A Methodology for the Calculation of the Global Economic Costs of Conflict*

Olaf J. de Groot†
DIW Berlin, Department for International Economics

GECC Project Paper N° 2, December 2009

Abstract

There is a substantial body of research on the calculation of the costs of conflict, but so far no satisfactory methodology has been proposed that is able to combine all potential channels in one single analysis. This paper uses the existing literature and its problems to propose a methodology for doing so.

The specific problems addressed in this study include the measurement of welfare, the imputation of missing data, the validity of the econometric techniques used in the estimation of conflict costs, the differentiation of existing conflict databases and the possibility of both direct and non-direct effects. These challenges are described in detail in this paper and a comprehensive methodological roadmap is proposed to be able to estimate the Global Economic Costs of Conflict. This contribution is an important continuation of our research agenda with regards to the calculation of the Global Economic Costs of Conflict.

Keywords: Conflict, development, costs of conflict, civil war
JEL code: C23, F50, O11

*The author would like to gratefully acknowledge the funding provided by the German Foundation for Peace Research (DSF) through the Global Economic Costs of Conflict project.

†Address of the author: Olaf J. de Groot, DIW Berlin, Mohrenstraße 58, 10117 Berlin, Germany. Tel: +49-30-89789-334. Email: odegroot@diw.de

1 Introduction

Nobody doubts that the world is suffering greatly as a result of violent conflict. The actual scale of this suffering, however, is difficult to determine and authors who have tried to do so have come up with a range of estimates. It is nonetheless important and interesting to determine the scale of the total global costs of conflict in order to acknowledge its significance. Additionally, it may contribute to a more focused discussion about attempts to reduce the terrible and costly consequences of conflict. After all, one needs to have a reasonable estimate about the actual size of these costs to be able to draw conclusions regarding the reduction thereof.

Previous authors have contributed significantly to the calculation of conflict costs and their work is pivotal for the further development of the field. In this paper, the previous contributions are used to propose further improvements to existing methodologies and to suggest reasonable methods to address issues that require further attention. Clearly, the current methodology does not exist in a vacuum and is complemented with case studies that address specific conflicts. These case studies play an important role in pointing out which particular channels should be taken into account in a cross-country study, such as this one. The current paper has a larger focus and provides a methodology for estimating the Global Economic Costs of Conflict. Case studies, on the other hand, are able to provide much more detailed information at the national or regional levels, which is more useful in the actual determination of policies designed to reduce conflict consequences, whereas cross-country analysis is important because of its ability to focus attention on the issue of conflict cost reduction.

In the following section, I discuss the current state of the art, both in terms of case studies and in terms of cross-country analyses. In section 3, a number of weaknesses in the existing literature are highlighted and in the section after that, I propose a solution for these problematic issues. That section basically stipulates the roadmap for future research on the Global Costs of Conflict. The fifth section gives some practical hints about the further development of our research plans and the final section concludes.

2 Current State of the Art

Most of the previous contributions to the field of conflict cost calculation have focused their attention on case studies. As mentioned earlier, case studies have significant value and can be very interesting as an inspiration for the types of costs that one should include in a calculation of the global costs of conflict. For that reason, despite it not being the main focus of this paper, the first subsection contains some information about a number of important case studies that address the issues that are typical

for case studies related to conflict cost calcualtions. A complete overview of case studies and other research in the field of conflict cost analysis can be found in Bozzoli et al. (2008). In the subsection that follows, the existing cross-country studies are discussed, highlighting both the methodologies used as well as the actual results found previously.

2.1 Case Studies

Case studies are very valuable (see also De Groot et al., 2009, for a more detailed description of different case studies), but suffer from a number of problems. One of the main problems is the limited consistency across studies. Different analyses about particular conflicts tend to come up with wildly varying estimates. The 1981-1985 conflict in Nicaragua, for example, has been estimated to have cost between 0.08 billion US$ (Stewart et al., 2001) and 1.13 billion US$ (according to a 1988 study by the Instituto Latinoamericano de Planificacion Economic y Social, as reported by DiAddario, 1997) per year, expressed in constant 2000 dollars: a thirteen-fold difference. However, one of the things illustrated particularly well by case studies, is that all conflicts are different. Not only are the underlying causes of conflict different, the consequences can also vary a lot depending on the initial conditions of the national economies, the way the conflict is resolved and the role other states play. Finally, an important place where case studies are able to play a pivotal role is in documenting the channels through which conflicts impose costs. There are several case studies that analyse specific channels, which can indicate whether those channels are sufficiently important to be included in cross-country analyses as well.

One of the best examples of a case study that looks at only the development of GDP, independent of the sources through which GDP is affected, is by Abadie and Gardeazabal (2003), who use a counterfactual approach to look at the costs of the Basque conflict in terms of GDP per capita. The authors use the non-Basque Spanish regions to recreate an artificial region with ex ante characteristics that are very similar to the Basque Region's. They then compare the development in the conflict-affected true and the conflict-free artifical Basque Regions to see what the impact of the presence of conflict is on the growth of GDP. They find that after about 20 years, the true Basque Region lags behind the artifical conflict-free one by approximately 10%. Contrary to Abadie and Gardeazabal, Kelegama (1999) attributes the opportunity costs in terms of GDP forgone as a result of the conflict in Sri Lanka to specific channels. He uses data on military expenditure to calculate the amount of forgone investment, and calculates the influence of forgone investment on the growth rate of GDP. Additionally, he analyses temporary losses in production on the basis of destroyed assets, and the losses due to forgone tourism. Finally, he even includes the rehabilitation costs of displaced persons as a cost of the conflict. In total, for the

periods 1983-87 and 1990-94, Kelegama finds an annual cost of 3.3% of GDP[1].

Reitschuler and Loening (2005) address a specific element of conflict and how it influences the rate of economic growth. They look at Guatemala and consider whether military expenditures have a positive or a negative influence. They actually find a non-linear effect, with low rates of military expenditure having a net positive effect, but high rates of expenditure having a negative effect. According to Reitschuler and Loening, the threshold at which military expenditures begin having a negative effect on growth in Guatemala is found at approximately 0.33% of GDP. Burnham et al. (2006) address another important conflict consequence that is often forgotten: health effects. The authors look at excess mortality in Iraq after the American invasion, using a large household survey. They find that during the conflict, the mortality rate increased from 5.5 to 13.3 per 1000 people, implying that a total of 655 thousand additional people have died as a result of the conflict.

Arrazola and De Hevia (2006) look at the Spanish Civil War to analyse the rates of return on education for men and women. While not the prinicipal aim of their contribution, they highlight the fact that conflicts have a significant impact on education levels, which affects a country's long-run growth potential. This implies that when discussing the costs of conflict, costs in terms of education should be considered too. After all, education is a necessity for long-run economic development and the destruction of the educational capacity of a population can be harmful to that long run growth.

2.2 Cross-country analyses

Studies that use a cross-country perspective generally assume the consequences of conflict to adhere to a common pattern across countries and time periods (after controlling for variables that can be country- or time-specific). A number of these studies have specifically aimed at analysing the overall impact of conflict on GDP growth, or on another measure of costs. However, before discussing these studies that addressed overall conflict costs from a cross-country perspective, a small number of studies need to be highlighted that address, like some of the case studies, specific channels through which conflict costs accumulate. The examples discussed here specifically differ from the types of costs already discussed in the previous subsection (such as Cappelen, 1984, who uses cross-country methods to look at military expenditures and growth).

Van Raemdonck and Diehl (1989) contribute to the discussion on the consequences of conflict by drawing attention to the long run. They provide an exhaustive list of negative and positive long-term effects resulting from conflict, arguing that this is a

[1]Expressed in constant 2000 dollars, he finds a total cost of 16.74$ billion, or 1.72$ billion per year (Bozzoli et al., 2008).

topic that is underlit in the existing literature. Murdoch and Sandler (2004) do a similar thing for the existence of spillover effects. They argue that conflict has effects that are felt beyond the borders of a conflict country and affect growth rates in neighbouring countries too. They show that, indeed, neighbouring countries risk forgoing growth due to the presence of neighbouring conflict. The impact of one additional neighbour in conflict is equal to approximately 30% of the impact of domestic conflict. Their result is robust to variations in the sample used, the definition of neighbours and different conflict types. Finally, Lai and Thyne (2007) look at education, where they find that conflict can affect the accumulation of education through two channels: the destruction of a state's education system and the reallocation of resources away from education. They find evidence for the first channel, but not for the second, and they also show that these conclusions hold mostly for high-intensity conflict, whereas low-intensity conflicts do not suffer significantly in terms of education.

In the more general literature on the cross-country estimation of the costs of conflict, most attention has always been paid to Collier's (1999) contribution. However, a number of earlier papers have paved the way for Collier's paper to be written. First of all it should be noted that the cross-country conflict literature is actually embedded in the overall growth literature. Barro and Lee (1994) already include war effects in their overall estimation of growth explanations, although they found no significant result. Sala-i-Martin (1997), on the other hand, does find a negative effect of conflict on subsequent GDP growth using an alternative methodology. The first noteworthy attempt that specifically focuses on the overall impact of conflict on GDP is from Stewart and Humphreys (1997), who compare several indicators in conflict nations with values before the conflicts start and with indicators in groups of similar countries. The indicators they consider include investment, government expenditure, exports and imports, savings, mortality et cetera. The authors do not follow up on their conclusions and merely conclude that conflict indeed impacts economies.

As mentioned above, Collier (1999) has had the largest impact on the literature and it continues to be highly influential. He focuses on civil conflicts only, because of the perceived economic strengthening effects of international conflict. Collier argues that civil conflict affects growth through the destruction of resources, the disruption of infrastructure and social order, budgetary substitution, dissaving and portfolio substitution of foreign investors. The first four of these channels are expected to influence an economy only during conflict, whereas the final one is likely to continue having an effect after the restoration of peace. This led Collier to come to his theory that the length of the conflict is going to influence the impact of the post-conflict period. In particular, he argues that long-running conflicts are more likely to be followed by a growth increase, whereas short-lasting conflicts will suffer reduced growth rates over a longer period of time. His way of testing this is by including not only the number of months of conflict per period and the number of post-conflict months, but also the interaction of the number of post-conflict months and the length of the

preceding conflict. From his regression model, Collier concludes that during civil conflict, the annual growth rate is reduced by 2.2%[2]. After a one-year conflict, the five post-conflict years will have a growth rate 2.1% below the growth path in absence of conflict. On the other hand, after a 15-year conflict, the post-war growth rate is 5.9% higher.

Following Collier (1999), the next contribution comes from Imai and Weinstein (2000), who address several specific issues. First, the authors focus strongly on investment, which they argue is the most important channel through which conflict influences the economy, and the effect is expected to take place particularly through private investment (as opposed to public). Second, they want to show that fiscal policy is affected by conflict which is likely to harm economies in the long run. Finally, the authors want to differentiate conflicts by their geographical spread. The authors start by showing simple output from pooled OLS regressions, but then argue that such an analysis is not necessarily correct. The two main problems they identify regard the statistical soundness of using OLS and the fact that the data availability is not random[3]. They suggest following King et al.'s (2001) method of multiple imputation to increase the scope of their dataset. For each variable they compute, the authors compute five different values, which are used separately in order to arrive at a robust conclusion. To improve the robustness of the estimation, Imai and Weinstein suggest using Islam's (1995) error-correction model with random effects. In the end, the authors' results confirm their hypotheses regarding the influence of investment.

Hess (2003) follows a very different approach from the standard Collier-style regressions. He sets out to estimate how much income people would be willing to give up in order to live in a peaceful world. He employs a technique developed by Lucas (1987) and compares the consumption path of the world's citizens with a hypothetical consumption path in a world in which there is no conflict at all. Hess differentiates between different intensities and locations of conflict and concludes that that a large external war fought on one's home territory that lasts at least a year has a negative impact of nearly twenty percentage points. Hess finds that citizens in different countries are willing to permanently give up different percentages of their income in order to live in a permanently peaceful world. For example, citizens from nations such as Iraq, Angola and Cyprus are willing to give up approximately 65, 40.5 and 7 percent respectively. Expressed in 1985 dollars and using the 1985 size of the world

[2]Imai and Weinstein (2000) claim that Collier (1999) misinterprets the results he finds. They argue that Collier overstates his growth effects by a factor 10, but this appears to be an incorrect statement. Collier's argument that "the coefficient on Warmonths must be multiplied by 120 to arrive at the effect on the annual growth rate" aims to seek out the effect of a decade-long conflict. Assuming the dependent variable is average GDP growth, this means that indeed per year of conflict, GDP growth is reduced by 2.2% and not by 0.2% as claimed by Imai and Weinstein.

[3]In other words, the availability of data, and thus the inclusion of observations, is related to the presence of conflict, as the presence of conflicts is likely to influence the quality/ability of data reporting.

population, he concludes that all people would together be willing to permanently forgo approximately 400 billion dollars.

Gupta et al. (2004) address the fiscal consequences of conflict from a cross-country perspective. They simultaneously estimate a system of equations, looking for the influence of conflict on GDP growth, government revenue and defense expenditures, using the Generalized Method of Moments (GMM) estimation technique. They conclude that conflict, or the risk thereof, increases military expenditure, which crowds out investments in other sectors, such as infrastructure and education. According to their estimations, there is no evidence for a further impact of (the threat of) conflict on GDP, apart from these fiscal effects. However, when using a different measure for domestic conflict and terrorism, they find that a direct effect of conflict does take place.

3 Gaps in the Literature

While the existing literature addresses a number of interesting issues, there are clearly several gaps that still need to be addressed in order to be able to estimate the actual costs of conflict. The issues can be divided in a set of theoretical challenges and a set of practical problems, and they are discussed as such.

3.1 Theoretical Issues

In general, the current literature has been following a fairly standard approach and there has been little debate on the different theoretical perspectives on the measurement of the global economic costs of conflict. Of course there are exceptions, in particular Hess's (2003) approach which indeed approached the question from a wholly different angle. However, staying within the currently prevailing body of literature, there are several issues that need to be addressed. The first of these is the measurement of welfare. As is fairly standard in economics, GDP or GDP per capita is often used as measures of welfare. The validity of this indicator as a measure of welfare has been subject to debate. Unorthodox solutions, such as the measurement of happiness[4], may sound attractive, but are obviously impractical. A more accessible measure of welfare could, for example, be consumption. After all, one cannot eat GDP (Davidson, 2000), and a measure of consumption may thus be much more indicative of welfare than a measure of GDP. However, from a practical perspective it is unfortunately impossible to gather consumption data for a worldwide representative sample over a long time period. The lack of alternative measures of welfare implies

[4]The government of Bhutan is currently the only country in the world expressing its national output not in terms of GDP, but in terms of National Happiness.

that GDP must be used, but it should be considered merely as a proxy for welfare. Unfortunately, this welfare proxy is not able to integrate important welfare-impeding elements such as increasing inequality and mortality beyond its influence on potential GDP. In addition to the debate concerning the proxy that is most appropriate in welfare analysis, the choice of previous authors to look at GDP per capita is at best debatable as well. After all, if the population size is endogenous to the presence of intensity of conflict, this distorts the measurement of the effect of conflict[5].

Related to this, there has been only little discussion as to whether current methodologies actually include all different channels through which conflict affects welfare. Conflict spillovers that affect neighbours have been the topic of several studies (Murdoch and Sandler, 2004; De Groot, 2010), but have not previously been included in any previous cross-country analysis of the global costs of conflict. This is an unfortunate development as these authors have shown that the welfare effects (in terms of GDP) are indeed significant and may contribute greatly to the global costs of conflict. In addition to the international spillovers, there are other indirect effects of conflict that are not always included in previous analyses. In particular, one can think of conflict-related damage that affects the long-run growth rate of an economy, such as a permanent reduction in educational attainment, a significant reduction of social capital or long-term environmental degradation. While it is not necessarily possible to include all the effects mentioned in a final analysis, it is important to at least acknowledge their existence. The spillovers of conflict costs are easily dealt with in regression analysis, but the reductions in educational attainment and social capital can also be dealt with as long as the researcher takes a very long-run perspective. After all, a permanent dent in educational attainment is likely to influence a country's development only in the long run. Environmental degradation, on the other hand, is an entirely separate issue. In part, environmental degradation will in the long run impact GDP and thus be felt, particularly in countries that are dependent on tourism or require their natural resources as a source of income. But an undetermined share of the environmental degradation is not accounted for and this will remain the case until a way is developed to properly value environmental wealth.

The next theoretial issue is something that has actually been addressed in some of the more recent work. It concerns the way conflict characteristics are included in analyses that look at the global costs of conflict. Individual conflicts differ in many dimensions, including intensity, geographical spread, the type of differences that are being contested and the location of the conflict that is taking place. The UCDP/PRIO dataset (Gleditsch et al., 2002) is most commonly used and differentiates between low-intensity (25-999 battle deaths per year) and high-intensity ($\geq$1000) conflicts, and the researchers at PRIO have recently made strides towards quantifying

[5]In other words, if conflict only costs lives, but the rest of the population stays equally productive, using a measure of GDP per capita would imply a conflict has no cost. Instead, using total GDP incorporates the decreased population size as a cost of conflict.

the geographical spread of conflict (Raleigh and Hegre, 2005). After all, low-intensity conflicts that only affect one particular region are not as likely to affect the long-run growth rate of a country as large-scale conflicts are that may be affecting the entire structure of a nation. For that reason, it is important to include these differentiations in any conflict analysis. The type of difference that is being contested may also be highly relevant. There are cases in which conflicts may in fact improve the prospects of a nation, for example when popular uprisings are battling with autocratic or kleptocratic regimes. In other cases, for example in the removal of Idi Amin by Tanzanian troops, international conflict can be beneficial as well. Finally, the location of conflict is very important. A conflict that takes place in one's own territory is much more likely to be affecting welfare than conflicts being fought in another's territory. We argue that for international conflicts, the effects should be modelled to be very different for the nation in which the actual fighting takes place than it is for others. This is particularly true in situations in which developed nations are involved in developing nations' conflicts, which was the case at the end of the colonial era, as well as in later situations such as Vietnam, Iraq and Somalia. Particularly regarding intensity, some studies do make this differentiation. For example, Collier (1999) only considers the high-intensity conflicts. This is one possible strategy, although for wide-spread conflict with relatively few battle deaths, one would also expect a large impact, particularly in terms of reduced investment and reduced international confidence. For that reason, further changes must be made to accommodate all the different elements in which conflicts can be differentiated.

The final theoretical issue that remains understudied is related to Collier's (1999) War Legacy arguments. He shows that the influence of post-conflict development depends on the length of the conflict itself[6]. While in itself a correct point, he does not develop the argument far enough. For reasons similar to the ones put forward by Collier, it is reasonable to argue that the first year of conflict (ie *conflict initiation*) is likely to affect a country more strongly than a subsequent year of conflict (ie *conflict continuation*). Similarly, one can wonder whether the so-called peace dividend should be expected to be equal during all years that are considered to be part of the post-conflict period. A differentiation between the year during which the conflict ends (ie *peace initiation*), the first fully conflict-free year (ie *peace establishment*) and subsequent years (ie *peace continuation*) is worth testing. This is not to say that Collier's argument should be ignored. Both his War Legacy arguments and a differentiation regarding the exact timing of conflict start and end may be relevant.

[6]Collier (1999) shows that short-lasting conflicts have lower growth rates after the conflict has ended, whereas long-lasting conflicts result in increasing growth rates after the end of the conflict.

3.2 Practical Issues

The econometric methodology employed is among the most important gaps in the existing cross-country conflict literature. While important work has so far been done regarding the creation of the perfect framework for estimation, more can and needs to be done to generate estimations that are more coherent, inclusive and consistent. The perfect methodology compares the situation in which conflict occured with the exact same situation in absence of conflict. This is obviously impossible, although for specific country studies some valid attempts have been made to closely approximate the perfect framework of analysis[7]. In the case of cross-country studies, however, replicating a conflict-free world is not feasible. Instead, by necessity, economists have turned to regression analysis to achieve more usable results, which in some ways tries to do the same: regression analysis tries to isolate the effects that can be contributed to particular factors (including the presence of conflict). The problem of such analyses is the identification of causal effects, with many different factors changing at the same time.

Both Collier (1999) and Imai and Weinstein (2000) use Ordinary Least Squares (OLS), as well as Fixed Effects (FE) and Random Effects (RE) models to correct potential bias introduced by the use of OLS, but their conclusions are different. Collier (1999) concludes that neither fixed, nor random effects models deliver superior results compared to OLS, whereas Imai and Weinstein find the opposite. Hess (2003) argues in favour of OLS, but using standard errors that are Newey-West robust, correcting for unknown heteroskedasticity and allowing for serial correlation. Gupta et al. (2004) propose to use the Generalized Method of Moments (GMM) estimation technique to correct for autocorrelation and autoskedasticity and finally Kang and Meernik (2005) employ Two-Stage-Least-Squares (2SLS) to estimate the influence of conflict on growth and vice versa simultaneously. It is clear that the use of simple pooled OLS is not feasible when there is a lagged dependent variable, as well as unobserved heterogeneity. Particularly when some of the unobserved country characteristics are correlated with some of the included explanatory variables, one must employ a dynamic panel data method, such as the ones described by Bond (2002). While OLS is infeasible due to the possible existence of unobserved heterogeneity, the RE and FE estimators are unable to consistently estimate time-invariant variables and the standard errors cannot be consistently estimated. None of these techniques are able to deal with simultaneous causation either. The classic solution for the problem of simultaneous causation is the use of Instrumental Variables (IV) or 2SLS. However, the need to to find instruments for all potentially endogenous variables and the difficulties of testing the validity of the instruments are underappreciated in the

[7] A well-known example of such a successful study is Abadie and Gareazabal (2003) who study the Basque conflict. For more comments about the difficulties of constructing valid counterfactuals in case studies, see De Groot et al. (2009).

existing literature. Kang and Meernik (2005), in particular, only instrument conflict, but no other potentially endogenous variables, such as foreign aid or investment.

In addition to the problem of estimation consistency, another issue requires attention. In growth regressions, it is common to control for many variables that directly affect growth, such as investment, education and population growth. However, due to the overarching influence of conflict on many facets of economies, the changes happening to these different control variables are likely to be endogenous to the occurrence of conflict. If this is neglected and only the direct influence of conflict on growth is taken into account, the estimated costs of conflict will be a significant underestimation. In extreme cases, where many control variables are included or where conflict affects growth only through a limited number of channels, one may even conclude that conflict does not affect GDP growth at all. In order to accommodate this problem, one needs to separately estimate the effects of conflict on the control variables used in the estimation and subsequently quantify this influence in terms of its influence on growth. The fact that previous authors, such as Collier (1999) neglected to do this, is another indication that the costs found by those authors are more likely to be an underestimation than an overestimation.

Another particularly important issue is that of data imputation. No-one doubts that the presence of conflict affects the probability that data is available. If, instead, data missingness were random and the degree of missingness were not too large, one could perform the regression analysis on the available sample and correct for the fact that it is a sample and not the entire population. However, when missingness is related to the variables of interest (conflict), not correcting for this issue leads to biased estimates. For that reason, researchers should take utmost care to impute the missing data before running any regressions. Given the difficulty of imputing data very precisely, a more effective methodology would be to estimate both a point estimate for all missing values and a confidence interval and repeatedly draw a distribution of values for the variables of interest. An important thing to keep in mind is that the imputation of missing variables is made significantly easier and more precise when one is able to use sources that are closely related to the indicator one wants to impute. In other words, one can use other indicators of the same variable (e.g. education) in order to construct an indicator that is as good as possible.

The final issue that needs to be dealt with in practice is the step from regression to total sum of costs. Hess (2003) did a terrific job, with his calculation of the willingness to pay of each representative consumer in every country. This is the kind of step that has been missing from most other papers in the field. A conclusion like Collier's (1999), that the presence of conflict in a country causes damage equal to 2% of GDP is interesting[8], but it is not the whole story. Apart from the fact that

[8]In fact, Collier (1999) already comes closer than some of the earlier writings on the topic.

it ignores conflict consequences suffered outside the country itself, it also does not actually put a monetary value on the costs of conflict. Having a particular estimate for how much different conflict types and conflict-related occurrences cost in terms of GDP, it is straightforward to calculate an annual sum for the total global costs of conflict. This requires, however, two important considerations. The first concerns the question whether one wants to calculate all the costs resulting from conflict during a particular year, or whether one wants to calculate all the costs of conflicts happening during a particular year. In the first case, the methodology is very straightforward, whereas in the second case, one needs to estimate the impact of conflict on future GDP, and the estimations start to differ depending on the existing length of the conflict. The second issue is that of future discounting. Deciding how long into the future conflict is going to influence growth (five years, according to Collier, 1999, and what the appropriate discount rate is (1.5%, according to Bilmes and Stiglitz, 2008), strongly influence the expected outcomes.

4 Proposed Estimation Methodology

As documented above, a significant number of difficulties need to be overcome to be able to consistently estimate the Global Economic Costs of Conflict. In this section, a methodology is proposed to come up with a *concise*, *consistent* and *complete* estimation of these costs of conflict. As a first step, as mentioned earlier, one has to think about the indicator one wants to include in order to measure costs. Gross Domestic Product (GDP) is an attractive measure, because it incorporates most of the different elements that one would want to include, including effects in terms of infrastructure damage, increased depreciation, reduced investment and increased mortality. Particularly in order to include the increased level of mortality, it is important not to use *per capita* GDP, because this endogenises the conflict if it has an influence on the size of the population. Other arguments in favour of using GDP as a relevant cost measure[9]

For example, Organski and Kugler (1977) argued that the post-conflict increased growth rate, also known as the Phoenix Effect, meant that economies were not in fact affected by conflict at all. Unfortunately, Organski and Kugler seem to confuse stock and flow variables in this case. If GDP were a stock variable (such as savings, or capital) and the stock would be replenished by an increased growth rate after the conflict, then conflict would indeed not have a long-term effect. Instead, GDP is a flow variable, so even if a country returns to its original growth path thanks to post-conflict conditional convergence, total production would still be lower, which is what we quantify as a cost of conflict. For example, if a nation's GDP is 2% below potential growth during a 2-year conflict, followed by four years of post-conflict boom with 1% above growth, it will have returned entirely to its pre-war growth path. However, during those years, it will still have lost 2% (year 1) + 4% (year 2) + 3%+2%+1%+0%, for a total of 12% of GDP (ignoring any potential discounting) due to the conflict.

[9]Particularly compared to unconventional welfare indicators, such as National Happiness. But even for more common indicators, such as consumption, there are no long-run time series available that cover most of the world.

include its wide availability and its ease of interpretation. A clear disadvantage of using GDP is its exclusion of mental suffering, particularly due to mortality of loved ones. Unfortunately, it is difficult to quantify this and the literature on the valuation of life is beyond the scope of this research project[10].

Using the above measure of welfare, an appropriate methodology for estimating conflict costs is required. As we have seen earlier, the use of OLS, RE or FE models is fraught with problems and should be avoided if possible. The idea, however, to use a growth equation in order to estimate the cross-country influence of conflict on growth is still valid. Therefore, a more practical methodology is required for the correct estimation of a regression of the style that we are proposing. The solution for the problem is the application of the Arellano-Bond estimator (Arellano and Bond, 1991), which transforms the existing model into first differences. Although this introduces correlations between the endogenous variables, the differenced error term and some of the control variables, it also provides instruments from the model itself that can be used to estimate the effects of the lagged regressors. The problem of the Arellano-Bond estimator is that it is not entirely clear what the influence of sample size is on the consistency of the estimator. For large samples, the estimator is clearly more efficient and has superior properties, but for smaller samples the inconsistent FE estimator may possibly be superior. Windmeijer (2005) has proposed one way to test the robustness of the Arellano-Bond estimator in the case of finite samples, which we are required to use here.

Another problem in the previous literature has been the way in which conflict has entered the regressions used to estimate the total costs of conflict. First of all, a differentiation has to be made between low- and high-intensity conflicts. As low-intensity conflicts are likely to have influence on growth than high-intensity conflicts, we will focus only on the latter and leave the former outside the analysis. Second, it is important to recognise that different conflict elements are likely to have different effects. For example, the first break-out of conflict is likely to have a much larger influence than the continuation of an existing conflict, even though in the previous literature these would have both simply been recorded as the presence of conflict. For that reason, I propose to differentiate between conflict initiation ($conf_{start}$), conflict continuation ($conf_{cont}$), the year a conflict ends ($conf end$), the first complete year of

[10] Bilmes and Stiglitz (2008, pp. 93-95) document different ways of valueing lives. The Department of Defence pays out $500,000 as compensation for the death of an American soldier. In other situations, juries often reach much higher amounts, up to $269 million in one famous case. The Environmental Protection Agency estimates the value of a life lost at $7.2 million, which is in the medium range for different government departments. Bilmes and Stiglitz use this same amount, which is supposed to be represent potential future income lost. However, it is clear that the values of lives in other countries are valued much lower because of this. It is therefore not feasible to put a monetary value on the average life, but using GDP (and not GDP per capita) and discounting future lost GDP should account for these facts and in fact be able to give more differentiation in terms of productivity of a person.

peace ($peace_{year1}$) and the continuation of peace ($peace_{cont}$), which are all expected to be affected by conflict in different ways. Third, a difference has to be recognised between interstate and intrastate conflicts. The first is more likely to be supportive of a country's social cohesion, whereas the second is more likely to break it down. Furtermore, in the case of interstate conflict, it is highly relevant whether conflict is fought on one's home territory or not. For example, the involvement of the United States or its allies in wars varying from Vietnam to Iraq and Afghanistan is probably less influential in terms of GDP growth than it would have been if conflicts of similar intensity had taken place on the territory of the United States (or its allies). For that reason, the differentiation in terms of conflict initiation and continuation, as well as peace times is not as relevant for conflicts one participates in outside the home territory. Furthermore, Collier's (1999) arguments regarding War Legacy are very strong and these need to be included as well. The final conflict-related effect that needs to be included in the analysis is related to spillovers, which can be easily included, following the methodology proposed by Murdoch and Sandler (2004).

Furthermore, the current estimation methodology is significantly underestimating the Global Economic Costs of Conflict, because it does not include the indirect costs that are effectuated through channels that are controlled for in the current estimation (in particular, channels such as education and capital). For that reason, we propose to estimate the influence of conflict on the variables used as control variables in the first stage of the analysis. This will yield point estimates for the influence of conflict variables on these different controls. Using the point estimates for the coefficients found in the first-stage regression, we can thus quantify the influence exercised by conflict through the control variables.

Having determined the type of data required for the calculations we propose, there is the significant problem of data availability. For many reasons, data sources are rarely available on the scale required for suitable analysis. This is particularly problematic because the data availability is related to the occurrence of conflict, and not randomly distributed. For that reason, it is absolutely adament to use advanced methods to impute data that is required to come up with a reasonable estimation. The works of King et al. (2001), Honaker and King (2010) and Honaker et al. (2009) are going to be very useful here. In the first two papers, they show the theory behind their multiple imputation model, which form the basics for the development of a programme called *Amelia II* that is introduced in the third paper. In summary, the multiple imputation methodology uses all the variability of the data to come up with estimated values for the missing variables, under the assumption that the data is Missing At Random, conditional on the information that is available. So if the probabality of data being missing is dependent on the presence of conflict, this is not a problem as long as conflict is included in the same dataset. Additionally, the methodology uses the distributions of all other variables to simulate the underlying (unobserved) distribution. For that reason, the inclusion of proxies that have slightly

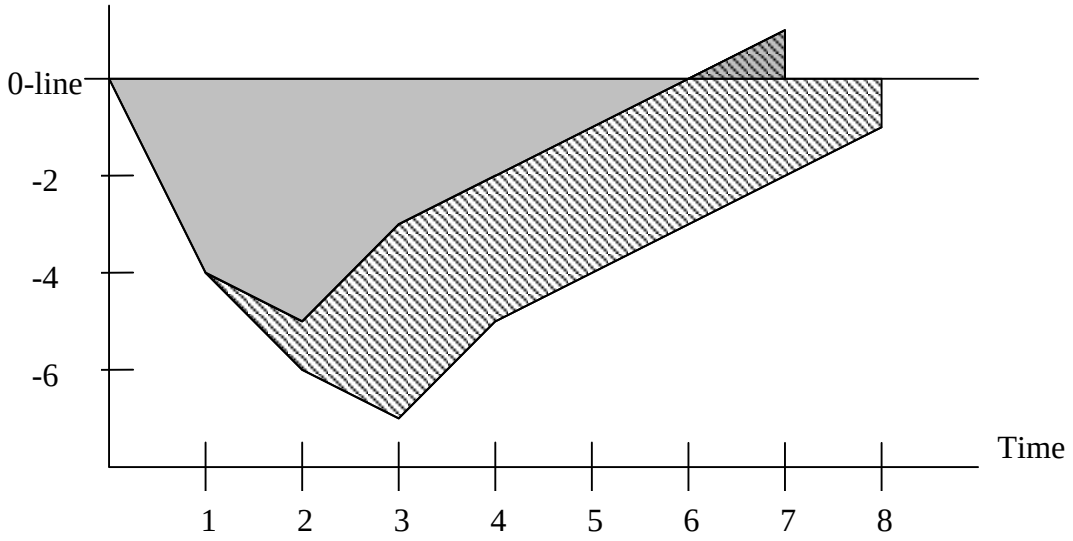

Figure 1: *This figure illustrates the way through which conflict influences growth. The 0-line is a normalised growth path for an unidentified nation. The coefficients are as follows:* $conf_{start} = -0.04$, $conf_{cont} = -0.02$, $confend = -.01$, $peace_{year1} = +0.02$, $peace_{year2-5} = +0.01$. *Assuming a conflict breaks out during year 1, the costs of that will be the total shaded area (adjusted for discounting), as it this is the total shortcoming assuming the conflict ends immediately. During year 2, if the conflict has not ended, but in fact is "continuing", the assumption is once more that the conflict will end immediately at the start of year 3 and the costs attributed to year 2 will be the lined area.*

different availabilities improve the programme's ability to estimate a usable proxy for the variable that one wants to approximate. For example, for the measurement of the degree of human capital, a typical proxy being employed would be the percentage of people who have completed at least secondary education. However, this proxy is directly correlated to the literature rate, which may have a different pattern of missingness and is thus a useful addition to the dataset before employing the multiple imputation methodology.

The outcomes of Honaker et al.'s (2009) methodology has a certain degree of uncertainty, and for that reason, the authors advice to run the programme several times and create several versions of the imputed dataset. These datasets only differ in terms of the missing imputed data and can be separately employed in our estimation model. Honaker et al. also describe methods to combine the estimates resulting from their imputation and the subsequent analysis into an appropriate form.

Finally, having determined the coefficients of all relevant variables, we can use this to estimate to actual costs of conflict in a particular year. However, this is not actually sufficient. In order to come up with an estimate of the costs of conflicts occuring during the current year, one must also include costs resulting from current conflict that are effectuated in the future. Figure 1 illustrates an example of a country's future costs of conflict, using the coefficient parameters described there[11]. The conflict start during year 1 clearly puts the country at a below-capacity growth path, which it is expected to return to after four years (and in this example, it is expected to supercede). The second year's *conflict continuation* in principal appears to have a smaller effect, but it should be remembered that the conflict not only reduces conflict in this year, but also postpones the future recovery, which in itself constitutes further damage. In this particular example, a five-year interval is chosen over which conflict is still expected to exercise influence, but this is obviously arbitrary. In fact, the correct interval has to be determined empirically through extensive further research. The exact costs of the conflict used in this example depend on two further factors. Firstly, the actual size of GDP, with which the damage in the percentage of GDP is multiplied in order to be able to sum up this conflict and other conflicts occurring elsewhere and secondly, the size of the discount rate. There have been different arguments regarding the size of the discount rate, but in order to fit with the most common literature, we will be using the long-run average risk-free rate as a reasonable proxy. Of course, different estimations are provided using alternative rates of discount (like 1.5%, as Bilmes and Stiglitz, 2008, assume).

5 Future Research Agenda

The future research agenda is going to consist of the completion of the research outline sketched in the previous section. In the first stage, a strong emphasis will be put on the collection of data, and the combination of a large range of datasets. This stage combines the selection of datasets usable as proxies for education, investment, et cetera with the decision-making regarding which variables are to be included in the analysis (policy-related variables, such as democracy are a significant question). Additionally, during this research stage, the different conflict indicators are further defined, looking at both home conflict and neighbouring conflict. Having combined the datasets into a usable and comparable format, it becomes visible how large the problem of missing data is. Given that it is already quite sure the problem is actually rather large, it is expected that some significant data imputation is going to be required. Once this has been done, the different imputed data sets will ready to be used to make a range of estimations, using the Arellano-Bond estimator, as well as the FE estimator in order to be able to compare its consistency.

[11] It is important to notice that Figure 1 uses a country whose growth rate has been normalised. In absence of conflict, its growth rate would thus be 0.

Once the definitive decision regarding the econometric model has been taken, we can then interpret the coefficients of the results. These coefficients are going to be the inputs for the final analysis that is going to yield an estimate for the Global Economic Costs of Conflict. In this stage it is important to remember that the indirect effects, which play through the variables used as control variables during the first stage, need to be taken into account as well.

6 Conclusion

This paper has given an overview of the existing literature regarding the calculation of the costs of conflict. While many interesting studies have previously been published that strongly contribute to the existing body of literature, we show that there is still some significant room for improvement. In fact, there are a large number of questions that one can pose regarding the existing literature, and we propose a number of improvements. One question that we have not addressed, however, is the following: Why calculate the Global Economic Costs of Conflict?

We believe one can make strong arguments in favour of the calculation of the costs of conflict. After all, it is well-known that (civil) conflict is a strong inhibitor of economic growth and that it negatively affects welfare in many ways. However, in order to stimulate further research regarding the topic of the reduction of the effects of conflict, one must first know what the effects of conflicts are. One can say that the solution and reduction of conflict is part of a large cost-benefit analysis, but that without knowing what the costs of conflict are, one cannot know the benefits of its reduction. It has previously been seen from the results of Stern (2006) that having a cost estimation for a global threat is able to spur an international movement to combat the threat at hand. While our aims our more modest, we hope the current paper is able to contribute to the existing debate regarding the importance of the reduction of (the effects of) conflict.

References

[1] Abadie, Alberto and Javier Gardeazabal (2003), "The Economic Costs of Conflict: A Case Study of the Basque Country", *American Economic Review*, Vol. 93(1), pp. 113-32.

[2] Arellano, Manuel and Stephen Bond (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations", *Review of Economic Studies*, Vol. 58(2), pp. 277-97.

[3] Arrazola, María and José De Hevia (2006), "Gender Differentials in Returns to Education in Spain", *Education Economics*, Vol. 14(4), pp. 469-86.

[4] Barro, Robert J. and Jong-Wha Lee (1994), "Sources of Economic Growth", *Carnegie-Rochester Conference Series on Public Policy*, Vol. 40, pp. 1-46.

[5] Bond, Stephen R. (2002), "Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice", *Portuguese Economic Journal*, Vol. 48(1), pp. 141-62.

[6] Bozzoli, Carlos, Tilman Brück, Thorsten Drautzburg and Simon Sottsas (2008), "Economic Costs of Mass Violent Conflicts", *Politikberatung Kompakt N° 42*, Berlin: DIW Berlin.

[7] Buhaug, Halvard and Kristian Skrede Gleditsch (2008), "Contagion or Confusion? Why Conflicts Cluster in Space", *International Studies Quarterly*, Vol. 52(2), pp. 215-33.

[8] Burnham, Gilbert, Rihadh Lafta, Shannon Doocy and Les Roberts (2006), "Mortality after the 2003 Invasion of Iraq: a Cross-Sectional Cluster Sample Survey", *The Lancet*, 368(9545): 1421-8.

[9] Cappelen, Adne, Nils Petter Gleditsch and Olav Bjerkholt (1984), "Military Spending and Economic Growth in the OECD Countries", *Journal of Peace Research*, Vol. 21(4), pp. 361-73.

[10] Collier, Paul (1999), "On the Economic Consequences of Civil War", *Oxford Economic Papers*, Vol. 51, pp. 168-83.

[11] Davidson, Eric A. (2000), *You Can't Eat GNP: Economics As If Ecology Mattered*, Cambridge, MA: Perseus.

[12] De Groot, Olaf J, (2010), "The Spill-Over Effects of Conflict on Economic Growth in Neighbouring Countries in Africa", *Defence and Peace Economics*, forthcoming.

[13] De Groot, Olaf J., Tilman Brück and Carlos Bozzoli (2009), "How many Bucks in a Bang: On the Estimation of the Economic Costs of Conflict", *DIW Discussion Papers N° 948,* Berlin: DIW Berlin.

[14] DiAddario, Sabrina (1997), "Estimating the Economic Costs of Conflict: An Examination of the Two-Gap Estimation Model for the Case of Nicaragua", *Oxford Development Studies*, Vol. 25(1), pp. 123-42.

[15] Gleditsch, Nils Petter, Peter Wallensteen, Mickael Eriksson, Margareta Sollenberg and Håvard Strand (2002), "Armed Conflict 1946-2001: A New Dataset", *Journal of Peace Research*, Vol. 39(5), pp. 615-37.

[16] Gupta, Sanjeev, Benedict Clements, Rina Bhattacharya and Shamit Chkravarti, "Fiscal Consequences of Armed Conflict and Terrorism in Low- and Middle-Income Countries", *European Journal of Political Economy*, Vol. 20, pp. 403-21.

[17] Hess, Gregory D. (2003), "The Economic Welfare Cost of Conflict: An Empirical Assessment", *CESifo Working Paper No. 852*, Munich: CESifo Group.

[18] Honaker, James and Gary King (2010), "What to do About Missing Values in Time Series Cross-Section Data", *American Journal of Political Science*, forthcoming.

[19] Honaker, James, Gary King and Matthew Blackwell (2009), "AMELIA II: A Program for Missing Data", Version 1.2-14, November 16,2009.

[20] Imai, Kosuke and Jeremy Weinstein (2000), "Measuring the Economic Impact of Civil War", *CID Working Paper No. 51*, Cambridge, MA: Center for Internal Development at Harvard University.

[21] Islam, Nazrul (1995), "Growth Empirics: A Panel Data Approach", *Quarterly Journal of Economics*, Vol. 110(4), pp. 1127-70.

[22] Kang, S. and J. Meernik (2005), "Civil War Destruction and the Prospects for Economic Growth", *Journal of Politics*, Vol. 67(1), pp. 88-109.

[23] Kelegama, Saman (1999), "Economic Costs of Conflict in Sri Lanka", in Robert I. Rotberg (ed.), *Creating peace in Sri Lanka: Civil War and Reconciliation*, Washington D.C:: Brookings Institution Press, pp. 71-87.

[24] King, Gary, James Honaker, Anne Joseph, and Kenneth Scheve (2001), "Analyzing Incomplete Political Science Data: An Alternative Algorithm for Multiple Imputation.", *American Political Science Review*, Vol. 95(1), pp. 49-69.

[25] Lai, Brian and Layton Thyne (2007), "The Effect of Civil War on Education 1980-97", *Journal of Peace Research*, Vol. 44(3), pp. 277-92.

[26] Lucas, Robert E., Jr. (1987), *Models of Business Cycles*, New York, NY: Basil Blackwell.

[27] Organski, A.F.K. and Jacek Kugler (1977), "The Costs of Major Wars: The Phoenix Factor", *American Political Science Review*, Vol. 71(4), pp. 1347-66.

[28] Murdoch, James C. and Todd Sandler (2004), "Civil Wars and Economic Growth: Spatial Dispersion", *American Journal of Political Science*, Vol. 48(1), pp. 138-51.

[29] Raleigh, Clionadh and Håvard Hegre (2005), "Introducing ACLED: An Armed Conflict Location and Event Dataset". Paper presented at the conference on 'Disaggregating the Study of Civil War and Transnational Violence', University of California Institute of Global Conflict and Cooperation, San Diego, CA, 7–8 March.

[30] Reitschuler, Gerhard and Josef L. Loening (2005), "Modeling the Defense-Growth Nexus in Guatemala", *World Development*, Vol. 33(3), pp. 513-26.

[31] Sala-I-Martin, Xavier X. (1997), "I Just Ran Two Million Regressions", *American Economic Review*, Vol. 87(2), pp. 178-83.

[32] Stern, Howard (2006), *Stern Review on the Economics of Climate Change*, London: HM Treasury.

[33] Stewart, Frances, Cindy Huang and Michael Wang (2001), "Internal Wars: An Empirical Overview of the Economic and Social Consequences", in Valpy FitzGerald and Frances Steward (eds.), *War and Underdevelopment*, Oxford: Oxford University Press, pp. 67-103.

[34] Stewart, Frances and Frank P. Humphreyes (1997), "Civil Conflict in Developing Countries over the Last Quarter of a Century", *Oxford Development Studies*, Vol. 25(1), p.11-41.

[35] Van Raemdonck, Dirk C. and Paul F. Diehl (1989), "After the Shooting Stops: Insights on Postwar Economic Growth", *Journal of Peace Research*, Vol. 26(3), pp. 249-64.

[36] Windmeijer, Frank (2005), "A finite sample correction for the variance of linear efficient two-step GMM estimators", *Journal of Econometrics*, Vol. 126(1), pp. 25-51.