(97)80070-4

MacQueen, G., & Santa-Barbara, J. (2000). Peace building through health initiatives. *BMJ*, *321*(7256), 293-299. https://doi.org/DOI: 10.1136/bmj.321.7256.293

Makinde, O. A., Olamijuwon, E., Mgbachi, I., & Sato, R. (2011). Childhood exposure to armed conflict and nutritional health outcomes in Nigeria. *Confl Health*. https://doi.org/10.1186/s13031-023-00513-0

Miller, S. (2016). *Winning the Virtuous Battle, but Losing the War? The tradeoffs of humanitarian aid and its impact on human development* [Bachelor's Thesis, University of Puget Sound]. https://soundideas.pugetsound.edu/cgi/viewcontent.cgi?article=1020&context=ipe_theses

Moyer, J. D., Bohl, D., Mapes, B. R., & Rafa, M. (2019, April 22). Assessing the impact of war on development in Yemen. *United Nations Development Programme*. https://www.undp.org/arab-states/publications/assessing-impact-war-development-yemen

Mrazek, P. J., & Haggerty, R. J. (1994). Reducing Risks for Mental Disorders: Frontiers for Preventive Intervention Research. *Institute of Medicine*. https://doi.org/DOI: 10.17226/2139

Mutschler, W., & Schularick, M. (2024). The Price of War. *Kiel Institute for the World Economy*. https://www.researchgate.net/publication/378309750_The_Price_of_War

Namasivayam A., Arcos González P., Castro Delgado R., Chi P.C. (2017). The Effect of Armed Conflict on the Utilization of Maternal Health Services in Uganda: A Population-based Study. *PLoS Curr*, 9. https://doi.org/10.1371/currents.dis.557b987d6519d8c7c96f2006ed3c271a

OECD. (2023). *Net official development assistance and official aid received (current US$)*. Development Assistance Committee of the Organisation for Economic Co-operation and Development, Geographical Distribution of Financial Flows to Developing Countries, Development Co-operation Report, and International Development Statistics database. https://data.worldbank.org/indicator/DT.ODA.ALLD.CD

Omand, D. (2005). Developing National Resilience. *The RUSI Journal*, *150*(4), 14-18. https://doi.org/DOI:10.1080/03071840508522884

Ozili, P. K. (2022). The Acceptable R-square in Empirical Modelling for Social Science Research. *Social Research Methodology and Publishing Results*. https://doi.org/https://dx.doi.org/10.2139/ssrn.4128165

Pedersen, D. (2002). Political violence, ethnic conflict, and contemporary wars: Broad implications for health and social well-being. *Soc Sci Med*. https://doi.org/DOI: 10.1016/s0277-9536(01)00261-1

Perfilyeva, E., & Arkhangelskaia, A. (2023, February 9). *Design of the National Human Development Report on Energy Vulnerabilities in the Kyrgyz Republic* [Workshop]. United Nations Development Programme (UNDP). https://www.undp.org/sites/g/files/zskgke326/files/2023-02/CK_Slides_FINAL_ENG.pdf

Pettersson, T. (2023). *UCDP Battle-related Deaths Dataset Codebook Version 23.1*. Uppsala Conflict Data Program. https://ucdp.uu.se/downloads/brd/ucdp-brd-codebook-231.pdf

Price, J. I., & Bohara, A. K. (2013). Maternal health care amid political unrest: The effect of armed conflict on antenatal care utilization in Nepal. *Health Policy Plan*, *28*(3), 309-328. https://doi.org/DOI: 10.1093/heapol/czs062

Quinn, J. M., Mason, T. D., & Guess, M. (2007). Sustaining the Peace: Determinants of Civil War Recurrence. *International Interactions*, *33*, 167-193. https://doi.org/DOI:10.1080/03050620701277673

Quota, S., Punamäki, R. L., & El Sarraj, E. (2008). Child development and family mental health in war and military violence: The Palestinian experience. *International Journal of Behavioral Development*, *32*(4). https://doi.org/10.1177/0165025408090973

Ross, M. (2006). Is Democracy Good for the Poor? *American Journal of Political Science,*, *50*(4), 860–874.

Rummel, R. (1979). *Understanding Conflict and War: VOL. 4: War, Power, Peace*. Sage Publications. https://www.hawaii.edu/powerkills/UCW.HTM

Saeedy, A. (2024, May 4). Bondholders to Push Ukraine to Resume Debt Payments After Hiatus. *The Wall Street Journal*. https://www.wsj.com/finance/ukraine-debt-payments-russia-war-1c0c301e

Sajedinejad, S., Majdzadeh, R., & Vedadhir, A. et al. (2015). Maternal mortality: A cross-sectional study in global health. *Global Health*, *11*(4). https://doi.org/10.1186/s12992-015-0087-y

Sami, S., Mayai, A., Sheehy, G. et al. (2020). Maternal and child health service delivery in conflict-affected settings: a case study example from Upper Nile and Unity states, South Sudan.*Conflict and Health,* 14 (34). https://doi.org/10.1186/s13031-020-00272-2

Shemyakina, O. (2011). The Effect of Armed Conflict on Accumulation of Schooling: Results from Tajikistan. *Journal of Development Economics*, *95*(2), 186-200. https://doi.org/DOI:10.1016/j.jdeveco.2010.05.002

Small, M. (1982). *Resort to arms : International and civil wars, 1816-1980*. Sage Publications. https://archive.org/details/resorttoarmsinte0000smal

Stock, J. H., & Watson, M. (2015). *Introduction to Econometrics, Third Update, Global Edition*. Pearson Education Limited.

Terr, L. C. (1991). Childhood traumas: An outline and overview. *Am J Psychiatry*. https://doi.org/DOI: 10.1176/ajp.148.1.10

Tir, J. (2003). Never-ending Conflicts? Territorial Changes as Potential Solutions for Territorial Disputes. *Conflict Management and Peace Science*, *20*(2), 59–83. http://www.jstor.org/stable/26273575

UCDP. (n.d.) Definitions, sources and methods for Uppsala Conflict Data Program Battle-Death estimates. *Uppsala Conflict Data Program*. https://ucdp.uu.se/downloads/old/brd/ucdp-brd-conf-41-2006.pdf

UNDP (1990, July 9). Human Development Report 1990. *United Nations Development Porgram*. https://www.undp.org/publications/human-development-report-1990#:~:text=July%209%2C%201990,sum%20total%20of%20human%20endeavour

UNDP (n.d.). *Human Development Index (HDI)*. Human Development Reports. Retrieved May 5, 2024, from https://hdr.undp.org/data-center/human-development-index#/indicies/HDI

UNDP. (2023). Trends in the Human Development Index, 1990-2022. *United Nations Development Program*. https://hdr.undp.org/data-center/documentation-and-downloads

UNFPA (2024, January 1). UNFPA Regional Response to Ukraine Emergency Situation Report #22. *United Nations Population Fund*. https://www.unfpa.org/sites/default/files/resource-pdf/Regional%20Ukraine%20Emergency%20Sitrep%20%2322%20%281%20Nov%20-%2031%20Dec%202023%29.pdf

United Nations Population Division, National Statistical Offices, Eurostat, United Nations Statistical Division, U.S. Census Bureau & Secretariat of the Pacific Community. (2023). *Population, total*. (1) United Nations Population Division. World Population Prospects: 2022 Revision. (2) Census reports and other statistical publications from national statistical offices, (3) Eurostat: Demographic Statistics, (4) United Nations Statistical Division. Population and Vital Statistics Reprot (various years), (5) U.S. Census Bureau: International Database, and (6) Secretariat of the Pacific Community: Statistics and Demography Programme. https://data.worldbank.org/indicator/SP.POP.TOTL

Victora, C. G., De Otis, M., Hallal, P. C., Blössner, M., & Shrimpton, R. (2010). Worldwide timing of growth faltering: Revisiting implications for interventions. *Pediatrics*. https://doi.org/DOI: 10.1542/peds.2009-1519

Von Clausewitz, C. (1918). *On War*. Princeton University Press. https://www.usmcu.edu/Portals/218/EWS%20On%20War%20Reading%20Book%201%20Ch%201%20Ch%202.pdf

Weldegiargis, A. W., Abebe, H. T., & Abraha, H. E., et al. (2023). Armed conflict and household food insecurity: Evidence from war-torn Tigray, Ethiopia. *Confl Health*, *17*(22). https://doi.org/10.1186/s13031-023-00520-1

Wilmoth, J., Mizoguchi, N., Oestergaard, M., Say, L., Mathers, C., Zureick-Brown, S., Inoue, M. & Chou, D. (2012). A New Method for Deriving Global Estimates of Maternal Mortality. *Statistics, Politics, and Policy*, *3*(2). https://doi.org/10.1515/2151-7509.1038

World Bank (n.d.). *Maternal mortality*. World Bank | Gender Data Portal. Retrieved May 5, 2024, from https://genderdata.worldbank.org/en/economies/ukraine#:~:text=17%20women%20die%20per%20100%2C000,same%20as%20its%20regional%20average.

World Bank (n.d.). *Population, total*. The World Bank. Retrieved May 5, 2024, from https://data.worldbank.org/indicator/SP.POP.TOTL?locations=1W

World Health Organisation (2024, April 26). *Maternal mortality*. Retrieved May 5, 2024, from https://www.who.int/news-room/fact-sheets/detail/maternal-mortality#:~:text=The%20MMR%20in%20low%2Dincome,the%20burden%20of%20maternal%20mortality

Zhang, T., He, Q., Richardson, S., et al. (2023) Does armed conflict lead to lower prevalence of maternal health-seeking behaviours: theoretical and empirical research based on 55

683 women in armed conflict settings. *BMJ Global Health*, 8. https://doi.org/10.1136/bmjgh-2023-012023

Annex 1. REPLICABILITY CODEBOOK

Dataframes

Name	Explanation	Observations	Variables
Upps_a	UCDP Battle-Deaths dataset with filtered out unnecessary columns, conflicts that less than two years long. Calculated the cumulative battle-deaths. Side A conflicts.	1038	10
Upps_b	UCDP Battle-Deaths dataset with filtered out unnecessary columns, conflicts that less than two years long. Calculated the cumulative battle-deaths. Side B conflicts. Filtered out both intrastate and intrastate with external power conflicts.	18	10
Upps_big	Combined Upps_a and Upps_b dataframes, with added intensity variable following the methodology, described in the research framework.	1056	10
Pop_1	Population dataset transformed from the wide to long format, using only country, year and population data. The names of the countries were changed to unify with the UCDP dataset.	17290	3
Pop_2	Pop_1 filtered by DR Congo (Zaire) to change its name	65	3
Pop_3	Pop_1 filtered by Servia (Yugoslavia) to change its name	65	3
Pop_big	Combined Pop_1, Pop_2, Pop_3 dataframes	17420	3
UppswPop	Upps_big joined with Pop_big dataframes. Only values from Pop_big were taken that have existing country + year combinations in Upps_big dataframe	1056	11
School_e	Expected years of schooling derived from HDI dataset that was transformed to the long format. Dataframe has changed names to unify with the UCDP dataset. Only country, year and expected years of schooling data has been kept.	6798	3
School_m	Mean years of schooling derived from HDI dataset that was transformed to the long format. Dataframe has changed names to unify with the UCDP dataset. Only country, year and Mean years of schooling data has been kept.	6798	3
Gni	GNI per capita derived from HDI dataset that was transformed to the long format. Dataframe has changed names to unify with the UCDP dataset. Only country, year and GNI per capita data has been kept.	6798	3

Hdi	Human Development Index values derived from HDI dataset that was transformed to the long format. Dataframe has changed names to unify with the UCDP dataset. Only country, year and HDI has been kept.	6798	3
Mmr	Mother Mortality Rate derived from HDI dataset that was transformed to the long format. Dataframe has changed names to unify with the UCDP dataset. Only country, year and MMR data has been kept.	6798	3
Imr	Infant Mortality Rate derived from IMR dataset that was transformed to the long format. Dataframe has changed names to unify with the UCDP dataset. Only country, year and IMR data has been kept.	17290	3
Aid	Net Official Direct Assistance and Aid derived from AID dataset that was transformed to the long format. Dataframe has changed names to unify with the UCDP dataset. Only country, year and AID data has been kept.	17290	3
Upps_complete	UppswPop with added one year to each conflict. The year is the previous one to the first year of conflict. Hdi, School_m, School_e, Gni, Mmr, Imr, Aid values were added to corresponding country + year pairs.	965	25
Upps_cleanHDIa	Upps_complete dataset with filtered out observations of NA values of HDI and AID	689	25
Upps_clean1a	Upps_complete dataset with filtered out observations of NA values of devi1 index and AID	659	25
Upps_clean2a	Upps_complete dataset with filtered out observations of NA values of devi2 index and AID	659	25
Upps_clean3a	Upps_complete dataset with filtered out observations of NA values of devi3 index and AID	659	25
Upps_clean4a	Upps_complete dataset with filtered out observations of NA values of devi4 index and AID	658	25

Variables

Variable	Dataframe	Formula
cumdeaths (changed later to "deaths")	Upps_a, Upps_b	Battle-deaths(nx) = Battle-deaths(n-1) + … + Battle-deaths(n0), where n0 is the first year of theconflict
percent_pop	Upps_complete	cumdeaths/total population * 100%

devi1	Upps_complete	((expected years of schooling – 0) / (18-0) +(mean years of schooling – 0) / (15-0)) (((((expected years of schooling -0)/(18-0))+((mean years of schooling -0)/(15-0)))/2)*((log(GNI per capita)-log(100))/(log(75000)-log(100))))^(1/2))
devi2	Upps_complete	(((log(MMR)-log(minimal MMR)))/(log(maximal MMR)-log(minimal MMR)))*((((expected years of schooling -0)/(18-0))+((mean years of schooling -0)/(15-0)))/2)*((log(GNI)-log(100))/(log(75000)-log(100))))^(1/3))
devi3	Upps_complete	(((log(maximal IMR-log(minimal IMR))/ (log(IMR)-log(minimal IMR)))*((((expected years of schooling -0)/(18-0))+((mean years of schooling -0)/(15-0)))/2)*((log(GNI)-log(100))/(log(75000)-log(100))))^(1/3))
devi4	Upps_complete	(((life expectancy-20)/(85-20))*((((expected years of schooling -0)/(18-0))+((mean years of schooling -0)/(15-0)))/2)*((log(GNI)-log(100))/(log(75000)-log(100))))^(1/3))
aid_cap	Upps_complete	Net Official Direct Assistance and Aid/ total population
aid-perc	Upps_complete	aid_cap / GNI per capita

Datasets download: https://drive.google.com/drive/folders/1T5Xoxa01kNyFzkSgK7QkQOMU7JyRGDKT?usp=share_link

Annex 2. CODE in R

```
setwd(dirname(rstudioapi::getActiveDocumentContext()$path))

library(plm)
library(lmtest)
library(sandwich)
library(purrr)
library(tidyverse)
library(readxl)
library(broom)
library(AER)
library(stargazer)
library(lmtest)

# ----------------------
# Battle-deaths - Uppsala

Upps_d <- read.csv("Uppsala_d.csv")


Upps_a <- Upps_d %>%
  select(conflict_id:battle_location) %>%
  select(-dyad_id,-side_a_id,-side_a_2nd,-side_b_id,-side_b_2nd,-incompatibility,-
bd_low,-bd_high) %>%
  filter(n() > 1) %>%
  group_by(year, side_a) %>%
  mutate(bd_best = cumsum(bd_best)) %>%
  ungroup() %>%
  group_by(year, side_a) %>%
  slice_max(order_by = bd_best, with_ties = FALSE) %>%
  ungroup() %>%
  group_by(conflict_id) %>%
  mutate(cumdeaths = cumsum(bd_best)) %>%
  ungroup() %>%
  mutate(group="a") %>%
  select(-side_b) %>%
  rename(side = side_a) %>%
  mutate(side = str_replace(side, "^Government of ", ""))

Upps_b <- Upps_d %>%
  select(conflict_id:battle_location) %>%
  select(-dyad_id,-side_a_id,-side_a_2nd,-side_b_id,-side_b_2nd,-incompatibility,-
bd_low,-bd_high) %>%
  filter(n() > 1)  %>%
  group_by(year, side_a) %>%
  mutate(bd_best = cumsum(bd_best)) %>%
```

```
  ungroup() %>%
  group_by(year, side_a) %>%
  slice_max(order_by = bd_best, with_ties = FALSE) %>%
  ungroup() %>%
  group_by(conflict_id) %>%
  mutate(cumdeaths = cumsum(bd_best)) %>%
  ungroup() %>%
  mutate(group="b") %>%
  select(-side_a) %>%
  rename(side = side_b) %>%
  mutate(side = str_replace(side, "^Government of ", "")) %>%
  filter(type_of_conflict !=3 & type_of_conflict !=4)


Upps_big <- bind_rows(Upps_a,Upps_b) %>%
  rename(country = side) %>%
  mutate(year = as.numeric(year)) %>%
  mutate(country = as.character(country))

# ----------------------
# Population data from Worldbank

Pop <- read.csv("WBPOP.csv",skip=4)

Pop_1 <-Pop %>%
  select(-Country.Code,-Indicator.Code,-Indicator.Name) %>%
  pivot_longer(
        cols = -Country.Name,
        names_to = "year",
        values_to = "pop") %>%
  mutate(year = str_replace(year, "X", "")) %>%
  rename(country = Country.Name) %>%
  mutate(year = as.numeric(year)) %>%
  mutate(country = str_replace(country, "Syrian Arab Republic", "Syria")) %>%
  mutate(country = str_replace(country, "Kyrgyz Republic", "Kyrgyzstan")) %>%
  mutate(country = str_replace(country, "Russian Federation", "Russia (Soviet Union)"))
%>%
  mutate(country = str_replace(country, "Egypt, Arab Rep.", "Egypt")) %>%
  mutate(country = str_replace(country, "Turkiye", "Turkey")) %>%
  mutate(country = str_replace(country, "Iran, Islamic Rep.", "Iran")) %>%
  mutate(country = str_replace(country, "Congo, Dem. Rep.", "DR Congo (Zaire)")) %>%
  mutate(country = str_replace(country, "Lao PDR", "Laos")) %>%
  mutate(country = str_replace(country, "Bosnia and Herzegovina", "Bosnia-
Herzegovina")) %>%
  mutate(country = str_replace(country, "Serbia", "Serbia (Yugoslavia)")) %>%
  mutate(country = str_replace(country, "Viet Nam", "Vietnam")) %>%
  mutate(country = str_replace(country, "Suriname", "Surinam")) %>%
```

```
  mutate(country = str_replace(country, "Cote d'", "Cote D’"))

Pop_2 <- Pop_1 %>%
  filter (country=="DR Congo (Zaire)") %>%
  mutate (country="Democratic Republic of Congo (Zaire)")

Pop_3 <- Pop_1 %>%
  filter (country=="Serbia (Yugoslavia)") %>%
  mutate (country="Yugoslavia (Serbia)")


Pop_big <- bind_rows(Pop_1,Pop_2,Pop_3) %>%
  mutate(country = as.character(country))

# ----------------------
# UPPSALA w/ Population data

UppswPop <- left_join(Upps_big, Pop_big, by = c("year", "country")) %>%
  mutate(year = as.numeric(year))

# ----------------------
# Life Expectancy HDI - UNDP

life <- read.csv("HDI.csv") %>%
  select(country,le_1990:le_2022) %>%
  pivot_longer(
    cols = -country,
    names_to = "year",
    values_to = "life") %>%
  mutate(year = str_replace(year, "le_", "")) %>%
  mutate(year = as.numeric(year))%>%
  mutate(country = str_replace(country, "Syrian Arab Republic", "Syria")) %>%
  mutate(country = str_replace(country, "Kyrgyz Republic", "Kyrgyzstan")) %>%
  mutate(country = str_replace(country, "Russian Federation", "Russia (Soviet Union)"))
%>%
  mutate(country = str_replace(country, "Egypt, Arab Rep.", "Egypt")) %>%
  mutate(country = str_replace(country, "Turkiye", "Turkey")) %>%
  mutate(country = str_replace(country, "Iran, Islamic Rep.", "Iran")) %>%
  mutate(country = str_replace(country, "Congo, Dem. Rep.", "DR Congo (Zaire)")) %>%
  mutate(country = str_replace(country, "Lao PDR", "Laos")) %>%
  mutate(country = str_replace(country, "Bosnia and Herzegovina", "Bosnia-
Herzegovina")) %>%
  mutate(country = str_replace(country, "Serbia", "Serbia (Yugoslavia)")) %>%
  mutate(country = str_replace(country, "Viet Nam", "Vietnam")) %>%
  mutate(country = str_replace(country, "Suriname", "Surinam")) %>%
  mutate(country = str_replace(country, "Cote d'", "Cote D’"))
```

```
# ----------------------
# EXPECTED YEARS OF SCHOOLING HDI - UNDP

School_e <- read.csv("HDI.csv") %>%
  select(country,eys_1990:eys_2022) %>%
  pivot_longer(
    cols = -country,
    names_to = "year",
    values_to = "School_e") %>%
  mutate(year = str_replace(year, "eys_", "")) %>%
  mutate(year = as.numeric(year))%>%
  mutate(country = str_replace(country, "Syrian Arab Republic", "Syria")) %>%
  mutate(country = str_replace(country, "Kyrgyz Republic", "Kyrgyzstan")) %>%
  mutate(country = str_replace(country, "Russian Federation", "Russia (Soviet Union)"))
%>%
  mutate(country = str_replace(country, "Egypt, Arab Rep.", "Egypt")) %>%
  mutate(country = str_replace(country, "Turkiye", "Turkey")) %>%
  mutate(country = str_replace(country, "Iran, Islamic Rep.", "Iran")) %>%
  mutate(country = str_replace(country, "Congo, Dem. Rep.", "DR Congo (Zaire)")) %>%
  mutate(country = str_replace(country, "Lao PDR", "Laos")) %>%
  mutate(country = str_replace(country, "Bosnia and Herzegovina", "Bosnia-
Herzegovina")) %>%
  mutate(country = str_replace(country, "Serbia", "Serbia (Yugoslavia)")) %>%
  mutate(country = str_replace(country, "Viet Nam", "Vietnam")) %>%
  mutate(country = str_replace(country, "Suriname", "Surinam")) %>%
  mutate(country = str_replace(country, "Cote d'", "Cote D’")) %>%
  mutate(year = year - 3)

School_m <- read.csv("HDI.csv") %>%
  select(country,mys_1990:mys_2022) %>%
  pivot_longer(
    cols = -country,
    names_to = "year",
    values_to = "School_m") %>%
  mutate(year = str_replace(year, "mys_", "")) %>%
  mutate(year = as.numeric(year))%>%
  mutate(country = str_replace(country, "Syrian Arab Republic", "Syria")) %>%
  mutate(country = str_replace(country, "Kyrgyz Republic", "Kyrgyzstan")) %>%
  mutate(country = str_replace(country, "Russian Federation", "Russia (Soviet Union)"))
%>%
  mutate(country = str_replace(country, "Egypt, Arab Rep.", "Egypt")) %>%
  mutate(country = str_replace(country, "Turkiye", "Turkey")) %>%
  mutate(country = str_replace(country, "Iran, Islamic Rep.", "Iran")) %>%
  mutate(country = str_replace(country, "Congo, Dem. Rep.", "DR Congo (Zaire)")) %>%
  mutate(country = str_replace(country, "Lao PDR", "Laos")) %>%
  mutate(country = str_replace(country, "Bosnia and Herzegovina", "Bosnia-
Herzegovina")) %>%
```

```
  mutate(country = str_replace(country, "Serbia", "Serbia (Yugoslavia)")) %>%
  mutate(country = str_replace(country, "Viet Nam", "Vietnam")) %>%
  mutate(country = str_replace(country, "Suriname", "Surinam")) %>%
  mutate(country = str_replace(country, "Cote d'", "Cote D’")) %>%
  mutate(year = year - 3)

# ----------------------
# GNI per capita HDI - UNDP

Gni <- read.csv("HDI.csv") %>%
  select(country,gnipc_1990:gnipc_2022) %>%
  pivot_longer(
    cols = -country,
    names_to = "year",
    values_to = "GNI") %>%
  mutate(year = str_replace(year, "gnipc_", "")) %>%
  mutate(year = as.numeric(year))%>%
  mutate(country = str_replace(country, "Syrian Arab Republic", "Syria")) %>%
  mutate(country = str_replace(country, "Kyrgyz Republic", "Kyrgyzstan")) %>%
  mutate(country = str_replace(country, "Russian Federation", "Russia (Soviet Union)"))
%>%
  mutate(country = str_replace(country, "Egypt, Arab Rep.", "Egypt")) %>%
  mutate(country = str_replace(country, "Turkiye", "Turkey")) %>%
  mutate(country = str_replace(country, "Iran, Islamic Rep.", "Iran")) %>%
  mutate(country = str_replace(country, "Congo, Dem. Rep.", "DR Congo (Zaire)")) %>%
  mutate(country = str_replace(country, "Lao PDR", "Laos")) %>%
  mutate(country = str_replace(country, "Bosnia and Herzegovina", "Bosnia-
Herzegovina")) %>%
  mutate(country = str_replace(country, "Serbia", "Serbia (Yugoslavia)")) %>%
  mutate(country = str_replace(country, "Viet Nam", "Vietnam")) %>%
  mutate(country = str_replace(country, "Suriname", "Surinam")) %>%
  mutate(country = str_replace(country, "Cote d'", "Cote D’"))

# ----------------------
# HDI - UNDP

Hdi <- read.csv("HDI.csv") %>%
  select(country,hdi_1990:hdi_2022) %>%
  pivot_longer(
    cols = -country,
    names_to = "year",
    values_to = "HDI") %>%
  mutate(year = str_replace(year, "hdi_", "")) %>%
  mutate(year = as.numeric(year))%>%
  mutate(country = str_replace(country, "Syrian Arab Republic", "Syria")) %>%
  mutate(country = str_replace(country, "Kyrgyz Republic", "Kyrgyzstan")) %>%
```

```
  mutate(country = str_replace(country, "Russian Federation", "Russia (Soviet Union)"))
%>%
  mutate(country = str_replace(country, "Egypt, Arab Rep.", "Egypt")) %>%
  mutate(country = str_replace(country, "Turkiye", "Turkey")) %>%
  mutate(country = str_replace(country, "Iran, Islamic Rep.", "Iran")) %>%
  mutate(country = str_replace(country, "Congo, Dem. Rep.", "DR Congo (Zaire)")) %>%
  mutate(country = str_replace(country, "Lao PDR", "Laos")) %>%
  mutate(country = str_replace(country, "Bosnia and Herzegovina", "Bosnia-
Herzegovina")) %>%
  mutate(country = str_replace(country, "Serbia", "Serbia (Yugoslavia)")) %>%
  mutate(country = str_replace(country, "Viet Nam", "Vietnam")) %>%
  mutate(country = str_replace(country, "Suriname", "Surinam")) %>%
  mutate(country = str_replace(country, "Cote d'", "Cote D’"))

# ----------------------
# MMR - HDI - UNDP

Mmr <- read.csv("HDI.csv") %>%
  select(country,mmr_1990:mmr_2022) %>%
  pivot_longer(
    cols = -country,
    names_to = "year",
    values_to = "MMR") %>%
  mutate(year = str_replace(year, "mmr_", "")) %>%
  mutate(year = as.numeric(year))%>%
  mutate(country = str_replace(country, "Syrian Arab Republic", "Syria")) %>%
  mutate(country = str_replace(country, "Kyrgyz Republic", "Kyrgyzstan")) %>%
  mutate(country = str_replace(country, "Russian Federation", "Russia (Soviet Union)"))
%>%
  mutate(country = str_replace(country, "Egypt, Arab Rep.", "Egypt")) %>%
  mutate(country = str_replace(country, "Turkiye", "Turkey")) %>%
  mutate(country = str_replace(country, "Iran, Islamic Rep.", "Iran")) %>%
  mutate(country = str_replace(country, "Congo, Dem. Rep.", "DR Congo (Zaire)")) %>%
  mutate(country = str_replace(country, "Lao PDR", "Laos")) %>%
  mutate(country = str_replace(country, "Bosnia and Herzegovina", "Bosnia-
Herzegovina")) %>%
  mutate(country = str_replace(country, "Serbia", "Serbia (Yugoslavia)")) %>%
  mutate(country = str_replace(country, "Viet Nam", "Vietnam")) %>%
  mutate(country = str_replace(country, "Suriname", "Surinam")) %>%
  mutate(country = str_replace(country, "Cote d'", "Cote D’"))

# ----------------------
# IMR - WB

Imr <- read.csv("IMR.csv",skip=4) %>%
  select(-Country.Code,-Indicator.Code,-Indicator.Name) %>%
  pivot_longer(
```

```
    cols = -Country.Name,
    names_to = "year",
    values_to = "IMR") %>%
  mutate(year = str_replace(year, "X", "")) %>%
  rename(country = Country.Name) %>%
  mutate(year = as.numeric(year))%>%
  mutate(country = str_replace(country, "Syrian Arab Republic", "Syria")) %>%
  mutate(country = str_replace(country, "Kyrgyz Republic", "Kyrgyzstan")) %>%
  mutate(country = str_replace(country, "Russian Federation", "Russia (Soviet Union)"))
%>%
  mutate(country = str_replace(country, "Egypt, Arab Rep.", "Egypt")) %>%
  mutate(country = str_replace(country, "Turkiye", "Turkey")) %>%
  mutate(country = str_replace(country, "Iran, Islamic Rep.", "Iran")) %>%
  mutate(country = str_replace(country, "Congo, Dem. Rep.", "DR Congo (Zaire)")) %>%
  mutate(country = str_replace(country, "Lao PDR", "Laos")) %>%
  mutate(country = str_replace(country, "Bosnia and Herzegovina", "Bosnia-
Herzegovina")) %>%
  mutate(country = str_replace(country, "Serbia", "Serbia (Yugoslavia)")) %>%
  mutate(country = str_replace(country, "Viet Nam", "Vietnam")) %>%
  mutate(country = str_replace(country, "Suriname", "Surinam")) %>%
  mutate(country = str_replace(country, "Cote d'", "Cote D’"))

# ----------------------
# AID - WB

Aid <- read.csv("AID.csv",skip=4) %>%
  select(-Country.Code,-Indicator.Code,-Indicator.Name) %>%
  pivot_longer(
    cols = -Country.Name,
    names_to = "year",
    values_to = "AID") %>%
  mutate(year = str_replace(year, "X", "")) %>%
  rename(country = Country.Name) %>%
  mutate(year = as.numeric(year))%>%
  mutate(country = str_replace(country, "Syrian Arab Republic", "Syria")) %>%
  mutate(country = str_replace(country, "Kyrgyz Republic", "Kyrgyzstan")) %>%
  mutate(country = str_replace(country, "Russian Federation", "Russia (Soviet Union)"))
%>%
  mutate(country = str_replace(country, "Egypt, Arab Rep.", "Egypt")) %>%
  mutate(country = str_replace(country, "Turkiye", "Turkey")) %>%
  mutate(country = str_replace(country, "Iran, Islamic Rep.", "Iran")) %>%
  mutate(country = str_replace(country, "Congo, Dem. Rep.", "DR Congo (Zaire)")) %>%
  mutate(country = str_replace(country, "Lao PDR", "Laos")) %>%
  mutate(country = str_replace(country, "Bosnia and Herzegovina", "Bosnia-
Herzegovina")) %>%
  mutate(country = str_replace(country, "Serbia", "Serbia (Yugoslavia)")) %>%
  mutate(country = str_replace(country, "Viet Nam", "Vietnam")) %>%
```

```
  mutate(country = str_replace(country, "Suriname", "Surinam")) %>%
  mutate(country = str_replace(country, "Cote d'", "Cote D’")) %>%
  mutate(year = year - 1)

# ---------------------
# MERGING all WAR and DEV data

maxMMR <- Mmr %>%
  mutate(MMR = as.numeric(MMR)) %>%
  filter(!is.na(MMR)) %>%
  summarise(maxMMR = max(MMR))
maxMMR <- maxMMR$maxMMR

minMMR <- Mmr %>%
  mutate(MMR = as.numeric(MMR)) %>%
  filter(!is.na(MMR)) %>%
  summarise(minMMR = min(MMR))
minMMR <- minMMR$minMMR

maxIMR <- Imr %>%
  mutate(IMR = as.numeric(IMR)) %>%
  filter(!is.na(IMR)) %>%
  summarise(maxIMR = max(IMR))
maxIMR <- maxIMR$maxIMR

minIMR <- Imr %>%
  mutate(IMR = as.numeric(IMR)) %>%
  filter(!is.na(IMR)) %>%
  summarise(minIMR = min(IMR))
minIMR <- minIMR$minIMR


#Upps_complete <- UppswPop %>%
#  group_by(conflict_id) %>%
#  slice(1) %>%
#  mutate(year = year - 1) %>%
#  mutate_at(vars(-country,-year,-conflict_id), ~ NA)

# Upps_complete <- bind_rows(UppswPop, Upps_complete)

Upps_complete <- left_join(UppswPop, Hdi, by = c("year", "country")) %>%
  left_join(School_m, by = c("year", "country")) %>%
  left_join(School_e, by = c("year", "country")) %>%
  left_join(Gni, by = c("year", "country")) %>%
  left_join(Mmr, by = c("year", "country")) %>%
  left_join(Imr, by = c("year", "country")) %>%
  left_join(Aid, by = c("year", "country")) %>%
```

```
  left_join(life, by = c("year", "country")) %>%
  rename(id = conflict_id) %>%
  rename(location = location_inc) %>%
  rename(territory = territory_name) %>%
  rename(deaths = bd_best) %>%
  rename(type = type_of_conflict) %>%
  select(-battle_location) %>%
  mutate(percent_pop = round(cumdeaths/pop*100,digits=5)) %>%
  mutate(devi1 = (((((School_e-0)/(18-0))+((School_m-0)/(15-0)))/2)*((log(GNI)-
log(100))/(log(75000)-log(100))))^(1/2)) %>%
  mutate(devi1 = round(devi1,digits=5)) %>%
  mutate(devi2 = (((log(maxMMR)-log(minMMR))/(log(MMR)-
log(minMMR)))*((((School_e-0)/(18-0))+((School_m-0)/(15-0)))/2)*((log(GNI)-
log(100))/(log(75000)-log(100))))^(1/3)) %>%
  mutate(devi2 = round(devi2,digits=5)) %>%
  mutate(devi3 = (((log(maxIMR)-log(minIMR))/(log(IMR)-
log(minIMR)))*((((School_e-0)/(18-0))+((School_m-0)/(15-0)))/2)*((log(GNI)-
log(100))/(log(75000)-log(100))))^(1/3)) %>%
  mutate(devi3 = round(devi3,digits=5)) %>%
  mutate(devi4 = (((life-20)/(85-20))*((((School_e-0)/(18-0))+((School_m-0)/(15-
0)))/2)*((log(GNI)-log(100))/(log(75000)-log(100))))^(1/3)) %>%
  mutate(devi4 = round(devi4,digits=5)) %>%
  mutate(aid_cap = AID/pop) %>%
  mutate(aid_cap = round(aid_cap,digits=5)) %>%
  mutate(aid_perc = aid_cap/GNI) %>%
  mutate(aid_cap = round(aid_perc,digits=5)) %>%
  filter(!is.na(percent_pop))

# ---------------------
# FOR REGRESSION

Upps_cleanHDIa <- Upps_complete %>% filter(!is.na(HDI) & !is.na(AID))
Upps_clean1a <- Upps_complete %>% filter(!is.na(devi1) & !is.na(AID))
Upps_clean2a <- Upps_complete %>% filter(!is.na(devi2) & !is.na(AID))
Upps_clean3a <- Upps_complete %>% filter(!is.na(devi3) & !is.na(AID))
Upps_clean4a <- Upps_complete %>% filter(!is.na(devi4) & !is.na(AID))

duplicates1 <- Upps_cleanHDIa[duplicated(Upps_cleanHDIa[c("id", "year")]), ]
duplicates2 <- Upps_clean1a[duplicated(Upps_clean1a[c("id", "year")]), ]
duplicates3 <- Upps_clean2a[duplicated(Upps_clean2a[c("id", "year")]), ]
duplicates4 <- Upps_clean3a[duplicated(Upps_clean3a[c("id", "year")]), ]
duplicates5 <- Upps_clean4a[duplicated(Upps_clean4a[c("id", "year")]), ]

Upps_cleanHDIa <- anti_join(Upps_cleanHDIa,duplicates1,by = c("id", "year"))
Upps_clean1a <- anti_join(Upps_clean1a,duplicates2,by = c("id", "year"))
Upps_clean2a <- anti_join(Upps_clean2a,duplicates3,by = c("id", "year"))
Upps_clean3a <- anti_join(Upps_clean3a,duplicates4,by = c("id", "year"))
```

```
Upps_clean4a <- anti_join(Upps_clean4a,duplicates5,by = c("id", "year"))

Upps_cleanHDIa <- bind_rows(Upps_cleanHDIa,duplicates1)
Upps_clean1a <- bind_rows(Upps_clean1a,duplicates2)
Upps_clean2a <- bind_rows(Upps_clean2a,duplicates3)
Upps_clean3a <- bind_rows(Upps_clean3a,duplicates4)
Upps_clean4a <- bind_rows(Upps_clean4a,duplicates5)

length(unique(Upps_complete$id))

# ---------------------
# REGRESSION
# ---------------------

# ---------------------
# Fixed effect
# ---------------------

# Increasing battle death negatively impact human development

model1 <- plm(HDI ~ percent_pop + year,
              data = Upps_cleanHDIa,
              index = c("id", "year"),
              model = "within",
             effects = "twoways")

model2 <- plm(devi1 ~ percent_pop + year,
              data = Upps_clean1a,
              index = c("id", "year"),
              model = "within",
             effects = "twoways")

model3 <- plm(devi2 ~ percent_pop + year,
             data = Upps_clean2a,
             index = c("id", "year"),
             model = "within",
             effects = "twoways")

model4 <- plm(devi3 ~ percent_pop + year,
             data = Upps_clean3a,
             index = c("id", "year"),
             model = "within",
             effects = "twoways")

model5 <- plm(devi4 ~ percent_pop + year,
             data = Upps_clean4a,
             index = c("id", "year"),
```

```
            model = "within",
            effects = "twoways")

model6 <- plm(log(MMR) ~ percent_pop + year,
            data = Upps_clean2a,
            index = c("id", "year"),
            model = "within",
            effects = "twoways")

model7 <- plm(log(IMR) ~ percent_pop + year,
            data = Upps_clean3a,
            index = c("id", "year"),
            model = "within",
            effects = "twoways")

# Aid is a mitigating factor

model1a <- plm(HDI ~ percent_pop + aid_perc + year,
               data = Upps_cleanHDIa,
               index = c("id", "year"),
               model = "within",
               effects = "twoways")

model2a <- plm(devi1 ~ percent_pop + aid_perc + year,
               data = Upps_clean1a,
               index = c("id", "year"),
               model = "within",
            effects = "twoways")

model3a <- plm(devi2 ~ percent_pop + aid_perc + year,
               data = Upps_clean2a,
               index = c("id", "year"),
               model = "within",
            effects = "twoways")

model4a <- plm(devi3 ~ percent_pop + aid_perc + year,
               data = Upps_clean3a,
               index = c("id", "year"),
               model = "within",
            effects = "twoways")

model5a <- plm(devi4 ~ percent_pop + aid_perc + year,
            data = Upps_clean4a,
            index = c("id", "year"),
            model = "within",
            effects = "twoways")
```

```
model6a <- plm(MMR ~ percent_pop + aid_perc + year,
            data = Upps_clean2a,
            index = c("id", "year"),
            model = "within",
            effects = "twoways")

model7a <- plm(IMR ~ percent_pop + aid_perc + year,
            data = Upps_clean3a,
            index = c("id", "year"),
            model = "within",
            effects = "twoways")

# ---------------------
# Random effect
# ---------------------

model1r <- plm(HDI ~ percent_pop + year,
           data = Upps_cleanHDIa,
           index = c("id", "year"),
           model = "random")

model2r <- plm(devi1 ~ percent_pop + year,
           data = Upps_clean1a,
           index = c("id", "year"),
           model = "random")

model3r <- plm(devi2 ~ percent_pop + year,
           data = Upps_clean2a,
           index = c("id", "year"),
           model = "random")

model4r <- plm(devi3 ~ percent_pop + year,
           data = Upps_clean3a,
           index = c("id", "year"),
           model = "random")

model5r <- plm(devi4 ~ percent_pop + year,
           data = Upps_clean4a,
           index = c("id", "year"),
           model = "random")

model6r <- plm(log(MMR) ~ percent_pop + year,
           data = Upps_clean2a,
           index = c("id", "year"),
           model = "random")

model7r <- plm(log(IMR) ~ percent_pop + year,
```

```
          data = Upps_clean3a,
          index = c("id", "year"),
          model = "random")

model1ar <- plm(HDI ~ percent_pop + aid_perc + year,
           data = Upps_cleanHDIa,
           index = c("id", "year"),
           model = "random")

model2ar <- plm(devi1 ~ percent_pop + aid_perc + year,
           data = Upps_clean1a,
           index = c("id", "year"),
           model = "random")

model3ar <- plm(devi2 ~ percent_pop + aid_perc + year,
           data = Upps_clean2a,
           index = c("id", "year"),
           model = "random")

model4ar <- plm(devi3 ~ percent_pop + aid_perc + year,
           data = Upps_clean3a,
           index = c("id", "year"),
           model = "random")

model5ar <- plm(devi4 ~ percent_pop + aid_perc + year,
           data = Upps_clean4a,
           index = c("id", "year"),
           model = "random")

model6ar <- plm(MMR ~ percent_pop + aid_perc + year,
           data = Upps_clean2a,
           index = c("id", "year"),
           model = "random")

model7ar <- plm(IMR ~ percent_pop + aid_perc + year,
           data = Upps_clean3a,
           index = c("id", "year"),
           model = "random")

hausman_test1 <- phtest(model1, model1r)
hausman_test2 <- phtest(model2, model2r)
hausman_test3 <- phtest(model3, model3r)
hausman_test4 <- phtest(model4, model4r)
hausman_test5 <- phtest(model5, model5r)
hausman_test6 <- phtest(model6, model6r)
hausman_test7 <- phtest(model7, model7r)
```

```
hausman_test1a <- phtest(model1a, model1ar)
hausman_test2a <- phtest(model2a, model2ar)
hausman_test3a <- phtest(model3a, model3ar)
hausman_test4a <- phtest(model4a, model4ar)
hausman_test5a <- phtest(model5a, model5ar)
hausman_test6a <- phtest(model6a, model6ar)
hausman_test7a <- phtest(model7a, model7ar)


print(hausman_test1)
print(hausman_test2)
print(hausman_test3)
print(hausman_test4)
print(hausman_test5)
print(hausman_test6)
print(hausman_test7)

print(hausman_test1a)
print(hausman_test2a)
print(hausman_test3a)
print(hausman_test4a)
print(hausman_test5a)
print(hausman_test6a)
print(hausman_test7a)

#----------------------------------------

bptest(model1r)
bptest(model2r)
bptest(model3r)
bptest(model4r)
bptest(model5r)
bptest(model6r)
bptest(model7r)

bptest(model1ar)
bptest(model2ar)
bptest(model3ar)
bptest(model4ar)
bptest(model5ar)
bptest(model6ar)
bptest(model7a)

#--- COEFFICIENTS ---
coeftest(model1r, vcov. = vcovHC, type = "HC0")
coeftest(model2r, vcov. = vcovHC, type = "HC0")
coeftest(model3r, vcov. = vcovHC, type = "HC0")
```

```
coeftest(model4r, vcov. = vcovHC, type = "HC0")
coeftest(model5r, vcov. = vcovHC, type = "HC0")
coeftest(model6r, vcov. = vcovHC, type = "HC0")
coeftest(model7r, vcov. = vcovHC, type = "HC0")

summary(model1ar)
coeftest(model2ar, vcov. = vcovHC, type = "HC0")
coeftest(model3ar, vcov. = vcovHC, type = "HC0")
coeftest(model4ar, vcov. = vcovHC, type = "HC0")
summary(model5ar)
summary(model6ar)
summary(model7a)

#-- Rsq ---

summary(model1r)
summary(model2r)
summary(model3r)
summary(model4r)
summary(model5r)
summary(model6r)
summary(model7r)

summary(model1ar)
summary(model2ar)
summary(model3ar)
summary(model4ar)
summary(model5ar)
summary(model6ar)
summary(model7a)
```

Annex 3. Indices formulas

Model 1. Unmodified Human Development Index (UNDP methodology)

$$HDI = \sqrt[3]{I_{Health} * I_{Education} * I_{Income}}$$

$$I_{Health} = \frac{life\ expectancy - \min life\ expectancy}{\max life\ expectancy - \min life\ expectancy}$$

$$I_{Education} = \frac{I_{EducationE} + I_{EducationM}}{2}$$

$$I_{EducationE} = \frac{expected\ years\ of\ schooling - \min expected\ years\ of\ schooling}{\max expected\ years\ of\ schooling - \min expected\ years\ of\ schooling}$$

$$I_{EducationM} = \frac{mean\ years\ of\ schooling - \min mean\ years\ of\ schooling}{\max mean\ years\ of\ schooling - \min mean\ years\ of\ schooling}$$

$$I_{Income} = \frac{\ln(GNI\ per\ capita) - \ln(\min GNI\ per\ capita)}{\ln(\max GNI\ per\ capita) - \ln(\min GNI\ per\ capita)}$$

Model 2. Devi1. HDI without life expectancy

$$Devi1 = \sqrt[2]{I_{Education} * I_{Income}}$$

$$I_{Education} = \frac{I_{EducationE} + I_{EducationM}}{2}$$

$$I_{EducationE} = \frac{expected\ years\ of\ schooling\ lagged - \min expected\ years\ of\ schooling}{\max expected\ years\ of\ schooling - \min expected\ years\ of\ schooling}$$

$$I_{EducationM} = \frac{mean\ years\ of\ schooling\ lagged - \min mean\ years\ of\ schooling}{\max mean\ years\ of\ schooling - \min mean\ years\ of\ schooling}$$

$$I_{Income} = \frac{\ln(GNI\ per\ capita) - \ln(\min GNI\ per\ capita)}{\ln(\max GNI\ per\ capita) - \ln(\min GNI\ per\ capita)}$$

Model 3. Devi2. MMR as a health dimension of HDI

$$HDI = \sqrt[3]{I_{Health} * I_{Education} * I_{Income}}$$

$$I_{Health} = \frac{\ln(MMR) - \ln(\min MMR)}{\ln(\max MMR) - \ln(\min MMR)}$$

$$I_{Education} = \frac{I_{EducationE} + I_{EducationM}}{2}$$

$$I_{EducationE} = \frac{expected\ years\ of\ schooling\ lagged - \min expected\ years\ of\ schooling}{\max expected\ years\ of\ schooling - \min expected\ years\ of\ schooling}$$

$$I_{EducationM} = \frac{mean\ years\ of\ schooling\ lagged - \min mean\ years\ of\ schooling}{\max mean\ years\ of\ schooling - \min mean\ years\ of\ schooling}$$

$$I_{Income} = \frac{\ln(GNI\ per\ capita) - \ln(\min GNI\ per\ capita)}{\ln(\max GNI\ per\ capita) - \ln(\min GNI\ per\ capita)}$$

Model 4. Devi3. IMR as a health dimension of HDI

$$HDI = \sqrt[3]{I_{Health} * I_{Education} * I_{Income}}$$

$$I_{Health} = \frac{\ln(IMR) - \ln(\min IMR)}{\ln(\max IMR) - \ln(\min IMR)}$$

$$I_{Education} = \frac{I_{EducationE} + I_{EducationM}}{2}$$

$$I_{EducationE} = \frac{expected\ years\ of\ schooling\ lagged - \min expected\ years\ of\ schooling}{\max expected\ years\ of\ schooling - \min expected\ years\ of\ schooling}$$

$$I_{EducationM} = \frac{mean\ years\ of\ schooling\ lagged - \min mean\ years\ of\ schooling}{\max mean\ years\ of\ schooling - \min mean\ years\ of\ schooling}$$

$$I_{Income} = \frac{\ln(GNI\ per\ capita) - \ln(\min GNI\ per\ capita)}{\ln(\max GNI\ per\ capita) - \ln(\min GNI\ per\ capita)}$$

Model 5. Devi4. Standard HDI with lagged parameters

$$HDI = \sqrt[3]{I_{Health} * I_{Education} * I_{Income}}$$

$$I_{Health} = \frac{life\ expectancy\ lagged - \min life\ expectancy}{\max life\ expectancy - \min life\ expectancy}$$

$$I_{Education} = \frac{I_{EducationE} + I_{EducationM}}{2}$$

$$I_{EducationE} = \frac{expected\ years\ of\ schooling\ lagged - \min expected\ years\ of\ schooling}{\max expected\ years\ of\ schooling - \min expected\ years\ of\ schooling}$$

$$I_{EducationM} = \frac{mean\ years\ of\ schooling\ lagged - \min mean\ years\ of\ schooling}{\max mean\ years\ of\ schooling - \min mean\ years\ of\ schooling}$$

$$I_{Income} = \frac{\ln(GNI\ per\ capita) - \ln(\min GNI\ per\ capita)}{\ln(\max GNI\ per\ capita) - \ln(\min GNI\ per\ capita)}$$

Table 4. Minimum and maximum values of the HDI dimensions

Dimension	Indicator	Minimum	Maximum	Source
Health	Life Expectancy	20	85	UNDP HDI
	MMR	1	6591	Own calculations, HDI data
	IMR	1	278	Own calculations, World Bank data
Education	Expected Years of Schooling	0	18	UNDP HDI
	Mean Years of Schooling	0	15	UNDP HDI
Income	GNI per capita (2017 PPP$)	100	75000	UNDP HDI