Aid in the Aftermath of Armed Conflict

A regression study on the effect of ODA on human capital, trade openness and technology in post-conflict countries.

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Abstract

Aid initiatives are both praised for positive outcomes and criticized for their apparent lack of effectiveness in stimulating economic growth. Under post-conflict conditions, official development assistance (ODA) is often given by donor states to improve the welfare of developing countries. Using a regression model of post-conflict periods for over a hundred countries between the time period 1960 - 2019, we analyze the impact of ODA on driving forces of growth: human capital, trade openness and technology. The findings from the present study show significant results of the relationship between ODA and human capital as well as ODA and trade openness. ODA and human capital showed a negative relationship. The impact on trade openness was so minimal that we interpret it as being unaffected by ODA during post-conflict conditions. A significant relationship was not found between ODA and technology. The study gives a general view on all ODA given during post-conflict periods in our data selection; it sheds light on the complex reality of post-conflict aid: it is neither guaranteed to be good or bad.

Keywords: ODA, post-conflict, aid, human capital, trade openness, technology, growth, developing countries.

1. Introduction

War has throughout history shocked the world and brought devastating long-term suffering to countries and their economic growth. In the past century, during and in the aftermath of war other countries have intervened in different ways to help. Current humanitarian crises in Palestine, Yemen and Syria are examples that emphasize the importance of effectiveness of aid from third-parties. When a country cannot help its own population, it can be argued that other countries have a responsibility to do what they can to help.

The debate regarding the effectiveness of foreign aid has strong arguments and evidence on both sides. Critics on one side argue that aid can in some cases be counterproductive, others argue that foreign aid is neither effective nor ineffective, and some argue that aid has proved to be effective in stabilizing social infrastructure and even generating economic growth. An umbrella term for different types of foreign aid that aims to increase the economic wellbeing and general welfare of a country is called Official Development Assistance (OECD, 2020). We will use the abbreviation ODA when referring to this.

Researchers, such as Martens et al. (2002) and Cassen (1994), who are critical to the effectiveness of ODA bring up aspects such as the true motives behind the donor country's incentives when giving aid. Besides intent, it is considered crucial when giving aid - whether it be through peacekeeping troops, loans or official development assistance - that it actually helps. When examining the outcome of development assistance, it has been found that it can be counterproductive. In some circumstances, post-conflict states can become too heavily dependent on foreign aid in a way that hems their possibilities for growth (Cassen, 1994; Martens et al., 2002). On the contrary, other researchers such as Collier and Hoeffler (2004) argue that ODA is especially effective in post-conflict periods.

In the field of research of ODA, there are ample studies on aid to developing countries and its effect on different sectors but not as much on how ODA affects different sectors under post-conflict conditions. We want to investigate the role of aid during post-conflict periods. In contrast to studies made on ODA to developing countries in general, generating growth in post-conflict countries is more about finding ways for them to converge back to their pre-conflict state. The methods will therefore vary for these countries and we need to distinguish between the measures necessary for these completely different situations in order to give aid in an effective way. By limiting our study to post-conflict countries we will investigate whether ODA can have positive results on certain factors under post-conflict conditions.

1.1 Problem statement

We want to fill a hole in the field of research by examining the effect of ODA on specific factors under post-conflict conditions. When analyzing ODA as a whole it is easy to overlook certain aid initiatives as ineffective, when only measuring effectiveness by looking at the relationship to economic growth. Economic growth takes time and it can be hard to quantitatively find a relationship between aid and economic growth. When instead looking at determinant factors that can trigger economic growth, it may be easier to empirically investigate if ODA can lead to positive effects. Many factors play an important role, we have chosen to limit the study to three factors that in economic growth theory are claimed to be driving forces of growth. We will test the effect of ODA under post-conflict conditions on key factors in stimulating economic growth: human capital, trade openness and technology.

We want to investigate, is ODA effective enough to show a significant change in our data selection and whether it is counterproductive as some researchers claim, or if it can have a positive effect in any of these three areas. Through a regression analysis on post-conflict countries that have received ODA in the past sixty years, we aim to answer the research question:

> *In post-conflict states, does ODA have an effect on human capital, trade openness and technology?*

1. 2 Definitions

We will in this section describe the definitions of "post-conflict period" and "ODA" that we will use throughout the study. Exactly how we measure the two will be further explained in section 3.

1.2.1 Post-conflict period

We will be investigating the impact of aid under post-conflict conditions. A simple definition of a post-conflict period in a country is when “open warfare has come to an end” (Junne & Verokren, 2005). The conflict data we use comes from the Uppsala Conflict Data Program. They make distinctions on different types of conflict depending on the number of fatalities. In their definitions, a minor armed conflict involves less than 25 fatalities in a year, an intermediate armed conflict involves more than 25 battle-related deaths in a year and when a conflict in a country has led to more than a thousand battle-related deaths in a year it is defined as a war.

By post-conflict period, we mean the period after an *intermediate armed conflict* or a *war*, following the definitions of UCDP (2020). The period after a conflict with less than 25 battle-related deaths (minor armed conflict) will not be included in our definition. The conditions under post-conflict periods vary greatly depending on the kind, length and number of parties involved in a conflict. We will not make distinctions between the different kinds in this study, but investigate ODA given in periods after conflicts in general. In section 3.2.2 we will further describe how we measure the post-conflict periods in our data.

1.2.2 ODA

In our study we write about financial aid in terms of official development assistance (ODA). We have chosen to use the definition from the Organisation for Economic Co-operation and Development (OECD) which defines ODA as:

> “*government aid that promotes and specifically targets the economic development and welfare of developing countries*” (OECD, 2020).

ODA can be given within many sectors such as, but not limited to: social infrastructure, economic infrastructure, production, humanitarian aid, programme assistance and debt relief.
We have collected our data on ODA given to recipient countries from OECD’s database. Therefore, we feel it appropriate that we use their definition in the study.

1.3 Outline

Next, in section 2, we will describe the assumptions from economic growth theory and previous research that have led us to test for the impact of ODA on human capital, trade openness and technology. In section 3 we will describe the method of the study. First, we describe the research design, the variables we investigate and ultimately we elaborate on how we avoid errors in our regressions such as heteroscedasticity, multicollinearity and autocorrelation. The following and 4th section, is where we present our results from our regression analysis which is followed by section 5 where we discuss the results and answer the research question. At last, we conclude the study and suggest areas for further research in section 6.

2. Background

2.1 Economic growth theory

Instead of merely measuring the impact of ODA in post-conflict countries on economic growth, we look at factors that in economic growth theory and in previous research are referred to as especially important in generating growth. In this section we give background information about economic growth theory and insight into the Harrod-Domar theory that sees positively on the relationship between aid and growth. Lastly, we describe theoretical assumptions on the possible impact of foreign investment and aid on human capital, trade openness and technology.

2.1.1 General assumptions in economic growth theory

In economic growth theory "steady state" is referred to as a desired equilibrium in the economy. This is, in theory, the goal of the economy and at this point the variables that contribute to economic growth (such as population growth, technological growth, growth in human capital) grow at the same constant rates (Jones & Vollrath, 2013:65-75). An economy further away from its steady state grows faster, while a country closer to its steady state has a lower growth rate due to transition dynamics. This could be applied to post-conflict periods where shocks put countries' economies below the steady state, which in theory could encourage a faster growth of converging back to the steady state. There are many models in economic growth theory that distinguish different factors as most vital in generating growth, in this section we will highlight a few (Jones & Vollrath, 2013:65-75).

The Harrod-Domar model is a Keynesian economic growth model, common in development economics. Simply put, in the model, growth depends on investment. In developing countries, the way towards growth is determined to be through foreign investment, such as ODA. In a closed economy, the investment should be equal to the savings ratio (Dalgaard & Erickson, 2006). In an open economy, foreign funds and aid are included in the model and the equation can be used to understand the impact on investment:

$$i_t = s_t + a_t + f_{pt} + f_{ot}$$

s_t represent the savings ratio, a_t represents the total aid as a share of GDP, f_{pt} and f_{ot} represent private and other foreign investment (Economics Network, 2021). In the model, it is suggested that since aid increases the investment in developing countries which is essential for growth, ODA should have a positive effect on growth (Hansen & Tarp, 2000; Dalgaard & Erickson, 2006). In this study we will however not investigate the effect on economic growth but rather on the effect on human capital, trade openness and technology.

According to the Solow model with human capital, an increase in years of schooling and productivity in the education sector will increase the GDP level and increase the growth rate of GDP temporarily, until the country reaches its steady state (Jones & Vollrath, 2013:54-63). In the technology transfer model, openness is an important factor in increasing economic growth. It is believed in the model that when an economy is open, it has better conditions for technological growth and growth in GDP/capita. Technological growth is a principal factor in several economic growth models and is often seen as the engine of economic growth. Investments in the Research and Development (R&D) sector in a country are encouraged to stimulate economic growth. We will in the next section develop on how theoretical models can explain the relationship between ODA and the variables: human capital, trade openness and technology (Jones & Vollrath, 2013:54-70).

2.1.2 Theories connected to the impact of ODA on human capital, trade openness and technology

In the Solow model with human capital, human capital is a measurement of the education, skills and competences of individuals in a society. The GDP is dependent on the human capital in a society with the productivity function: $Y = K^{\alpha} AH^{1-\alpha}$. Human capital per capita is equal to $e^{\psi u}$, where Ψ represents the productivity in the education sector and u the years of schooling (Jones & Vollrath, 2013:54-60). When a country invests in education, such as in the quality of teachers and access to technology, for example wifi and computers - the productivity in the sector can increase, meaning that students will gain more from an extra year of schooling, giving them and the society higher returns. The government can also invest in education by subsidizing schooling, making it accessible to groups of society that could otherwise not afford an extra year of education. Developing and post-conflict countries with limited resources to invest in education, can gain from financial aid. In this way, foreign aid, such as ODA, can be used as an investment in social infrastructure and in the education sector to increase the human capital in a country (Jones & Vollrath, 2013:54-63).

When analyzing the possible effect of aid on trade openness, the economic theory called the Dutch disease can be applied. When there are large financial inflows into one sector of the economy, it can lead to appreciation in the currency, increasing the exchange rate. This can reduce the demand for exports from the recipient country, leading to decreased trade openness. Theoretically, ODA could therefore in the short-term have a negative effect on trade (Pettinger, 2017).

Theory within economic growth can also be applied to analyze a connection between ODA and technological level. According to the Romer model, developing countries should focus on investment in the R&D sector to stimulate growth. Foreign investment and aid directed to R&D will create opportunities for more people to work within the sector. Moreover, an increased budget in R&D means a country can afford to encourage researchers and scientists to focus on innovation and technological advancements. In post-conflict countries with possible lasting humanitarian crises, their investment rate in the R&D sector can be compromised. Since technological growth is seen as a result of profit-maximizing opportunities in the Romer-model, developing countries will sometimes need foreign investment to build up the R&D to make innovation and risk-taking worthwhile and possible. It is often described how the way for developing countries to "catch up" is by directing foreign investment and foreign aid on stimulating technological growth (Jones & Vollrath, 2013:98-117).

2.2 Previous research on ODA

After the overview of what economic growth theory can suggest about the effectiveness of ODA in general, and its effect on human capital, trade openness and technology, we will now give a review of what studies show within the research field of ODA.

2.2.1 Previous research on the effectiveness of ODA

In the field of research, there are many studies done with opposing claims. Some researchers argue that aid is effective, some argue that it has no effect at all, and some argue that aid is counterproductive. Many studies also examine the outcome of ODA under post-conflict conditions, but less focus in this research area is put on different sectors that the aid is directed to.

Those who argue that aid actually can be counterproductive, include Martens et al. (2002). They argue that the incentives of donor countries can harm the receiving countries and create a moral hazard. Also, in these situations where the donor countries' incentives are based on national interest, another aspect of aid effectiveness is brought up - who actually benefits and gains from the aid? According to Martens et al., the countries receiving aid are not the winners - the winners are the donors who approve political and commercial programmes (Martens et al., 2002).

Robert Cassen's book based on case studies of countries that have received foreign aid also debates this issue. The findings include that ODA tends to create a “reasonable rate of return” and that aid is effective in terms of meeting the goal the donor country sought to achieve. Overall it can be hard to assess effectiveness of all efforts in the same way when the objectives of the aid given differ. Cassen also brings up examples of when foreign aid projects have failed and factors that contributed to this, in a similar way to Martens et al. However, the conclusion from Cassen’s research is that aid over a wide range of sectors and countries has been effective in contributing to the recipient country’s economy and made a positive impact on the country (Cassen, 1994:225).

In Collier and Hoeffler’s empirical study (2004) they examine the efficacy of aid with special focus on eliminating poverty in post-conflict societies. They investigate a possible saturation rate of aid - when it is best absorbed and when returns are diminishing. They found that during the decade following a conflict as a whole, aid is well absorbed although not during the first few years. Their empirical calculations suggest that the optimal share of ODA/GDP in ending poverty in post-conflict societies is most efficient when it is around 7% (Collier & Hoeffler, 2004:8-13). They also claim that the disbursements of aid should be double the amount in post-conflict environments. They write that: “First, we find that aid is considerably more effective in augmenting growth in post-conflict situations than in other situations” (Collier & Hoeffler, 2004:12-13). Their study also shows that the most important factors to focus the aid on is on social priorities, and that macro policies should be prioritized at a later stage (Collier & Hoeffler, 2004).

2.2.2 Previous research on ODA affecting Human Capital, Trade Openness and Technology

In this section we provide an overview of previous research related more specifically to our research question and about what is found in the research field of the effect of ODA on human capital, trade openness and technology.

<u>Human capital</u>

Studies in the field have shown a positive impact of ODA on education. In a study by Donaubauer et al. (2016) they investigate sector-specific aid effectiveness in post-conflict conditions using panel regression analysis. Their hypothesis is that effectiveness of post-conflict aid differs between specific sectors, and that investing ODA in social infrastructure should be most effective since it deals with the most urgent issues. Their results show that in the education sector within social infrastructure, ODA was effective in creating a positive impact in their regression analysis of post-conflict states. Their study proves that post-conflict aid can be effective in improving social infrastructure but ineffective for improving economic infrastructure (Donaubauer et al., 2016).

In the study by Bircher and Michaelowa (2016) the authors develop on the impact on education as they empirically test the impact of ODA on aspects within social infrastructure, specifically primary school enrollment, and the indirect effect of this on economic growth. In their regression model, they estimate that increasing aid targeted in the education sector would increase primary enrollment. They claim that most of this aid is focused on primary school and suggest that more aid should be directed to secondary school as well. It can be seen from these two studies that ODA can have a positive impact on years of schooling within human capital.

Trade openness

When it comes to the effect of ODA on openness to trade, previous research shows different results. The United Nations has an initiative called "*Aid for Trade"* together with the World Trade Organization, OECD and other partners (Alonso, 2016; WTO, 2021). In the initiative, ODA to developing countries is directed towards generating investments for trade, technical assistance, building up infrastructure that enable trade and helping countries with trade-strategy and negotiations. The initiative has been successful in some cases but not always been effective (Alonso, 2016; WTO, 2021).

In some case studies, it can be seen that receiving ODA has created a relationship between the donor and recipient country, and encouraged trade between the two thus increasing the trade-to-GDP ratio for the recipient country overall. At times it is speculated that donor countries give ODA for geo-strategic motives. In a study by Liu and Tang (2017) they test econometrically the short- and long-term effects of ODA on the imports and exports between donor and recipient country. Their conclusions are that both for the US and China, their exports increased significantly to the African countries they had given ODA to (Liu & Tang, 2017).

A phenomenon contradicting that ODA would lead to increased trade openness is the Dutch Disease, as described in 2.1.2. In a study by Nowak-Lehman et al. (2010), they come to the conclusion that in the short- to medium-run the recipient countries are affected by the Dutch Disease. The exchange rate appreciates reducing the trade in the recipient country. In the long-run they found that the ODA had a positive impact on trade between recipient and donor, especially in Latin America, Asia and the Caribbean (Nowak-Lehman et al., 2010).

Another study that highlights the effect of the Dutch Disease is Tekin's study (2012). He tests using the Granger method if there is a causality between ODA to the least developed countries in the world and openness to trade. His results indicate that in all countries where there was a significant causality relationship, the impact of ODA on trade openness was negative. This was in the study explained by the appreciation of exchange rates in recipient countries leading to decreased trade. We investigate the same relationship as Tekin, also measuring trade openness through the trade-to-GDP ratio. The difference is that while he tests for least developed countries, we test for post-conflict countries.

Technology

According to previous research, ODA can have a significant impact on the technology level in the recipient country. A case-study example of post-conflict recovery is Rwanda. After a civil war that escalated to what is commonly refered to as the bloodiest genocide in modern history (Singh, 2014), they recovered in record-time and has since the 2000's had a yearly economic growth rate of between 6-7% (Jansson, 2013). Donor countries gave ODA and foreign direct investment which was invested in the R&D sector. Rwanda adopted a National Information Communications Infrastructure policy in 2000 and has since then developed its information and communications-technology-sector (ICT) greatly in terms of digitization (Ben-Ari, 2014). It is analyzed that ODA given by Japan acted as a catalyst in Rwanda's technological development and economic growth and also gave Japanese companies a strategic entrance into the markets in Africa in a win-win situation (Government of Japan, 2013; Naito, 2018).

In UNCTAC's report (2007) it is concluded that foreign aid, such as ODA, in the sectors science, technology and innovation is needed more in developing countries. Most donors do not prioritize science, technology and innovation, even though it's proven that technological change is a vital aspect of economic growth. They claim that the inefficiency of foreign aid can be partly explained by donors not acknowledging this crucial aspect. Changing the objective of aid to improve the country's technological growth could lead to higher efficiency in foreign aid and minimize the problem of failed aid projects. The report concludes that this would not be a handout of aid to developing countries but instead a hand up and provide more long term assistance (UNCTAC, 2007).

The studies described in this section reflect the dissensus in the research field regarding whether aid is effective or not. It can be seen that many factors play important roles in determining whether ODA leads to growth. Empirical studies brought up in this section conclude that ODA can have a positive effect on increasing investments in the R&D sector and in education, making an increase in human capital and technological level possible. Moreover, ODA can impact trade openness negatively in the short run due to the "Dutch disease" but can also lead to positive results from the transfer of technology and knowledge between recipient and donor in the long run. Hence, when looking more closely on the effect of ODA on human capital, trade openness and technology, it can be seen from these studies that ODA can have an effect on our chosen dependent variables. We will contribute to the research field by investigating if the same results will be achieved when examining the effect on post-conflict countries in particular.

3. Method

3.1 Research Design

In order to test our research question "*In post-conflict states, does ODA have an effect on human capital, trade openness and technology?*" we need to test several explanatory variables and have therefore chosen to use a multiple regression model. We are using panel data from countries that have been in a post-conflict period some time between the years 1960 - 2019 and received ODA. We will control for both time- and country-specific effects. Our baseline model will be specified in this manner:

$$Y_{it} = \alpha + \beta_1 x_{it} + \beta_2 x_{it} + \beta_2 x_{it} + \dots + \beta_k x_{it} it\, x_{it} + \varepsilon_{it}$$

Where i controls for country and t controls for time.

3.2 Variables

3.2.1 Data selection

In our data selection, we took inspiration from the study by Donaubauer et al. (2016). They investigate the impact of ODA in post-conflict countries on social infrastructure and economic infrastructure while we look at the effect on human capital, trade openness and technology. They selected data by including all countries that have been in a post-conflict period between the years 1995 - 2017 and determined the countries to include from UCDP and PRIO's database as well. (Donaubauer et al., 2016:10)

Consequences of focusing on post-conflict periods is shortage of data in some variables. We chose the time period 1960 - 2019 in order to have as many observations as possible, knowing that a limited number of observations can become problematic. Therefore we included all countries that according to the UCDP/PRIO database called "Armed Conflict Dataset version 20.1" (2020) were in a post-conflict period between 1960 - 2019 which became a total of 111 countries [see Appendix, Table 6 for list of countries].

3.2.2 Independent variable

We have created the interaction variable: (ODA/Capita * *post-conflict dummy)* which will be our independent variable. In our *post-conflict dummy*, we code a "1" for the years we define as a post-conflict period in our measurement and a "0" for all other years.

Previous research and studies have shown that foreign aid to post-conflict countries is more effective a few years after the settlement of the conflict, more specifically after five years (Chauvet et al., 2010). The calculated risk of another conflict flaring up during the first five years following the peace settlement is determined to be approximately 44%, and the foreign aid received in these first years can be relatively low (Chauvet et al., 2010). We take this into account, and therefore start measuring the effect of ODA the fifth year after a conflict has ended and until the 20th year. In our "*post-conflict dummy"* variable, we code a "1" when a country has sustained peace for four years after an armed conflict, and continue to code a "1" every year until it has sustained peace for 20 years. We make this decision too, with inspiration from the study by Donaubauer et al. (2016) who create their dummy variable for post-conflict periods in a similar way (Donaubauer et al., 2016:10).

Data for the ODA/capita variable is obtained from OECD (2020) in USD at current prices. We use ODA/capita instead of only ODA to more easily compare data between countries of different population sizes. This means that an increase in ODA/capita with one USD means an increase of differing amounts depending on the population size of the country. For example, if a population consists of 50 million people, an increase in ODA/capita by one USD in that country means an increase in ODA by 50 million USD. This is important to understand when looking at our results from the regressions.

When interacting ODA/capita with the *post-conflict dummy* variable, we will measure the impact of ODA under post-conflict periods (starting year five after armed conflict has ended) on our dependent variables human capital, trade openness and technology.

3.2.3 Dependent variables

For the variable human capital, we use the Human Capital Index created by Penn World Table 10.0 from 2021 (Feenstra et al., 2015; Zeileis, 2021). They have created the index based on the years of schooling and returns to education. A high value means a higher human capital. For the countries included, the index level ranges from 1.007 to 3.892 with the average 1.789 [see Table 2 in 3.2.5].

Trade openness is commonly measured by using a trade-to-GDP ratio. This means adding the total imports and exports and dividing them by the country's GDP that year. The value can show a country's integration in the world economy (OECD, 2011). We felt it appropriate to use this measure as it is commonly used in other studies measuring trade openness, for example in the study by Tekin where he investigates the impact of ODA on trade openness but in the least developed countries of the world (Tekin, 2012). We want to test whether the results are similar for post-conflict countries. We have used the data from World Bank called Trade % of GDP (2021 A). The data ranges from 0.02% to 347%, since imports and exports can account for a higher level than their GDP level [see Table 2 in 3.2.5].

We have measured technology level by using data for medium- and high-technology industry exports as a percentage of total manufactured exports. We have collected this data from World Bank (2021 B). This measure is commonly used to illustrate the structural transition from low technology to more advanced technological skills. Another common measure of technology is the number of patents per year, the share of investment in the R&D sector and technicians as a share of the labour force (World Bank, 2021 C). Due to a lack of data on these variables in developing countries, we chose to use the measurement of medium- and high-technology industry exports as a share of total manufactured exports instead. Several other studies measuring technological level have used this method as well (Deleri, 2019; Gallagher & Porzecanski, 2008; Ciocanel & Sandua, 2014) and we find the measurement suitable to use in our regression model. The share is presented in percentage-form.

3.2.4 Control variables

For all three regression models we will have the interaction variable $ODA/cap_{postconflict} = (ODA/capita \ * post\ conflict\ dummy)$ as the independent variable. We will also include the control variable $ODA/cap_{postconflict}{}^{2}$ to test for diminishing returns to ODA. Other studies, such as Donaubauer et al. (2016) and Burnside and Dollar (1997) have squared their independent variable for the same reason. Donaubauer et al. (2016) square the interaction variable "Aid*post-conflict dummy" and Burnside and Dollar (1997) square the interaction variable of "ODA*Policy dummy".

We will also include ODA/capita without the *post-conflict dummy* as a control variable in all models. This will control for ODA affecting the dependent variables when not under post-conflict conditions. We have more control variables included in the models that we anticipate will have a possible impact on the separate dependent variables. We will describe them below and their connection to the dependent variable in more detail.

<u>Control variables in Model H</u>

In Model H, with human capital as the dependent variable, our first control variable is GDP/capita. We have included this since we find it reasonable that a country with an increased GDP/capita will have more money to invest in education. Moreover, if citizens in the country have an increased income, citizens will afford to attend an extra year of school.

We have also included life expectancy as a control variable. If the life expectancy is low, individuals educating themselves to a high level may not live to bear the fruits of this investment according to a study by Hansen (2011). Since the index we use for human capital, created by Penn World Database, is calculated partly by returns to schooling this will increase if the life expectancy is higher. Moreover, more people will feel it is worthwhile to attend more years of school if the investment will pay off (Hansen, 2011).

We have also included trade openness and technology as control variables. This is partly so the three different regressions will have similar specifications, meaning a similar number of observations and groups. It will then be easier to compare the different regressions with each other. We have also included them as they according to previous research and economic growth theory can have an impact on each other. According to the technology transfer model, human capital is dependent on technology level and openness (Jones & Vollrath, 2013:146-150). The change in human capital is estimated to follow the model:

$$\dot{h} = \mu e^{\psi u} A^{\gamma} h^{1-\gamma}$$

where μ symbolizes openness (which is similar to the control variable trade openness) and A symbolizes the technology level. (Jones & Vollrath, 2013:146-150) Hence, model has the following equation:

$$Model\ H:\ Human\ Capital_{it} = \alpha + \beta_1 (ODA/cap * Post\ conflict)_{it} + \beta_2 (ODA/cap * Post\ conflict)^2_{it} + \beta_3 ODA/cap_{it} + \beta_4 GDP/cap_{it} + \beta_5\ Life\ Expectancy_{it} + \beta_6 Technology_{it} + \beta_7\ Trade\ Openness_{it} + \varepsilon_{it}$$

Control variables in Model O

In the model with Trade openness as the dependent variable, referred to as Model O, we will control for variables GDP/ capita, technology and human capital.

According to Ghimire et al. (2016) it is common to test for GDP/capita as a control variable when investigating trade openness. GDP increases when the country has a trade surplus, when the export to foreign markets is larger than the import from foreign markets. (Brock, 2019) Since our variable trade openness is measured by a country's export and import added together and measured as a percentage of GDP, we will control for GDP /capita.

Moreover, we will also include human capital as a control variable, testing if it has any effect on trade openness as previous research suggests. The variable is made up of years of schooling and returns to schooling. In Ojeaga's study (2014) he tests the effect of foreign aid on trade openness, like us, and controls for primary school enrollment. He does this in order to control the available skill level in the labour market (Ojeaga, 2014).

According to the technology transfer theory, technological growth has an impact on openness. It is suggested that the drive to be innovative and make further technological advancements acts as an incentive for countries to have more open economies and trade more (Jones & Vollrath, 2013). Technology will therefore be used as a control variable when investigating the impact ODA has on trade openness.

The equation of model can be seen as followed:

$$Model\ O: Trade\ Openness_{it} = \alpha + \beta_1(ODA/cap * Post\ conflict)_{it} + \beta_2(ODA/cap * Post\ conflict)^2_{it} + \beta_3 ODA/cap_{it} + \beta_4 GDP/cap_{it} + \beta_5 Technology_{it} + \beta_6\ Human\ Capital_{it} + \varepsilon_{it}$$

<u>Control variables in Model T</u>

In model T, where technology is the dependent variable, we include GDP/capita as a control variable. Countries that are richer have more resources to invest in the R&D sector. R&D is seen as fundamental for technological growth according to the Romer model (Jones & Vollrath, 2013:115). A decreased GDP/capita could similarly cause the technology level to decrease, due to decreased amounts of capital that can be invested.

Also, we expect that life expectancy could impact the dependent variable. In a study by Arun et al. (2020) they prove a significant relationship between life expectancy and technological development. In the Schumpeter model, innovation is driven by the potential future gains for an individual, rather than winnings for a society as a whole. If people do not expect to live long enough to see their innovation give payoff, they will not take the risk in creating technological advancements (Arun et al., 2020; Jones & Vollrath, 2013:120-122).

We include human capital as a control variable as well, as it can have a spillover effect on technological growth since a higher level of education can increase the productivity in the R&D sector in the Romer-model (Jones & Vollrath, 2013).

For the model we therefore have the following equation:

$$Model\ T: Technology_{it} = \alpha + \beta_1(ODA/cap * Post\ conflict)_{it} + \beta_2(ODA/cap * Post\ conflict)^2_{it} + \beta_3 ODA/cap_{it} + \beta_4 GDP/cap_{it} + \beta_5\ Life\ Expectancy_{it} + \beta_6 Human\ Capital_{it} + \beta_7\ Trade\ Openness_{it} + \varepsilon_{it}$$

Apart from evidence of a possible causation between the control variables chosen on the dependent variables, we also consider it an advantage to use the dependent variables from the other models as control variables. It will give the models similar numbers of observations and groups making model H, O and T more appropriate to compare.

3.2.5 List of variables and frequency table

Table 1. Variable list

Variable name
(ODA/cap*Post conflict)
Human Capital
Trade Openness
Technology
ODA/cap
(ODA/cap*Post conflict)^2
GDP/cap
Life expectancy

[See Appendix Table 7 for an extended variables list with sources]

Table 2. Frequency table

Variable	Observations	Mean	Std. Dev.	Min	Max
Human Capital	5,174	1.786332	0.6085594	1.007038	3.89154
Trade Openness	5,041	61.82494	33.74658	0.0209992	347.9965
Technology	2,474	27.0254	20.59481	0.00002	97.2
ODA/capita * ***post-conflict dummy***	1,421	25.92246	45.21718	-39.8	662.7979

[See Appendix Table 8 for extended frequency table for ODA/capita * *post-conflict dummy*]

3.3 Regression models

In the first regression model we will use three-year averages, in order to smooth out sudden changes in all variables in the model (Donaubauer et al., 2016). For example, a country may be given a lot of aid one year that is intended to be used for the next few years as well. Without averages, the effects of aid given in one time period affecting the dependent variable in another time period could go missed. The purpose of this is to create a more well-suited specification, although it means that we lose many observations. In the second model, we will run regressions without 3-year averages to see if the specification is improved through a higher number of observations.

In the third model, we investigate if the ODA given one year has impacts on human capital, trade openness and technology in future years. When analyzing the effect of aid, one must take into account that it can take many years before investments lead to actual change that can be observed - especially for countries that have recovered from armed conflicts. For this reason we use lags for one, three and five years in the independent variable and in the controlled variables that are linked to ODA. The variables we lag are: $ODA/cap_{post\ conflict}$, $ODA/cap_{post\ conflict}{}^{2}$ and ODA/cap.

<u>Expectations of the results of our models</u>

Based on previous research and empirical studies, ODA can have a positive correlation with human capital (Donaubauer et al., 2016; Bircher & Michaelowa, 2016) which proved a significant positive relationship between post-conflict aid and improving the receiving country's social infrastructure and/or primary school enrollment.

Based on previous research we expect that ODA will have a positive correlation with our measure of human capital. If this is true we expect a positive β -value for the variable ODA/capita and our interaction variable ODA/capita * *post-conflict dummy*. On the other hand, it takes time for human capital to increase so we are uncertain if a change can be measured during only a five-year period. If results would show that ODA has an effect on the human capital more than five years after it is given, we expect the change to be small.

From previous research and in initiatives like the United Nations' "*Aid for Trade"* we can see many cases where ODA has been given to generate investment for trade and resulted both positively and negatively. Furthermore, concerning the phenomenon of "The Dutch disease" as brought up by Nowak-Lehman et al. (2010) and Tekin (2012), ODA can have a negative impact on trade openness in the short- and medium-run. However, Tekin's results (2012) also indicated that ODA can have positive long-term effects on trade openness. Based on this, we expect our regression models to have a negative correlation between ODA and trade openness. We expect the coefficient for ODA/capita and ODA/capita * *post conflict dummy* to be negative, since we investigate the effect of ODA in the short term.

Previous research and theory analysis presented in the background showed that an increase in investments (which can be made possible when receiving ODA) in the R&D sector will allow for more people to work with R&D and in turn increase technological growth. Based on this, we expect to see a positive β -value on ODA/ capita and our interaction variable ODA/capita *post conflict dummy*, meaning that an increase in the received ODA would result in an increase in the high- and medium-level technology exports as a share of total exports.

3.4 Tests

In order to properly assess our data we will perform econometric tests. We will test the Gauss Markov assumptions, to see if our estimates are "best linear unbiased estimators" (BLUE) (Dougherty, 2016).

Fixed or random effects

In order to test if our specification should account for fixed or random effects, we will do a Hausman test. We have performed two Hausman tests to test whether our specification should be with fixed or random effects. Both these tests show that our specification should be "fixed effects- specification" [see Appendix "Hausman test"].

Heteroscedasticity

Heteroscedasticity is referred to as having uneven error terms in a regression model. If our error terms are heteroscedastic we cannot draw the same conclusions from our regression. Heteroscedasticity can occur when the error terms change according to a proportional factor (Frost, 2017).We will use robust standard errors to minimize the problem of heteroscedasticity in all of our regressions. This method also helps prevent autocorrelation.

Autocorrelation

Testing for autocorrelation illustrates the similarities (correlation) between time series and the lagged time series - showing the impact the past values have on future values (Smith, 2019). The use of robust standard errors in the regressions will minimize this problem like it does with the problem of heteroscedasticity.

Testing for multicollinearity

Multicollinearity means that there is a linear association between two or more variables and could result in unstable estimates. We will test multicollinearity through a Variance Inflation Factor (VIF) test, which measures the (extent of) multicollinearity in our regression variables. A VIF value below 10 is accepted, higher values than 10 suggest that there is a presence of multicollinearity between the independent variable and the other variables (Cran R Project, 2021). From the results we can conclude that we do not have critical multicollinearity in our specifications as no VIF value was below 4 [see Appendix, Table 9].

From the performed tests we can conclude that our specification should account for fixed effects and we will use robust standard errors to minimize the problem of heteroscedasticity and autocorrelation. This is done in Stata by adding the command *", fe robust"* in our specification.

3.5 Source criticism

Previous research on post-conflict aid, many authors explain the disadvantages with doing regression analyses of data from post-conflict periods: the limited data supply. A shortage of data in developing countries has affected the number of observations in our study. We keep this in mind when drawing conclusions and our results need to be treated accordingly.

We do not expect to find results that we could draw generalized conclusions on for all post-conflict scenarios - that is not the purpose of the present study. We want to test whether ODA during post-conflict conditions in general has an impact on the three dependent variables human capital, trade openness and technology that are important factors in economic growth theory.

4. Results and analysis

Our baseline models are based around three different specifications with the dependent variables: human capital, trade openness and technology. The different specifications will be tested first with 3-year moving averages, next without them and lastly with lags.

$$Model\ H:\ Human\ capital_{it} = \alpha + \beta_1(ODA/cap * Post\ conflict)_{it} + \beta_2(oda * postconflict)^2_{it} + \beta_3(ODA/cap)_{it} + \beta_4 GDP/cap_{it} + \beta_5 life\ expectancy_{it} + \beta_6 Trade\ Openness_{it} + \beta_7 Technology_{it} + \varepsilon_{it}$$

$$Model\ O: Trade\ Openness_{it} = \alpha + \beta_1(ODA/cap * Post\ conflict)_{it} + \beta_2(ODA/cap * Post\ conflict)^2_{it} + \beta_3(ODA/cap)_{it} + \beta_4 GDP/cap_{it} + \beta_5 Technology_{it} + \beta_6 Human\ capital_{it} + \varepsilon_{it}$$

$$Model\ T:\ Technology_{it} = \alpha + \beta_1(ODA/cap * Post\ conflict)_{it} + \beta_2(ODA/cap * Post\ conflict)^2_{it} + \beta_3(ODA/cap)_{it} + \beta_4 GDP/cap_{it} + \beta_5 life\ expectancy_{it} + \beta_6 Trade\ Openness_{it} + \beta_7 Human\ Cap_{it} + \varepsilon_{it}$$

Model 1: Three-year-averages

Firstly we have run regressions of the specifications above stated, model H, model O and model T, where *t* is in three year averages. The results are shown in table 3.

Table 3

Variables	Human Capital	Trade Openness	Technology
(ODA/capita * *post-conflict dummy*)	-0.0028422	7.68E-07	0.0260285
	(0.293)	(0.741)	(0.842)
(ODA/capita * *post-conflict dummy*)^2	0.0000181	1.22E-15	-0.0005934
	(0.215)	(0.950)	(0.397)
ODA / capita	0.0002651	-9.69E-07	0.0181012
	(0.907)	(0.541)	(0.844)
GDP / capita	0.0000426***	0.0005743	0.0009613*
	(0.000)	(0.624)	(0.038)
Life expectancy	0.0148884*	---	0.4066041
	(0.029)	---	(0.272)
Trade Openness	0.0009572	---	0.0163491
	(0.246)	---	(0.685)
Technology	0.0020168	0.1927163	---
	(0.987)	(0.403)	---
Human capital	---	23.32039	0.1251848

	---	(0.229)	(0.987)
Constant	0.7059128 ∘	14.58071	-9.851087
	(0.075)	(0.685)	(0.624)
Observations	163	175	163
Groups	44	46	44
r^2	0.549597429	0.08216812	0.198485706
r^2 adjusted	0.526199893	0.043696125	0.1568486
Three-year average	Yes	Yes	Yes
Country and Year-fixed effects	Yes	Yes	Yes
p-values in parenthesis; ∘ p<0.1, * p<0.05, **p<0.01, ***p<0.001			

When looking at the estimated coefficients, our explanatory variable (ODA/capita * *post-conflict dummy*) does not have a significant impact on the different dependent variables. Had the results been significant, ODA in post-conflict countries would be expected to decrease the human capital level by 0,0028422 units, increase the trade openness by 0,000000768 percentage points and decrease the technology by 0.0260285 percentage points. Such conclusions cannot be drawn from the estimations due to high p-values. These are very small numbers, and had they been significant it would suggest that our explanatory variable has little effect on the dependent variables.

The determination coefficient, R^2, represents how much of the change in the dependent variables can be explained by the independent and control variables included in the models. A higher determination coefficient means a more fitting specification of the model. When doing regressions, it is generally preferred to have a R^2 value above 50%, the higher the better.

The R^2 value was the highest for the regression model with human capital as the dependent variable: around 54,5% (adjusted 52,6%). The R^2 was much lower in Model O, for the dependent variable Trade Openness: 8,2% (adjusted 4,37%) and 19,8% (adjusted 15,7%) for Model T, technology.

Our control variables GDP/capita and life expectancy have a positive correlation with human capital. This makes sense since we included them because they have shown, in previous research, to have an effect on school enrollment.

Model 2: Yearly

Table 4

Variables	Human Capital	Trade Openness	Technology
(ODA/capita * *post-conflict dummy*)	-0.0023268*	2.63E-07***	0.0353988
	(0.013)	(0.000)	(0.640)
(ODA/capita * *post-conflict dummy*)^2	8.35E-06*	-3.41E-15***	0.0003369
	(0.016)	(0.000)	(0.201)
ODA / capita	0.0000964	5.06E-08	-0.1125852 ⚬
	(0.842)	(0.637)	(0.077)
GDP / capita	0.0000192*	-0.0003294	0.0004696
	(0.022)	(0.598)	(0.257)
Life expectancy	0.0346115***	----	0.3448487
	(0.000)	----	(0.251)
Trade Openness	0.0012882*	----	0.0676993
	(0.040)	----	(0.121)
Technology	0.0001479	0.129135	----
	(0.831)	(0.124)	----
Human capital	----	22.47903*	1.329472
	----	(0.011)	(0.828)
Constant	-0.4202963	17.88255	-5.565505
	(0.261)	(0.282)	(0.731)
Observations	1742	1794	1742
Groups	67	69	67
r^2	0.60146762	0.073546647	0.073467417
r^2 adjusted	0.599627886	0.069915531	0.069190291
Three-year average	No	No	No
Country and Year-fixed effects	Yes	Yes	Yes
p-values in parenthesis; ⚬ p<0.1, * p<0.05, **p<0.01, ***p<0.001			

When removing the three-year averages in the control variables, the observations increase to about ten times as many. In this regression we received significant results in the coefficients of the independent variable in Model H and Model O. With 5% significance, our model estimates that when ODA/capita is increased by one USD in post-conflict countries, the human capital would decrease by 0.0023268 units in the index and the trade openness would increase by 2.63E-07 percentage points (significant at the 0.1% level). The coefficient for the model with technology was not significant, however if it had been significant the model would estimate that an increase in ODA/capita by one USD would increase the technology by 0.03 percentage points.

The control variables that were significant in the model for human capital were GDP/capita with the coefficient 0.0000192 (significant at the 5% level), life expectancy with coefficient 0.035 (significant at the 0.1% level) and trade openness with the coefficient 0.0012882 (significant at the 5% level). In Model O, it is estimated that an increase of human capital with one unit in the index would increase the level of trade openness with 22.47903 units (significant at the 5% level). In Model T, ODA/capita is estimated to increase the technology level by 1.329472 percentage points which was significant at the 10% level.

We can see that the R^2 value for Model H with human capital as the dependent variable is approximately the same as with averages: 60,14%. The R^2 is also similar for Model O with trade openness as the dependent variable at 7.3% while the R^2 was halved for Model T from 19.8% to 7.34%. This suggests that the model with 3-year averages had a better-suiting specification for the model with Technology as the dependent variable.

Model 3: Lags

For model H with lags and without 3-year averages, we receive significant coefficients at the 10% level at most. We estimate that when the ODA/capita is increased by one USD, the Human capital would decrease by 0.0031554 units in the index after one year. After three years, the human capital is estimated to decrease slightly less by -0,00274 units in the index (also significant at the 10% level). After five years a change caused by ODA/capita in post-conflict countries is not significant in our model. The R^2 is 54.57% with one lag, 47,37% with three lags and 39,94% for five lags. The number of observations for the models is between 154 and 175 observations [see Appendix Table 10].

For the Model O, more significant results are achieved. When ODA/capita is increased by one USD in post-conflict countries, we estimate that the trade openness one year later decreases by a very small amount -3,33E-07 percentage points (significant at the 1% level), -2,74E-07 percentage points after three years (significant at the 5% level) and -2,07E-07 percentage points after five years (significant at the 10% level). As can be seen in the table below, the R^2 are extremely small, suggesting that the specification is not well suited for the regression.

Dependent variable: Trade Openness

Table 5

Variables	Lag 1	Lag 3	Lag 5
(ODA/capita * *post-conflict dummy*)	-3.33E-07**	-2.74E-07*	-2.07E-07 ⚬
	(0.007)	(0.018)	(0.051)
(ODA/capita * *post-conflict dummy*)^2	1,11E-14	-1,35E-14***	3,81E-15*
	(0.317)	(0.000)	(0.037)
Constant	22.43428	58.00927 ⚬	49.18877
	(0.581)	(0.074)	(0.186)
Observations	163	183	187
Groups	46	47	49
r^2	0.0053133983	0.0359159796	
r^2 adjusted	0.010372292	0.003049479	
Number of control variables	5	5	5
Three-year average	No	No	No
Country and Year-fixed effects	Yes	Yes	Yes
p-values in parenthesis; ⚬ p<0.1, * p<0.05, **p<0.01, ***p<0.001			

When running the regression model with lags with technology as the dependent variable no significant results were received in the independent variable. This could be due to the low number of observations of between 154 to 175 for the different lags. Had they been significant, an increase in ODA/capita with one USD in post-conflict countries, the technology level would increase by 0,20 percentage points after one year, 0,23 percentage points after three years and 0,34 percentage points after five years [see Appendix, table 11].

5. Discussion

The results from our regression models show significant results regarding the relationship between post-conflict ODA on human capital and trade openness. When it comes to the effect on trade openness, the coefficient for our independent variable ODA/capita**post-conflict dummy* was significant, yet very small. Previous research has shown that trade openness can decrease when aid is given, due to large inflows of capital into one sector causing appreciation in the currency. The coefficient was positive, but so close to zero that we conclude that trade openness was not changed by an increase in ODA, at least not the same year the ODA was given.

The model with lags also showed significant results on the relationship between ODA/capita and trade openness. The coefficient with lags was negative, but still very small. The results indicate that even after a five-year period the trade openness is unaffected. This contradicts previous research that suggests that ODA damages a country's exports and imports in the short-run, known as the Dutch disease theory, due to the risk of appreciation in the currency. Other studies convey that in the long-term, trade openness is positively affected by ODA as a consequence of the relationship built between the donor- and recipient-country. With only five lags, we cannot test whether this positive long-term relationship also is true under post-conflict countries in our data selection.

Human capital showed a significant negative correlation with ODA/capita during post-conflict conditions. This could suggest that aid is counterproductive in its effect on years of schooling and returns to education, like some researchers believe. Instead, we interpret this result as a consequence of the aftermath from the conflict. One must take into account that this variable is multiplied with a dummy variable for post-conflict periods, meaning only countries that are in the period of 5-20 years post-conflict are accounted for in the estimation.

Moreover, post-conflict conditions commonly consist of poverty and can put adolescents in a position where they are forced to quit their education to work instead. The years of schooling and returns to education could be decreasing even years after a conflict has ended despite receiving ODA. This can explain the negative β -value for the first few years. Our measurement of human capital is, like stated previously, an index measure for human capital based on average years of schooling and returns to education. It takes time for an *average* of the years of schooling to increase - partly because only a fraction of the population (mainly children and young adults) would attend school.

It is logical too that an increased ODA one year does not lead to increased human capital in the same year. It takes time to build back up a society in order for education to give increased returns again. At the same time, the coefficient could also indicate that ODA is ineffective in stimulating human capital growth in a short time period. It becomes a question of distinguishing between what is an impact of the post-conflict period and what is an effect of the ODA during the period. Countries receiving most aid are often those that are in the worst conditions to stimulate growth to begin with, which can give misleading results. We are cautious about drawing a generalized conclusion regarding this.

The model with technology did not show significant results and conclusions cannot be drawn in the same manner as for trade openness and human capital. We expected to see that ODA had a positive effect on technology due to increased investments in the R&D sector and in improving and infrastructure more productive and well-functioning. It can be seen from our results that the coefficient is positive, however not significant. We know that it is possible for technological growth to take place within the time period of 5-20 years after armed conflicts have ended. As presented in the section previous research, this has happened in Rwanda - a country that suffered the most systematic and efficient genocide in modern history. Six years after the genocide and conflict ended, the country directed aid and investment towards the ICT sector and saw a rapid technological growth rate. Our study shows that the technological level was not increased when generalizing during the first five years after giving ODA in the time period of 5-20 years after conflict had ended.

6. Conclusion

This study aimed to investigate the impact of official development assistance to post-conflict countries on human capital, trade openness and technology. To answer the research question, under post-conflict conditions for our dataset, significant results showed that trade openness was not affected by ODA. We saw a negative significant relationship with human capital and furthermore for the technological level we did not see any significant impact of ODA during post-conflict periods. Hence we can conclude that ODA may not be successful in positively affecting our dependent variables.

However, we should keep in mind that there is no universal solution for all post-conflict states. Conflicts and giving aid to countries in post-conflict situations in an effective way should be adapted after the specific needs of a country. Effectiveness is more easily measured when investigating what sectors ODA is spent on and whether the outcome matches the set objectives.

The research in this report takes into account all ODA given from the years 1960-2019. It could be the case that aid effectiveness has improved in more recent years but that it cannot be seen in our models as we do not investigate the impact of time. A suggestion for future research would be to compare different aid initiatives during different time periods. It would also be interesting to investigate similar regressions using a “difference in difference” model and compare the results of post-conflict periods when ODA is not given to a treatment group that received ODA.

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8. Appendix

Table 6: List of countries included

Afghanistan	Croatia	Iran (Islamic Republic of)	North Macedonia	Sudan
Albania	Cuba	Iraq	Oman	Suriname
Algeria	Cyprus	Israel	Pakistan	Syrian Arab Republic
Angola	D.R. of the Congo	Jordan	Panama	Taiwan
Argentina	Djibouti	Kenya	Papua New Guinea	Tajikistan
Azerbaijan	Ecuador	Kuwait	Paraguay	Thailand
Bangladesh	Egypt	Lao People's DR	Peru	Togo
Bolivia (Plurinational State of)	El Salvador	Lebanon	Philippines	Trinidad and Tobago
Bosnia and Herzegovina	Eritrea	Lesotho	Republic of Korea	Tunisia
Brunei Darussalam	Ethiopia	Liberia	Republic of Moldova	Turkey
Burkina Faso	Gabon	Libya	Romania	U.R. of Tanzania: Mainland
Burundi	Gambia	Madagascar	Russian Federation	Uganda
Cambodia	Georgia	Malaysia	Rwanda	Ukraine
Cameroon	Ghana	Mali	Saudi Arabia	Uruguay
Central African Republic	Greece	Mauritania	Senegal	Uzbekistan
Chad	Grenada	Mexico	Serbia	Venezuela (Bolivarian Republic of)
Chile	Guatemala	Morocco	Sierra Leone	Vietnam
China	Guinea	Mozambique	Slovenia	Yemen
Colombia	Guinea-Bissau	Myanmar	Somalia	Zimbabwe
Comoros	Haiti	Nepal	South Africa	
Congo	Honduras	Nicaragua	Spain	
Costa Rica	India	Niger	Sri Lanka	
Côte d'Ivoire	Indonesia	Nigeria	State of Palestine	

Hausman test

When doing the Hausman test our first H_0 is that a fixed effects-specification is appropriate for our model: (1) $H_0 = The\ model\ has\ fixed\ effects$

The test shows that the Chi2 value is negative, chi^2_{obs} = -51.9 < chi^2_{krit}, meaning that (1)H_0 is not rejected.

We have also performed another Hausman test with the hypothesis that a random effects-specification is appropriate for our specification: (2) $H_0 = The\ model\ has\ random\ effects$

We get a the following values: $chi^2_{obs} = 50.67 > chi^2_{krit} \rightarrow Prob > chi^2 = 0.0000^{***}$ resulting in that the (2) $H_0 = The\ model\ has\ random\ effects$ is rejected.

Table 7. Variable list with sources

Variable name in study	Variable name in data source	Source
ODA/capita	ODA/capita	OECD https://stats.oecd.org/Index.aspx?DataSetCode=Table2A
post-conflict dummy	(coded manually from year started to year ended for intensity level 1 and 2; see section 3.3.1 for explanation)	UCDP/PRIO Armed Conflict Dataset version 20.1 https://ucdp.uu.se/downloads/index.html#armedconflict
Human capital	hc	Penn World Database 10 https://www.rug.nl/ggdc/productivity/pwt/?lang=en
Trade Openness	Trade (% of GDP)	The World Bank https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS
Technology level	Medium and high-tech exports (% manufactured exports)	The World Bank https://data.worldbank.org/indicator/TX.MNF.TECH.ZS.UN
Life expectancy	Life expectancy at birth, total (years)	The World Bank https://data.worldbank.org/indicator/SP.DYN.LE00.IN
GDP/capita	rgdnpa / pop GDP/capita	Penn World Database 10 https://www.rug.nl/ggdc/productivity/pwt/?lang=en The World Bank https://data.worldbank.org/indicator/NY.GDP.PCAP.CD

The following variables were calculated based on the variables in table in stata: (ODA/cap*Post conflict), ln(Trade Openness), ln(Technology), (ODA/cap)^2, (ODA/cap*Post conflict)^2

Table 8 Frequency table of ODA/capita in post-conflict countries between 1960-2019

oda_cap_post

	Percentiles	Smallest		
1%	-.8	-39.8		
5%	.37	-21.65		
10%	1.05	-11.65259	Obs	1,421
25%	4.101408	-11.29	Sum of Wgt.	1,421
50%	12.91		Mean	25.92246
		Largest	Std. Dev.	45.21718
75%	30.33	352.6382		
90%	61.12	506.717	Variance	2044.594
95%	89.12	634.4822	Skewness	6.410318
99%	209.9029	662.7979	Kurtosis	68.86592

Table 9 VIF Test

Variable		VIF	
	Human Capital	**Trade Openness**	**Technology**
ODA/cap * *post-conflict dummy*	2.52	9.49	2.52
(ODA/cap * *post-conflict dummy*)^2	2.46	8.97	2.46
ODA/capita	3.55	6.21	3.55
BNP/capita	1.5	1.67	1.5
Life Expectancy	1.03	---	1.03
Human Capital	---	1.62	1.64
Trade Openness	1.32	---	1.32
Technology	1.21	1.22	---
Mean VIF	1.94	4.86	2.00

Table 10, Model 3 with lags

Dependent variable: Human capital

Variables	Lag 1	Lag 3	Lag 5
(ODA/capita * *post-conflict dummy*)	-0.0031554 ⚬	-2.74E-03 ⚬	-0.0006151
	(0.073)	(0.098)	(0.775)
(ODA/capita * *post-conflict dummy*)^2	4.78E-06 ⚬	2.48E-06	-1.68E-06
	(0.088)	(0.506)	(0.751)
Constant	0.7021072	0.6992758	0.5823466
	(0.113)	(0.206)	(0.419)
Observations	154	171	175
Groups	44	45	47
r^2	0.545722333	0.47368593	0.399446768
r^2 adjusted	0.523941897	0.451083485	0.374273878
Number of control variables	6	6	6
Three-year average	No	No	No
Country and Year-fixed effects	Yes	Yes	Yes
p-values in parenthesis; ⚬ p<0.1, * p<0.05, **p<0.01, ***p<0.001			

Table 11, Model 3 with lags

Dependent variable: Technology

Variables	Lag 1	Lag 3	Lag 5
(ODA/capita * *post-conflict dummy*)	0.2055364	2.31E-01	0.3432559
	0.332	0.126	0.266
(ODA/capita * *post-conflict dummy*)^2	-5.24E-04	-5.67E-04 ∘	-1.20E-04
	0.123	0.076	0.767
Constant	-5.301925	5.872376	20.11175
	0.839	0.768	0.474
Observations	154	171	175
Groups	44	45	47
r^2	0.092834758	0.194634548	0.223281549
r^2 adjusted	0.049340534	0.160048301	0.190724489
Number of control variables	6	6	6
Three-year average	No	No	No
Country and Year-fixed effects	Yes	Yes	Yes
p-values in parenthesis; ∘ p<0.1, * p<0.05, **p<0.01, ***p<0.001			