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How many Bucks in a Bang: On the Estimation of the Economic Costs of Conflict*

Olaf J. de Groot*, Tilman Brück and Carlos Bozzoli

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1. Introduction

The estimation of the costs of conflict is a relatively new field of research. Whilst the discussion of the relationship between economics and conflict has a long history, this has focused mainly on the creation of the economic capacity to wage war (e.g. Von Clausewitz, 1812) and the question as to whether the existence of adverse economic conditions will improve the probability of conflict (Lenin, 1916). The analysis of the economic consequences of violent conflict from a non-strategic perspective is more recent. This chapter aims to give a thorough overview of the existing literature in conflict cost analysis. We are particularly concerned with previously developed case studies and studies that look at cost sources not included in those case studies. In the end, we aim to discuss the missing links in the literature and suggest a future direction for research that is able to include the shortcomings we find.

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This is a broad field that covers a wide range of topics and methodologies. There are several noteworthy case studies that estimate the direct costs of specific conflicts, using a variety of different techniques. One conclusion from these studies is that it is difficult to indicate what the consequences are for a *typical* conflict, as the cost estimations vary wildly. Indeed, even between different studies that address the costs of one particular conflict, the variability of these cost estimations is much larger than one might expect beforehand[1]. This is due to the difficulty of quantifying many of the costs involved, as well as the difficulty of choosing which costs to include and which not to. One overlapping feature of most studies is that they tend to express the economic consequences of conflict as a proportion of Gross Domestic Product (GDP). Secondly, many case studies only include *effects that are directly attributable* to the conflict and omit many non-direct effects that may significantly increase the burden of conflict. Below, we discuss some of these studies and compare both the methodologies and the outcomes. A thorough overview of the different studies is provided by Bozzoli et al. (2008).

In addition to the case studies that look at the direct effects of conflict on the state of the economy, there is another body of literature that addresses the *indirect costs of conflict*. These are costs that are effectuated through other channels, and are often difficult to express in monetary terms. This literature includes analyses of the effects of conflict on education, inequality and investment. Additionally, there is another body of work that analyses the costs of conflict for neighbouring countries and the influence of military expenditure on GDP.

In the following section, we discuss a number of case studies and compare their methodologies and conclusions. We take a specific look at Sri Lanka to be able to compare the methodologies and results regarding a specific conflict. In section 3, we

[1] Bozzoli et al. (2008) show that, for example, the 1981-85 conflict in Nicaragua had an average annual estimated cost of between $0.08 billion and $1.13 billion, an astonishing thirteen-fold difference.

examine the literature on indirect effects, addressing in particular the influence of military expenditures on economic growth, the international and intertemporal spillovers of conflict that affect economic growth and the way human capital is affected by violent conflict. In the fourth section, we address what should be the direction of future research and in the final section, we conclude.

2. Case Studies for Direct Conflict Effects

In the literature on direct conflict costs, there are two main lines of research: one employs so-called accounting techniques, while the other one uses counterfactual analysis (Lindgren, 2006). The first tries to calculate the total value of goods destroyed as a result of conflict, whereas the latter estimates a conflict-free counterfactual outcome and considers the gap between such counterfactual and the actual situation as a cost. The basic premise of counterfactual analysis is that the conflict region is explicitly or implicitly artificially replicated while leaving out the actual conflict. This can, for example, be done by generating an artificial country on basis of conflict-free countries elsewhere, or by using underlying economic fundamentals to estimate what the economic performance would have been like in absence of conflict. Figure 1 shows an example country's level of GDP over time, where at time *C* a conflict occurs and GDP decreases (the solid line). The counterfactual analysis attempts to replicate the country's GDP in absence of conflict (the dotted line). In this example, the *economic costs of conflict* in terms of GDP are equal to the shaded area between the true and artificial outcomes. While this example is highly simplified, it provides an illustration of the concept of counterfactual analysis.

<Figure 1 approximately here>

One of the first major case studies that looked at conflict costs is FitzGerald's (1987) analysis of the costs incurred during the Nicaragua conflict. He uses time series analysis for estimating the overall costs of the conflict, as well as separate regressions to analyse the disaggregated elements. FitzGerald looks at five years (1981-1985) and concludes that the total cost resulting from the Nicaragua conflict amounts to 2.09 billion US$ (expressed in constant 2000 dollars), which implies a cost of 0.42 billion US$ per year (equal to approximately 5% of GDP for each year). The disaggregation shows that the output of the primary and secondary sectors declines by around ten percent, export revenues decrease by up to thirty percent, the fiscal deficit goes up by five percentage points of GDP and the annual inflation rate increases by thirteen percentage points. However, it is noteworthy that other studies yield entirely different results, varying 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.

Another worthwhile contribution comes from Nordhaus (2002) who uses both accounting and counterfactuals when looking (ex ante) at the potential costs of a war in Iraq. He addresses only the costs for the United States, and includes a) the direct military spending, b) the costs of occupation and peacekeeping, c) reconstruction expenditures, d) humanitarian assistance transfers, e) the impact on the oil markets and f) the macroeconomic impact in the USA. In addition, it should be noted that his figures for a) and b) also include the associated healthcare costs. Using two scenarios, the *short and favourable* one and the *protracted and unfavourable* one, he estimates the potential costs to range from $121 to $1,595 billion, expressed in 2002 dollars. Naturally, Bilmes and Stiglitz (2008) have since shown that this was a gross underestimation of the final costs, with their estimate that the total military costs of

the invasion and the occupation had already exceeded $3,000 billion; with Nordhaus estimating it to be $640 billion even in the most unfavourable scenario. Bilmes and Stiglitz had the advantage of hindsight for their calculations and include slightly different factors than Nordhaus did, such as military pension costs and future debt servicing, but the difference is still remarkable.

Lopez and Wodon (2005) take a different approach to the concept of counterfactual analysis. They analyse a Rwandan GDP time series to look for the presence of outliers (using methods based on the work by Tsay, 1988). If any outliers that are found can be associated with the conflict, they argue it is possible to approximate Rwandan growth in the absence of conflict. They argue outliers can be additive (single shot), lasting (level shift) or transitory. The three different regression models used by Lopez and Wodon all conclude that 1994 contains a negative outlier and 1995 contains a positive one. The negative shock amounts to between 37.4 and 39.9% of GDP, while the positive shock is between 28.9 and 31.0% and on basis of these numbers, the authors conclude that in the absence of conflict, the level of GDP in 2001 would have been between 25 and 30 percent higher than it was in reality.

Finally, Abadie and Gerdeazabal (2003) use the counterfactual approach to look at the costs in terms of GDP of the conflict in the Basque Region. Their approach is different from previous authors, in the sense that they formalise the foundation of their counterfactual region more rigorously. They argue that the Basque conflict in Spain is limited to the Basque Region, which they back up with convincing evidence. Following that argument, non-Basque regions in Spain can thus be used as alternative regions in which no conflict takes place. However, as there are obviously many differences between the different regions, in addition to the presence of conflict in the Basque Region, this cannot be done straightforwardly. Instead, Abadie and Gardeazabal match the pre-conflict economic fundamentals of the Basque Region

with a combination of the characteristics of other regions, in order to recreate a synthetic pre-conflict Basque Region. They do so by searching for a combination of other regions that minimises the difference between the weighed average of the fundamentals of those other regions and those of the Basque Region[2]. This way, the authors are able to set up an artificial region that has the same pre-conflict underlying characteristics as the true Basque Region. The underlying assumption therefore is that, in the absence of conflict, the macroeconomic evolution of the Basque region would be that of the artificial counterfactual. When comparing the true Basque Region (in which conflict takes place) and the artificial (conflict-free) one, the true Basque Region lags by approximately 10% of GDP compared to the artificial region. Further evidence can be found in the fact that large increases in the GDP gap are associated with increases in the intensity of the conflict.

Sri Lanka Studies

Sri Lanka is often used by conflict cost researchers due to the quality of the available data and the intense conflict it has suffered. In this section, we discuss a number of these studies, in order to compare how different authors use different methodologies to approach the same problem. Additionally, the outcomes of the different contributions illustrate the large variation in final conclusions.

Since 23 July 1983, Sri Lanka has been involved in a civil conflict causing an estimated 75,000 deaths (Fisas, 2009), in addition to numerous injuries and resulting disabilities. The Western perception has been that this was a conflict only between the government and the Tamil Tigers, who strived to establish their own independent nation. However, at the same time, another high-intensity conflict took place as well between the government and the Janatha Vimukthi Peramuna (Peoples'

[2] It turns out that the optimal synthetic region is formed by a combination of Catalunya and Madrid. All other regions have weight zero.

Liberation Front). During the last fifteen years, five different studies have been conducted to analyse the economic costs of the combination of these two conflicts.

Methodology

Two of these studies use an economic model to estimate only the effect of the conflict on GDP, while the other studies use a mixed methodological framework. A comparison of the results of the different papers requires a comparison of the methodologies employed and of which costs the authors aim to include.

Grobar and Gnanaselvam (1993) develop their model with the hypothesis in mind that missing investment due to increased military expenditures hinders economic development. Their basic idea is that military expenditures crowd out capital investment. In the long run, this reduces the capital stock to a level below its peacetime potential. Using time series data, the authors estimate coefficients for the impact of military expenditure on the investment rate. Next, this coefficient is multiplied with the military expenditure increase during the conflict and this is finally multiplied with an incremental-capital-output-ratio (ICOR) to measure the (negative) GDP-growth-effect of lost capital investment. The ICOR is calculated as the average of this coefficient during the decade before the initiation of the conflict. One important caveat of this approach is its omission of the destruction of capital due to the conflict. This would exacerbate the capital stock gap and thus increase the actual costs of the conflict.

Harris (1997) also concentrates on savings and its impacts. He uses survey data from before the onset of the conflict and up to a decade after the onset to estimate the difference between ideal and actual consumption rates and links that back to the savings rate. He then uses the previously mentioned ICOR to calculate the impact the conflict has on GDP through the capital stock. This contribution suffers from a

similar caveat as the previously mentioned study by Grobar and Gnanaselvam's (1993).

The three other studies use a larger number of channels through which conflict costs accumulate. For example, Richardson and Samarashinghe (1991) account for the destruction of physical infrastructure, costs for providing help to refugees, costs of migration (travel tickets) and international capital migration. In addition to these accounting tabulations, they also estimate forgone GDP growth by performing a counterfactual analysis using projections of pre-conflict trends.

Kelegama (1999) calculates the costs of forgone investment and production opportunities based on military expenditure in a similar way to Grobar and Gnanaselvam (1993). In addition to that, he considers temporary losses in production and tourism as a result of destruction and insecurity by calculating the service value of destroyed assets as well as projections of potential tourism on basis of previous tourism revenues. Finally, he also takes into account the rehabilitation costs of displaced persons: the costs of relief assistance, in particular.

Finally, Arunatilake et al. (2001) include direct costs like war-related expenditure, and add estimations using time series regressions based on a differentiated forgone-investment model. In contrast with Grobar and Gananaselvam (1993) and Kelegama (1999), they use a regression analysis to re-estimate separate values for ICOR for each year. Other regressions are used to estimate tourism losses and forgone foreign investment. Lost lives and injuries are calculated as forgone labour force, calculated using average unskilled labour wages multiplied by the forecasted working-life expectancy.

Results

The results of the aforementioned studies can be found in table 1. In order to increase comparability between the studies we have recalculated all the results in terms of costs per year and expressed in constant 2000 US$.

<Table 1 approximately here>

Table 1 clearly shows there is a large variation in the estimated economic costs of the mass violent conflict in Sri Lanka. In fact, the lowest and highest estimates differ by a multiple of six. Where disaggregated data is available, the share that is attributed to forgone growth is remarkable. This suggests that using only GDP time series may capture most losses due to conflict. While the lack of a coherent framework of analysis makes a comparison across studies difficult, the most recent study (Arunatilake et al., 2001) GDP losses due to forgone investment and tourism account for more nearly 60% of the total costs.

3. Indirect Effects

Whilst the previous section looked at studies that aim to analyse conflict costs in a comprehensive manner, this section focuses on studies that highlight specific channels of conflict consequences. These are mostly studies that analyse how conflict affects a particular attribute of economic wellbeing. These studies are highly relevant, as they highlight some of the channels that may be underrepresented in previous analyses and that deserve to be brought to our attention in a careful manner. It conveniently shows where some of the previous studies may be lacking and suggests methods to fill the gap.

However, one must continue to keep in mind that one risks double-counting when addressing channels separately. We are therefore not suggesting that any researcher should address all channels separately and simply aggregate these separate costs. The

literature focusing on specific channels simply indicates what the nature is of the costs that one should integrate in a unified framework of analysis.

The relevant papers are discussed in four different subsections. First of all, the literature on *military expenditure* is examined. Previous contributions have focused on the economic costs associated with military expenditure (such as the crowding out of investment), but we will see that there are other elements that need to be taken into account as well. Second, only a small number of papers have addressed the question whether conflict affects growth in other countries as well. This issue of *international spillovers* can become highly relevant in terms of total costs when conflict takes place in extremely poor countries (where even a significant percentage of GDP may still be only a small cost), neighboured by wealthy ones. Third, the *intertemporal growth effects* are discussed in post-conflict countries, looking at how post-conflict development can be highly path-dependent and costly. Finally, there will be an examination of studies that address channels through which *human capital* is affected by the presence of conflict, by impacting on health and education. These are issues that are not necessarily easy to express in monetary terms, but are important to include in any conflict cost calculation.

Military expenditure

Smith (1989) estimates a demand function for military expenditure in the United Kingdom. He argues in favour of the non-orthodox methodology of *guesstimation* to see which factors are the most important. Among the most relevant factors, according to Smith, are political factors, the military expenditures of the United States and the USSR and several measures of inflation. Analyses like Smith's are highly relevant, as the costs of building and maintaining militaries can have a major impact on the total cost of conflict. This was also illustrated by the work of Bilmes and Stiglitz (2008),

who estimated the total cumulative military costs of the Iraq war to reached US$3,000 billion by 2008.

Dunne and Perlo-Freeman (2003) have a similar aim when estimating a military expenditure function for a cross-section of developing countries. An important element in their analysis is the idea of a security web, which represents the military expenditures of nearby nations that can be considered either enemies or allies. They conclude that in the period after the Cold War, increased military expenditure in the surrounding region, increased expenditure by potential enemies, being involved in a large civil war and being located in the Middle East or in proximity to China are factors that increase the military burden. Population size and democracy, on the other hand, decrease the military burden for developing nations.

Neither Smith (1989), nor Dunne and Perlo-Freeman (2003) attempt to analyse the influence of military expenditure on the growth of GDP, but there are authors who have attempted to do so. Table 2 shows the different channels through which it is hypothesised that conflict can influence the economy. It is important to note that there are both positive and negative channels and it is not a priori clear whether the net effect should be positive or negative. The earliest literature argued that the positive effects from military expenditures prevailed (Benoit, 1973), but recent literature often reveals the opposite (e.g. Dunne and Vougas, 1999).

<Table 2 approximately here>

A classic example with a cross-country point-of-view is by Cappelen et al. (1984), who use a panel of OECD countries to conclude that defence spending has a generally negative effect on economic growth. Interestingly, they find that this result is the outcome of two opposite effects, where the negative effect on investment through *crowding out* mostly outweighs the positive effect defence spending has on *manufacturing output*. The only region within their sample that they consider to be

an exception for its net positive influence of military expenditure on GDP growth is the set of Mediterranean OECD member states.

Two specific country studies shed further light on the need to consider the impact of defence spending on GDP. Firstly, Dunne and Vougas (1999) propose using more advanced alternatives of the standard Granger causality analysis when analysing military expenditure in South Africa. South Africa is interesting in that there has been a large variation in military expenditure, as well as in the political landscape. Their results show that there is a significant negative relationship going from military expenditures to economic growth. However, in the case of Guatemala, Reitschuler and Loening (2005) actually find a positive effect at lower ranges of spending. These authors use a factor productivity approach to show that there is a strong non-linear effect of defence spending on economic growth. For ratios of defence spending up to 0.33% of GDP the influence is actually positive, but beyond that it turns negative, although insignificantly so.

International spillovers

The effect of conflict on growth in neighbouring countries is a topic that is surprisingly underrepresented in the general conflict literature. It is surprising as spillovers can significantly increase the costs of an individual conflict and should therefore be part of any analysis of conflict costs, as well as studies that look at the cost-benefit analysis of intervention.

The topic was jumpstarted by Murdoch and Sandler (a.o. 2004), who use the basic Solow growth model to analyse the influence of neighbouring conflict on growth. In their different papers, they use different samples and definitions of contiguity, but the conclusion remains the same: conflict affects growth in neighbouring countries as well as host countries. An interesting element that Murdoch and Sandler highlight is the different ways of defining contiguity. In their seminal paper (2004), they employ

five different kinds of contiguity matrices: direct contiguity, borderlength contiguity and dummies for whether the distance of closest approach is within 100, 300 or 800 km. Using their 84-country sample over the time period 1960-1995, they conclude that the negative effects of conflict are experienced by all neighbours up to the 800 km limit of closest approach.

In response to their paper, De Groot (2009) proposes a different method for distance measurement. In his method, the effects of conflict are no longer linear, and this leads to different outcomes. On basis of data for Africa, he concludes that direct neighbours of conflict countries do indeed suffer negative consequences from the presence of conflict, whereas non-contiguous proximate countries actually benefit.

Intertemporal effects

In addition to the effects that take effect during the conflict, there are also effects that only become relevant in the post-war period. When thinking about these intertemporal effects of conflict, a clear evolution in the literature can be recognised. A classic contribution that has long been considered the most influential is by Organski and Kugler (1977), who argue that the occurrence of conflict does not significantly alter the growth potential of a country and it will therefore reverse back to its long term trend[3]. Clearly, even if their conclusion that conflict has no long-term effects is valid, it does not take into account that during the transition period from low growth during conflict, back to the equilibrium growth path, there are a number of years during which production is below potential, and thus wellbeing is actually decreased during those years. Additionally, more recent contributions have not always reached the same conclusion as Organski and Kugler did. The different paths an economy may follow are shown in figure 2. In panel a, a situation is shown in which the conflict does not affect the growth rate, but only has a level effect. Organski

[3] This is basically a *conditional convergence* type of argument.

and Kugler's convergence model is illustrated in panel b and panel c contains a situation in which for one reason or another the post-conflict growth rate is lower and the gap between the true and counterfactual levels of GDP further increases over time.

<figure 2 approximately here>

Van Raemdonck and Diehl (1989) provide a thorough overview of both the theoretical and empirical results on how conflict influences post-conflict growth dynamics, even though they acknowledge that up to that moment, "What have generally been ignored are the long-term consequences of war" (p.249). In their extensive literature review, they show that many of the channels through which post-conflict states are influenced by previous conflict can be positive or negative, depending on policies implemented or one's point of view[4].

The first of a series of separate elements[5] promoting either high or low growth rates in post-conflict societies is related to the *role of government*. Conflicts tend to greatly increase the role the government plays in the economy. If it continues to do so after the conflict ends, this can be considered to be either positive or negative, depending on one's perception of the role of governments. Definite deadweight losses, however, are the military budgets that tend to continue to be inflated for a long time and the servicing of debts run up during the conflict period. Finally, during the conflict, the increased military output is likely to have led to an increased demand for natural resources. If this has also led to an increased exploration, one could expect positive effects for future growth. If, on the other hand, the stronger demand has increased the government's role in resource distribution, this is more likely to lead to economic inefficiencies.

[4] Particularly when it concerns the role of government, some may argue that an increasing government role is by definition good, while others argue it is typically bad.

[5] These separate elements are based on the work by Van Raemdonck and Diehl (1989).

In the *human capital* channel, different perspectives are also likely to reach different conclusions. The most obvious is the destruction of human capital on the battle field and, in case of large-scale wars, the resulting demographic distortions. Additionally, demilitarisation may increase the labour supply very rapidly, thereby causing further imbalances. On the other hand, Van Raemdonck and Diehl argue that conflict can also lead to an improvement of managerial and organisational capacities that benefit the economy. Finally, following in the footsteps of the arguments on conditional convergence, it could be argued that the population's memories of the pre-war level of development will give an extra motivation to rebuild the country and return to its pre-conflict growth path.

Finally, and possibly most importantly, there are the channels of *capital* and *technology*. At first thought, the destruction of plants and equipment appears to be unequivocally bad for an economy and a definite impediment to post-conflict growth. However, this destruction can also be viewed as an opportunity to cross a technological threshold, when an economy was previously entrenched in obsolete technology[6]. If post-conflict reconstruction leads to the construction of more productive industries, this can lead to a large improvement in the economic fortunes of a population. Finally, conflicts and the increase in research and development that accompany them may also lead to technological improvements that benefit an economy's development.

An important theoretical improvement for the empirical calculation of the size of the effect of post-conflict economic growth is proposed by Collier (1999). His influential contribution that calculates forgone growth resulting from the average conflict, introduces the concept of *war legacy*. In addition to a *post-war* variable that describes the post-war period, *legacy* captures the interaction between war duration

[6] This is one of Organski and Kugler's (1977) arguments in favour of the so-called *phoenix effect*, which refers to the phoenix rising from the ashes.

and the post-conflict period, which together account for the conflict overhang. He concludes that the growth rate of countries coming out of conflict depends on the cumulative decrease the country has suffered during the conflict. Collier argues that countries that have suffered strongly from long-lasting conflict are more likely to receive a boost to their growth rate, whereas countries that have suffered only a little are more likely to suffer reduced growth rates for a longer time. When one looks at the potential influences described by Van Raemdonck and Diehl (1989), this fits rather well. After all, short conflicts are not as likely to benefit from positive effects due to technological innovation, replacement of obsolete infrastructure, improved managerial experience or increased resource exploration. At the same time, debt overhang, permanently increased military expenditure and trade disruptions are all likely to continue to affect a country.

Collier and Hoeffler (2004) shift focus to an important element of the post-war period: the role of international aid. They show that aid is able to mitigate some of the caveats that threaten post-conflict societies. In particular, they show empirically the best results in terms of GDP growth is yielded when during the first four years after conflict, aid increases before returning to its steady state level. In general, disregarding aid, the authors find that post-conflict countries have a growth level that is higher than they would have had in the absence of conflict[7]. Along the same lines, the World Bank (2003) published a report that also highlights the importance of aid in the post-conflict arena. This shows the importance of the role of international donors, which is yet another element that is going to be of major importance for the overall calculation of conflict costs.

[7] This argument resembles the Conditional Convergence literature, if one believes that the steady state growth rate is unchanged and an economy merely has to catch up in terms of capital stock that was destroyed in the conflict.

Human capital effects

The human capital effects of conflict are an important element of the calculation of conflict costs that have so far been left out of the typical conflict-cost case studies. The influence of conflict on GDP through the human capital channel takes several different forms. In addition to the obvious effects in terms of the number of lives lost, the influence of conflict on trends in morbidity, possibly due to the increasing presence of disease and reduced healthcare quality is an important topic. Both of these effects fall within the theme of *health*. However, there is a second human capital effect through which conflict can have a long-lasting impact on growth, which is through *education*. Education is a important for long-term development and the fact that school-age children are among the most vulnerable in conflict impacts strongly on the educational achievements during those difficult times. The literature on health and education effects will be discussed separately in this section, although there clearly are interactions between the two as well (for example when children are unable to attend school due to conflict-related health issues).

Health

Most people will argue that the foremost channel through which conflict affects health is through battle-related mortality. However, this is not the only channel and even its importance is debatable (Burnham et al., 2006). During conflict, battle-related deaths are important, but so are the circumstances under which refugees survive in refugee camps, as well as the increasing rates of violence and homicide during conflict episodes. Finally, conflict interrupts ordinary economic transactions and infrastructure which is problematic and, as is the case for education, government funds may be diverted away from healthcare. Interestingly, only the direct battle-related mortality is likely to benefit immediately from the signing of a peace agreement. In fact, it has been shown that these health effects can continue to be

present for up to ten years after a conflict ends (Ghobarah et al., 2003). The relationship between conflict and health and mortality is a field of study on its own and we will discuss only a few interesting research examples here.

Burnham et al. (2006) look at the total excess mortality in Iraq after the American invasion, where they interview 1849 households containing 12,801 individuals to question them about births and deaths. They are then able to construct an estimated pre-invasion mortality rate, and compare that to the mortality rate after the conflict started. They find that the mortality rate increased from 5.5 to 13.3 per 1000 people per year, with considerable variability over the different years. Using this estimate, they go on to estimate that approximately 655 thousand *additional* people have died since the start of the conflict.

Ghobarah et al. (2003) use data on the disability-adjusted life years (DALY) lost due to different causes, and analyse the impact of conflict on the DALYs lost by different population groups and as a result of different diseases. They set out to show that conflict has a long-term impact beyond its end, and therefore analyse a cross-section of countries to see what the effect of civil conflict[8] during the 1991-97 period on DALYs lost in 1999 is. Their conclusions are impressive as they show that for the year 1999, more DALY's are lost as a result of conflict from the 1991-1997 period than from civil conflict actually taking place in 1999. Furthermore, the authors show that the strongest effects are felt by women and children and that residing in a country with contiguous conflict has a strongly negative impact as well. The particular ways the population is affected by previous conflict include the increased incidence of malaria, tuberculosis and respiratory diseases, but also due to increases in transportation incidents and homicides. Li and Wen (2005) expand on Ghobarah et al. (2003) by showing that, as expected, larger conflicts have a much stronger impact on the health

[8] Please note that Ghobarah et al. (2003) specifically mention that the analysis particularly holds for *civil* conflict and that they leave interstate conflict out of consideration.

outcomes of the population. Additionally, they show that intrastate conflict particularly affects the population *during* the conflict, whereas interstate conflict has more lingering consequences.

None of the authors above have made the step to express the health costs in terms of forgone GDP. This is a missing link in the literature that needs to be addressed, because only once the economic significance of the health outcomes as a result of conflict have been quantified, it is possible to include them in overall conflict cost analyses. Of course, if one were to attempt such an inclusion, it is important to take care of the double-counting problem; that is, the fact that issues like increased mortality may already be included in the first stage of the analysis looking at the way conflict affects GDP growth.

Education

One of the major contributions regarding the relationship between conflict and education is by Lai and Thyne (2007), who use cross-sectional and time series methods to analyse the issue. They consider two different channels: the first entails the fact that civil conflict is likely to *destroy a state's education system* through the loss of personnel and infrastructure, while the second concerns the *reallocation of resources* away from education. Lai and Thyne use UNESCO education data for all states between 1980 and 1997 and examine the percentage change in educational expenditures for all education levels as a result of conflict. They find evidence for their first claim, as both expenditures and enrolment decline during periods of conflict, but they do not find any proof for the reallocation of education funds towards other (military) spending. An important caveat is that the results are only valid for higher-level conflicts.

Arrazola and De Hevia (2006) use the Spanish Civil War as an instrumental variable to research the rates of return to education for men and women. They argue there are three main reasons why educational attainment decreases during war periods:

1. Increasing difficulties in the physical access to schools.
2. A decline in financial means for school attendance.
3. Increasing need for school-aged children to leave school and contribute to family earnings.

Both previous papers, however, consider mostly supply-side effects in the influence of conflict on education. De Groot and Göksel (2009), on the other hand, analyse the Basque conflict to consider what happens in a more low-profile conflict in which the channels suggested by Arrazola and De Hevia (2006) are not relevant. De Groot and Göksel instead examine how the presence of conflict affects the *demand for education*. When using a method of analysis that is similar to that of Abadie and Gardeazabal (2003), they conclude that the presence of conflict actually increases the demand for education. This effect is particularly noticeable in the middle part of the educational distribution.

A final paper that looks at how conflict influences education is by Blattman and Annan (2009), who interviewed a sample of 741 young men from northern Uganda, 462 of whom had been abducted by the Lord's Resistance Army (LRA) for some time. Whilst it is not possible to compare the experience of conflict-affected children with another group of children who have not suffered any conflict, it is possible to compare children who have been abducted by the LRA and those who have not because in this particular situation abduction was an apparently random treatment and thus the abducted and non-abducted children have the same baseline characteristics. It turns out that those children who had been abducted had approximately 10% fewer years of education, keeping everything else constant.

4. The Way Forward

In the previous section we reflected on how this topic has already been covered in the literature, but it is also important to consider what still needs to be done in the future. Based on the aforementioned literature, as well as other sources, we propose a number of concerns that can be considered most pressing for researchers who wish to calculate the costs of conflict. We divide this analysis into two separate subsections, addressing case-study analyses that estimate the cost of single conflicts separately from estimations that look at the conflict costs of average conflicts or an aggregation of all conflicts. While case studies have been the primary focus of this contribution, there are also important lessons to be learned for cross-country analysis, and for that reason, it is included here.

Case Studies

Case studies can be particularly interesting to analyse, as the estimations are more precise than those based on cross-country analyses (as one can take into account local conditions), and they provide a good background for the ranking of priorities in addressing the consequences of conflict. When one thinks about the reduction of conflict and its consequences, analyses always need to be specifically tailored to the conflict under consideration. However, as shown previously, most case studies address only a limited number of elements that contribute to the total costs of a conflict. This is fine in the case of e.g. Bilmes and Stiglitz (2008) or Reitschuler and Loening (2005), who specifically choose to address one particular element (the military cost of intervention and the influence of military expenditure on GDP growth respectively). However, when one sets out to analyse the total costs of a particular conflict, one has to take all elements that may contribute to that total into account.

There are two main approaches for this. One can be considered *additive*, and its biggest caveat is *double-counting*. The other approach is a *unified* one and the biggest worry is the *inclusion* of all relevant effects.

The additive approach

In the additive approach, one analyses the separate channels through which conflict influences the state of the economy separately and tries to combine these separate channels afterwards. This means that one has to consider what the conflict means in terms of lives lost, or education forgone and then use these estimations to see what the consequences of that are in monetary terms. This appears to be straightforward, but as seen in the Sri Lanka studies, it is very difficult to quantify exactly what the actual losses are in terms of e.g. investment, lives or tourism. One must therefore carefully consider how to construct the alternative non-conflict scenario. The use of a well-defined and comparable counterfactual (like Abadie and Gardeazabal, 2003) is an important way to solve that problem.

<Table 3 approximately here>

The second consideration is which separate effects to include, when one has to weigh the requirements of *comprehensiveness*, *efficiency* and *relevance* (see also Bozzoli et al., 2008). Studies need to include all important channels that significantly contribute to the total costs (comprehensiveness), but one must keep in mind that there has to be a cut-off for the amount of effort it requires to include another channel (efficiency). Finally, only channels that actually contribute significantly to a conflict and that are indeed important to the conflict should be included (relevance).

Table 3 highlights the most important elements of such a study and why they are important. The most important caveat in such an additive analysis is to avoid *double-counting*. For example, when education decreases during conflict because all males aged 20-30 years old (who tend to be relatively highly educated) die on the battle

field, this is a cost that is already included in the loss of life section. Similarly, the influence of military expenditures on public investment in capital accumulation should only be included as an element of capital accumulation and should not be repeated by the military expenditures discussion.

The unified approach

The unified approach, as opposed to the additive one, aims to include all conflict-related costs in one analysis. A basic assumption for enabling the possibility of such an approach is that all costs are expressed as an element of GDP. This means that one does not have to separately account for losses in terms of e.g. education, because this loss already shows up as part of the relevant GDP time series[9]. The most obvious method to go about this is similar to Abadie and Gardeazabal (2003) and requires the construction of a reasonable (hypothetical) alternative for the conflict region and looks at the differences between the conflict region and its conflict-free counterpart. Such an analysis would include most elements that acutely affect GDP growth. To be able to include the long-run effects (e.g. through education or through higher debt servicing) of the conflict, long time series are needed though. This appears to make this method unsuitable for the immediate calculation of conflict costs from particular conflict cases. However, one already needs to forecast the hypothetical region, and using similar methods it can also be reasonable to forecast the future development of the conflict country itself. This enables the researcher to include conflict-related elements that only affect GDP (growth) in the long term.

Another effect that is not included here are international spillovers. These are a special case, because the inclusion of spillovers in the calculation of the costs of a specific conflict is potentially questionable. We argue, however, that these costs are part of a conflict and should thus be included. The way to do this is in fact a repetition

[9] For the example of education, this is only true if education influences productivity, which seems a reasonable assumption that is in line with the general productivity literature.

of the original premise for this method. One must replicate neighbouring states to create hypothetical ones that are not affected by the conflict spillovers and analyse what the impact is on GDP (growth) in these countries. Particularly when wealthy countries are neighbouring relatively poor and conflict-affected ones, this cost type may be important.

An important challenge to be overcome in the unified approach is the construction of the hypothetical region. In their study, Abadie and Gardeazabal (2003) can use different regions from the same country, because the conflict is clearly contained in one part of the country. This is optimal and using other countries to replicate the conflict host is fraught with difficulty. A researcher wishing to employ the unified method of case-study conflict analysis must keep this difficulty in mind.

Cross-country Analyses

While this paper mainly looks at case studies, there are important lessons to be learned for cross-country analysis as well. An important element in cross-country analysis is the assumption that all relevant costs will in fact be included in the development of GDP. So for example, like with case studies, human suffering in itself is excluded from the analysis to the extent that it does not affect GDP trends. For cross-country analyses, the basic premise is based on a simple Solow growth model (Mankiw et al., 1992), to which one can straightforwardly add a number of conflict-related dummies[10] to analyse the impact of conflict on economic growth. Or is the true solution of this problem more complicated?

The principal idea of cross-country analysis is exactly as described above, but the precise execution takes more effort. The foremost thing is the question as to whether this estimation, in the way it was executed by Collier (1999), is in fact correct. Put

[10] Depending on one's perspective, one may want to include conflict presence, as well as neighbouring conflict presence. Additionally, one may want to recognise the existence of a range of different kinds of conflicts.

simply, this simple treatment may likely lead to *inconsistent parameter estimates* and a more sophisticated treatment is indeed necessary. Whereas the actual solution is beyond the scope of this contribution, it suffices to say that using dynamic panel data techniques (Blundell et al., 2000) will solve many of the problems involved in the consistent estimation of the coefficients, although the method is not free of criticisms (Roodman, 2009).

However, apart from these econometric complexities, there is another range of issues that one needs to address in order to find consistent estimates of the costs of conflict. The treatment of *data* deserves a fair share of attention. There are two important facets to the discussion of data treatment: data availability and data differentiation. Data availability is a large problem in the estimation of conflict costs, due to the endogenous nature of data availability. After all, it is those countries where basic infrastructures and livelihoods have broken down (due to conflict) that are most likely not to report data. For that reason, a researcher must come up with an appropriate technique for imputing missing data to make sure that missing values adhere to a more random pattern. With data differentiation, we mean the amount of information contained by certain data points. In particular, one should think of conflict data, where an observation "dummy=1 if there is conflict" is often employed, while this underutilises the information regarding the conflict's typology, intensity and geographical spread. It is important to recognise these different types of data in the simple framework of analysis, to guarantee the consistency of the final estimation.

Another important caveat to keep in mind during the estimation of the cross-country impact of conflict is the integration of control variables used in the growth equation. The simple growth equation we propose to use here includes certain elements that have a direct influence on growth, such as the growth of physical and human capital.

While controlling for these elements is important, the question remains whether the changes in these factors are exogenous or not. If they are not, and are instead due to the presence of the conflict, then controlling for them will lead to an incorrect estimation of the costs of conflict[11]. For that reason, one should estimate what the impact is of conflict on the control variables used in the equation and analyse what its impact is on growth.

The final component of the analysis that is important to draw attention to is the aggregation of conflict costs over time. As pointed out in figure 1, conflict may have a lasting impact on the economic development of a nation. In this case, it is not the drop of GDP occurring at the time of the conflict that is the actual cost, but the Net Present Value of the stream of losses that will happen in the future. Authors like Organski and Kugler (1977) may have argued that an economy may converge back to its previous growth path, but they fail to recognise that GDP is not a stock variable but a flow variable instead[12]. Decisions regarding the appropriate rate of discount and how to estimate the future development of countries that currently suffer conflict are other important questions the researcher needs to address and sensitivity analysis is recommended to gauge the uncertainty surrounding the estimates.

5. Conclusion

Having reviewed the literature on the calculation of conflict costs, it becomes clear that there is still a lot of room for further improvement. Case studies addressing the overall costs of specific conflicts continue to come up with wildly varying estimates,

[11] This statement assumes that the control variables included in the original estimation are in fact relevant and significant. The direction of the error depends on the covariance between conflict and the control variables as well as the sign of the those variables, but an underestimation of the total costs of conflict is most likely.

[12] The Organski and Kugler (1977) argument is that if a country were to have zero GDP for two years and then return to its pre-conflict level, it would have lost nothing. Of course this is not true, because it will have lost two years worth of GDP, instead.

as there is no clear framework that indicates what the optimal estimation strategy is and as a result, studies risk both double-counting and underestimation. As a result, different authors decide to address different specific issues, instead of the overall costs. While this is interesting in its own right, it does not address the question of what the exact costs of conflict are. In order to answer that question, further research needs to be done. The answer to this question is not only relevant from an academic perspective, but also for the proposal of policies regarding different strategies to minimise or prevent the costs associated with conflict. Research on channels that contribute to the costs of conflict together with variation in policies may additionally help to allocate resources to specific types of post-conflict reconstruction policies.

Cross-country analysis regarding the average costs per conflict, or the total costs of all conflicts has received the lion's share of attention recently, but further strides will need to be made. In particular, micro-level analysis based on economic and demographic household surveys deserves further exploration, as well as the evaluation of policy interventions in conflict-prone countries. Although these studies are country or even region specific, they are very informative about the links between conflict and topics such as capital formation (human and physical), migration and displacement, and coping strategies, all of which matter to calculate the costs of conflict. These types of studies may also be informative about pockets of vulnerable populations within countries, and thus are very informative to target policies at the micro-level.

6. References

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Table 1. Results of previous studies regarding costs of Sri Lanka conflict

Costs in billion US$ (constant 2000 prices)	Richardson and Samarasinghe (1991)	Grobar and Gnanaselvam (1993)	Harris (1999)	Kelegama (1999)	Arunatilake et al. (2001)
War years	1983-88	1983-88	1983-92	1983-87+ 1990-94	1994-1996
Total costs	6.15b US$	1.99b US$	6.31b US$	16.74b US$	22.34b US$
Average p.a.	1.02b US$	0.33b US$	0.63b US$	1.72b US$	1.93b US$
% of GDP p.a.	2.2%	0.7%	1.3%	3.3%	3.5%

This table includes the results from five previous studies expressed in constant 2000 US$, including the time period the studies concern, as well as the annual averages per study. The exact calculations are our own, on basis of the studies mentioned.

Table 2. The different channels related to military expenditures

Channel	*direction*	*Explanation*
Crowding out	-	*Crowding out* refers to the reduction of useful investment due to its competition for limited resources with military expenditure.
R&D	+	It is argued that an economy can benefit from the (civilian) spin-offs from military *research and development*.
Demand	+/-	Military expenditure can be part of a Keynesian stimulus package using *public demand* to stimulate the economy. At the same time, increasing public demand when an economy is already growing can lead to *overheating*.
Competition for resources	-	The military complex's demand for *limited resources* drives up the prices of these resources for the private sector, thereby harming the economy
Exports	+	Having a productive military complex can be an important *export market*.
Debt/tax increase	-	Military expenditures need to be paid for, either by current taxpayers through an increased *tax burden* or by future ones through larger *debt servicing*, both of which may be a deadweight loss to the economy.

This table includes the different sources through which military expenditure can impact on GDP growth.

Table 3. Important elements of an *additive case study*

Channel	*Explanation*
Capital accumulation	Estimate the influence conflict has on both domestic and foreign investment and its related impact on GDP growth.
Military expenditures	The approximate impact of military expenditure, including the macroeconomic stimulus (if domestically produced), potential as export market, deadweight loss of costs.
Effective cost in lives	Calculate the estimated number of lives lost and their future contribution to the economy. This can contribute to a number, although it is open to criticism for the quantification of the value of human life.
Education gap	Particularly in the case of a long-lasting violent conflict, education acquisition may be disturbed leading to a legacy for a generation of reduced education.
Infrastructure	The destruction of the capacity of the state, including both physical infrastructure (roads, bridges) and societal infrastructure (trust, cooperation).
Refugees	Analyse the impact of the conflict on individuals and their livelihoods. Masses of refugees are a) less productive and b) more costly to the state. So these numbers are important to keep in mind too.
Future losses	Use the previous factors to look at what the total impact is of the conflict on GDP and estimate the future recovery of these elements. This enables one to quantify the future impact in terms of lost GDP.
Debt servicing	Related to the previous factors, what is the legacy of the conflict in terms of debt and what percentage of the economy the servicing of that debt requires.

This table highlights different elements that need to be part of a case study analysis aiming to use additive techniques to come up with a realistic cost estimation.

Figure 1. Illustration of the concept of the counterfactual analysis of conflict cost calculation

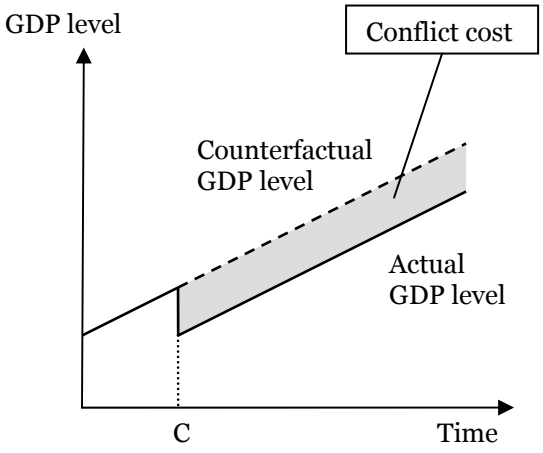
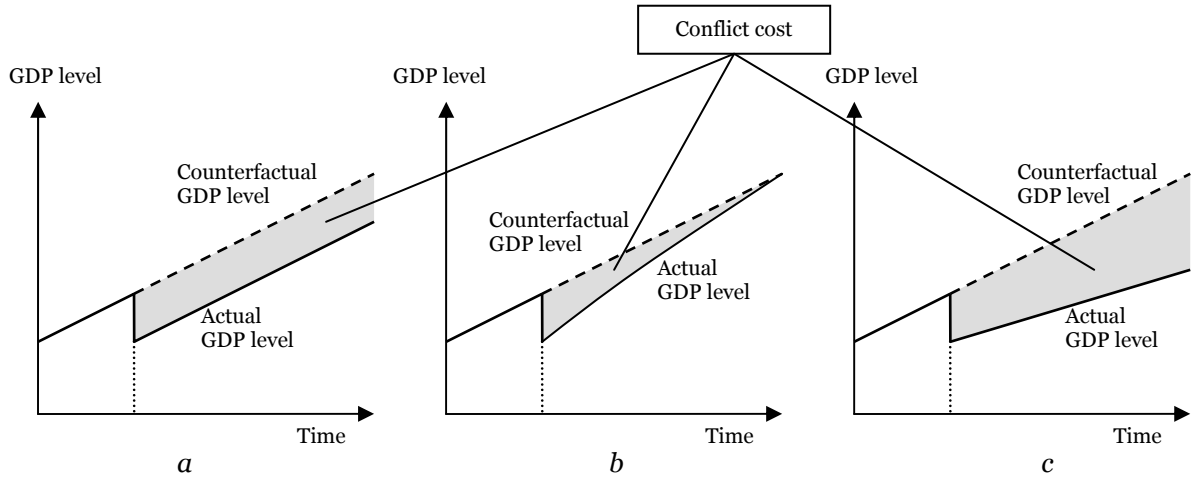


Figure 2. Illustration of the different possible post-conflict developments.



Panel a shows the size of conflict costs in the case of a level shift. Panel b illustrates the situation in which there is convergence and panel c shows a situation in which conflict causes the growth rate to deteriorate.