Caught in a Trap: Simulating the Developmental Consequences of Civil War*

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Abstract

This study proposes a statistical model of the "conflict trap" phenomenon - a period of recurring outbreaks of violence following an initial outbreak of armed conflict. The framework captures conflict dynamics in the conflict trap through a discrete-time Markov process. The state space is composed of a state of stable peace and the conflict trap consisting of a state of conflict and multiple states of increasingly stable peace. The model is estimated using a dataset of conflict and GDP growth for the years 1989-2021 and over 190 countries. The framework is then simulated to study the effect of the conflict trap in isolation. On average, a random year of conflict is followed by only 4 more years of uninterrupted conflict but 18 years inside the conflict trap. A conflict outbreak leads to an average aggregate reduction in GDP per capita of almost 20% after 30 years. But the lower tails of the phenomenon are much worse. Sampling from the worst affected countries the model generates output losses of close to 45%.

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1 Introduction

Civil conflict is often regarded as a key inhibitor to economic development. Debates in policy circles often focus on the fact that an increasing share of the poor live in conflict-affected countries.[1] If we compare across countries, armed conflict appears to be an important determinant of developmental differences. The Democratic Republic of Congo, for example, has a GDP per capita that is less than one tenth the one of South Africa. Most economists agree, however, that this difference in GDP should not be solely attributed to armed conflicts as there are clearly other factors that could drive a wedge between the output of the two countries and also make one more prone to armed conflict.

The literature has therefore turned toward using within-country difference, both on the time and geographic dimension, to identify the costs of war. But there is a stark difference in results between the *cross-sectional* findings, comparing peaceful and conflict-affected countries, and the *within-country* view as estimates from within-country tend to suggest a much smaller impact of civil war. This matters, if conflict is not a major determinant of cross-country differences in economic development then the recent pivot of developmental agencies towards armed conflict as a causal driver of economic development will not have a transformative effect.

In this article we develop a conceptual framework to bridge part of the gap between the large cross-country differences and the well-identified country evidence. Specifically, we propose a conceptual definition of civil war which includes the post-conflict period. In this view, the event to be studied is not an episode of ongoing war and its impact on the economy but the first outbreak into intensive violence after prolonged episodes of peace. These outbreaks are often followed by decades with episodes of open violence - a phenomenon known as the *conflict trap*. It has long been argued that the conflict trap exists - but to the best of our knowledge this is the first attempt to gauge its impact on long term development quantitatively.[2]

Our definition of political violence follows UCDP/GED which we aggregate to the country/year. The cross-country literature typically defines civil wars using a threshold violence intensity. We define civil war as a level of per capita violence that significantly harms the macroeconomy.[3] This threshold is met for the for top 40% most violent years in our data. According to this definition, we have 700 civil war country/years which makes our definition relatively inclusive when compared to the standard 1000 fatalities threshold with 400 civil war country/years.[4]

We propose the definition of the conflict trap as the period between the first onset of civil war and the crossing of a threshold of time without a renewed outbreak.[5] Figure 1 shows the the likelihood of

[1]See, for example, the World Bank report Corral et al (2020).

[2]Hegre et al. (2017) is an example of research that conceptualizes the conflict trap for conflict prediction purposes.

[3]See Mueller (2016) for an argument for per capita violence intensity measures at the macro level.

[4]In the appendix we discuss this in detail and show robustness checks for a more restrictive definition as well. We show that this definition leads to larger estimates of the developmental impact of civil wars.

[5]Our analysis here closely follows the conflict risk analysis in Mueller and Rauh (2022).

resurgence of civil war in the first seven years after the last civil-war year. We show the resurgence likelihood with its 90 and 95 percent confidence intervals in the data. In the first year after conflict the likelihood of a renewed outbreak is over 10 percent. It then falls relatively monotonically to 3 percent after 4 years. Outside the 7-year period the likelihood of resurgence is close to just 1 percent. This means that the post-conflict period is extremely risky. These numbers indicate that around 1 in 3 countries will end up stuck in the conflict trap of repeated episodes of war and peace.

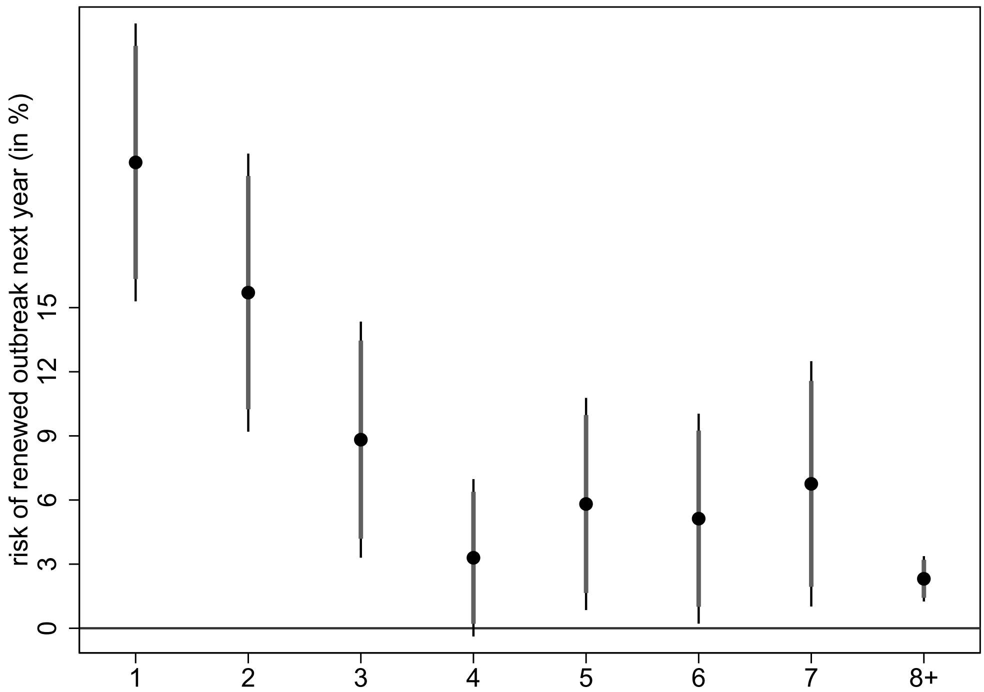

Figure 1: The Conflict Trap

Figure 1 has a second, more subtle, message as well. Thinking of risk as something that is fixed at the country level seems an oversimplification. Countries can and do escape ongoing episodes of conflict. If they manage to stay peaceful for 7 years the likelihood of having another conflict is fairly low on average. When thinking about country histories it therefore seems to make sense to think of episodes inside and outside the conflict trap.

We model the conflict trap through a discrete-time Markov process. The state space is composed by a state of conflict, multiple states of post-conflict collectively referred to as unstable peace, and a state of stable peace. We then link these states to real GDP per capita growth numbers through country fixed effects regressions. The combination of a Markov chain transition matrix and the state's effect on growth allows us to take a simulation-based approach in which the distribution of economic damage suffered by countries entering the conflict trap is simulated by drawing repeatedly from the regression coefficients and Markov transitions. Our main result is that entering civil war leads to an average real GDP per capita loss of close to 20%, a loss of 30% in the 75th percentile and a decline of close to 45% in the 90th percentile. In contrast to the conventional approach of reporting aggregate losses after a set number of years in conflict, our approach captures the long-term impact of a single year of conflict by accounting for the dynamics it initiates.[6] This emphasizes the detrimental effects of the conflict trap and highlights the significance of conflict prevention.

Making predictions of countries inside the conflict trap therefore seems key to our understanding of the developmental effects of conflict. We show that existing variables like ethnic and religious factionalization and polarization, the dependence on natural resources and political institutions can explain up to one quarter of the extent to which countries are affected by the conflict trap. We then use our simulation approach to highlight the differences in transition likliehoods and conflict damages between the most and less affected countries.

Our article relates to a large literature on the costs of conflict. Most closley related is the overview article by Rohner and Thoenig (2020) who also focus on the role of conflict traps and development. They identify a series of what they call *war traps* wherein self-reinforcing dynamics lead to vicious cycles of poverty and violence. They discuss how conflicts deteriorate material conditions and social ties, which in turn constitutes a powerful breeding ground for future violence. They conclude that studying the impact of conflict on development without taking into consideration conflict traps may lead to seriously wrong conclusions on the role of conflict for development. We contribute to this literature by proposing a conceptual framework to better capture the developmental impact of the conflict trap empirically.

Our model of the conflict trap is directly related to the literature in Macro studying economic growth in emerging economies. Aguiar and Gopinath (2007) note that emerging market growth is characterized by shocks to trend growth rather than transitory fluctuations around a stable trend. In other words, growth histories in emerging markets are characterized by long-lasting episodes in which economic growth is consistently low which are then followed by sudden growth spurts with a different trend growth. We argue here that this is the kind of growth behavior that conflict traps generate, i.e. they do not simply cause year-to-year volatility but longer episodes of low and high growth. Intense armed conflict could therefore be one reason for the empirical pattern observed by Aguiar and Gopinath (2007).

Finally we also contribute to an older literature that analyzes the causes of conflict. We show that issues like political institutions (Fearon and Laitin, Besley and Persson, Acemoglu and Robinson), natural resources (Dube and Vargas, Bazzi and Blattmann, Behrmann et al) and ethnic and religious composition (Esteban and Ray (1994), Montalvo and Reynal-Querol (2005), Michalopoulos and Papaioannou (2016)). However, we take a predictive approach in that we are trying to develop a model that predicts the presence of the conflict trap as good as possible. Interesting, our results here are very much in line

[6] For instance, Collier (1999) reported a 30% decrease in GDP per capita for countries experiencing 15 years of civil war, while Costalli et al. (2017) found a 15.7% decrease for a war duration of 9.5 years.

with the seminal paper by Fearon and Laitin in that we find ethnic factionalization is a main predictor of a persisting conflict trap. However, our results also suggest that non-linear and interactive effects are important when predicting conflict experiences.

The following section outlines the conceptual model of the conflict trap and its calibration and estimation. The simulation method is then described in Section 3. In Section 4, we present and discuss the results, followed by our conclusions in the final section. Figures of our results and robustness checks can be found in the Appendix.

2 Model

2.1 A Model of the Conflict Trap

This section presents our empirical model of the conflict trap. Our central assumption is that the transition between conflict and peace can be described by a discrete-time Markov process. The state space is composed of a state of conflict, multiple states of post-conflict collectively referred to as unstable peace, and a state of stable peace. The conflict trap consists of the conflict state and the multiple post-conflict peace states with decreasing risk of conflict resurgence shown in Figure 1.

When a country is in the state of conflict, it can either stay in conflict or transition to the first year of post-conflict peace. When a country is in this first year, it can either return to conflict or transition to the second year of post-conflict peace. This pattern repeats until the country reaches τ consecutive years of post-conflict peace. It can then go back to conflict or enter stable peace. Stable peace represents a state that is not conditioned by a conflict trap, which means, transitions to conflict are as if the country would have had no conflict to start with. τ determines the threshold of consecutive post-conflict years of peace needed to escape from the conflict trap.

The state space is defined as $S = \{0, 1, \ldots, i, \ldots, \tau, \tau + 1\}$ and t is the time indice. s_t is the state at period t, and $\boldsymbol{s^t} = \begin{pmatrix} s_0 & s_1 & \ldots & s_t \end{pmatrix}$ denotes the history until time t. The distribution of states at t is represented by $\boldsymbol{p_t} = \begin{pmatrix} p_{t,0} & p_{t,1} & \ldots & p_{t,\tau} & p_{t,\tau+1} \end{pmatrix}'$.

When $s_t = 0$, the country is in the state of *conflict*. If $s_t = k$ s.t. $k \in [1, \tau]$, the country is in the *kth consecutive year of post-conflict peace*. Finally, when $s_t = \tau + 1$, the country is in *stable peace*.

By the structure of the Markov process we assume, a country can only transition in two directions. This allows us to simplify the notation of the transition probabilities, making π_i to be the probability of transition to conflict from state i. Then, $1 - \pi_i$ is the probability of adding a year of peace from state i.

The transition matrix is

$$\mathbf{\Pi} = \begin{pmatrix} \pi_0 & 1-\pi_0 & 0 & \dots & 0 & 0 \\ \pi_1 & 0 & 1-\pi_1 & \dots & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \pi_\tau & 0 & 0 & \dots & 0 & 1-\pi_\tau \\ \pi_{\tau+1} & 0 & 0 & \dots & 0 & 1-\pi_{\tau+1} \end{pmatrix} \tag{1}$$

To capture the impact of conflict on development we focus on real GDP per capita. For this, we associate each of the states with growth numbers and then use these associations to simulate growth paths. Denote $GDP_t(\boldsymbol{s^t})$ as the real GDP per capita when the Markov process is at period t. At each period, the realization of the state affects real GDP per capita through the growth shock $u_{t+1}(s_{t+1})$ s.t.

$$GDP_{t+1}(\boldsymbol{s^t}, s_{t+1}) = GDP_t(\boldsymbol{s^t})(1 + u_{t+1}(s_{t+1})) \tag{2}$$

For example, if $u_2(0) = -0.01$, it implies that real GDP per capita has been reduced by 1% from period 1 to 2 in the state of conflict ($i = 0$). In the following section, the associations between the growth shock and the state will be estimated using country-fixed effects regressions.

Note, the assumption of a Markov process implies that the dynamics in all countries can be described by a single transition matrix. Importantly, this also means that the likelihood of re-entering the conflict during the stabilization process or from stable peace is not a function of the longer history of the country. This is obviously not realistic. Much of the conflict literature is linking armed conflict outcomes to their colonial history or geographic features. Some countries will have a higher baseline likelihood of conflict. However, we show in the appendix that predicting which countries will get stuck in the trap is surprisingly difficult. We return to this point in Section 4.

2.2 Calibration and Estimation

We calibrate and estimate the model using conflict history data (Uppsala Conflict Data Program, 2021). and real GDP per capita data (World Bank, 2021), which give a dataset for the years 1989-2021 and over 190 countries. The data is a yearly cross-country panel data so that t denotes years and j denotes countries.

From Figure 1 we know that the risk of renewed outbreak next year stabilizes for higher states. We choose $\tau = 7$ so be sure to have enough observations to have meaningful transition likelihoods.[7] This leads to a total of 9 states in our model.

The transition matrix is estimated using the relative frequencies of the observed transitions. The

[7] Mueller and Rauh (2022) show that conflict history loses its predictive power for renewed outbreaks between 4 and 10 years

Table 1: Estimated Transition Probabilities

Stay in Conflict	Unstable Peace to Conflict							Stable Peace to Conflict
$\hat{\pi}_0$	$\hat{\pi}_1$	$\hat{\pi}_2$	$\hat{\pi}_3$	$\hat{\pi}_4$	$\hat{\pi}_5$	$\hat{\pi}_6$	$\hat{\pi}_7$	$\hat{\pi}_8$
0.76	0.22	0.16	0.09	0.03	0.06	0.05	0.07	0.02

corresponding estimates are shown in Table 1. According to this model, the likelihood of staying in an additional year of conflict when starting in conflict is 76%. This leads to an expected duration of uninterrupted conflict of 4.17 years.[8] Once conflict ends, the likelihood of going back to conflict falls dramatically to 22% in the first year after conflict, 16% in the second year, and 7% after seven years in peace. Finally, the baseline likelihood of conflict is just 2% in stable peace. In the simulation, we make stable peace absorbing to force all countries to end in stable peace. This allows us to capture the net aggregate effect of a conflict trap.

This pattern of high persistence in conflict and falling risks in post-conflict is extremely robust across country samples and definitions of conflict. It captures the fact that many countries are caught in repeated cycles of violence. On average, it takes 18.46 years, i.e. almost two decades, to escape the trap.[9]

We regress real GDP per capita growth on a set of dummy variables d_{ijt} that correspond to the state of country j at period t. The regression equation is

$$Growth_{jt} = \sum_{i=0}^{\tau+1} \beta_i d_{ijt} + \mu_j + \gamma_t + \varepsilon_{jt}, \tag{3}$$

where μ_j and γ_t represent country and time fixed effects respectively. The results are shown in Table A1. A year in conflict lowers growth by 3 percentage points. This result lies inside the bounds of the literature but is a relatively large coefficient given that we classify a lot more years as conflict compared to the standard 1000 fatalities threshold.[10] The coefficients of the rest of the states are positive, showing some post-conflict recovery, although these are not significant. We also use a more demanding specification with country time trends which we show in Table A1.

Stable peace is the omitted category in our regressions and when simulating we normalize growth to 0, i.e. $\hat{u}_t(\tau+1) = 0 \ \forall t$. For the rest of the states, we use the estimates from our regressions and their standard deviations to account for the imprecision of the estimation. Formally, for $h < \tau + 1$, $u_t(h) \sim \mathcal{N}(\hat{\beta}_h, \hat{\sigma}_h^{SE})$ with $\hat{\sigma}_h^{SE}$ being the standard error of β_h. This means that real GDP per capita growth is stochastic for all states but not for stable peace due to the 0 growth normalization that we impose. We can consolidate all the states' growth shock distributions into a single element by defining the estimated vector of states' growth shock distributions as $\hat{\boldsymbol{f}}_{\boldsymbol{u}} = \begin{pmatrix} 0 & \mathcal{N}(\hat{\beta}_0, \hat{\sigma}_0^{SE}) & \ldots & \mathcal{N}(\hat{\beta}_{\tau+1}, \hat{\sigma}_{\tau+1}^{SE}) \end{pmatrix}$. Assumptions

[8]We calculate it using the geometric distribution formula: $1/(1-\hat{\pi}_0)$.

[9]To obtain this statistic one can use the fundamental matrix of $\hat{\boldsymbol{\Pi}}$ when stable peace is set to be an absorbing state. Among other statistics, it gives the expected number of periods until being absorbed from conflict, which is equivalent to the expected number of periods to reach state peace for the first time from conflict.

[10]The reason is that defining conflict relative to population is a better model of conflict damage.

regarding the baseline growth do not affect the relative GDP losses we show in the results.

Then, given our estimated transition matrix ($\hat{\mathbf{\Pi}}$) and the estimated distributions of the growth shocks ($\hat{\boldsymbol{f}}_{\boldsymbol{u}}$) we can simulate growth paths that countries experience as they move through the state space.

3 Simulation of the Conflict Trap

To estimate the overall loss from the conflict trap, we simulate the Markov process of a country with $GDP_0 = 100$. We simulate the Markov process assuming that countries start in conflict, i.e., $\boldsymbol{p_0} = \begin{pmatrix} 1 & 0 & \dots & 0 \end{pmatrix}'$ and making stable peace absorbing to capture the net aggregate effect of a conflict trap. This leads to a clear comparison with a counterfactual in which the country remains in peace and stays there. Then, we draw transition paths from the estimated transition matrix and the growth numbers from the estimated distribution of the growth shocks. The simulation has $T = 30$ periods and it is repeated $N = 100,000$ times to get a good sense of the distribution of the resulting loss when compared to the baseline. Finally, we compute statistics that describe the distribution of real GDP per capita at each period.

4 Results

The results of the simulations are shown in Figure 2. Since all countries start in conflict, the average loss increase sharply. Then, as time goes by, more countries reach absorbing stable peace which means that growth converges back to the baseline growth rate. The average aggregate loss in real GDP per capita after 30 years is almost 20%. Importantly, there is a large heterogeneity across simulations with the 75th percentile experiencing a decline of 30% while the 90th percentile declines by almost 45%.

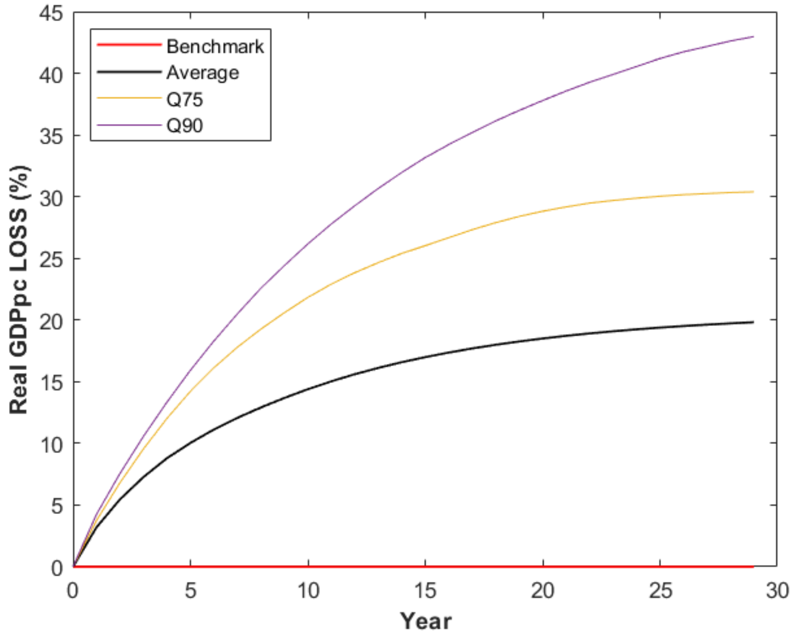

Figure 2: Evolution of real GDP per capita loss with an initial period of conflict and absorbing stable peace. ($T = 30$, $N = 100,000$)

This is a large effect. Median growth of GDP per capita in the 30 years between 1990 to 2020 was about 50 percent. According to our estimates, this gain would be almost compensated by the conflict trap for the worst conflict-affected countries. In other words, doing better or worse inside the conflict trap can explain substantial changes in the long run.[11]

Note that our novel approach leads to a nuanced interpretation of the results, which differs from the conflict literature where aggregate losses are typically reported based on a predetermined number of years in conflict. Instead, we only impose a starting year in conflict, and the rest of the incurred losses are a result of the estimated conflict dynamics, i.e., the conflict trap. This emphasizes the importance of conflict prevention by underscoring the significant losses induced by one random year of conflict.

As a robustness check, we split the sample up into two parts - one relatively peaceful and one relatively violent. To reduce the problem of ad-hoc ways of splitting the data we use a summary measure of conflictousness derived from the conflict literature. First, we use machine learning to predict the extent to which a country will experience the conflict trap using a set of variables used in the cross-country literature: continents, ethnic and religious composition, natural resources, and political institutions. We find that predicting the extent of the conflict trap in this way is relatively hard ex-ante with an R-squared of less than 20 percent. Second, we use the fitted value from this exercise to generate two samples with the

[11]We checked whether the random growth element coming from the growth regression alone can explain some of this variation. We find that the long run level changes that could be explained by this part are extremely small. See Figure A4 in the Appendix.

same total number of years of conflict. In the larger and less conflict-prone sample, referred to as *peaceful sample (PS)*, countries have low predicted conflict scores. In the smaller and more conflict-prone sample, referred to as *conflict sample (CS)*, countries have higher scores. We then repeat our analysis on these two samples including the re-estimation of the transition matrices ($\hat{\mathbf{\Pi}}^{PS}, \hat{\mathbf{\Pi}}^{CS}$) and the vector of states' growth shock distributions ($\hat{f}_u^{PS}, \hat{f}_u^{CS}$) . The transition matrices and estimation results are presented in Appendix Tables AX and AX+1.

The transition probabilities show that the likelihood of transitioning to conflict is generally and significantly higher in the conflict sample, indicating a higher tendency to remain in the conflict trap. Specifically, the expected duration of uninterrupted conflict is 3.7 years for the peaceful sample and 4.76 years for the conflict one. Meanwhile, the expected number of periods in the conflict trap is 15.51 for the peaceful sample and 23.7 for the conflict one.

Regarding the growth distributions, the beta coefficients for the conflict state show that an year in conflict lowers growth by 4.2 p.p. in a peaceful country and 2.2 p.p. in a prone to conflict one. However, there are no significant differences for the other states. The larger negative impact of conflict in peaceful countries may be attributed to various factors, such as conflict-prone countries relying more on economic sectors that are less vulnerable to conflict, with natural resources being a seminal example. Natural resources increase a country's risk of conflict since it provides an income stream that is disconnected from the general economic activity or political environment. Moreover, conflict countries might have developed a stronger ability to adapt to conflict-related disruptions.

Therefore, despite the conflict sample exhibiting a more severe conflict trap, the actual impact of conflict is lower than that in the peaceful one.

To evaluate the impact of the change in the transition matrices alone, we simulate the model using the different sample transition matrices ($\hat{\mathbf{\Pi}}^{PS}, \hat{\mathbf{\Pi}}^{CS}$) but the same growth shock distributions, specifically the unconditional one used in the general case ($\hat{f}_u$). The results are shown in the first row of Figure X, and they indicate that the higher transition probabilities from the estimation with the conflict sample lead to significantly greater losses. Additionally, we observe that the loss stabilizes within the 30-year window when using the peaceful transition matrix, whereas the conflicted one is still far from stabilizing. This indicates that the negative impact of the conflict trap persists even after 30 years when using the estimated transition matrix of a conflict-prone country. Therefore, identifying the scope of the conflict trap is crucial in accurately quantifying the economic effect of conflict.

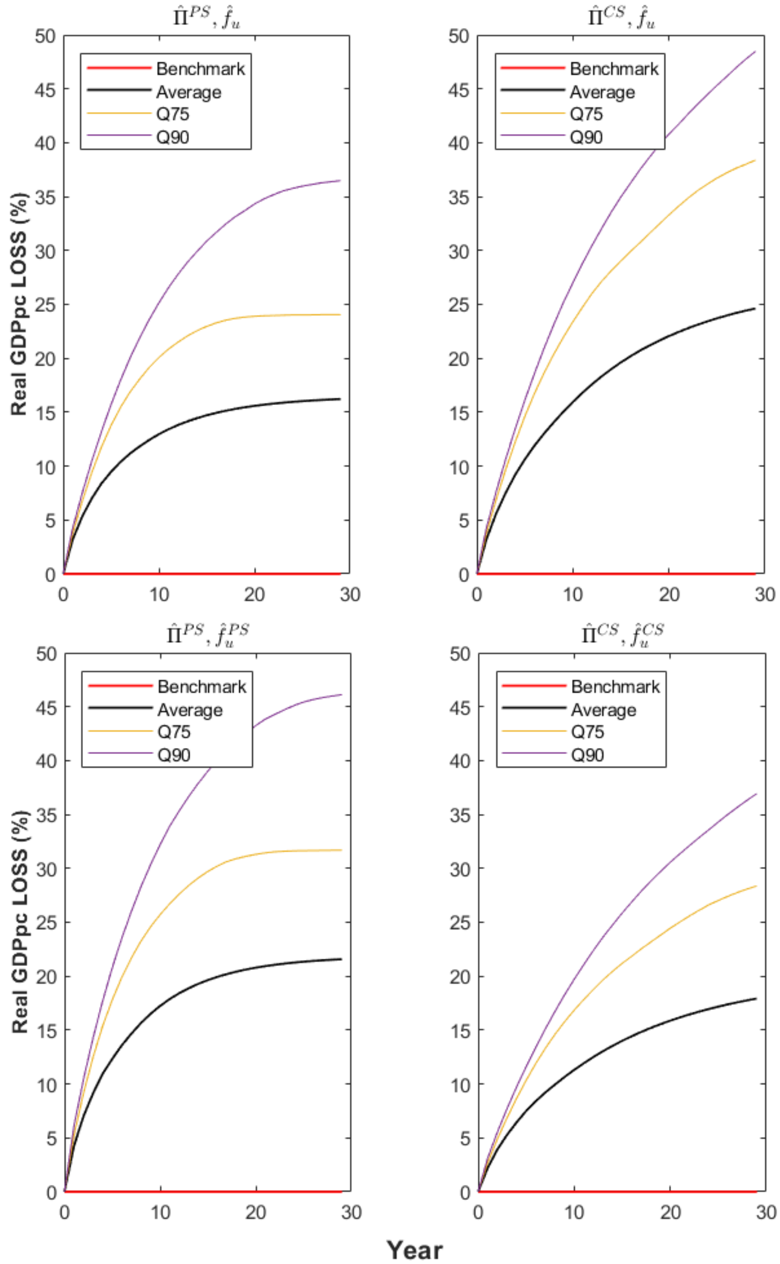

Figure 3: Robsutness checks ($T = 30$, $N = 100,000$)

The results of the simulations where we condition on both, the transition matrices ($\hat{\boldsymbol{\Pi}}^{\boldsymbol{PS}}, \hat{\boldsymbol{\Pi}}^{\boldsymbol{CS}}$) and the estimated vector of states' growth distributions ($\hat{\boldsymbol{f}}_{\boldsymbol{u}}^{\boldsymbol{PS}}$, $\hat{\boldsymbol{f}}_{\boldsymbol{u}}^{\boldsymbol{CS}}$), are displayed in the second row of Figure 4. The effect of the change of growth shock distribution dominates the one of the transition probabilities for the mean loss, and even more for the top percentiles. Consistent with previous simulations, the losses stabilize more quickly in the peaceful sample, while in the conflict sample, losses continue to increase beyond the 30-year horizon. However, the losses in the conflict sample will not ultimately exceed those in the peaceful one.

Therefore, although peaceful countries may seem less vulnerable to the conflict trap than conflict-prone countries, our simulations show that they are not immune to its devastating effects. Therefore, policymakers in peaceful countries should not overlook the risk of conflict and must take proactive measures to prevent it.

5 Conclusion

The aim of this study is to enhance our comprehension of the long-term developmental consequences of conflict. To achieve this, we propose a conceptual framework that helps to bridge the gap between cross-country variations in economic development and the relatively smaller impact of civil war in within-country analyses. Our framework incorporates the post-conflict period, which is characterized by a phenomenon known as the ”conflict trap” - a period of recurrent violence after an initial outbreak.

We define conflict as a level of per capita violence that significantly damages the macroeconomy, and we describe the conflict dynamics using a discrete-time Markov process. This process involves a state of conflict, several states of post-conflict collectively referred to as unstable peace, and a state of stable peace. We estimate the transition probabilities and the distribution of the states' impact on economic growth using fixed-effects estimation on cross-country panel data. This allows us to simulate growth paths that countries experience as they progress through the state space.

The simulation results indicate that entering conflict will induce a average loss in real GDP per capita by close to 20%, a loss of 30% in the 75th percentile, and a decline of nearly 45% in the 90th percentile. This is despite the fact that only one year of conflict is imposed, and the remainder of the losses are due to the estimated conflict dynamics, namely the conflict trap. This approach presents a nuanced interpretation of the results, which contrasts with the conflict literature, where aggregate losses are generally reported based on a predetermined number of years in conflict. It highlights the significance of conflict prevention by underscoring the severe losses incurred by one random year of conflict.

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Online Appendices

A Definition of Conflict

We define civil war as an intensity that significantly harms the economy. To find the threshold we order country/years according to their violence intensity and bin them into deciles. We then run a country-fixed effects regression of growth on these deciles. The results are displayed in Figure A1 below. Point estimates on the decile dummies are displayed as circles where bars indicate significance at 5 and 10%. A clear pattern emerges in which the most intense conflicts are also associated with the largest contraction of GDP per capita. The coefficients at the 7th, 8th, 9th, and 10th decile are significantly negative at the 5% level.

B Predicting the Conflict Trap

We use two simple models to predict the conflict trap: a linear lasso regression and a random forest. The predicted score is the share of years that the country is in the conflict trap in the period 1989-2021. We use only variables that are pre-determined to this period: a set of continent dummies, the share of GDP produced in the natural resource sector in the previous years, the earlier average over the polity2 score, executive constraints, executive openness and executive competitiveness from PolityIV, ethnic and religious fractionalizatin and polarization scores from Esteban et al (2015). We impute the average values for all variables with missing values. This does not affect the R-squared substantially.

We then use cross validation to tune hyperparameters $(lasso - alpha : 0.0001, randomforest - max\_depth : 4, min\_samples_leaf : 20, n\_estimators : 500)$ and to calculate the R-squared statistics. For the random forest the R-squared score is 0.128, for the lasso regression this is 0.149 and when we combine both through an average we get 0.173. We therefore always stick to the average (ensemble). In Figure A2 below we show the importance in the random forest and in Figure A3 we show the within-fitted values when compared to the actual variation.

C Appendix Figures

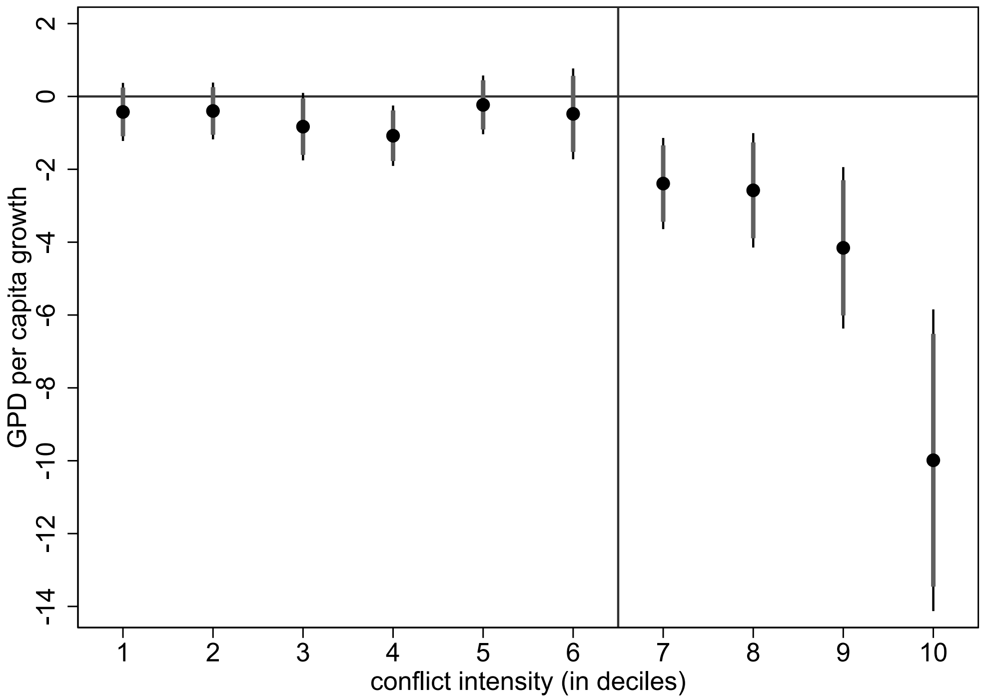

Figure A1: Violence Intensity and Economic Growth

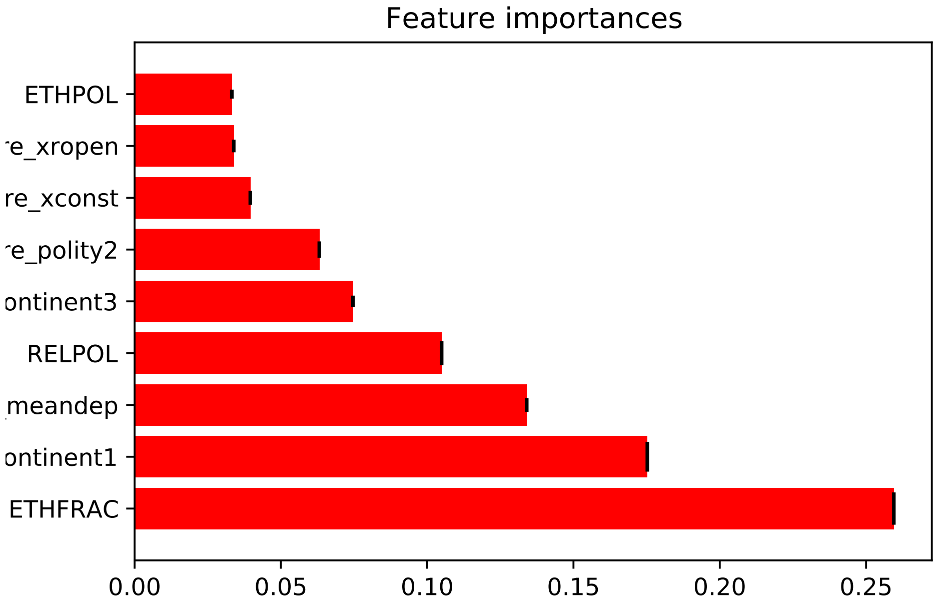

Figure A2: Importances of Random Forest when Predicting Conflict Trap

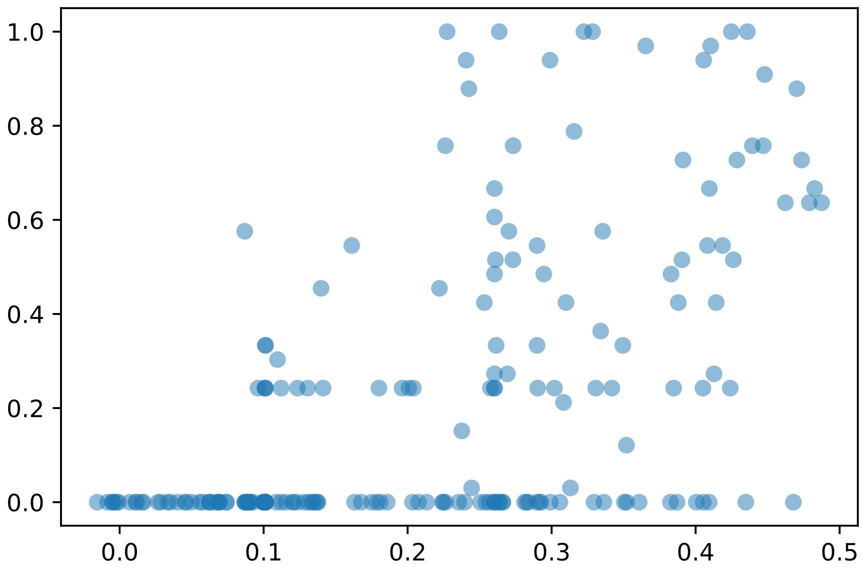

Figure A3: Fitted Values of Ensemble Model and Actual Values

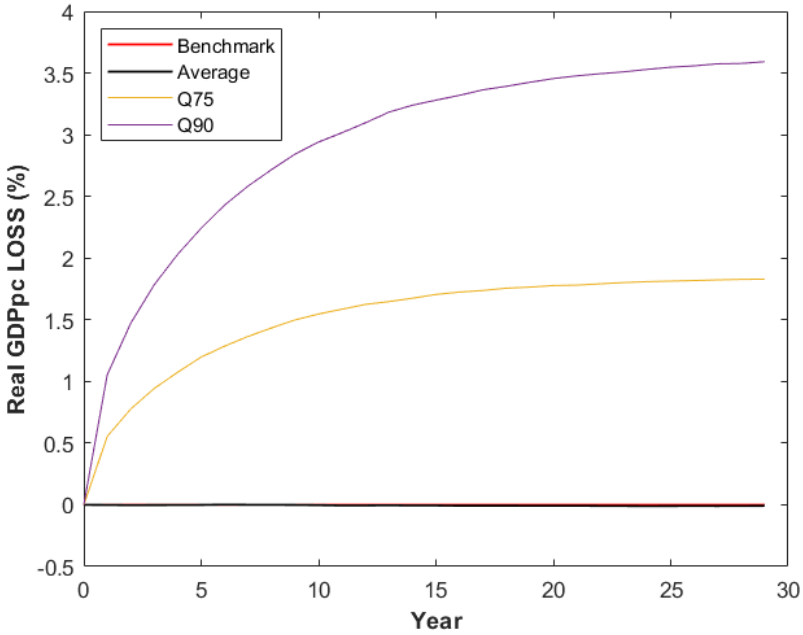

Figure A4: Evolution of real GDP per capita loss with an initial period of conflict and absorbing stable peace ($T = 30$, $N = 100,000$). To account for the loss resulting from the random growth element in the growth regression, we simulate the model with $u_t(h) \sim \mathcal{N}(0, \hat{\sigma}_h^{SE})$ for $h < \tau + 1$.

D Appendix Tables

Table A1: Fixed-Effects Estimation

	Real GDPpc Growth	Real GDPpc Growth
Conflict	-0.0320***	-0.0371***
	(0.00823)	(0.00851)
1st Year Post-conflict Peace	0.00481	0.00542
	(0.00761)	(0.00770)
2nd Year Post-conflict Peace	0.00176	0.00154
	(0.00713)	(0.00708)
3rd Year Post-conflict Peace	0.000921	0.000591
	(0.00633)	(0.00677)
4th Year Post-conflict Peace	0.00608	0.00655
	(0.00562)	(0.00587)
5th Year Post-conflict Peace	0.000295	0.000269
	(0.00503)	(0.00502)
6th Year Post-conflict Peace	0.00217	0.00173
	(0.00461)	(0.00519)
7th Year Post-conflict Peace	0.00155	0.00103
	(0.00417)	(0.00464)
Country FE	Yes	Yes
Time FE	Yes	Yes
Country Time Trends	No	Yes
Observations	5730	5730
R^2	0.11	0.11

Robust Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A2: Estimated Transition Probabilities of Not Conflicted sample and Conflicted

	Stay in Conflict	Unstable Peace to Conflict							Stable Peace to Conflict
	$\hat{\pi}_0$	$\hat{\pi}_1$	$\hat{\pi}_2$	$\hat{\pi}_3$	$\hat{\pi}_4$	$\hat{\pi}_5$	$\hat{\pi}_6$	$\hat{\pi}_7$	$\hat{\pi}_8$
Peaceful	0.73	0.22	0.10	0.1	0.04	0.04	0.02	0.02	0.01
Conflict	0.79	0.22	0.22	0.07	0.03	0.08	0.09	0.14	0.04

Table A3: Fixed-Effects Estimation for model

	Real GDPpc Growth PC	Real GDPpc Growth CS
Conflict	-0.0426**	-0.0222**
	(0.0145)	(0.00709)
1st Year Post-conflict Peace	0.00866	0.00131
	(0.0125)	(0.00829)
2nd Year Post-conflict Peace	0.00296	0.00442
	(0.0113)	(0.00751)
3rd Year Post-conflict Peace	-0.00319	0.00276
	(0.00962)	(0.00757)
4th Year Post-conflict Peace	0.00797	-0.00201
	(0.00655)	(0.0101)
5th Year Post-conflict Peace	-0.00381	0.00366
	(0.00759)	(0.00660)
6th Year Post-conflict Peace	-0.000126	0.00184
	(0.00580)	(0.00696)
7th Year Post-conflict Peace	-0.00317	0.00376
	(0.00503)	(0.00785)
Country FE	Yes	Yes
Time FE	Yes	Yes
Country Time Trends	No	No
Observations	4369	1361
R^2	0.10	0.10

Robust Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$