Stuck in a Conflict Trap
The Case of the Central African Republic Civil War

Pierre Mandon
Vincent Nossek
Diderot Sandjong Tomi
Abstract

This paper uses the synthetic control method to assess the impact of the civil war in the Central African Republic on the main socioeconomic indicators. Based on a donor pool of low-income countries, the paper builds a synthetic counterfactual to evaluate the magnitude of the socioeconomic impacts of the civil war. The results indicate that the civil war led to a significant drop in gross domestic product per capita (41.6 percent), nighttime light intensity (33.8 percent), industrial production (34.1 percent), manufacturing value added (33.7 percent), and the human asset index (20.2 percent), from 2013, which is considered as the starting point of the ongoing political and civil crisis.
Stuck in a Conflict Trap: The Case of the Central African Republic Civil War

Pierre Mandon\textsuperscript{a}, Vincent Nossek\textsuperscript{a,b}, Diderot Sandjong Tomi\textsuperscript{a,c}

\textsuperscript{a}: World Bank Group
\textsuperscript{b}: CERDI, University Clermont Auvergne (UCA)
\textsuperscript{c}: University of Ottawa

The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

Keywords: C31; D74; O11

JEL codes: Central African Republic; Civil war; Development trap; Synthetic control method
Introduction

To what extent have repeated cycles of conflict and violence derailed socio-economic development of the Central African Republic (CAR)? The cycle of conflict in this paper refers to the CAR civil war that officially began in December 2012 and which is still ongoing, mainly in the northern and western borders as well as in the eastern part of the country. Following the signature of the peace accord (the Political Agreement for Peace and Stability, or APPR in French acronym) in February 2019 between the government and leaders of the 14 armed groups, the prospect for a gradual return to peace and stabilization surfaced but was quickly thwarted in early 2021 following the presidential elections of December 27, 2020. In contrast to previous coups and the first civil war officially called the “CAR Bush war” of 2004-07, CAR’s civil war is exceptional in many ways. First, its duration is remarkable since it lasted 10 years and is still ongoing. Second, the conflict has had a significant extension. For instance, between mid-December 2012 and January 2014, the capital city of Bangui was captured by rebel groups, and transport along the country’s two main international transit corridors, namely the Ubangi River and Douala-Bangui road axis, was severely disrupted during the initial phase of the war. Third, the parties to the conflict display a high degree of fragmentation as evidenced by the involvement of numerous armed groups and the “de facto” partition of the country into a network of fiefdoms. Finally, the intensity of the conflict is alarming. It has been marked by widespread ethnic cleansing, including extrajudicial killings, rape, and massive forced internal and international displacement. As identified by the latest World Bank Country Economic Memorandum (1) these factors have had massive impacts on the overall fragility of the country. The appendix to this paper provides more background and context of the CAR’s civil war.

The contemporary academic literature regarding the economic costs of conflicts originated with the work of Organski and Kugler (1977) (2) who examined the impact of World Wars I and II (WW I and WW II) on European countries. Since then, an extensive literature has emerged to quantify the impact of conflicts (in a broad sense) on economic outcomes across different countries and periods (3). Different techniques have been adopted to capture the economic costs of conflicts, including the cost accounting method (4), cross-country regression methods (5), econometrics on time-series data (6), and econometrics on panel data (7). In the 2000s, a new methodology, proposed by Abadie and Gardeazabal (2003) (8) called the synthetic control method (SCM hereafter), emerged, originally to quantify the GDP loss due to local conflict in Spain. More precisely, they analyzed the economic costs of the conflict, with the armed Basque nationalist and far left separatist organization Euskadi Ta Askatasuna (ETA), in the Basque Country from 1975 to 1997 by constructing a ‘synthetic’ region composed of two other Spanish regions (Catalonia and Madrid) as a comparator or “counterfactual”. Based on this counterfactual, they concluded that per capita GDP in the Basque region fell by about 10 percent compared to what it would have been if the conflict had not occurred. More recently, Matta et al. (2017) (9) found a loss of about 5.7 percent of per capita GDP due to a drop in gross capital formation in Tunisia in the three years following the Arab Spring; Kešeljević and Spruk (2023) (10) found a loss of about 14 percent of per capita GDP in the Syrian Arab Republic in the nine years following the civil war.
Beyond these three papers, the SCM has been used to assess the economic impacts of several revolts and conflicts, including the *Arab Spring* in the Arab Republic of Egypt (11) and Libya (12), the Donbass war in Ukraine (13), the Kurdish separatism in Türkiye (14,15), the Second Intifada for the Israeli economy (16), and the Yugoslav civil war (17). The SCM is a powerful statistical technique that has gained prominence in the field of program evaluation and causal inference. It has numerous advantages and is well adapted to our case of study for the following reasons developed in Abadie *et al.* (2010, 2015) (18,19):

- The SCM is suitable for undertaking causal inference. One of the primary advantages of SCM is its ability to provide causal estimates. SCM enables researchers to assess the causal impact of a policy, event or treatment by constructing a synthetic control group that closely resembles the treated unit before the intervention. By comparing the post-intervention outcomes of the treated unit with the synthetic control, researchers can estimate the causal effect of the policy or treatment.

- Estimates derived from the SCM are robust even in a small sample setting. The SCM is particularly valuable in settings where the number of treated and control units are small, which is typically an inadequate situation for the use of traditional matching or difference-in-differences (DiD) approaches.

- The SCM considers the pre-intervention dynamics of the treated unit. This implies that it does not rely on parallel pre-implementation trends like DiD for instance; unlike other methods that rely on post-intervention data only, SCM constructs a synthetic control group that captures the pre-intervention trends and characteristics of the treated unit. This makes the method robust to potential confounding factors and allows for more accurate causal inferences.

- The SCM enables researchers to estimate the counterfactual scenario by constructing a synthetic control that represents what would have happened to the treated unit in the absence of the policy or treatment. This counterfactual estimation is crucial for evaluating the effectiveness of interventions and guiding policy decisions, or in our case, to evaluate the impact of the CAR civil war.

- The SCM is a transparent and replicable method as the construction of the synthetic control group involves clear and systematic processes, allowing other researchers to reproduce the results and assess the robustness of the findings. This transparency enhances the credibility and reliability of the estimated causal effects.

In summary, the SCM offers several advantages that make it an indispensable tool for causal inference and impact evaluation. Specifically, there are three key issues that motivated our
preference for the SCM compared to Difference-in-Difference (DiD) approaches. First, a DiD approach could conflate differences in outcomes associated with the war with differences due to pre-treatment characteristics associated with war if the control group was not similar enough to the CAR. The SCM is guaranteed to be at least as similar to CAR as a simple weighted mean of control states or any one other control country (19). Second, traditional DiD methods assume unobserved confounders are time constant, whereas the effects of pre-war confounders do not have to be time constant in the synthetic control method (20). Third, traditional DiD methods provide asymptotic large-sample inference that is inappropriate given the comparative case study design, whereas the synthetic control method uses exact inference (21).

Compared to the previous studies, the contributions of this paper are threefold. First, we assess the costs of conflict in the specific context of the CAR civil war from 2013, mainly through a descriptive analysis. Second, we take advantage of recent progress in satellite nighttime lights, or NTL measurements (22) to bypass the lack of data inherent to low-income countries, or LICs (like the CAR), and to control for potentially artificially inflated GDP figures due to political economy reasons (23). Finally, we expand the analysis beyond the potential loss of GDP (and lights intensity) and explore the potential detrimental impact of the civil war on the sectoral composition of the economy, and key social indicators (acknowledging the quantitative literature on the social costs of conflicts is much scarcer (10,24,25)) to establish the diagnostic of a possible conflict trap.

We recognize however some limitations in the analysis. The choice to select all other LICs for the potential donor pool to build our counterfactual is explained both for practical and transparency reasons (see the Methodology section for more details) and for structural reasons (although each country is unique and has a specific national context, all LICs face the challenges of structural vulnerability and development trap (26)). These states, however, are also more likely to experience large-scale social unrest and localized armed conflicts (27). If some of the LICs in the donor pool are selected ex-post in the synthetic control, while they also suffered consequences of conflicts during 2013-17, the estimates provided here can be considered conservative.

We did not find any other paper assessing the socio-economic impacts of the CAR civil war using the SCM, so far. Although SCM has been previously used in the literature to assess the economic impact of local conflicts and revolts (8–10) and the social and institutional impacts of civil war (10), we expand the analysis on a variety of key macro-socio indicators, including the innovative satellite NTL extended time series (22), the sectoral composition of the economy, and a reduced version of the human asset index (28) to establish the formal diagnostic of a conflict trap (29), or fragility trap (1). Over the period 2012-17, we find that the civil war led to a significant drop in GDP per capita (41.6 percent), NTL intensity (33.9 percent), industrial production (34 percent), manufacturing value added (33.7 percent), and human asset index (20.2 percent). These results are consistent with Abadie and Gardeazabal (2003) and Matta et al. (2017) (8,9), although the magnitude of the adverse socio-economic impacts of the CAR’s civil war seem significantly worse, with cumulative GDP per capita loss found to be between 2.9 times and 7.3 times larger than in
these two studies. We also highlight an economic loss about 3.1 higher than found in Kešeljević and Spruk (2023) (10) although the authors also identify dramatic human development and infant mortality costs of the Syrian civil war. To the best of our knowledge, the estimated cumulative loss of GDP per capita during the CAR civil war is among the highest in the academic literature, just below the Libyan case between 2011-14 (12)– which was a mix of revolts following the Arab Spring, a civil war and an international war– and comparable in magnitude with the local cumulative loss of GDP found in the Donetsk and Luhansk Oblasts of Ukraine between 2013-16 (13).

It is important to note that we do not discuss here any potential solution for the CAR, including the potential role of official development aid, structural reforms and financing programs (1,30–34). The remainder of the paper is structured as follows: The first section presents the methodology used to estimate the socio-economic impacts of the 2013 civil war in CAR as well as our identification strategy. The second section elaborates on the key variables used and data. The third section presents the empirical results. The last section provides some concluding remarks.

**Methodology and identification strategy**

To assess the socio-economic impacts of the 2013 civil war in CAR, we consider country-year level data, with a post-'treatment’ period starting in 2013. We distinguish two phases in the civil war: the period 2013-14, when the Séléka rebel coalition took over Bangui and a subsequent period (2015-17) when the conflict has fragmented into several localized skirmishes concentrated mostly in regions (called locally Préfectures) close to the northern and western borders and in the East of the country. We do not go beyond 2017 to avoid noisy effects possibly coming from more recent events (e.g., Wagner group starting to operate in 2018, leading to the cut of budget support from France and other traditional partners; the COVID-19 lockdowns, the crypto-asset law of 2022). As the main macro-socio indicators, we focused on GDP per capita, industrial value added and manufacturing value added (over GDP) from the World Development Indicators (35), satellite NTL from the DMSP data (22), and a reduced version of the (harmonized) human asset index.

We use a SCM to estimate the expected levels of our key outcomes in the absence of war and compare theses to the observed actual series to quantify the war’s impact on CAR’s socio-economic development during the period 2013-17. This method provides causal estimates and incorporates pre-intervention dynamics, especially with small-N settings. It has previously been used to estimate the effects of local conflicts and massive revolts (8,9) although these papers focused only on the evolution (and demand decomposition) of GDP per capita series after the events. More recently, the SCM has also been used to assess the social and institutional impacts of the Syrian civil war (10). We used permutation (or placebo) tests to assess whether our results could be due to chance.
We rely on the SCM initially proposed by Abadie and Gardeazabal (2003) (8), then developed and proposed by Abadie et al. (2010, 2015) (18,19). The method uses a weighted combination of unit of observations (i.e., countries) to create a `synthetic' control CAR, which provides an estimate of expected socio-economic outcomes of interest (i.e., GDP per capita, satellite NTL, industrial and manufacturing valued added, human asset index) if the civil war (our ‘treatment') had not occurred. The countries that comprise CAR’s synthetic control are selected by using all pre-2012 outcomes (36) among a donor pool of comprising all LICs according to the World Bank classification to avoid pre-selection bias in the composition of the donor pool, with the exception of Afghanistan, the Syrian Arab Republic and the Republic of Yemen which faced a mix of interstate and civil armed conflicts, including in the perimeter of their capital cities during the same period (see Table A1, for more details). Those that are best able to predict the pre-2012 outcome trends in CAR are chosen for the synthetic control group. The expected socio-economic outcomes for CAR from 2012-17 in the absence of civil war are then compared against the observed outcomes. A difference between the observed and expected values can therefore be interpreted as the impact of the civil war on our outcomes of interest.

Formally, the synthetic outcomes are computed as follows:

$$\hat{Y}_{Synth;t} = \sum_{r=1}^{R} w_r^* Y_{r;t},$$

where $Y_r$ and $Y_{Synth}$ stand for respectively for the outcome of interest in country $r$ and synthetic CAR, at year $t$, $R$ stands for the vector of countries in the donor pool, and $w_r^*$ stands to the optimal weight attached to country $r$. The impact of civil war on CAR’s development outcomes can therefore be calculated as follows:

$$\alpha_t = Y_{CAR;t} - \hat{Y}_{Synth;t},$$

for years $\geq 2013$, where $\alpha_t$ stands for the post-treatment impact and $Y_{CAR}$ stands for the outcome of interest in CAR.

While traditional statistical inference techniques do not work with this approach, given the small sample size, a permutation test (also called placebo test) can be used to assess how unusual such an effect would be if it were due to chance and thus control for the effect size. This permutation test involves implementing the synthetic control technique for each country in our donor pool, as though it were the one that had experienced civil war during 2012-17. The estimated effect for CAR can then be compared to the size of these other effect estimates. Typically, the permutation test results are compared for states in which pre-war outcome trends are well predicted by the synthetic control. Results of the test for all countries, in addition to the results for those states with up to 5 times the mean squared prediction error (MSPE) observed for CAR are presented. Countries with a poorly matched synthetic control might indeed appear to have more extreme differences as an artifact of poor prediction.
By examining the effects of the CAR civil war on GDP per capita, NTL intensity, and various economic indicators such as industrial and manufacturing value added, as well as social indicators represented by the human asset index, it becomes possible to determine whether the observed shock to GDP is genuine or merely a statistical artifact. Additionally, this analysis helps evaluate the negative consequences of the civil conflict on crucial macroeconomic factors, ultimately affecting long-term development.

Data and variables

As a proxy of economic development, we consider the GDP per capita in purchasing power parity (in constant 2017 international US dollars) from the World Development Indicators (35) from 1990 (the first year available for CAR) up to 2017, as in Matta et al. (2019) (9).

When accounting for satellite NTL intensity, we use the Defense Meteorological Satellite Program (DMSP) data from the Earth Observation Group (EIG) at Colorado Schools of Mine’s (Ghosh et al., 2021) (22), as they provide original DMSP-OLS data from 1992 to 2013 but also an extended version of the DMSP NTL from 2013 to 2021. The regular DMSP NTL series has been discontinued after 2013 for two mains reasons. First the launch of a new generation of satellites equipped with more capable sensors, named Visible Infrared Imaging Radiometer Suite (VIIRS), providing more accurate NTL data. Second the orbital shifts from day/night to dawn/dusk of previously used DMSP satellites. The shift to NTL data collected by VIIRS prevented the use of NTL data for long temporal analysis and pushed researchers to produce harmonized data series combining DMSP and VIIRS data. Ghosh et al. (2021) provide consistent time series for the NTL from 1992 to 2021 by exploiting the constant orbital shift of satellites, which brought back older DMSP satellites (F15 and F16) into a usable day/night cycle to continue data collection with DMSP satellites. To have harmonized series for CAR, we select the period 2005-2017 as 2005 saw major structural reforms for Enerca (the main energy utility company of the CAR) and a policy shift towards liberalization of the electricity sector. We extract the sum of the NTL within a buffer zone of a 10 km radius around the capital location of each country. The sum of the NTL gives an aggregate that is a good proxy for electric power output (37) as well as economic activity (38) both at the national and local level. We use the capital as a reference city for a country rather than the all country to improve the signal-to-noise ratio of the NTL time series, as LICs tend to have poor electricity infrastructure, and the NTL data would measure large areas of noisy data. Capitals are usually the most infrastructure rich and economically dynamic locations (especially in LICs) and are therefore indicative proxies in the case of economic shocks.

Data on the share of industrial (including construction) and manufacturing value added over GDP are derived from the World Development Indicators from 2009 (the first year available for CAR) up to 2017. Due to lack of data the pre-treatment period for these two outcomes is limited, but the use of these indicators enables us to check consistency in our results. Due to large differences in sectoral composition among our donor pool of LICs and CAR, we convert the indicators in index base 100 in 2012 (i.e., just before the first clashes) which enables us to capture sectoral dynamics after the start of the civil war.
Finally, we use a reduced version of the human asset index taken from Feindouno and Goujon (2019) (28). Their HAI is a simple composite index from 0 (low score) to 100 (best score) which includes four subcomponents: i) undernourishment index, ii) the under five years old mortality index, iii) the adult literacy rate index, and iv) the secondary school enrollment index. We recompute the HAI by excluding the adult literacy rate index as it is difficult to interpret this indicator in post-war situation for CAR due to the significant number people registered as international refugees (744, 000 or 13.3 percent of the population at end of 2022), mostly in neighboring countries, comprising an unknown proportion of literate and illiterate adults. The reduced version of HAI is available from 1990 (the first year available for CAR) up to 2014, which enables us to only capture the short-term impact of the civil war during the rule of Michel Djotodia as the President of the Republic after the Séléka rebel coalition took over Bangui.

Table A1 lists the countries included in the synthetic controls, along with their weights. It also provides pre-war and post-war outcome values in CAR for the synthetic controls. Additionally, this table displays CAR MSPE in the pre-war period for each type of outcome, offering a comprehensive overview of the synthetic controls' performance.

**Empirical results**

CAR has faced a persistent lack of economic growth since gaining independence in 1960. The country’s history of political instability is characterized by a series of coups, which led to a fragile institutional framework and a decline in overall productivity. This decline is noticeable in the absence of structural transformation, limited technological progress and innovation, and poor management of both public and private enterprises. Moreover, the country’s GDP per capita in 2012 was equivalent to the level recorded in 1990, highlighting the stagnation that had plagued the nation for over two decades (see Figure 1).

In addition, the subsequent civil war in 2013 triggered a devastating divergence in CAR’s actual GDP per capita compared to its synthetic control. This divergence remained massive in 2017 (see Figure 2). A permutation test reveals that this impact is not only significant but also the most substantial when compared to other countries, surpassing even the six states (out of 19 in the donor pool) with MSPE less than or equal to five times that of CAR (see Figure 3). The disparities in GDP per capita between CAR and its synthetic control from 2012 to 2014 indicate a drastic collapse in income levels during the fall of Bangui, amounting to approximately USD 490 per capita. Furthermore, the extended period from 2012 to 2017 witnessed a staggering decline of approximately USD 503 per capita. These figures represent normalized gaps of 40.6 percent and 41.6 percent, respectively, when compared to the actual GDP per capita in 2012. Consequently, it is not surprising that CAR is unlikely to reclaim its pre-war economic development level until the late 2030s (1). In the analysis that follows, we take a closer look at the factors contributing to this gloomy outlook, which reinforces the plausibility of this scenario.

**Figure 1:** Income level in CAR, 1990-2017
Source: GDP per capita series are from the World Development Indicators (35), from 1990-2017. Note: The grey bar indicates the beginning of the civil war up to the departure of Séléka rebel coalition from Bangui (from December 2012 to January 2014). The subsequent period translates into localized conflicts areas in Northwestern and Eastern parts of the country, outside of major cities.
Figure 2: Income level in CAR and its synthetic control, 1990-2017

Source: GDP per capita series are from the World Development Indicators (35), from 1990-2017. Note: In upper chart, the blue (lighter in greyscale) line indicates actual GDP series, and the orange (darker in greyscale) line indicates synthetic GDP series. The grey bar indicates the beginning of the civil war up to the departure of Séléka rebel coalition from Bangui (from December 2012 to January 2014). In the lower chart, the dark continuous line indicates the gap between actual and synthetic GDP per capita series (normalized to 0 in 2012), the dark dash horizontal line indicates a null gap, and the two red vertical lines indicates the period of Séléka occupation in Bangui (2012, excluded, up to 2014, excluded). The subsequent period translates into localized conflicts areas in Northwestern and Eastern parts of the country, outside of major cities.
Figure 3: Differences between income level for CAR and control countries and their respective synthetic controls, 1990-2017

Source: GDP per capita series are from the World Development Indicators (35), from 1990-17. Note: The dark dash line indicates the gap between actual and synthetic GDP per capita series for CAR and the gray lines indicates the gap between actual and synthetic GDP per capita series for control countries (normalized to 0 in 2012). The dark dash horizontal line indicates a null gap, and the two red vertical lines indicates the period of Séléka occupation in Bangui (2012, excluded, up to 2014, excluded). The subsequent period translates into localized conflicts areas in Northwestern and Eastern parts of the country, outside of major cities.
Martínez (2022) (23) finds that authoritarian regimes are prone to overstate yearly self-reported GDP growth and using satellite NTL intensity helps to assess the reality of the economic activity. Although GDP series are checked by international institutions, it is possible that the relatively good economic performance observed under former president François Bozizé was overestimated (GDP per capita grew by 25.5 percent in 2012, from USD 963 per capita in 2003 to USD 1209 per capita in 2012) while the country was under scrutiny for traversing a trajectory toward authoritarianism, as suggested by its Polity2 score (i.e., a common autocratic-democratic score produced by Ted Robert Gurr and Monty G. Marshall and released by the Center of Systemic Peace) of -1 at the time, corresponding to a closed anocracy (39). Consequently, the subsequent drastic correction of GDP from 2013 could be partly artificial. Accordingly, we check the dynamics of NTL intensity in the perimeter of Bangui following the first clashes, for robustness check. Although we observe a divergence of NTL intensity over the period 2011-12 (before the start of the civil war) between actual CAR series and its synthetic control, the divergence stems from the dynamism of synthetic CAR, while the intensity of the real lights stagnated for CAR. For subsequent years the growing divergence also comes from the crash of actual luminosity in the area of Bangui, as attested by the artificial gap closure in 2012 to check for post-war divergence (Figure 4). The permutation test shows that this divergence is larger than both the average and median of all other donor countries. The divergence is also larger than the average and median of the eight states (out of 24 in the donor pool) with MSPE less than or equal to five times that of CAR (see Figure 5). Only Asmara (Eritrea), and Bissau (Guinea-Bissau) are doing worse over the whole period in terms of NTL dynamics. The differences in luminosity between CAR and its synthetic control indicate a drop in light intensity of approximately 22.5 percent from 2012-14 and a drop of 33.9 percent for the extended period 2012-17. The growing gap over time suggests that power production and grid transmission capacity in Bangui were durably impacted, indicating a medium-to-long-term deterioration of essential network infrastructure for shared prosperity and poverty reduction (40).
Figure 4: NTL intensity in CAR and its synthetic control, 2005-17
Source: Satellite NTL series are from Gosh et al. (2021) (22) and authors’ estimate. Note: In upper and middle charts, the blue (lighter in greyscale) line indicates actual light series, and the orange (darker in greyscale) line indicates synthetic light series. The grey bar indicates the beginning of the civil war up to the departure of Séléka rebel coalition from Bangui (from December 2012 to January 2014). In middle and lower charts, we normalize the gap between CAR and its synthetic control for 2012 and subsequent years, for consistency. In the lower chart, the dark continuous line indicates the gap between actual and synthetic NTL intensity (normalized to 0 in 2012), the dark dash horizontal line indicates a null gap, and the two red vertical lines indicates the period of Séléka occupation in Bangui (2012, excluded, up to 2014, excluded). The subsequent period translates into localized conflicts areas in Northwestern and Eastern parts of the country, outside of major cities.
Figure 5: Differences between NTL intensity for CAR and control countries and their respective synthetic controls, 2005-17

Source: Satellite NTL series are derived from Gosh et al. (2021) (22), and cover the period 2005-17. Note: The dark dash line indicates the gap between actual and synthetic light series for CAR and the gray lines indicates the gap between actual and synthetic light series for control countries (normalized to 0 in 2012). The dark dash horizontal line indicates a null gap, and the two red vertical lines indicates the period of Séléka occupation in Bangui (2012, excluded, up to 2014, excluded). The subsequent period translates into localized conflicts areas in Northwestern and Eastern parts of the country, outside of major cities.
Despite a pre-treatment period starting only in 2009, this paper shows the existence of a massive and sharp divergence of the share of actual industrial and manufacturing value added over GDP from synthetic controls between 2013 throughout 2017 (see Figures 5 and 6). This result underscores the fact that structural transformation remains a major challenge for the economic development of African countries (41) and especially for resource-rich economies (42), preventing them from escaping the natural resource curse (43). Moreover, results from the permutation tests indicate the existence of a significant drop in both the industrial (-23.9 percent) and manufacturing (-35.5 percent) value added over GDP compared to other countries during the Séléka rebels’ occupation of Bangui in 2013-14. Even when keeping the closest comparator countries with CAR in terms of MSPE, only Sierra Leone (due to the Ebola crisis between 2014-16) and Rwanda (due to the boom of ecotourism and more generally a service-oriented economy on labor intensive activities (44)) are doing worse in terms of manufacturing dynamics if we extend the analysis up to 2017 (see Figures 7 and 8). The differences between CAR and its synthetic controls suggest that the shares of industrial and manufacturing value over GDP declined by approximately 34.1 percent and 33.7 percent respectively between 2012 and 2017, probably due to the destruction and flight of capital (45). Although closely interconnected, these two results do not induce the same macro issues:

i) The collapse of the industrial sector as a whole (including construction activity) is in line with the previous results on light intensity and indicates the degradation of the ability to rebuilt and maintain essential public and network infrastructure to bridge the infrastructure gap (46).

ii) The relative decline of manufacturing in the sectoral composition of the CAR’s economy indicates that the sector failed to advance towards more sophisticated products (47).

iii) Altogether, these results reassess the vicious cycle of the lack of state building, civil conflicts over control of political power and natural resource wealth, and the poverty trap (48).
Figure 6: Industrial value added (over GDP) in CAR and its synthetic control, 2009-17

Source: Industrial value-added series are from the World Development Indicators (35), from 2009-17. Note: In upper chart, the blue (lighter in greyscale) line indicates actual industrial value-added series, and the orange (darker in greyscale) line indicates industrial value-added synthetic series. The grey bar indicates the beginning of the civil war up to the departure of Séléka rebel coalition from Bangui (from December 2012 to January 2014). In the lower chart, the dark continuous line indicates the gap between actual and synthetic industrial value-added series (normalized to 0 in 2012), the dark dash horizontal line indicates a null gap, and the two red vertical lines indicates the period of...
Séléka occupation in Bangui (2012, excluded, up to 2014, excluded). The subsequent period translates into localized conflicts areas in Northwestern and Eastern parts of the country, outside of major cities.

Figure 7: Manufacturing value added (percent of GDP) in CAR and its synthetic control, 2009-17

Source: Manufacturing value-added series are from the World Development Indicators (35), from 2009-17. Note: In upper chart, the blue (lighter in greyscale) line indicates actual manufacturing value-added series, and the orange (darker in greyscale) line indicates manufacturing value-added synthetic series. The grey bar indicates the beginning of the civil war up to the departure of Séléka rebel coalition from Bangui (from December 2012 to January 2014).
the lower chart, the dark continuous line indicates the gap between actual and synthetic industrial value-added series (normalized to 0 in 2012), the dark dash horizontal line indicates a null gap, and the two red vertical lines indicates the period of Séléka occupation in Bangui (2012, excluded, up to 2014, excluded). The subsequent period translates into localized conflicts areas in Northwestern and Eastern parts of the country, outside of major cities.

**Figure 8: Differences between industrial value added (percent of GDP) for CAR and control countries and their respective synthetic controls, 2009-17**

Source: Industrial value-added series are from the World Development Indicators (35), from 2009-17. Note: The dark dash line indicates the gap between actual and synthetic light series for CAR and the gray lines indicates the gap.
between actual and synthetic light series for control countries (normalized to 0 in 2012). The dark dash horizontal line indicates a null gap, and the two red vertical lines indicates the period of Séléka occupation in Bangui (2012, excluded, up to 2014, excluded). The subsequent period translates into localized conflicts areas in Northwestern and Eastern parts of the country, outside of major cities.

Figure 9: Differences between manufacturing value added (percent of GDP) for CAR and control countries and their respective synthetic controls, 2009-17

Source: Manufacturing value-added series are from the World Development Indicators (35), from 2009-17. Note: The dark dash line indicates the gap between actual and synthetic light series for CAR and the gray lines indicates
the gap between actual and synthetic light series for control countries (normalized to 0 in 2012). The dark dash horizontal line indicates a null gap, and the two red vertical lines indicates the period of Séléka occupation in Bangui (2012, excluded, up to 2014, excluded). The subsequent period translates into localized conflicts areas in Northwestern and Eastern parts of the country, outside of major cities.

With regard to the conflict-development nexus, the direction of causality is unclear (49), as we observe a drop in CAR’s human asset index (HAI, hereafter) between 2011 and 2012, before the beginning of the civil war (see Figure 9). After artificially closing the gap between CAR’s actual HAI and its synthetic control for 2012, the permutation tests confirm the significant drop in 2013-14; this drop holds true even for the eight states out of the total 23 in the donor pool, where the MSPE was less than or equal to five times that of CAR (see Figure 10). The time span for the reduced HAI is limited to 1990-2014, so we only observe a short-term (but very sharp) drop of 20.2 percentage points compared to 2012 in terms of human development, during the first phase of the war. In other words, even if the causality is uncertain, the CAR civil war is correlated with a sharp aggravation in two subcomponents of the reduced HAI, namely the general undernourishment of the population and the decline of secondary school enrollment. The latter finding is in line with the recent literature on Cameroon’s Anglophone conflict (50). This is extremely concerning when considering that the decline in general living conditions, specifically in terms of food access (first dimension of the reduced HAI), may indicate the possibility of state collapse in the near future (51). Additionally, the decrease in access to secondary schooling (second dimension of the reduced HAI) not only hampers the country’s economic recovery, but also perpetuates informal, subsistence-level activities and provides a potential pool for recruitment by armed groups (1), further exacerbated by the additional challenge of early pregnancies (52).

**Figure 10: Reduced HAI in CAR and its synthetic control, 2005-17**
Source: The reduced HAI series are derived from Feindouno and Goujon (2019) (28), from 1990-2014. Note: In upper and middle charts, the blue (lighter in greyscale) line indicates actual light series, and the orange (darker in greyscale) line indicates synthetic light series. The grey bar indicates the beginning of the civil war up to the departure of Séléka rebel coalition from Bangui (from December 2012 to January 2014). In middle and lower charts, we normalize the gap between CAR and its synthetic control for 2012 and subsequent years, for consistency. In the lower chart, the dark continuous line indicates the gap between actual and synthetic GDP per capita series (normalized to 0 in 2012), the dark dash horizontal line indicates a null gap, and the two red vertical lines indicates the period of Séléka occupation in Bangui (2012, excluded, up to 2014, excluded).
Figure 11: Differences between HAI for CAR and control countries and their respective synthetic controls, 2009-17

Source: The reduced HAI series are derived from Feindouno and Goujon (2019) (28), from 1990-2014. Note: The dark dash line indicates the gap between actual and synthetic light series for CAR and the gray lines indicates the gap between actual and synthetic light series for control countries (normalized to 0 in 2012). The dark dash horizontal line marks the Seleka Occupation.

No pre-HAI’s MSPE five times higher than CAR’s
line indicates a null gap, and the two red vertical lines indicates the period of Séléka occupation in Bangui (2012, excluded, up to 2014, excluded).

Conclusion

We found overall evidence that the civil war in the CAR led to a massive drop in living standards proxied by the GDP *per capita* from 2013 to 2017, and the results are confirmed with NTL dynamics in the area of Bangui. Maybe even more worrying, our results on NTL also suggest a long-lasting inability to ensure electricity provision, an essential public service, which is also necessary for the emergence of the formal private sector. We also find a large drop in industrial/manufacturing activities in the post-war sectoral composition of the economy and a significant degradation of human capital, especially in the dimensions of undernourishment and secondary school enrollment. The persistence of human capital losses is confirmed as the CAR ranks at the bottom of the human capital and development indices (it was 188th out of 191 countries in 2022) (53).

Quantitatively, we found that the civil war led to a significant drop in GDP *per capita* (41.6 percent), NTL intensity (33.9 percent), industrial production (34.1 percent), manufacturing value added (33.7 percent), and the human asset index (20.2 percent) over the period 2012-17. These sharp declines in the four key socio-economic indicators are quite similar in magnitude, ranging from 34 to 44 percent. The cumulative loss of GDP *per capita* is found to be about 3 times larger than the effect of the civil war in the Syrian Arab Republic highlighted by Kešeljević and Spruk (2023) (10), 4.2 times larger than the effect of ETA terrorism and direct actions in the Basque Country highlighted by Abadie and Gardeazabal (2003) (8), and 7.3 times larger than the effect of the Arab Spring in Tunisia highlighted by Matta *et al.* (2017) (9). The lower decline of NTL compared with that of per capita GDP may also suggest overestimated GDP series under the presidency of François Bozizé (23). Furthermore, this paper emphasizes that there are no signs suggesting a positive trajectory for the CAR to regain its pre-war living standards by 2030. The ongoing conflicts persisting as of early 2023, combined with the lack of any indications of economic and social recovery from 2017, further reinforce this lack of progress (1). Overall, we identify a vicious conflict-development cycle in the CAR.

We recognize however some limitations in the analysis. The choice to select all other LICs for the potential donor pool is explained both for practical and transparency reasons (we use the World Bank classification) and for structural reasons (although each country is unique and has a specific national context, all LICs face the challenges of structural vulnerability and development trap (26)). These states, however, are also likely to experience large social unrest and localized armed conflicts(27). If some of the LICs in the donor pool are selected ex-post in the synthetic control, while they also suffered consequences of conflicts during 2013-17, the estimates provided here can be considered conservative. That is the reason we automatically discarded Afghanistan, the Syrian Arab Republic, and the Republic of Yemen from the donor pool, as they also faced generalized armed conflicts, including within their capital cities, during the period of interest. In
addition, LICs also suffer from a general lack of regular data collection, explaining the constraints on timespan and data availability for our key macro-indicators.

Future studies might further explore i) the complex interaction between income shocks and civil conflicts (54), ii) a more global overview of the socio-economic impact of war and conflicts, and iii) potential solutions for collapsed states and their population.
References


Appendix

Background of the CAR civil war

The Central African Republic (CAR) civil war is a conflict that officially began in December 2012 and is still ongoing close to the northern and western borders and in the eastern part of the country, despite the signature of a peace agreement (the Political Agreement for Peace and Stability, or APPR in the French acronym) between the government and 14 armed groups in February 2019. The conflict is characterized by violence between various armed groups, including government forces, rebel groups, and ethnic militias. The roots of the conflict can be traced back to the coup that brought President François Bozizé to power in 2003. Bozizé’s presidency was characterized by political instability, lack of achievements in terms of development, authoritarian stance (ruled by decrees) and physical abuses on the opposition (55), and, in 2012, a coalition of rebel groups known as Séléka launched an armed rebellion against the government.

The Séléka rebels, who were mainly from the northeast of the country, accused Bozizé's government of neglecting their region and favoring his own ethnic group, the Gbaya. The rebels quickly gained control of much of the country, and in March 2013 they overthrew Bozizé's government. In response to the Séléka numerous exactions, a Christian militia known as the Anti-Balaka was formed. The Anti-Balaka targeted Muslim civilians, leading to reprisal attacks by Muslim militias and the displacement of hundreds of thousands of people. The conflict continued to escalate, with various armed groups vying for control of territory and resources (forestry concessions and extractive resources).

In 2014, the United Nations Security Council authorized the deployment of a peacekeeping mission to the CAR, known as MINUSCA. The mission was tasked with protecting civilians, supporting political dialogue, and helping to disarm armed groups. From 2018, the Russian paramilitary group Wagner started to operate in the country (56) with the active support of the newly elected president Faustin-Archange Touadéra and his government, and Rwanda also deployed what it called “force protection troops” in 2020 under a bilateral agreement on defense. Thanks to these external forces, the government regained control in Bangui region and major cities, but despite the signature of a peace agreement in 2019, the conflict is still ongoing at a regional level.

Contrary to previous coups and the Bush war of 2004-07, CAR’s civil war is exceptional in terms of duration (10 years and still ongoing), extension (the capital city Bangui was overtaken between 2013-14 and the two main corridors, the Ubangi river and Douala-Bangui road axis were severely disturbed in the first step of the war), fragmentation (regarding the number of armed groups involved and the de facto partition of the country into a network of fiefdoms) and intensity (widespread ethnical cleansing, including extrajudicial killings, rape, and massive forced internal and international displacement) (57).
Table A1. Weights assigned to countries for CAR’s outcomes of interest

<table>
<thead>
<tr>
<th>Potential donor pool (SCM weight in parenthesis)</th>
<th>GDP per capita (PPP, constant 17 int. USD)</th>
<th>Nighttime lights (NTL) intensity**</th>
<th>Ind. value added (over GDP), index 100= 2012</th>
<th>Manuf. value added (over GDP), index 100= 2012</th>
<th>Tranformed human asset index (HAI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burkina Faso</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (2.5%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Burundi</td>
<td>Yes (19.1%)</td>
<td>Yes (10.5%)</td>
<td>Yes (11.4%)</td>
<td>No [unbalanced series]</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Chad</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (3.4%)</td>
<td>Yes (33.4%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Congo, Dem. Rep.</td>
<td>Yes (5.7%)</td>
<td>Yes (0%)</td>
<td>Yes (2.4%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Eritrea</td>
<td>No [unbalanced series]</td>
<td>Yes (0%)</td>
<td>No [unbalanced series]</td>
<td>No [unbalanced series]</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>Yes (15.7%)</td>
<td>Yes (7.6%)</td>
<td>Yes (3.2%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Gambia, The</td>
<td>Yes (0%)</td>
<td>Yes (2.1%)</td>
<td>Yes (29.3%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Guinea</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (3.1%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (2.4%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Korea, Dem. People’s Rep.</td>
<td>No [unbalanced series]</td>
<td>Yes (1.7%)</td>
<td>No [unbalanced series]</td>
<td>No [unbalanced series]</td>
<td>No [unbalanced series]</td>
</tr>
<tr>
<td>Liberia</td>
<td>No [unbalanced series]</td>
<td>Yes (0%)</td>
<td>Yes (5.1%)</td>
<td>No [unbalanced series]</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Madagascar</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (2.9%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Malawi</td>
<td>Yes (6.8%)</td>
<td>Yes (2.1%)</td>
<td>Yes (3.1%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Mali</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (2.3%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Mozambique</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (2.9%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Niger</td>
<td>Yes (36%)</td>
<td>Yes (0%)</td>
<td>Yes (2.5%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Rwanda</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (5.8%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (1.6%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Somalia</td>
<td>No [unbalanced series]</td>
<td>Yes (76%)</td>
<td>No [unbalanced series]</td>
<td>No [unbalanced series]</td>
<td>Yes (30.2%)</td>
</tr>
<tr>
<td>South Sudan</td>
<td>No [unbalanced series]</td>
<td>Yes (0%)</td>
<td>No [unbalanced series]</td>
<td>No [unbalanced series]</td>
<td>No [unbalanced series]</td>
</tr>
<tr>
<td>Sudan</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (2.8%)</td>
<td>No [unbalanced series]</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Syrian Arab Republic</td>
<td>No [automatically discarded]</td>
<td>No [automatically discarded]</td>
<td>No [automatically discarded]</td>
<td>No [automatically discarded]</td>
<td>No [automatically discarded]</td>
</tr>
<tr>
<td>Togo</td>
<td>Yes (16.7%)</td>
<td>Yes (0%)</td>
<td>Yes (5.2%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Uganda</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (3.3%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
<tr>
<td>Zambia</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
<td>Yes (4.9%)</td>
<td>Yes (0%)</td>
<td>Yes (0%)</td>
</tr>
</tbody>
</table>

Source: Authors’ construction. Notes: The list of low-income countries (LICs) is taken from the World Bank website (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups) for fiscal year 2023 (FY23) or calendar year 2021. GDP per capita, industrial value added, and manufacturing value added (over GDP) are taken from the World Development Indicators (35), satellite nighttime lights (NTL) intensity is derived from the DMSP data (22), and the reduced version of the (harmonized) human asset index is derived from Feindouno and Goujon (2019) (28). *: Adjusted SCM values for NTL and reduced HAI. **: For NTL intensity we focus on a 10km radius around capital cities of each country (enabling us to include every country in the donor pool, even South Sudan before country’s independence, through Juba’s light intensity).