How Much is Prevention Worth?*

Background Paper for Joint UN/WB Study

Hannes Mueller

IAE (CSIC), Barcelona GSE, CEPR

September 20, 2017

Abstract

This report estimates the prevented damages to conflict-affected countries and saved costs for the donor community if more resources were spent on prevention, i.e. in identifiable high-risk situations before the outbreak of violence. The focus here is on using modern prediction methods to spot situations in which conflict might break out and engage in prevention before violence occurs, i.e. before humanitarian aid, peacekeeping or peacebuilding become necessary. According to the main scenario, prevention in about five countries each year would prevent about 34 billion USD in losses per year at a cost of 2.1 billion USD in the first years after adoption. In addition, the donor community would save close to 1.2 billion USD each year from spending less on aid and peacekeeping. Systematic prevention would also lower the number of refugees by over 1.5 million within 15 years. Over time, costs would fall and benefits would rise so that after 15 years prevention benefits in the main scenario reach 150 billion USD per year. By that time, prevention would almost pay for itself through reduced costs for aid and peacekeeping.

*Excellent research assistance from Alberto Sánchez Martín is gratefully acknowledged. I also thank Bledi Celiku, Andrew Mack, Gary Milante and Jacob Shapiro for useful feedback on this project.

1 Introduction

The goal of this report is to present the results from a unified conceptual framework for the evaluation of cost-effectiveness and the different trade-offs involved in prevention. The context for the development of this framework is a radical rethinking of the peacebuilding architecture embodied by several reports published in 2015. One of these reports, an expert report, which formed part of the review of the United Nations peacebuilding architecture, argued for a shift away from a narrow understanding of peacebuilding, where the aim is to avoid a relapse into violent conflict, to an understanding that entails sustaining peace. If this advice is heeded, the World Bank and United Nations institutions will need to leave behind the predominantly post-conflict focus of peacebuilding, and understand it as a more comprehensive enterprise where also prevention is included.

Such a shift in focus requires a cost-benefit analysis. In line with this, the aforementioned expert report asks:

[...] if more global priority were consistently given to efforts at sustaining peace, might there not, over the course of time, be reduced need for crisis response? (United Nations (2015), page 42-3.)

The answer to this question is most likely yes. However, the goal in this report is to provide a much more quantitative answer, i.e. how *much* resources would be saved if global priority were consistently given to efforts at sustaining peace. The answer to this question will obviously always be speculative but there is enough data to dare a quantitative approach.

This report provides an empirical framework which aims at helping decision-makers think about the different trade-offs involved in prevention. In particular, the framework will build a structure to analyze the interplay between three factors: the dynamics of conflict and peace; the costs of early and late interventions; and the suffering, damage and destruction caused by violent conflict.

At the centre of the framework stands the insight that true prevention is impossible without a definition of conflict risk, i.e. without prediction. Interestingly, the ongoing discussion has often side-stepped this issue by focusing on ongoing conflicts or post-conflict scenarios where the risk of conflict is inherent in the experience of the recent past or present. However, if we want to move from building peace to sustaining peace we need to know which countries to focus on. This report will therefore rely on recent advances in the ability to predict the timing of civil war. Prevention is then defined as actions taken in high-risk but highly uncertain environments which anticipate violence. Of course, a policy based on these risk evaluations will err in the allocation of resources because prediction will indicate some situations as high-risk that would never develop conflict and by missing some other future conflict onsets.

However, this uncertainty is compensated by the fact that conflict often persists once it started and that, even after it ended, the likelihood of relapse is relatively high. This means that preventing the entry into the conflict cycle has dynamic benefits that become stronger over time. Put differently, prevention is not about preventing a year of civil war, it is about preventing a future path of repeated episodes of conflict that can last decades. An additional benefit of prediction and prevention is that the policy response would take place in an environment without armed violence. Measures such as diplomatic efforts, mediation and capacity building can therefore be used to address fault lines in societies that have not, yet, experienced large scale armed violence and the resulting death and destruction.

The simulated gains of a prevention system for the high-risk countries are dramatic. Under reasonable assumptions they could average close to 34 billion USD per year in the first fifteen years of the implementation of a system that intervenes in about five countries every year. More importantly, the benefits of such a system are growing over time since prevention indirectly affects economic growth. After fifteen years, the benefits could stand at close to 150 billion USD per year. At this stage the world would have to host 1.5 million refugees less.

But can prevention save resources for the donor community? Existing spending patterns in peacekeeping and ODA suggest as much. Both are strongly focused on countries in or after conflict and, if prevention stabilizes a country, these resources could be saved. Indeed, a full dynamic analysis suggests that large cost savings could be achieved with prevention. After fifteen years, the donor community would save close to 2.5 billion USD each year from spending less on aid and peacekeeping. According to our main estimates this would almost cover the costs of prevention.

However, the question whether cost savings for the donors could be achieved this way critically hinges on the funding requirements and effectiveness of the prevention action. We therefore provide alternative scenarios which illustrate the uncertainty surrounding these estimates. Strikingly, we find that there are still substantial cost savings from prevention if preventive action only works in 25 percent of all cases and costs the donor community 1 billion USD per year and intervention. If, on the other hand, prevention would cost only 100 million USD per intervention and worked 75 percent of the time the cost savings would be so big that the prevention system would pay for itself within a few years through reduced spending requirements.

The key here is to target high-risk countries, i.e. to do few interventions in situations that would otherwise likely descend into conflict. Systems that would spread the spending in a larger group of countries, i.e. without identifying concrete risks, would be much less cost-effective. However, using forecasts for prevention is no panacea. Relying on a forecast means that the large majority of prevention efforts will take place in situations that would not have escalated in any case. The forecast we use marks countries as "high risk" that have a likelihood of escalation of only 11 percent. In other words, one in ten cases would not have escalated in any case - with or without prevention. This means that a lot of resources need to be spent in vein. Still, under reasonable assumptions, prevention is still worth every dollar despite this large uncertainty.

This report is structured as follows. Section 2 presents the dynamic framework used for the simulation. Section 3 then presents the results of the simulation. All technical details are discussed in the appendix.

2 Constructing the Framework

This section describes the intuition of the framework and its most important findings. At the same time, this section offers a view at the status quo. We first discuss the different risks of escalation and conflict persistence as they currently appear in the data. Second, this section presents data on the losses caused by conflict in the conflict-affected countries. Thirdly, the publicly available data on peacekeeping expenditures and aid flows is analyzed to give an overview over the current costs for the donor community from conflict. These three factors (probabilities, damages to the affected countries and costs to the donors) together form the framework which we will use in section 3 to contrast the status quo with an alternative future with more prevention.

2.1 Risks in the Conflict Cycle

The framework builds on the idea that conflict follows a cycle in different phases which can be distinguished and analyzed in the data. A previously latent conflict comes to the surface, erupts into violence, escalates into civil war, continues for a while then ends and peace stabilizes. However, all these phases follow each other randomly. The outbreak of violent conflict, for example, is clearly hard to predict. So even if some situations are deemed high-risk, the outbreak is far from certain. In addition, it can be that conflict starts but does not escalate. It can be that peace after conflict is more or less stable or that the conflict period lasts only a year or decades.

The framework captures these complicated, random risks by defining seven states of conflict. It is then assumed that, ex ante, these states follow each other randomly and with fixed probabilities. One can then calculate these probabilities from the history of conflict. We use the period 1975 till 2014 to define states and calculate the probabilities by which they follow each other. The seven states described in Table 1 are:

1. stable peace: Most countries are in this state most of the time. The likelihood of an outbreak of civil war conflict in this state is just 0.09 percent. The likelihood of a lower-intensity armed conflict is 2.32 percent and only 1.55 percent of countries transition into a high-risk situation in a given year.

2. high-risk: High-risk is defined as a situation in which an early-warning model warns of an outbreak of civil war. The appendix framework uses a risk evaluation from an actual early warning model.[1] Accordingly, the risk of civil war in this scenario is 5.5 percent - more than 60 times the baseline risk. The likelihood of an armed conflict is 5.75 percent - about twice as high as the baseline risk.

3. armed conflict: defined by a year with more than 25 battle-related deaths but not a civil war, i.e. no violence at a larger scale. In armed conflict the risk of an escalation to civil war is 4.2 percent. However, the likelihood that armed conflict persists is at over 75 percent.

4. civil war (first year): Civil war is defined as a situation in which a country experiences more than 0.08 battle-related deaths per 1000 population. The framework in this report distinguishes the first year of civil war from all other years because often there are short outbursts of conflict. In other words, in the data it is very often the case that the first year of civil war is not followed by more civil wars years - in about 43 percent of the cases. This leaves about 57 percent which escalate into longer civil wars.

5. other civil war years: If a conflict does not stop after the first year it is likely to go on much longer. The likelihood of an end to civil war falls to about 23 percent after the first year. In other words, close to 77 percent of all civil war years are now followed by another year of civil war. This high persistence contributes significantly to the danger of civil war.

[1] This is a risk model where only newspaper text is used to predict the timing of conflict within-sample. For a discussion of the out-of-sample performance of this model see Mueller and Rauh (2017) who show that the method yields a focus on new conflict risks. For the purpose of this report we use the overall model presented in their paper. For further discussion see the appendix.

6. recovery year (first year): This is the first year after civil war.[2] Peace is particularly unstable in this first year. The likelihood of another civil war following the first year of recovery is almost 18 percent.

7. other recovery years: These are the 2nd to 5th year after the end of civil war. During this time, peace is more stable than in the first year but still fairly unstable. After the 5th year of recovery the country can transition back to the more stable peace defined above.

A convenient way to summarize the entire dynamics of peace, conflict and recovery is a matrix where one dimension captures where the transition is from and the other dimension where the transition is to. We show this in Table 1. The states that can follow armed conflict, for example, are in the third column with the title "armed conflict". Peace, for example, follows armed conflict with a likelihood of 17.26 percent. Armed conflict follows armed conflict with a likelihood of 75.44 percent. Armed conflict escalates to civil war with a likelihood of 4.2 percent.

		transition from						
		peace	high risk peace	armed conflict	first year of civil war	other year of civil war	first year of recovery	2nd to 5th year of recovery
transition to	peace	96.04%	15.50%	17.26%	0%	0%	0%	4.33%
	high risk peace	1.55%	73.25%	3.10%	0%	0%	0%	10.58%
	armed conflict	2.32%	5.75%	75.44%	0%	0%	0%	4.81%
	first year of civil war	0.09%	5.50%	4.20%	0%	0%	17.81%	9.13%
	other year of civil war	0%	0%	0%	57.33%	77.20%	0%	0%
	first year of recovery	0%	0%	0%	42.67%	22.80%	0%	0%
	2nd to 5th year of recovery	0%	0%	0%	0%	0%	82.19%	71.15%

Table 1: Summary of States and Transition Likelihoods

Using this matrix one can build future scenarios for each country. For example, a country that is currently in state 1 (peace) will most likely stay in that state. A country that is currently in armed conflict has a much higher likelihood of suffering an escalation of the conflict but also has a decent chance to escape the conflict trap by transitioning back to peace.

Importantly, the definition of the different states of the conflict cycle also allows a policy-maker to simulate an alternative world where policy shifts resources towards prevention. In particular, section 3 shows the result of a policy experiment in which resources are spent on de-escalation in high-risk years (state 2). The benefit of such an intervention hinges on the costs associated with the different states which we discuss next.

2.2 Losses to High-Risk Countries

This section looks at the terrible reality of civil wars through the lense of the framework, i.e. data on fatalities, refugees and economic growth will be analyzed separately for the seven states defined by the

[2] In order to capture the post-conflict period we include years of armed conflict which follow civil war.

framework. The results of this analysis can then be used to simulate what would happen if some of the states, in particular states 3 to 7, were prevented more often.

First, turn towards the fatalities inflicted by civil war on the affected population. Figure 1, Panel A, reports the number of battle-related deaths per year over the conflict cycle. By definition, peace (both low-risk and high-risk) is associated with no fatalities. During armed conflict, an average of over 650 people lose their lives per year. The first year of civil war is associated with over 3,500 deaths on average while all subsequent years are associated with almost 8,000 deaths. In other words, civil-war becomes more vicious and persistent after the first year. After conflict, the number of fatalities drops back to close to zero.

A similar dynamics can be seen in the number of refugees who flee a country. Panel B in Figure 1 reports the average number of refugees across the conflict cycle. It shows that over 200,000 people have fled their country after the first year of civil war. This number increases dramatically to over 820,000 people for subsequent years. After civil war, the number of refugees adjusts downward as refugees return to their home.

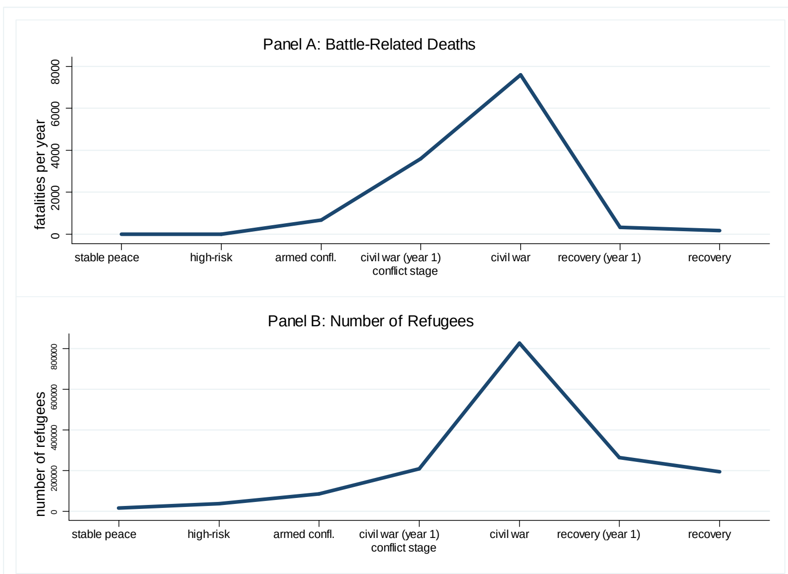

Figure 1: Fatalities and Refugees in the Conflict Cycle

It is hard to grasp the suffering behind these numbers. This is part of the problem of prevention. Humanitarian efforts, for example, often organize the resources to help by mobilizing empathy with the victims. They do this by combining numbers with images or individual stories of victims. What prevention tries to achieve is to act before the violence starts. This implies that prevention cannot rely on the stories or images. Prevention needs rationality, it needs to rely on the power of numbers and cost-benefit analysis. This report therefore tries to give monetary values to the suffering so that it can be compared to the costs of interventions like peacekeeping and aid. This is, obviously, a difficult task which is bound to be unsatisfactory.

In order to calculate the loss we will include two factors. First, battle-related deaths are evaluated using the Value of Statistical Life (VSL) method to compute costs. To escape an income-based evaluation this report will rely on new estimates of the VSL from León and Miguel (2017) which estimate an average VSL of

0.577 million USD.[3] This is the lower of two numbers given by León and Miguel (2017). Also, as highlighted in Fearon and Hoeffler (2014) VSL methods do not fully take into account the pain and suffering of family members and friends, or long-run effects on children, among other factors, although it would include the pain and suffering of family members reflected to the extend that the individuals take this into account when considering their compensation for the mortality risks.

However, as the number of refugees compared to the number of deaths already makes clear, civil war has a much broader and worrying impact than can be captured with fatalities alone. Civil wars often cause a humanitarian crisis, destroy assets, institutions and disrupt the economy of a country. The humanitarian crisis linked to civil wars in particular has the potential to damage a whole generation.[4] Large parts of these effects can be captured by looking at growth outcomes across the whole conflict cycle, i.e. not only during conflict but also in the recovery period. In particular, this report looks at how countries have grown compared to their own growth rate during peacetime across the entire conflict cycle. The results are reported in Figure 2 which, for completeness, also reports confidence intervals as dotted lines. From the estimated coefficients and confidence intervals one can see that both high-risk and armed conflict have no discernible effect on growth, i.e. the change in growth when a country moves from peace to high-risk or armed conflict is close to none.

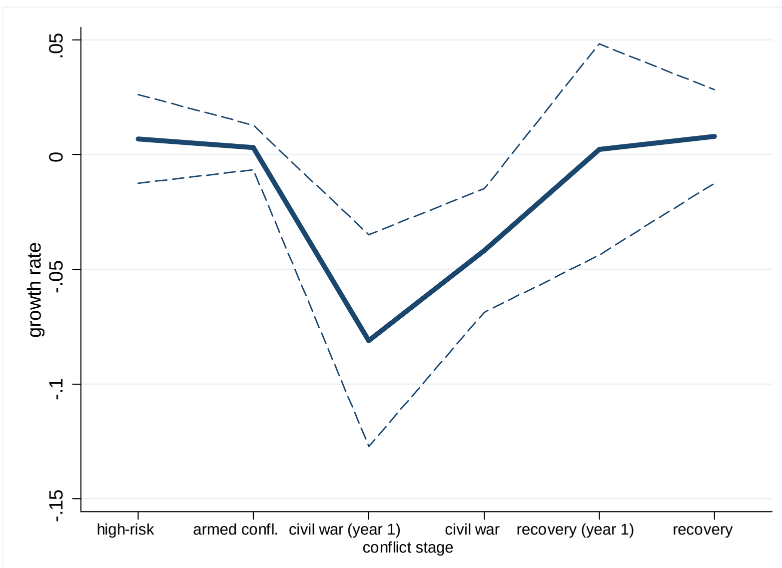

Figure 2: Growth Across the Conflict Cycle

However, Figure 2 indicates that something dramatic happens during civil war years. In the first year of civil war, growth is 8.5 percentage points lower on average than during peace years. Other civil war

[3]For example, McCollister et al. (2010) estimate the VSL in the US which is mainly relying on average lifetime earnings of victims. León and Miguel (2017) take advantage of the situation of the Sierra Leone's Lungi International Airport which can be reached by different transportation means. As each of these transportation means are subject to very different and known mortality risks this can be used to estimate the travelers' evaluation of their own life.

[4]See Mueller et al (2017) for a discussion.

years are not as damaging but growth is still 4.6 percentage points lower in a civil war year than in peace. Importantly, Figure 2 also shows that the recovery years after civil war do not feature extraordinary high growth rates. In fact, the difference to other peace years is again close to zero. This implies that countries tend to stay below previous trend level of GDP per capita after conflict ends.[5]

It is hard to overstate the significance of this result for the benefits of prevention. If a system of prevention manages to keep countries from moving from high-risk situations into armed conflict and civil war then this will have a growth effect which can lead to large overall level differences in the long run. A successful prevention system has the potential to change the growth path of large parts of the developing world and, in this way, can lead to huge economic benefits in the long-run.

The numbers we find in Figure 2 are the basis for a substantial part of the total long-term gains from prevention. It is therefore important to discuss their validity. Cross-country studies like ours face the standard omitted variable bias and reverse causality problems faced by cross-country panels. In this regard the key question is whether the impact of civil war on growth can be understood by looking at growth in the same country but during peacetime. Several factors make us believe it can. First, we don't find significant pre-trends in growth before conflict and, as can be seen in Figure 2, we do not find significantly higher growth in the post-conflict period either. Secondly, the magnitude of the effects are very similar when controlling for time fixed effects and country-specific time trends. Thirdly, the extent of per capita violence is directly related to the extent of the growth damage. The more intense is the violence the lower is growth. Finally, Mueller (2016) shows that growth effects are also of similar magnitude within country, i.e. the findings at the country level are not driven by country effects. However, to alleviate remaining concerns we will also use the standard deviations of the estimates depicted in Figure 2 to provide alternative upper and lower bounds in terms of the damage done by conflict.

In summary, we will use the deaths caused by conflict and the relative GDP per capita collapse during conflict to capture the costs of conflict. Naturally, this does not include a lot of other factors. We ignore international spill-overs, we ignore the plight of refugees, we ignore increasing mortality rates caused by thirst, hunger and the break-down of public services. We ignore the terrors of war and their immediate and long-term psychological effects on the affected. However, if we tried to find monetary values for this suffering, we would end up doing some double counting as all this is, in parts, also reflected in declining GDP. What this reports tries to do is to produce a reasonable lower bound of the costs of conflict and so we prefer to err by disregarding costs rather than by double-counting. The results should be read with this in mind.

2.3 Intervention Costs for Donors

The 2015 review of the United Nations peacebuilding architecture suggested that the international community might not spend enough in early phases of the conflict cycle to prevent the necessity to spend later.

[5] Mueller et al (2017) discuss related literature and various reasons for this result.

A very simple way to look at this would be to compare general spending levels on peacekeeping and humanitarian aid (around 30 Billion USD per year) to the budget for prevention measures. The problem is that prevention is not clearly defined in the budgets of governments or international organizations because high-risk initiatives are not defined as a spending category. Very often the discussion instead moves towards post-conflict initiatives as prevention.

In order to look at this more systematically, this report therefore matches data on spending on peacekeeping missions data from the United Nations Peacekeeping Factsheet Archive and total net bilateral ODA flows from DAC countries to the definition of the seven states defined through violence and violence risk. These two spending categories provide a good overview over how spending is allocated across the conflict cycle.[6]

Figure 3 summarizes average spending on peacekeeping and total bilateral aid flows at each state of the cycle. Panel A reports average spending on peacekeeping. Reassuringly, the recovery period is where most spending on peacekeeping happens. Spending increases from around 30 million USD before recovery to about 300 million USD on average when conflict ends. This high spending level is maintained in the following recovery years. These numbers imply that during a full recovery when a country comes out of civil war over 1.1 billion USD would be spent on average. Of course, a country that would flip back and forth between recovery and civil war would generate higher costs.

The numbers for foreign aid are in Panel B of Figure 3. What is most interesting here is the stark difference between aid spending during peace and conflict. Of course, this is partly due to the fact that conflict countries tend to be poorer countries.[7] But there is something striking about aid spending here. Spending during armed conflict is extremely high but spending during high-risk years is actually extremely close to spending during stable peace years. Donors seem to treat "high-risk" peace similar to other peaceful years. Spending only increases dramatically once it is too late, i.e. once violence has started. We will return to this pattern below.

In the simulation exercise, this report will treat the additional late peacekeeping and aid expenses as resources that could be saved if conflict was prevented. For peacekeeping expenditures, this is obvious as peacekeeping expenses are directly and causally linked to conflict. For ODA, however, the causality is a lot harder to establish. Still, it is now an accepted truth that those countries failing development goals most dramatically are so-called fragile states. Hence, in the long-run at least, there is a causal link from preventing conflict and the need to spend on development. Also, large parts of aid, like spending on reconstruction, peacebuilding and humanitarian aid, can be directly linked to conflict.

[6] The United Nations Peacekeeping Factsheets include monthly data reports from 2004 to 2016 on budget, personnel and fatalities for missions running at the time the respective report is issued. Reports were downloaded from the `http://www.un.org/en/peacekeeping/resources/statistics/factsheet_archive.shtml` on January 4th 2017.

[7] Throughout, the analysis always excludes developed countries to prevent some of this effect.

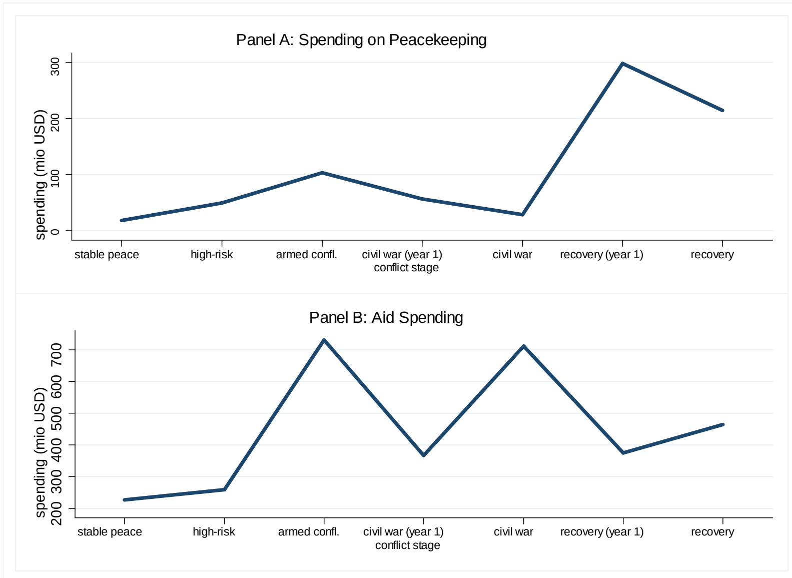

Figure 3: Donor Spending in the Conflict Cycle

3 Three Prevention Scenarios

The framework presented in the previous section can be used to simulate different versions of the future. Two futures are particularly interesting for the study here. The first future is when the status quo is maintained so that high-risk situations escalate into civil war and armed conflict with a probability of about 5 to 6 percent. In this *status quo* future, spending on aid and peacekeeping will only increase when conflict breaks out and the population of the affected countries will suffer as populations have previously suffered under civil war.

In the second simulated future, prevention measures are set in motion in high-risk years. These measures are assumed to help prevent escalation into armed conflict and civil war and increase the likelihood that the high-risk situation transitions to low-risk again. The idea here is that a system is put into place so that it reacts to situations which have been identified by prediction models and/or experts as high-risk. Such a system would need to rely on permanent resources in order to guarantee a fast response. It would not intervene in situations with open conflict or recent conflict, i.e. it would differ from already existing peacekeeping and peacebuilding systems.

A problem for contrasting these two scenarios is that the prevention system is currently not in place and important aspects are therefore unknown. We therefore present three scenarios for the future with prevention: a *pessimistic*, a *neutral* and an *optimistic* scenario. These three scenarios vary the assumptions made regarding three key parameters: the effectiveness of an intervention, the cost per intervention and the growth collapse that is prevented with an intervention. We discuss these three parameters in turn.

3.1 Prevention Effectiveness

The impact of prevention on the likelihood of conflict is a major determinant of its effectiveness. The Institute for Economics and Peace (IEP (2017)), for example, calculates the benefits from peacebuilding by looking at a scenario in where conflict will break out with certainty. This implies that the effectiveness of prevention is assumed to be close to 100 percentage points, from certain conflict to (almost) certain peace. Chalmers (2007) assumes a lower leverage but still proposes a reduction of conflict likelihood between 50 and 80 percentage points. What is often not appreciated is that these levels of effectiveness require that the policy maker is relatively sure that conflict will break out without a prevention effort. However, when doing prevention one deals in probabilities which are often quite small and initiatives which have an uncertain influence on outcomes.

We have no way to causally infer the impact of prevention on the likelihood of conflict. Instead we make three assumptions in the three scenarios. We assume that the likelihood of escalation is reduced by 25 percent, 50 percent or 75 percent respectively. In addition, we assume that a transition to another year with high risk is respectively 12.5 percent, 25 percent and 37.5 percent less likely. Table 2 illustrates this at the example of a reduction of 50 percent in the neutral scenario. In Panel A we show the original transition matrix in the status quo which was described in section 2. The shaded region captures the transition likelihoods out of high-risk states. Note, that there is only a likelihood of 15.5 percent that high-risk de-escalates.

Panel A: Without Prevention (Status Quo)

		transition from						
		peace	high risk peace	armed conflict	first year of civil war	other year of civil war	first year of recovery	2nd to 5th year of recovery
transition to	peace	96.04%	15.50%	17.26%	0%	0%	0%	4.33%
	high risk peace	1.55%	73.25%	3.10%	0%	0%	0%	10.58%
	armed conflict	2.32%	5.75%	75.44%	0%	0%	0%	4.81%
	first year of civil war	0.09%	5.50%	4.20%	0%	0%	17.81%	9.13%
	other year of civil war	0%	0%	0%	57.33%	77.20%	0%	0%
	first year of recovery	0%	0%	0%	42.67%	22.80%	0%	0%
	2nd to 5th year of recovery	0%	0%	0%	0%	0%	82.19%	71.15%

Panel B: With Prevention (50% Reduction of Escalation Probability)

		transition from						
		peace	high risk peace	armed conflict	first year of civil war	other year of civil war	first year of recovery	2nd to 5th year of recovery
transition to	peace	96.04%	39.44%	17.26%	0%	0%	0%	4.33%
	high risk peace	1.55%	54.94%	3.10%	0%	0%	0%	10.58%
	armed conflict	2.32%	2.88%	75.44%	0%	0%	0%	4.81%
	first year of civil war	0.09%	2.75%	4.20%	0%	0%	17.81%	9.13%
	other year of civil war	0%	0%	0%	57.33%	77.20%	0%	0%
	first year of recovery	0%	0%	0%	42.67%	22.80%	0%	0%
	2nd to 5th year of recovery	0%	0%	0%	0%	0%	82.19%	71.15%

Table 2: Transition Likelihoods With and Without Prevention

Panel B in Table 2 shows the assumed impact that prevention has on these probabilities in the neutral scenario. The probabilities of armed conflict and civil war fall by 50 percent, i.e. by around 2.8 percentage points each. The likelihood of staying in high risk is reduced by 25 percent, i.e. by about 18 percentage points. All this probability mass is moved to the stable peace state and so stable peace becomes more likely by close to 24 percentage points. In other words, prevention makes escalation less likely and instead increases the likelihood of a de-escalation.

It should be kept in mind how conservative these assumptions are when compared to existing studies.[8]

[8] A real comparisson to our estimates is difficult as the time horizon in both IEP (2017) and Chalmers (2007) are longer.

The main reason is that we assume that events in the future cannot be foreseen with anything close to certainty. Instead, our goal here is to capture the massive degree of uncertainty in which policy makers need to operate. Often it is impossible to be sure that an escalation will take place or, even more difficult, would have taken place without an intervention.

3.2 Prevention Costs

We also know little about the costs of prevention. Again, one of the few studies which looks at prevention explicitly is Chalmers (2007). He estimates the costs of hypothetical prevention packages for several case studies in which, arguably, conflict was imminent. Chalmers proposes relatively large expenditures at a minimum of around 1 billion USD per intervention per year. For example, the prevention package proposed for the Balkans in 1989 would include diplomatic engagement, debt relief and economic assistance made conditional on peace talks and de-escalation. According to Chalmers, such a prevention package would cost 15.4 billion USD spent over 15 years. According to IEP (2017) peace could be built effectively by spending between 16.4 and 20.3 billion USD per year in 31 conflict-affected countries. This is between 520 million USD and 650 million USD per country per year. However, these numbers come from post-conflict situations in countries like Rwanda, Afghanistan or Iraq where building peace should be more complicated than in countries which do not come out of a civil war.

In any case it is clear that much less is currently spent. For the years 2016–17, the Department of Political Affairs (DPA), the UN organization most clearly responsible for prevention, has requested a total of 50 million USD to cover its priority areas of engagement over two years.[9] With an engagement in five countries this would leave only 5 million USD per country per year. And most of this spending actually flows into countries which the framework presented above would have categorized as in conflict or recovery, not high-risk. This lack of engagement in high-risk countries is also visible in the overall ODA data we used in Figure 3. From Panel B of Figure 3 we know that only about 250 million USD ODA flow into high-risk countries on average. Finally, the IEP (2017) report goes through a detailed analysis of different parts of ODA and categorizes some of it as peacebuilding. In this way the report can show that 60.3 billion USD were spent on peacebuilding in 31 conflict-affected countries between 2002 and 2013. This is about 130 million USD per country/year.

We take the current spending in ODA in high-risk countries and the IEP numbers as a starting point. Based on these numbers we assume a range of additional costs of prevention of 100 million, 500 million and 1 billion USD per year per intervention in high-risk situations. In the pessimistic scenario we assume that each intervention costs 1 billion USD to stay close to the Chalmers estimates. In the neutral scenario we assume that prevention costs 500 million USD per year which is close to the IEP estimate of what should be spent. In the optimistic scenario we assume prevention costs only an extra 100 million USD per year. In other words, we assume that a targeted increase of ODA resources by 40 percent, from currently 250 million

[9] Where the money is spent and for what is exactly is hard to know from the reports. However, it is clear that spending is low in many countries. For more details on the DPA budget see the appendix.

to 350 million USD with prevention would suffice to lower the likelihood of conflict.

3.3 Growth Damage

Finally, we will vary the damage that ongoing civil war does to the growth rate in our three scenarios. We do this because the growth damage is a major determinant of the overall cost of conflict and therefore of the benefits of prevention. In the neutral scenario we assume that the growth reduction follows the estimates in Figure 2, i.e. -3.9 percentage points during civil war. In the optimistic scenario, the conflict damage is assumed to be one standard deviation higher than in the neutral scenario.[10] The standard deviation of the coefficient is 1.3 percentage points so that in the optimistic scenario we assume that civil wars lead to a growth decrease of -5.2 percentage points on average. In the pessimistic scenario, the conflict damage is assumed to be one standard deviation lower than in the neutral scenario.

3.4 Summary of Prevention Scenarios

We summarize all these assumptions in the *optimistic*, *neutral* and *pessimistic* scenario. In order to get to the pessimistic scenario we combine high intervention costs with low effectiveness and a low growth damage. We assume that:

- In the optimistic scenario, the conflict damage is assumed to be -5.2 percentage points on average. In addition, the effectiveness of interventions is assumed to be high (75 percent success rate) and the cost of an intervention is assumed to be only 100 million USD per year.
- In the neutral scenario, the conflict damage is assumed to be -3.9 percent during civil war. The effectiveness of interventions is assumed to be intermediate (50 percent success rate) at an intermediate cost of 500 million USD per year.
- In the pessimistic scenario, the conflict damage is assumed to be one standard deviation lower than the main estimate (-2.5 percent during civil war) and the effectiveness of interventions is assumed to be low (25 percent success rate) and to cost 1 billion USD per year.

While every assumption in the optimistic and pessimistic scenarios might be realistic on its own right, we don't think that a combination of all three is. We therefore see the optimistic and pessimistic scenario as bounds on what we think is realistic and not as likely alternatives to the neutral scenario which we will treat as our main result.

4 How Much is Prevention Worth?

Civil wars lead to immense damage. This implies that even a narrow and limited prevention system which focuses on a few high-risk cases each year will lead to tangible benefits after a few years. Our simulations

[10] A higher damage implies larger benefits from prevention.

show that with prevention the number of countries in stable and high-risk peace increases by about four after fifteen years. In other words, despite the fact that high-risk interventions are rare events, and not always effective, they lead to a new long run equilibrium with about four countries less suffering from organized violence.

This section provides a cost/benefit calculation in which the results from the simulation are used to calculate both benefits of prevention and the expected costs for the three scenarios. We first turn towards the benefits then the costs and then bring them together for our final result.

4.1 The Benefits of Prevention

Figure 4 displays the resulting prevented number of refugees for the three scenarios to illustrate the dynamics of the model. After five years the implemented prevention system would lower the number of refugees by about 1 million in the neutral scenario. After fifteen years, this number would increase to over 1.5 million. This is, of course, a direct result of the fact that more and more countries would be at peace with a prevention system in place. Strikingly, even in the pessimistic scenario more than 1 million refugees would be prevented after fifteen years.

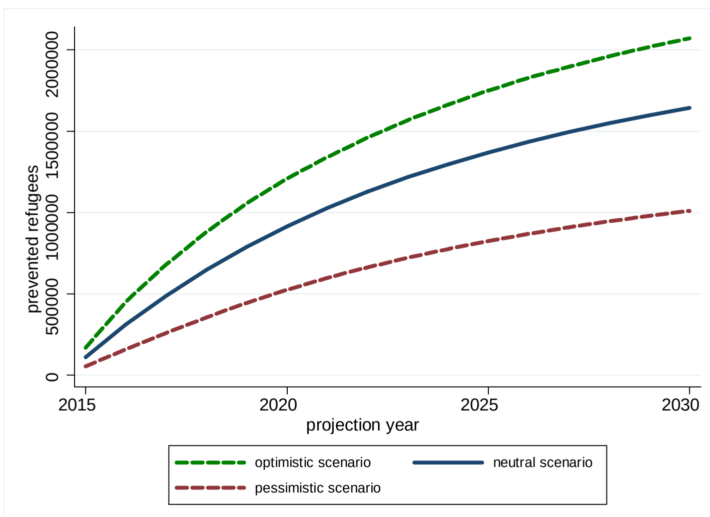

Figure 4: Prevented Refugees from High-Risk Countries

However, as discussed in the previous section our estimates will focus on the growth effect and loss of life to capture the damage caused by civil war. This is done through a simulation of total worldwide GDP with and without prevention for fifteen years. The difference between the status quo GDP and GDP with prevention then establishes the benefits of prevention. To this difference the framework then adds the costs generated by fatalities.

The result for the three scenarios is displayed in Figure 5. The Figure shows accelerating benefits which, in the neutral scenario, reach close to 150 billion USD per year after fifteen years. The reason for this huge benefit of prevention lies in the fact that prevention affects the rate of growth in high-risk years. It does so in a very subtle way, by replacing years of conflict by years of peace in a few instances, but given the size of total output the divergence in growth paths quickly leads to sizable absolute differences in output. The divergence even accelerates as more and more countries become peaceful with prevention. Due to the accelerating nature of gains, the prevented damage in the optimistic and pessimistic scenario diverge from the neutral scenario. Still, even in the pessimistic scenario the prevented damage reaches 40 billion USD per year in 2030.

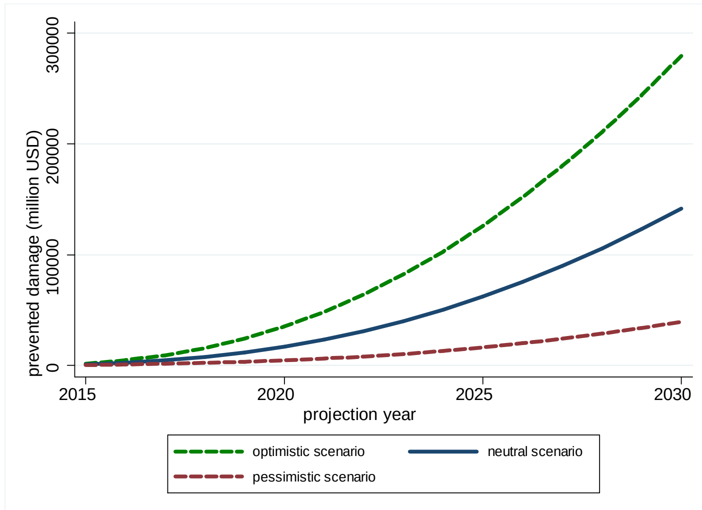

Figure 5: Prevented Loss in High-Risk Counries

It is important to stress that the estimates in Figure 5 are conservative for several reasons. First, the simulation assumes only minimal baseline growth so that the differences in growth rates do not lead to larger accumulated benefits. We show in the appendix that benefits reach over 200 billion USD if this assumption is dropped. Second, the richest countries are excluded from the model so that only a total GDP of 29 trillion USD, about a third of global output, are included in the simulation. Results are also qualitatively robust to excluding more countries from the sample. Third, the simulation assumes that countries can escape the so-called violence trap by staying stable for long enough. If one assumed that countries keep a high-risk state beyond the 5-year recovery period this would increase the benefits of prevention further.

One can use a similar technique to simulate how much resources would be saved each year in aid and peacekeeping spending with early intervention. The results of this simulation are in Figure 6. From this, it is clear that donors will need to spend much less on late interventions with prevention in place. After fifteen years, the donor community would save close to 2.5 billion USD each year from spending less on aid and peacekeeping in the neutral scenario. Even in the pessimistic scenario cost savings are well over 1 billion USD after fifteen years. The key for the savings here is that early interventions prevent countries from entering the conflict cycle and thereby prevents the much higher costs during the conflict and recovery phases depicted in Figure 3. The gains are increasing because more and more countries enter stable peace.

4.2 The Costs of Prevention

In order to circumvent the problem of unknown intervention costs we assumed that prevention costs 100 million USD in the optimistic scenario, 500 million USD in the neutral scenario and 1 billion USD in the pessimistic scenario. All these costs are costs per intervention per year, i.e. if a country stays in high-risk for three years in the pessimistic scenario it will cause a cost of 3 billion USD. In Figure 7 we show how overall costs evolve in the three scenarios.

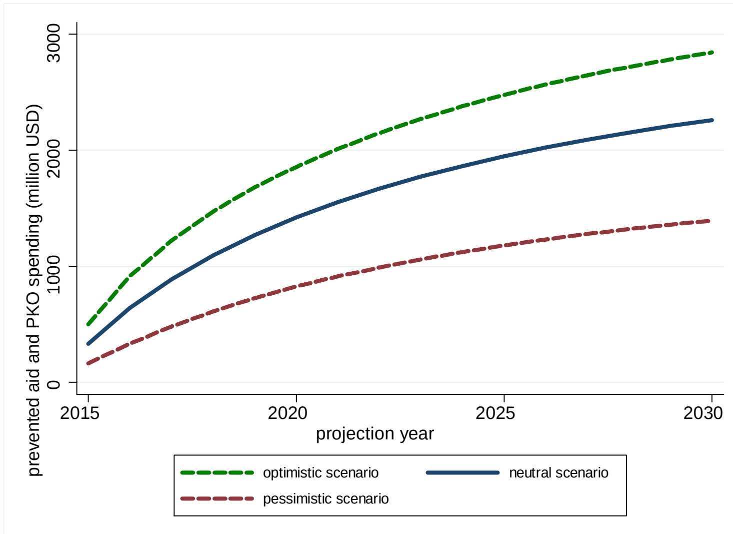

Figure 6: Reduction in Spending with Prevention

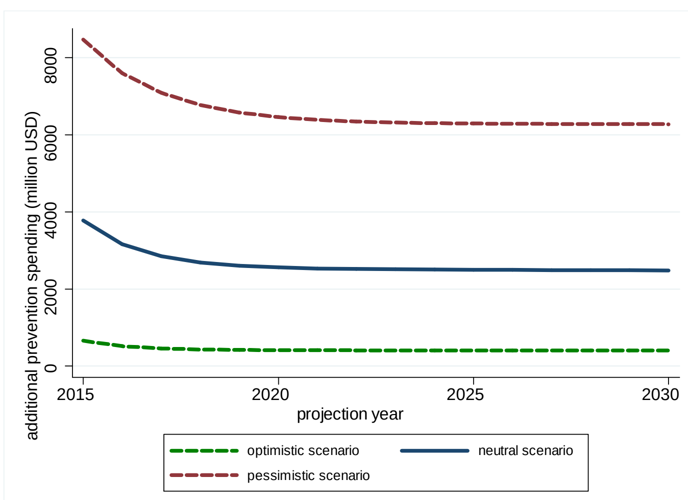

Figure 7: Total Yearly Costs of Prevention

Costs are highest in the pessimistic scenario with over 8 billion USD after the first year and close to 6 billion USD after 15 years. Costs are much lower in the neutral scenario with less than 4 billion USD after the first year and just over 2 billion USD after 15 years. In the optimistic scenario costs are very low, i.e. never over 1 billion USD. Note, that two factors lead to such different levels of costs in Figure 7; the number of interventions and the cost per intervention. The number of interventions is given by the number of high-risk situations and since interventions are less effective in the pessimistic scenario, for example, more are necessary. In the long run we have over six preventive interventions per year in the pessimistic scenario but only four in the optimistic scenario.

4.3 The Business Case for Prevention

This sections puts the different pieces of the puzzle together and compares costs with benefits. The question is whether the adoption of a prevention framework would save resources and, if yes, how much?

An important take-away from the dynamic view of the previous two sections is that costs start high and end up falling whereas benefits start being low but rise steeply. When comparing costs to benefits we therefore want to compare the overall benefit instead of making a year-by-year comparison. We do this by comparing average yearly values and discounting the future a little so that gains a year later count slightly less.[11]

The resulting, discounted numbers are in Table 3. It becomes immediately clear that, even in the lower bound pessimistic case, prevention would still provide net benefits of over 4.8 billion USD per year. In the neutral scenario net benefits are over 33.3 billion USD per year. In the optimistic scenario net benefits are close to 70 billion USD per year.

Damages, savings and costs in millon USD per year

	scenario		
	optimistic	neutral	pessimistic
prevented damage	68736	34251	9377
saved costs	1523	1176	698
additional cost	-352	-2118	-5247
net savings per year	**69907**	**33309**	**4828**

Table 3: The Business Case for Prevention

Table 3 also provides information regarding which share of the benefit is in saved costs and which part is prevented damage. This distinction is important as these benefits arise in different ways. The "prevented damage" item is a crude, monetized measure of the prevented deaths and destruction in conflict affected countries and the suppression of social and economic development that violence brings. This benefit will

[11] As a discount rate we use 3 percent which is fairly high for the current interest rate regime and therefore biases us slightly against prevention.

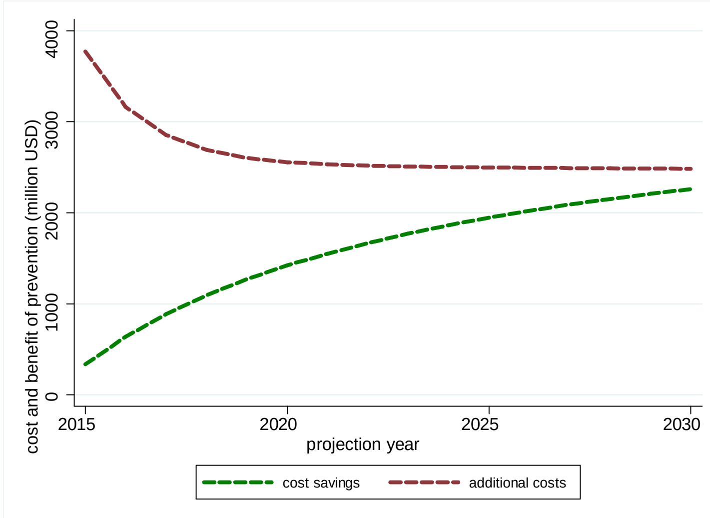

Figure 8: Dynamic Cost and Benfit for Donors in the Neutral Scenario

accrue in developing countries. The "saved costs" will manifest themselves in fewer peacekeeping missions and fewer humanitarian crisis and reconstruction efforts. In other words, we would expect these savings to lighten budgetary pressures for international organizations and development agencies worldwide. It is striking to see that in the neutral scenario these savings are more than half the additional costs caused by the prevention system. In other words, the system would finance itself by half. In the optimistic scenario, saved costs are more than four times higher than additional costs. In other words, the donor community would save resources with more prevention.

Since the costs and benefits are dynamic, the average numbers in Table 3 hide another big advantage of engaging in prevention which only plays out over time. As the world becomes more stable, prevention costs fall and savings and prevented damage rise. Depending on the horizon of the donor community this might change perspectives - even if very narrow cost/benefit calculations are conducted. In Figure 8 we show the yearly cost savings and additional costs together. These have both appeared before in Figures 3 and 7 but when bringing them together we see that after fifteen years the additional costs are almost compensated by the savings, even in the neutral scenario.[12]

Figure 9 adds the prevented damages to the cost savings and compares the total to the additional costs across time. This clearly shows the accelerating benefits that accrue due to the growth effect of prevention. The total benefits reach close to 150 billion USD in 2030 - this is the yearly gain over the status quo. By this time additional costs have fallen to about 2.5 billion USD. Prevention has huge long-term benefits for countries affected by conflict which clearly outweigh its costs.

[12] Attentive readers will not that the additional costs are always above 2.5 billion USD but average costs in Table 3 are 2.1 billion USD. The reason is the discounting of 3 percent which transforms future values into smaller, discounted values. For example, the present value of 2.5 billion in fifteen years is $(1/1.03)^{15} * 2.5 = 1.6$.

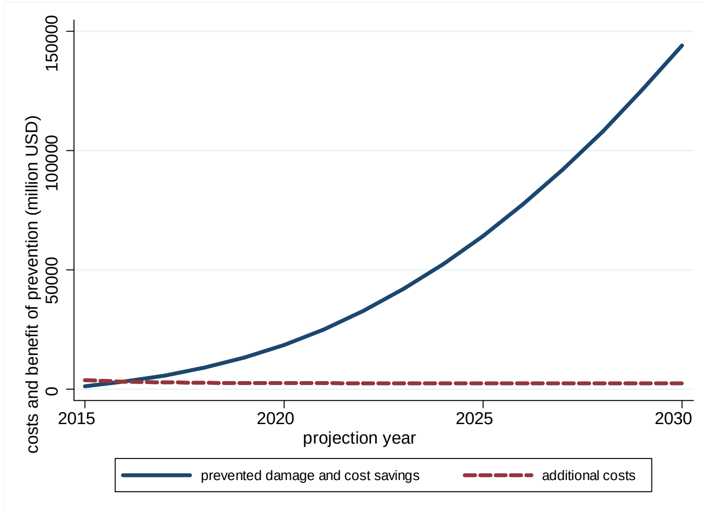

Figure 9: Increasing Benefits of Prevention

5 Conclusion

The conclusion from this report is that, clearly, the benefits from engaging in prevention for countries affected by conflict make the costs of prevention look insignificant. Even if we assume that prevention only works half the time only about five interventions are needed a year to increase the number of countries at peace by four in the long run. Therefore, if donors would need to spend an additional 500 Million USD per prevention per year then 2.5 billion USD spent per year will prevent losses of close to 150 billion USD per year after 15 years. Even when we discount these values to the present we get an average of 2.1 billion USD preventing 35.4 billion USD in total damages per year within the first fifteen years.

A part of this benefit goes to donors who can expect lower costs from spending on aid and peacekeeping. In the first fifteen years, a discounted value of close to 1.2 billion USD per year can be saved through prevention. After fifteen years the yearly savings reach close to 2.5 billion USD which implies that, under the assumptions of our neutral scenario, prevention would start to pay for itself.

Needless to say, all these estimates are just that - estimates. Given the large uncertainties involved in prevention, there are no guarantees that prevention will have exactly the benefits described in the neutral scenario, i.e. the actual realized benefits and costs could be higher or lower. The provided optimistic and pessimistic scenarios illustrate this uncertainty. Still, yearly discounted net benefits are 70 and 4.8 billion USD respectively in these two alternative benchmarks. This means even in the most pessimistic scenario the gains are substantial. At this point it is important to remember that this report tried to give a lower bound of the benefits of prevention. It is therefore extremely likely that prevention as a strategy would have huge payoffs for developing countries.

This report also points clearly in a direction for further research. Strikingly little is known about prevention. Donors should start by taking stock of their actions in high risk situations so that these can be analyzed systematically. Importantly, this should be done regardless of whether these actions were aiming at conflict prevention. A particularly interesting area of research is the trade-off between forecasting precision and prevention costs. It would, for example, be possible to improve the forecast of civil war significantly by including violence of lower intensity in the forecast. However, prevention might be much more costly at this stage.

References

[1] Fearon, James and Anke Hoeffler (2014) Benefits and Costs of the Conflict and Violence Targets for the Post-2015 Development Agenda. Conflict and Violence Assessment Paper, Copenhagen Consensus Center.

[2] Institute for Economics and Peace (2017) Measuring Peacebuilding Cost-Effectiveness. IEP Report, 46.

[3] León, Gianmarco and Edward Miguel (2017) Risky Transportation Choices and the Value of a Statistical Life. American Economic Journal: Applied Economics, 9(1), 202–228.

[4] McCollister, Kathryn E., Michael T. French and Hai Fang (2010) The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation. Drug and Alcohol Dependence, 108(1), 98-109.

[5] Mueller, Hannes (2016) Growth and Violence: Argument for a Per Capita Measure of Civil War. Economica, 83(331), 473-497.

[6] Mueller, Hannes, Lavinia Piemontese and Augustin Tapsoba (2017) Recovery from Conflict: Lessons of Success, World Bank Policy Research Working Paper, WPS7970.

[7] Mueller, Hannes and Christopher Rauh (2017) Reading Between the Lines: The Prediction of Political Violence Using Newspaper Text. Barcelona GSE Working Paper, 990.

[8] United Nations (2015) The Challenge of Sustaining Peace: Report of the Advisory Group of Experts for the 2015 Review of the United Nations Peacebuilding Architecture.

A Data Description

This section describes the data sources used in this study.

A.1 Conflict Data

The conflict data is from the Uppsala Conflict Data Program (UCDP) which collects information on a large number of aspects of armed conflicts occurred since 1946. The UCDP provides several datasets that allow to explore different features of armed conflicts. In this report, we make a large use of the UCDP Battle-Related Dataset. This dataset provides yearly information on country-level number of fatalities related to combat. The time period covered is 1946-2014. Four our main estimates we use the forty years between 1975 and 2014 as we need estimates of high-risk which is only available after 1975.

The data on battle-related deaths are collected through the use of news sources. All reports, which contain information about individuals killed or injured in fighting, are gathered and coded manually into an event-year level dataset. For every event, several details are recorded and translated into variables: the date and location of the event, the reporting source, the primary source, the actors involved, what happened, and three estimates of fatalities caused by the event (low, high, and best estimate).

For the purpose of the present report, we focus on three variables provided by the UCDP Battle-Related Dataset that we describe below. These variables describe the *type* of the violent event, its *location* and the estimate of the *number of fatalities*.

The UCDP/PRIO Armed Conflict Dataset identifies four different types of conflict. For each conflict event coded in the dataset we can distinguish among:

1. Extra-systemic conflict: occurs when a government of a state is fighting to retain the control of a territory outside the state system.

2. Interstate conflict: occurs between two or more different states.

3. Internal conflict: occurs when the government of a state fight against one or more internal groups. In this type of conflict there is no intervention from other states.

4. Internationalized internal conflict: occurs when the government of a state fight against one or more internal groups and external states intervene to support one or both sides.

Given that in this report we analyze civil conflicts, we only focus on two types of conflict reported in this dataset, namely internal conflict and internationalized internal conflict, i.e. conflict of types 3 and 4.

The UCDP Battle-related deaths Dataset provides three estimates of the number of fatalities that each violent event implies. These variables are:

- *bdlow*: this variable provides the low estimate of the occurred battle related deaths for each conflict event and year. This estimate is the results of the aggregation of low estimates for all the fatalities related to battle-related incidents.

- *bdhigh*: this variable results from the aggregated high estimates for all battle-related incidents in a given conflict event and year.

- *bdbest*: this estimate consists of the aggregated most reliable numbers for all battle-related fatalities in a given conflict event and year. If different reports provide different estimates, the estimate provided by the most reliable source is provided. If no such distinction can be made, the lowest among these numbers is used.

In this report we use variable *bdbest.* We define armed conflict as a year with more than 25 battle-related deaths but not a civil war.

Civil war is defined as a situation in which a country experiences more than 0.08 battle-related deaths per 1000 population. This definition is non-standard as, typically, civil war is defined through an absolute value of 1000 battle-related deaths. Here a relative measure is chosen in accordance with Mueller (2016) who shows that this is a better way to capture the situation a country is in. This alternative definition is one of the reasons why we find a larger growth impact of conflict compared to the literature.

A.2 Refugee Data

Data on refugees is provided by the UNHCR Population Statistics Database. The database provides information about UNHCR's populations of concern from the year 1951 up to 2014. This database lists seven categories: refugees, asylum-seekers, returned refugees, internally displaced persons (IDPs), returned IDPs, stateless persons and others of concern. For each group the database provides yearly information about their composition by location of residence and origin. We exploit only the data on refugees.

According to the UNHCR definition, refugees are "individuals recognized under the 1951 Convention relating to the Status of Refugees; its 1967 Protocol; the 1969 OAU Convention Governing the Specific Aspects of Refugee Problems in Africa; those recognized in accordance with the UNHCR Statute; individuals granted complementary forms of protection; or those enjoying temporary protection; and people in a refugee-like situation".

In particular, the report uses the annual stock of refugees for each country of origin, i.e. how many people with refugee status have left their home country each year. Hence, for each country of origin we sum the stock of refugees reported in each host country.

A.3 Aid Data

Net bilateral aid flows from DAC donors are the net disbursements of official development assistance (ODA) or official aid from the members of the Development Assistance Committee (DAC). Net disbursements are gross disbursements of grants and loans minus repayments of principal on earlier loans. ODA consists of loans made on concessional terms (with a grant element of at least 25 percent, calculated at a rate of discount of 10 percent) and grants made to promote economic development and welfare in countries and territories in the DAC list of ODA recipients.

Official aid refers to aid flows from official donors to countries and territories in part II of the DAC list of recipients: more advanced countries of Central and Eastern Europe, the countries of the former Soviet

Union, and certain advanced developing countries and territories. Official aid is provided under terms and conditions similar to those for ODA. Part II of the DAC List was abolished in 2005. The collection of data on official aid and other resource flows to Part II countries ended with 2004 data.

DAC members are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States, and European Union Institutions. Data are in current U.S. dollars.

A.4 Spending from DPA

To get an idea of the resources available for prevention it is useful to look at the budget of the Department of Political Affairs (DPA), the organization explicitly responsible for prevention. The Department is funded primarily through the UN regular budget. However, over the last few years, the Department has become increasingly reliant on extra-budgetary resources to rapidly respond to needs on the ground. These are raised through Multi-Year Appeals which are designed to increase the coherence of DPA fund-raising efforts and to secure support for the less predictable parts of DPA's work like the crisis response system, a network of Envoys, Special Political Missions (SPMs), and the DPA-UNDP Peace and Development Advisers (PDAs).

However, while contributions have nearly tripled in four years (from 7.2 million USD in 2010 to 19.2 million USD in 2014), funds still lack predictability, and often come with significant earmarking (around 50 percent), both of which reduce the flexibility of the response. For 2016–17, DPA has requested a total of 50 million USD to cover the priority areas of engagement over two years.[13] With an engagement in five countries this would leave 5 million USD per year and country.

B The Framework and Simulation

At the Core of the Framework is the idea that conflict follows a random pattern which, despite its randomness, follows some predictable patterns. These patterns are captured by seven states described in the main text and fixed probabilities that determine the likelihood that a conflict stage follows another.

After defining the different stages one can simply look at how often each state followed another and record the probabilities in a matrix which we call transition matrix. Table A1 below reports this transition matrix. The matrix shows, for example, that the likelihood that peace follows peace is 96 percent. The likelihood that armed conflict follows peace is 2.3 percent. The 0% probabilities in the table are determined by the definitions we used in the table. For example, it is impossible to transition from peace to recovery or to the second year of civil war. From the first year of civil war a country can only transition to another year of civil war or to the first year of recovery.

[13] In addition, an analysis of the initiatives funded by the extra-budget resources shows again a striking focus on post-conflict situations.

Table A1: Likelihood of Transitions in Framework

transition to \ transition from	peace	high risk peace	armed conflict	first year of civil war	other year of civil war	first year of recovery	2nd to 5th year of recovery
peace	96.04%	15.50%	17.26%	0%	0%	0%	4.33%
high risk peace	1.55%	73.25%	3.10%	0%	0%	0%	10.58%
armed conflict	2.32%	5.75%	75.44%	0%	0%	0%	4.81%
first year of civil war	0.09%	5.50%	4.20%	0%	0%	17.81%	9.13%
other year of civil war	0%	0%	0%	57.33%	77.20%	0%	0%
first year of recovery	0%	0%	0%	42.67%	22.80%	0%	0%
2nd to 5th year of recovery	0%	0%	0%	0%	0%	82.19%	71.15%

The matrix makes clear why it makes sense to distinguish the first year of civil war and the first year of recovery. In both cases the state is less stable in the first year, i.e. it is more likely that recovery follows the first year of conflict than any other conflict year.

Note, that we define the recovery such that they include years with peace, high-risk peace and armed conflict. We do this to have a consistent definition of "recovery". This also explains why the transition period from the first year of recovery to peace, high risk and armed conflict is 0. The transition likelihoods in the 2nd to 5th year of recovery are explained by the fact that after the 5th year all countries can again transition to peace, high risk and armed conflict (or the first year of civil war obviously). Note, that the probability of going back to an outbreak of civil war falls from 17.81 percent to 9.13 percent after the first year of recovery.

B.1 Simulating GDP

The framework simulates the GDP loss as follows. First, consider a counterfactual transition matrix. The parameter $1-\tau$ is used to model the decrease of the transition probability to conflict. This probability mass is added to the likelihood of transitioning to stable peace. In addition, it is assumed that the likelihood of remaining in high risk peace decreases by a share of $(1-\tau)\,0.5$. For our main experiment we assume that $\tau = 0.5$ so that prevention is assumed to work in 50 percent of all cases. As an example, assume that original transition probabilities from high-risk to peace, high-risk, armed conflict and civil war are 0.1, 0.7, 0.1 and 0.1, respectively. Then, in the counterfactual, the probability distribution would change to 0.375, 0.525, 0.05 and 0.05, where the likelihood of transitioning to peace, 0.375, comes from $0.1+0.25*0.7+0.5*0.1+0.5*0.1$. The remaining probabilities in the transition matrix are kept as originally estimated. The changes to the transition matrix in the neutral case was depicted in Table 2. We show the changes in the optimistic and pessimistic case below.

Panel A: Pessimistic Scenario

		transition from						
		peace	high risk peace	armed conflict	first year of civil war	other year of civil war	first year of recovery	2nd to 5th year of recovery
transition to	peace	96.04%	27.47%	17.26%	0%	0%	0%	4.33%
	high risk peace	1.55%	64.09%	3.10%	0%	0%	0%	10.58%
	armed conflict	2.32%	4.31%	75.44%	0%	0%	0%	4.81%
	first year of civil war	0.09%	4.13%	4.20%	0%	0%	17.81%	9.13%
	other year of civil war	0%	0%	0%	57.33%	77.20%	0%	0%
	first year of recovery	0%	0%	0%	42.67%	22.80%	0%	0%
	2nd to 5th year of recovery	0%	0%	0%	0%	0%	82.19%	71.15%

Panel B: Optimistic Scenario

		transition from						
		peace	high risk peace	armed conflict	first year of civil war	other year of civil war	first year of recovery	2nd to 5th year of recovery
transition to	peace	96.04%	51.41%	17.26%	0%	0%	0%	4.33%
	high risk peace	1.55%	45.78%	3.10%	0%	0%	0%	10.58%
	armed conflict	2.32%	1.44%	75.44%	0%	0%	0%	4.81%
	first year of civil war	0.09%	1.38%	4.20%	0%	0%	17.81%	9.13%
	other year of civil war	0%	0%	0%	57.33%	77.20%	0%	0%
	first year of recovery	0%	0%	0%	42.67%	22.80%	0%	0%
	2nd to 5th year of recovery	0%	0%	0%	0%	0%	82.19%	71.15%

Table A2: Alternative Scenario Transition Matrixes

Second, we regress GDP growth on the seven states using country fixed effects. We use the regression coefficients but ignore the individual country fixed effect coefficients to represent the estimated GDP growth in each state and keep them in the growth vector g^c with dimensions 7×1 for each country c. Ignoring the fixed effects means that we artificially lower the growth rate in our simulations. This lowers the benefit of prevention. We return to this point in the robustness checks.

Third, we consider the initial state vector s_0^c with 1×7 dimension for each country c. For a given country, we look to the last year in the sample, Y, and define the initial state vector s_0^c accordingly. For example, if the last year of the sample is 2014 and the state of a given country x in that year is 4 then we set the initial state vector to be $s_0^x = (0, 0, 0, 1, 0, 0, 0)$, that is, the column of the vector equal to 1 corresponds to the initial state and the rest of the vector elements equal to zero.

Finally, we start simulating by using the following formula

$$GDP_{Y+1}^c = s_0^c\,(P)\,(1 + g^c)GDP_Y^c.$$

where $GDP_{Y+1}^{c,l}$ is the GDP in the year $Y + 1$, for each country c, and P is the modified transition matrix. More specifically, for a given country, we compute the simulated next year GDP by using the initial state vector, the estimated growth vector, and the counterfactual transition matrix. Multiplying the initial state vector and the counterfactual transition matrix, we obtain the vector containing the probabilities of transition to each of the states from the initial state. By multiplying the result by the estimated growth vector we obtain the expected GDP growth given the initial state. Using this number together with the initial GDP, one gets the expected one-year ahead average GDP. Then, we get the expected two-years ahead GDP by multiplying again by P and so on. So that, for any t-years ahead the equation becomes:

$$GDP_{Y+t}^c = s_0^c\,(P)^t\,(1 + g^c)GDP_Y^c \quad for \quad t = 1, ..., T.$$

We end up having for each country a path of expected GDP consistent with the estimated individual fitted GDP growth and the constructed counterfactual transitions. We also do the same using the original estimated transition matrix. Hence, to compute the GDP loss, one just needs to compare the actual GDP with one of the Counterfactual GDP.

One can compute the difference between expected GDP in the status quo and the expected GDP with prevention. Because the estimated GDP growth in civil war states is lower than in other states, the constructed counterfactual transitions matrices above makes any counterfactual world better in terms of GDP growth. That is because in the counterfactual world, countries are more likely to stay away from armed conflict and civil war. Hence, any counterfactual expected GDP will be larger than the actual expected GDP and this happens for any forward iteration and country.

Summing over all countries in our sample and taking the difference between world GDP in the status quo and with prevention gives the benefit of prevention.

C Robustness Checks

The first important choice made in the report is regarding which countries should be included in the simulation. The key thought-experiment one needs to dare here is which countries, potentially, might end up in a situation with armed conflict and civil war. The cut-off we choose includes as the richest countries Oman, Portugal and Venezuela. We do so because violence is actually present in Venezuela. But the results are qualitatively robust to picking a lower cut-off in which Libya is the richest country in the sample. The average discounted prevented damage in the neutral scenario would then be 33.1 billion USD instead of 34.2 billion USD.

We conducted ample experimentation with the parameters of the model to make sure that results are qualitatively robust to changing parameters. Figure A1 shows how the simulated benefit from prevention changes in the three scenarios if we allow the countries in the sample to grow by their previous growth rates, i.e. if we add the country fixed effects from the panel regression of growth to the simulated growth rates. Note, that this is not affecting how conflict affects growth; it only affects the baseline growth which, in turn, affects the accumulated benefits from higher growth rates without conflict. The benefit in the neutral scenario now goes over 200 billion USD after fifteen years which is more than 50 billion USD more than what is reported in the text. Of course, nothing else changes in other parts of the simulation in this scenario.

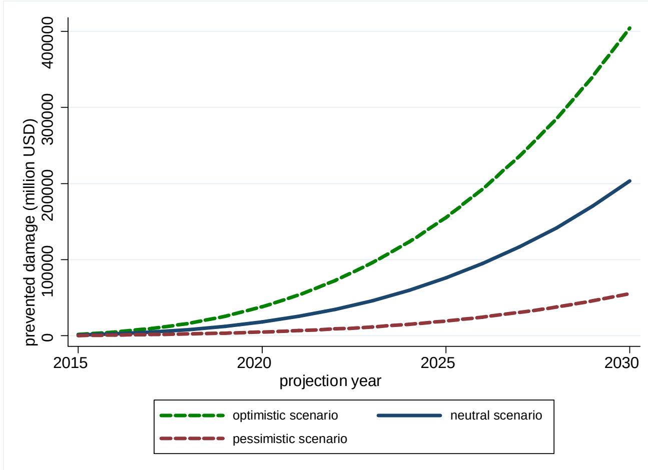

Figure A1: Simulation with Country Fixed Effects

Finally, we use the within forecasting model from Mueller and Rauh (2017) to do the forecasting that delivers the definition of high risk. Forecasting in the within model is less precise and does not focus on the "usual suspects". Mueller and Rauh show that this leads to a much higher awareness regarding new instabilities. In other words, a prevention system with such a forecast would need to intervene in a much broader set of countries and much quicker. At the same time, the set of countries that can fall into high risk is a lot larger so that the benefits of prevention are spread out much more. The modified transition matrix displayed below in Table A3 demonstrates this. It displays a much higher likelihood that countries at peace enter high risk and a much higher likelihood that countries in high risk transition to stable peace again.

		transition from						
		peace	high risk peace	armed conflict	first year of civil war	other year of civil war	first year of recovery	2nd to 5th year of recovery
transition to	peace	90.13%	45.89%	17.26%	0	0	0	9.62%
	high risk peace	6.90%	48.57%	3.10%	0	0	0	5.29%
	armed conflict	2.59%	3.25%	75.44%	0	0	0	4.81%
	first year of civil war	0.39%	2.29%	4.20%	0	0	17.81%	9.13%
	other year of civil war	0	0	0	57.33%	77.20%	0	0
	first year of recovery	0	0	0	42.67%	22.80%	0	0
	2nd to 5th year of recovery	0	0	0	0	0	82.19%	71.15%

Table A3: Alternative Transition Probabilities in the Within Model

The system defined this way would intervene much more (in about 10 cases each year) and would therefore generate more costs and benefits. It would also, over the years, intervene in an increasing number of cases. The reason is that prevention now pushes more countries towards stable peace but stable peace is much more likely to generate high risk situations. Strikingly, this system built on a within forecast with lower precision would still yield positive and even stronger benefits across all three scenarios as shown in Table A4.

Damages, savings and costs in millon USD per year

	scenario		
	optimistic	neutral	pessimistic
prevented damage	100565	59344	25219
saved costs	775	553	298
additional cost	-761	-4096	-8867
net savings per year	**100579**	**55801**	**16649**

Table A4: The Business Case in the Within Model

Table A4 clearly illustrates the higher additional costs caused by the prevention system compared to Table 3. What is striking in this system is that the differences between the neutral and the optimistic and pessimistic scenario increases dramatically. However, this is entirely driven by the prevented damage and not saved costs.