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The distributional impact of the Sierra Leone conflict on household welfare

Abstract

This study examines the impact of the Sierra Leone civil war on household expenditure inequality. The paper exploits three rounds of household survey data for Sierra Leone in an attempt to estimate the impact of the conflict on the distribution of household welfare over both short-run and long-run periods. The empirical approach uses RIF measures based on the Gini index and also provides estimates of treatment effects at selected quantiles of the unconditional household expenditure distribution. The key findings reveal that localities subject to a protracted period of occupation by rebel forces experienced a sharp reduction in household expenditure inequality in the immediate aftermath of the conflict with most of the contraction evident at the top end of the distribution.

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1 Introduction

The economics literature on conflict has focused both on the causes and more often the consequences of conflict (see Swee, 2016). It is generally accepted that conflict impairs the economic development and social progress of affected countries and regions. It is associated with death and injury, the depletion of productive capital (both human and physical), the disruption of markets and social cohesion, and the weakening and erosion of civic and other institutional structures. It has been characterized as "development in reverse" (e.g., see Collier et al., 2003). There is persuasive empirical evidence that it reduces economic growth at the macro-level (e.g., see Collier and Hoeffler, 1998, 2000) and adversely impacts household welfare at the micro-level (see Justino, 2011).

Micro-level analysis has explored the consequences of conflict for human capital outcomes relating to education and health, institutions, social cohesion, labor market participation, and household consumption (see, respectively, Bellows and Miguel, 2006, 2009; Bundervoet et al., 2009; Shemyakina, 2011; Serneels and Verpoorten, 2015). The vulnerability of developing countries can be exacerbated and amplified by economic shocks related to civil conflict, which reduce household expenditure levels and increase poverty (see Justino and Verwimp, 2008).

The empirical evidence on the distributional impact on household welfare of conflict is limited. The literature on the relationship between inequality and conflict has largely focused on the role of vertical inequality (e.g., income distribution across individuals) and horizontal inequality (e.g., endowment differences across groups defined in terms of ethnicity or religion) in triggering conflict, with the research findings being somewhat ambiguous. The evidence suggests vertical inequality is a less important trigger of conflict (see Fearon and Laitin, 2003; Collier and Hoeffler, 2004) than various forms of horizontal inequality (see Østby, 2008). In contrast, the reverse relationship linking conflict to inequality has attracted limited research interest to date, and is largely confined to cross-country macro-level analysis (see Bircan et al., 2017).

This paper exploits a number of household-level survey rounds from Sierra Leone to examine the consequences of the civil war for household welfare inequality. The conflict spanned the period from 1991 to 2002 and led to an estimated 50,000 fatalities with a significantly greater number left maimed or injured. It also temporarily displaced households and individuals, damaged the country's physical and social infrastructures, and disrupted economic activity. A peace agreement between the warring factions (i.e., the government and the rebels) was eventually signed in 2002.

The empirical approach adopted in this research exploits the fact that the incidence of protracted territorial occupation by rebel forces was concentrated in certain geographical areas of the country. In particular, some parts of the country remained largely unaffected by the conflict and were not subject to an extended period of rebel force occupation. The largely unaffected zones provide the control group for the empirical analysis. The primary objective of this study is to examine both the short-term and long-term impacts of the conflict on household welfare inequality using a household expenditure metric. The impact of the civil war on the household expenditure distribution is analyzed using a Gini index situated within a Recentred Influence Function (RIF) framework (see Firpo et al., 2009). The empirical approach also exploits both propensity score matching (PSM) and a re-weighting technique based on the work of Firpo (2007) to estimate unconditional quantile treatment effects of interest.

The empirical findings reveal that locations that endured a protracted period of rebel force occupation exhibited lower household expenditure inequality in the immediate aftermath of the war. The effect is found to be deepest at the top end of the distribution. This is resonant of a conflict's "leveling effect" as emphasized in the work of Scheidler (2017). A potential explanation for the finding in the current application rests on the destructive strategies employed by the rebel forces toward visible high-value assets like residential property. This military tactic reflected an explicit policy encouraged by the rebel leadership to purloin (or loot) household assets in order to provide a mode of payment for rebel troops. This strategy inevitably affected richer households more adversely. The estimated effect on inequality is found to weaken a decade after the completion of the civil war, though a complete recovery at the top end of the distribution appears absent.

The remainder of the paper is organized as follows. The next two sections provide, respectively, a contextual background and a review of the relevant literature. A subsequent section discusses the data, the construction of the conflict measures, and the empirical strategy used. This is followed by two sections that focus in turn on the econometric methodology and the empirical results obtained. A penultimate section provides an array of robustness and other checks for the core empirical findings, and a final section provides some concluding remarks.

2 Contextual Background

The West African country of Sierra Leone gained independence from Britain in 1961 and covers a geographical area of 71,740 km^2. In its first 30 years of self-rule the country endured poor governance with corruption being a characteristic feature of both civilian and military administrations. In the years preceding the war in 1991, the economy's poor growth rates and low per capita income levels confirmed its status as one of Africa's poorest countries. This led to a widening in economic discontent among the population, and encouraged sympathy for the Revolutionary United Front (RUF) rebel group. It was this faction, with the support of Charles Taylor's National Patriotic Front of Liberia, that originally launched an invasion of the country in March 1991 from neighboring Liberia in an attempt to overthrow the military-led regime of Joseph Momoh. The conflict originated in the Eastern region of the country with rebel forces eventually reaching as far as the outskirts of the capital city Freetown in early 1999.

The conflict was characterized by attacks on the civilian population, significant military battles and firefights, and two successful coups d'état involving the national government. The civil war arguably spanned three distinct phases. The first (1991–1995) covered the country's invasion by the Revolutionary United Front (RUF) culminating in the assumption to power of a military junta eventuating in a ceasefire agreement between the rebel factions and the national government. The second phase (1996–1999) was prompted by the election to the presidency of Tejan Kabba in March 1996, and ultimately led to a second coup d'état in May 1997. This period also featured a rebel-led assault on the capital city, which was repulsed by a coalition comprising both national and international forces. The final phase of the conflict (2000–2002) encompassed peace talks leading to an amnesty for RUF combatants and the introduction of retirement packages for national army soldiers. The peace agreement was signed in Lomé in 2002 and marked an official end to the civil war.

The conflict was one of the longest within the Economic Community of Western African States (ECOWAS). It was also viewed as one of the more brutal in terms of the acts perpetrated largely by the rebel groups (e.g., killings, limb amputations, rape, and the destruction of private property and public infrastructures). The military action was heavily concentrated in certain geographical areas of the country with households in the Eastern regions in particular exposed to intense violence and protracted periods of occupation by the RUF forces. Although the conflict extended its geographical reach throughout the duration of the war, it exerted a limited impact on the Western and Northern areas of the country.

The recovery process was underpinned by post-war financial support from international organizations including the World Bank, the United Nations Development Program (UNDP), USAID, the UK's Department for International Development (DfID), and a variety of non-Governmental organizations (NGOs). A Truth and Reconciliation Commission (TRC) was established in 2000. The subsequent TRC findings were released in October 2004 (see Conibere et al., 2004), and outlined a set of recommendations for post-conflict recovery. One was the provision of a reparation program for conflict victims who were either war widows or wounded, had suffered war-related amputations, or had been subject to sexual violence. The interventions based on these recommendations were first introduced in 2009 and were intended, *inter alia*, to enhance the livelihood skills of war victims and their families. The implementation of the reparation program in conjunction with a war victims' trust fund was launched by the then president of the Republic of Sierra Leone with the assistance of the United Nations Peace Building Fund (UNPBF). The primary purpose of the fund was to provide financial support for war victims to mitigate the extreme effects of poverty, disability, trauma, and unemployment risk (see NaCSA Newsletter, 2016).

3 Literature Review

One of the most influential pieces of macroeconomic research on the economic effects of conflict was undertaken by Collier and Hoeffler (1998). The authors undertook cross-country analysis from 1960 to 1989 exploiting data from 92 countries and found economic growth decreased by 15% after 7 years of conflict. The broad magnitude of their findings was corroborated in later work by Hoeffler and Reynal-Querol (2003). Thus, at the macroeconomic level, civil war induces a sharp contraction in per capita income, which also has the potential to trigger conflict resurgence (see Collier and Hoeffler, 1998; Fearon and Laitin, 2003; Miguel et al., 2004).

It is fairly well established that conflict in its many forms (e.g., civil war, ethnic violence, and genocide) leaves a horrific set of legacies. Depending on its scale and reach, it has the potential to propel households into extreme forms of poverty (see Verwimp, 2005; Bundervoet and Verwimp, 2007; Justino, 2009; Shemyakina, 2011). Justino and Verwimp (2008) evaluated the effect of the Rwanda civil war and genocide on household welfare and poverty dynamics and reported that households with destroyed property or confiscated land incurred a 20-percentage point higher risk of poverty. Ibáñez and Moya (2010), using household-level data for war-displaced Colombians, estimated a 19% contraction in household consumption consequent on conflict-induced forced migration. The work on the northern Mozambique conflict

undertaken by Bozzoli and Brück (2009) reported a reduction in per capita household welfare of between 16% and 31% for households engaged in cotton production.[1]

There is a well-developed research agenda emphasizing the role inequality performs as a catalyst for conflict (see Stewart, 2008). However, the provenance of the inequality in this literature is found to be important with horizontal inequality (e.g., social, ethnic, and political disparities) interpreted as a more significant driver for conflict compared to vertical inequality (e.g., income and wealth disparities). A common measure of vertical economic inequality within a society is provided by the Gini coefficient. The empirical literature using this measure as a proxy for vertical economic inequality has found no evidence of a relationship with conflict insurgence (see Fearon and Laitin, 2003; Collier and Hoeffler, 2004). The role of grievance stemming from vertical inequalities as a trigger for conflict has also found little support (see Davies, 1962; Gurr, 1970; Muller and Sleigson, 1987; Collier and Hoeffler, 2004). Resource curse theorists like Tilly (1978) and Muller (1972) have criticized such individual-level frustrations as plausible drivers for political action or civil war.[2] In contrast, inequality measures along the horizontal dimension reflecting social class, caste, and ethnic differences have proved more potent in providing traction for violent revolution (see Boix, 2008; Acemoglu et al., 2002).

It is generally acknowledged the civil war in Sierra Leone was not motivated by religious or ethnic identity issues (Fanthorpe, 2005; Humphreys and Weinstein, 2006; Dupuy and Binningsbø, 2007). The factors driving the conflict in Sierra Leone are likely to be more prosaic. The country was one of the poorest in the world prior to the conflict and ranked bottom of the World Development Index in the late 1980s. In addition, high levels of corruption and the absence of effectively functioning institutions created fertile conditions for the consolidation of vertical income inequality.

The investigation of the potential impact of conflict on vertical inequality is a less well-researched theme within the existing literature. There is a small strand of literature suggesting conflict increases such inequality (see McKay and Loveridge, 2005; Bircan et al., 2017). The work of the economic historian Scheidel (2017) extensively documents the potential impact of conflict on income inequality using an array of both recent and distant historical records. The author interprets conflict (among other events) as a mechanism through which inequality can be "leveled out" within a country or region. Scheidel (2017) argues that conflict, which affects society through the destruction of capital assets and a direct assault on "the haves," contains strong inequality-leveling potential. The leveling outcome can be achieved through the redistribution of income from the rich to the poor or through the total destruction of the asset holdings of the wealthier groups in society. Leveling through destruction can occur as a consequence of property being destroyed or looted, or by the theft by disaffected groups of assets from society's more affluent sections. Scheidel (2017) systematically documented

1 Conflict also exerts indirect effects on household welfare through its impacts on female fertility (e.g., see Agadjanian and Prata, 2002; Kraehnert et al., 2019; Thiede et al., 2020; Torrisi, 2020) and the accumulation of human capital (e.g., see Justino et al., 2013; Akbulet-Yuksel, 2014; Pivovarova and Swee, 2015; Bertoni et al., 2018; Brück et al., 2019; Di Maio and Nisticò, 2019). In particular, the adverse impact of conflict on fertility and human capital is likely to affect household welfare inequality.

2 The natural resources of Sierra Leone (e.g., diamonds) are often implicated as providing one of the key motives for the war. However, the study of Voors et al. (2017) reports no evidence that natural resources triggered the onset or the duration of the country's civil war, though Keen (2005) suggests otherwise. However, see Bazzi et al. (2019) for a study on the difficulties in predicting conflict outbreak.

descriptive evidence that many historical conflicts were associated with subsequent sharp reductions in income inequality.

The analysis of the impact of conflict on household welfare inequality is often integrated into a focus on household poverty. For instance, Bisogno and Chong (2002) analyzed poverty risk and the distribution of income in Bosnia and Herzegovina after that country's civil war with contrasting results across regions, ethnic differences, and household characteristics. Ansoms (2005) provided a descriptive analysis of Rwanda's post-war growth path using cross-country evidence suggesting that increased post-conflict household poverty induced a greater degree of inequality. Bircan et al. (2017) used macro-level panel data for 128 countries covering the years 1960–2004. The authors analyzed the impact of violent conflict on economic inequality as measured by the Gini index. The study found that, on average, inequality increased by 1.7 and 2.7 Gini points, respectively, for the period during and then immediately after a conflict. These macro-level findings contrast sharply with Scheidler's (2017) notion of conflict's leveling effects.

The foregoing suggests a significant gap in the existing literature examining the distributional implications of conflict. This is the case for most conflict-prone countries including Sierra Leone. The empirical evidence on the welfare effects of the Sierra Leone conflict is fairly limited with the existing literature largely focusing on its effects with respect to political engagement and local institutions (see Bellows and Miguel, 2009), individual behavior (see Cecchi et al., 2016), and enterprise-level outcomes (see Collier and Duponchel, 2013). An explicit focus on the impact of the Sierra Leone conflict on household welfare inequality is currently absent from the literature.

A key motivation for the current paper is to augment the modest volume of empirical literature on the micro-level distributional effects of conflict using the specific case of the Sierra Leone civil war. For instance, as already noted, the tactics adopted by the rebel groups against the local populations during the war were largely driven by acquisitive motives, with their activities focused on targeting the high-value assets of the wealthy within the local districts under their control. This strategy is likely to have implications for the upper segments of the household welfare distribution. Thus, investigating the distributional impact of the Sierra Leone conflict offers a novel contribution to both the broader literature on conflict and more specifically to that on Sierra Leone.

4 Data and Empirical Strategy

The 1989 Sierra Leone Household Survey (SLHS), and the 2003 and 2011 Sierra Leone Integrated Household Surveys (SLIHS) conducted by Statistics Sierra Leone in conjunction with the World Bank, provide the main data sources for the analysis in this study. These data reflect household welfare and socio-economic status prior to the war (1989) and at two subsequent points after the 2002 peace settlement (i.e., 2003 and 2011).

A key difference in the sampling approach adopted in the earliest available survey compared to the latter two is that sampling in 1989 was restricted to a randomly selected set of 64 of Sierra Leone's 152 chiefdoms in existence at that time. In the subsequent follow-up surveys for the two later years, the sampling of households was drawn from all 152 chiefdoms. We assess, as part of a robustness check, whether the key findings reported are sensitive to the more restrictive chiefdom sampling used at the baseline in 1989.

The key welfare metric used in the analysis is per capita household expenditure. The 1989 survey data collected prior to the onset of the civil war provides the baseline or benchmark for the welfare status of households, against which the conflict effects are then compared. The subsequent 2003 and 2011 SLIHS datasets provide information, respectively, on the immediate and longer term post-war socio-economic status of households. In particular, the first post-war survey permits the empirical estimation of the short-term effects of the civil war on the distributional outcome of interest. The more recent of the two post-war surveys provides insights on how household welfare distribution was affected by the conflict nearly 10 years after its conclusion. Hence, the latest survey data also potentially incorporate the influence of the war-related reconstruction and rehabilitation programs implemented by the government of Sierra Leone from 2009 onward.

The empirical strategy entails allocating households to chiefdoms within Sierra Leone that were either characterized by protracted rebel occupation (i.e., the "treatment" group) or by no protracted rebel occupation (i.e., the "control" group). The war wrought substantial destruction in its wake for those areas that experienced prolonged rebel occupation. In contrast to the Eastern located chiefdoms, some Western and many Northern areas experienced limited or no conflict given such areas were protected by government and other international forces, and thus remained largely free from rebel force incursion or occupation. It is worth noting that the rebel penetration of the Western and surrounding areas only occurred near the end of the war, was transient in nature, and exerted minimal impact on the local populations resident within these areas.

In order to classify households by their exposure to conflict, a dummy variable based on the length of rebel occupation in each administrative chiefdom is created. The data used to construct this dummy variable are obtained from the *No Peace Without Justice* report (see Smith et al., 2004). The binary measure for a household's exposure to the conflict is coded 1 if the chiefdom, within which the household is located, experienced a protracted period of rebel group occupation. This is defined here as the presence of a rebel military headquarters in the chiefdom for ≥9 years. The variable is coded 0 otherwise. The construction of the dummy variable is restricted to using chiefdom level information as this represents the finest compatible level of regional disaggregation available across the three datasets.[3] Table A1 in Appendix I lists the chiefdoms allocated to the separate "treatment" and "control" groups by survey year using this definition. In addition, Figure A1 in the same appendix provides a map of Sierra Leone detailing the spatial distribution of rebel occupation across the country during the period of the civil war.

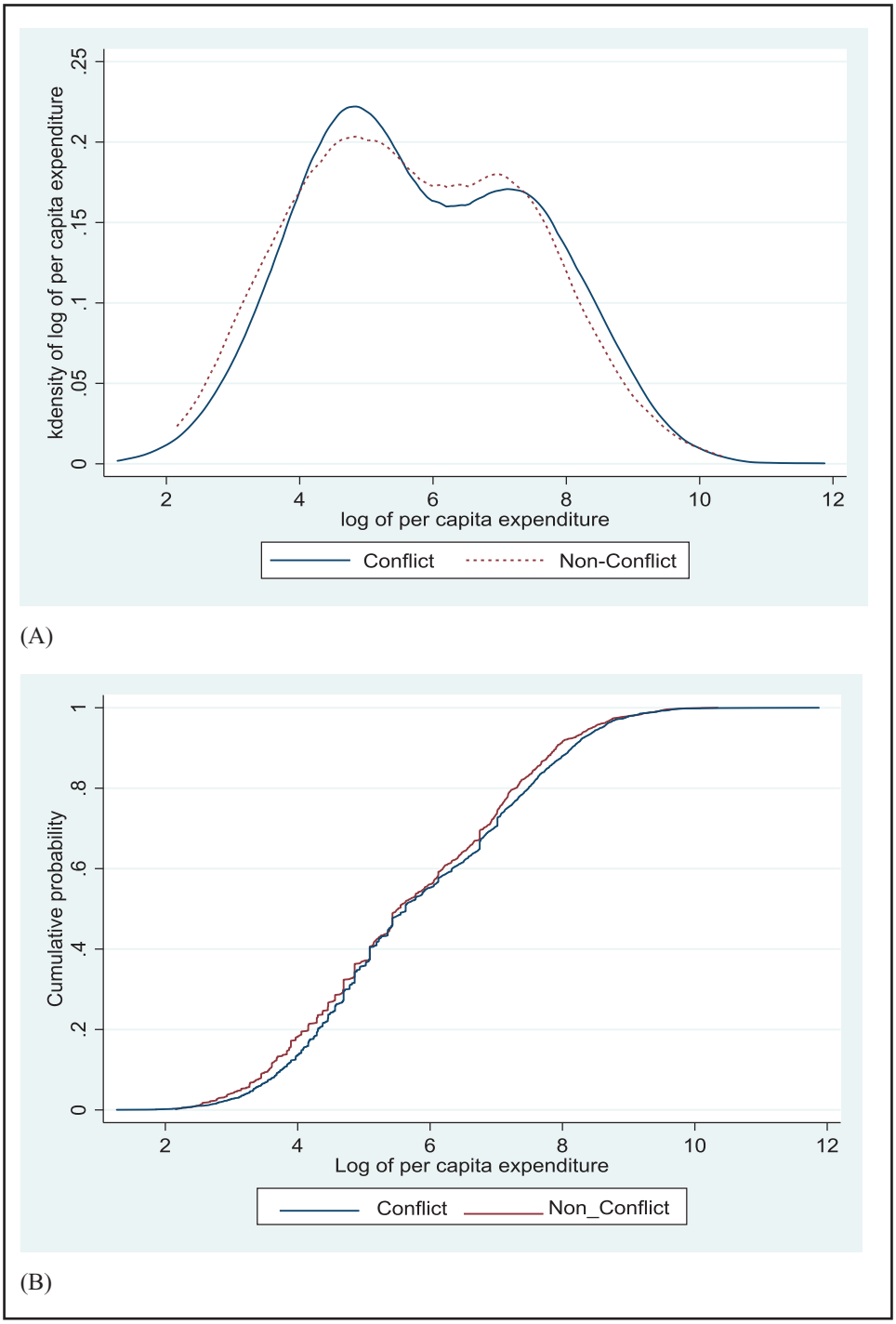
The choice of ≥9 years covers almost the complete duration of the civil war and is chosen to ensure the period of rebel rule was sufficiently long to directly and persistently impact the economic behavior and activity of households in the affected zones. The occupation endured by those within the "treatment" group was characterized by an absence of the "rule-of-law," the perpetration of often gratuitous acts of brutality by (mostly) rebel forces, a failure to maintain physical and institutional infrastructure, and an absence of investment in health and educational facilities. Therefore, the "treatment" exposure is interpreted in broader terms than that

3 It is worth noting the correlation coefficient across chiefdoms between the treatment dummy based on a 9-year length of rebel occupation and conflict fatalities per 1,000 of the chiefdom population is 0.84, suggesting the former measure adequately captures the brutal intensity of the civil war. See also endnote 8 below.

described by measures based exclusively on conflict fatality rates. The definition also captures more explicitly the mechanisms through which the civil war potentially impacts economic activity and thus the distribution of household welfare.

The kernel density plots for the log of per capita household expenditure by conflict exposure status defined above are depicted in Figures 1A to 3A for the years 1989, 2003, and 2011, respectively. The plots for the first year of the study (see Figure 1A) roughly overlap with little evidence of a significant shift in the central location or the dispersion of the distributions

Figure 1 (A) The Density Functions of Household Expenditure by Conflict Exposure (1989). (B) The Distribution Functions of Household Expenditure by Conflict Exposure (1989).



between the conflict and non-conflict zones. In contrast, the density plot for the non-conflict areas in 2003 (see Figure 2A) exhibits a locational shift to the right compared to the corresponding plot for the conflict zones with evidence of narrowing dispersion within these zones. A similar pattern emerges for the density plots for the most recent year of 2011, though the impact on expenditure inequality appears less clear-cut (see Figure 3A).

Figure 2 (A) The Density Functions of Household Expenditure by Conflict Exposure (2003). (B) The Distribution Functions of Household Expenditure by Conflict Exposure (2003).

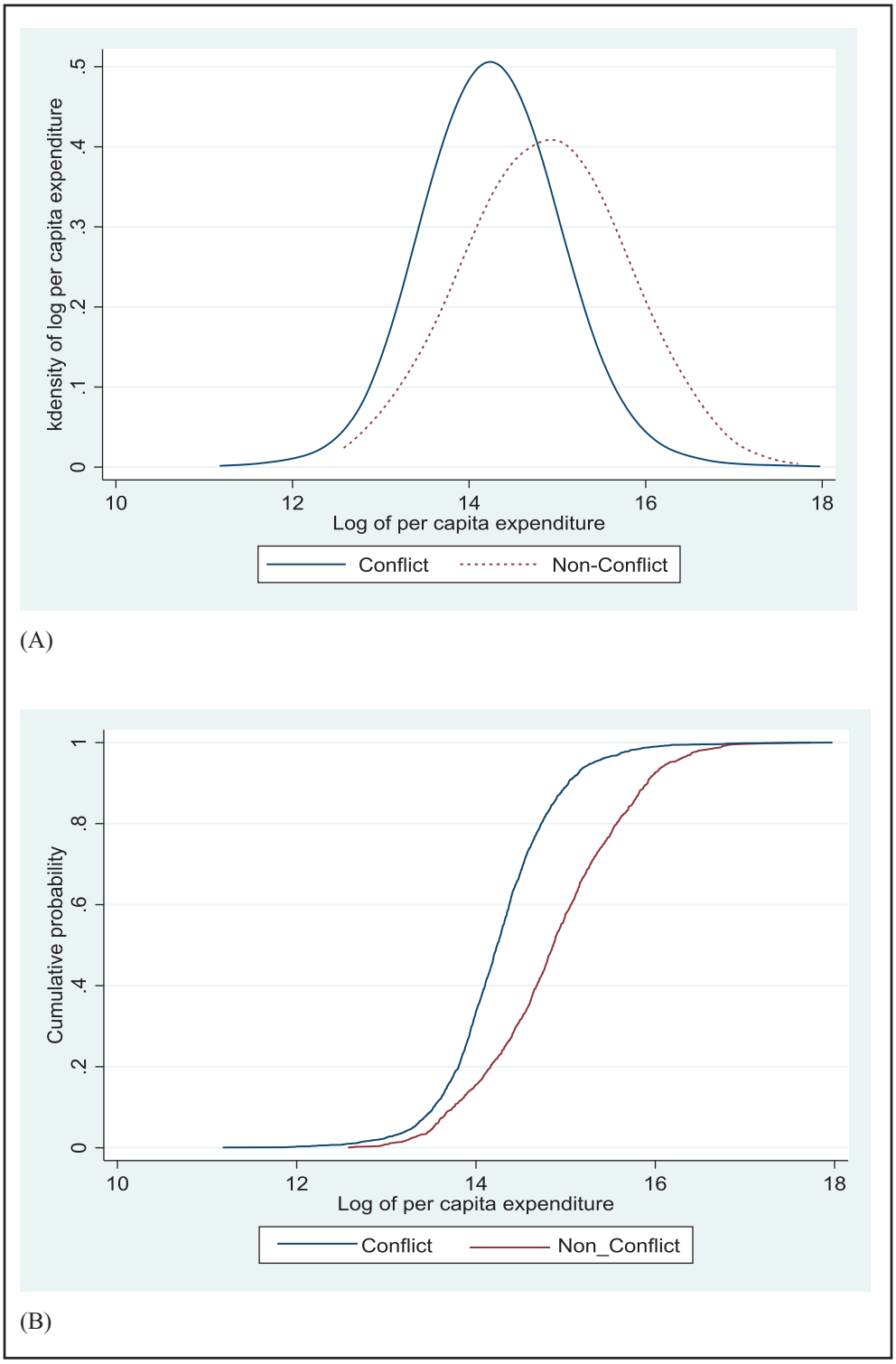
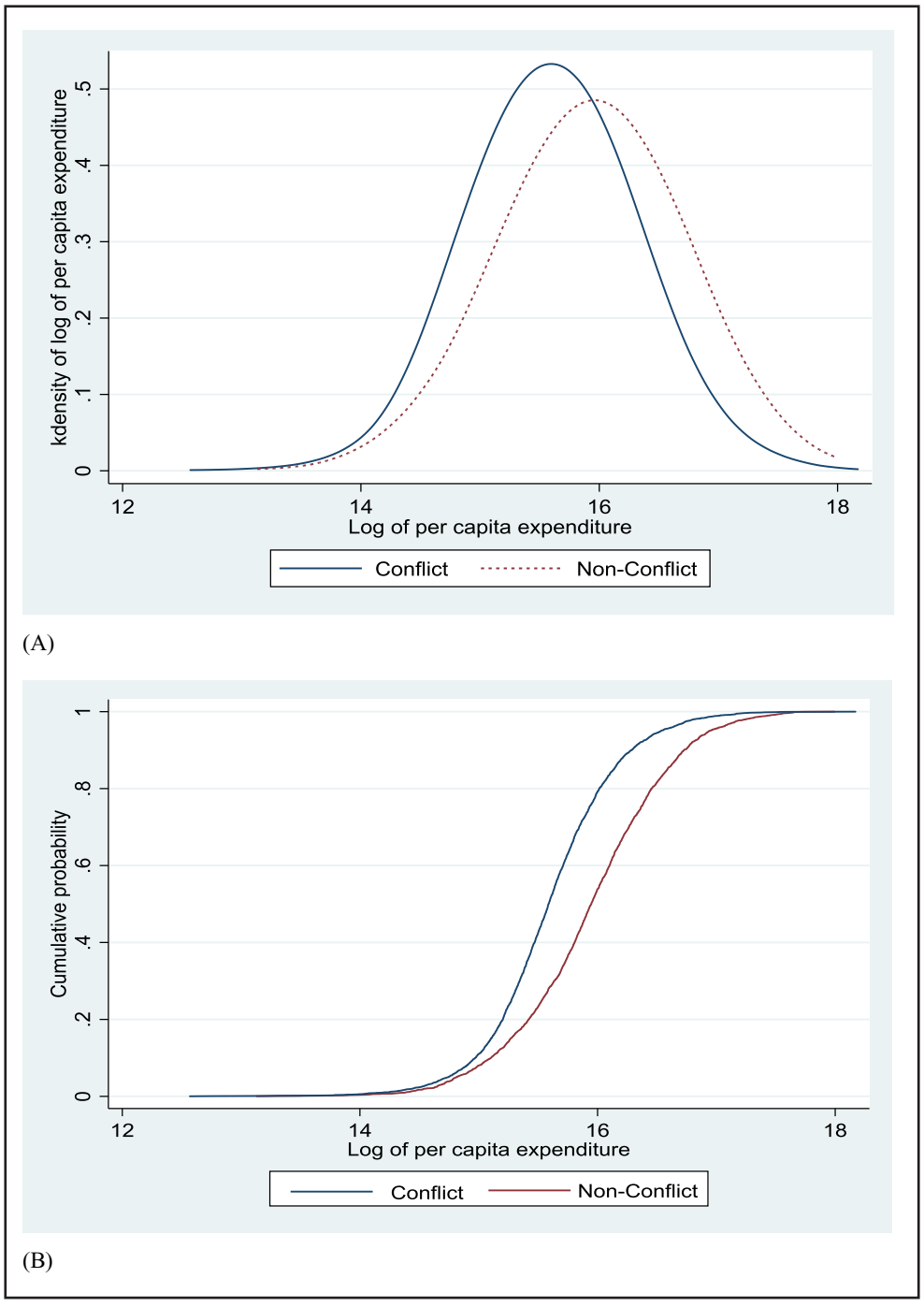


Figure 3 (A) The Density Functions of Household Expenditure by Conflict Exposure (2011). (B) The Distribution Functions of Household Expenditure by Conflict Exposure (2011).



The foregoing findings are corroborated when plotting the corresponding empirical distribution functions for the log of per capita household expenditure by conflict status. These overlap strongly for the initial year (see Figure 1B) but sharply diverge in the latter two post-conflict years (see Figures 2B and 3B). The difference in the empirical distribution functions between the conflict and non-conflict zones is statistically assessed using the two-sample Kolmogorov–Smirnov testing principle. This test procedure uses the maximum vertical distance between the two empirical functions to measure how closely the two functions resemble each other. It is ultimately a statistical test for whether the vertical maximum distance between

the distribution functions is statistically different from zero. Table A2.1 in Appendix II provides the Kolmogorov–Smirnov test results and confirms no statistical difference between the distributions in the earlier pre-conflict year. However, statistically significant differences between the distribution functions emerge for the two post-conflict years.

Percentile ratios are reported in Table 1 to provide additional descriptive insights on the distribution of pre-war and post-war household expenditure. The difference between the 50th and the 10th percentiles relative to the median in Table 1 informs the pattern of expenditure at the lower end of the distribution, while the difference between the 90th and the 50th percentiles relative to the median reflects the top end of the distribution. The differences between the top and bottom 10% of the unconditional expenditure distribution relative to the median are reported in column 1 of Table 1. The raw data reveal that prior to the civil war, Sierra Leone exhibited a higher expenditure gap between the "richest" and "poorest" households compared to the two post-war years with most of the inequality sourced at the top end of the distribution.

The dispersion of household expenditure in Sierra Leone as measured by the standard deviation (see Table 2) also reveals higher variation in household expenditure prior to the civil war compared to immediately after. The pre-war phenomenon of a fairly unequal expenditure

Table 1 Sierra Leone Household Expenditure Percentile Ratios by Conflict Exposure

	90th–10th	90th–50th	50th–10th
	50th	50th	50th
1989:			
Overall	10.1315	9.3909	0.7406
Conflict	8.1130	7.2757	0.8373
Non-conflict	9.3891	8.6631	0.7260
Change	–1.2761	–1.3874	0.1113
2003:			
Overall	2.5614	2.0107	0.5507
Conflict	1.6637	1.1458	0.5178
Non-conflict	3.2174	2.6255	0.5919
Change	–1.5537	–1.4797	–0.0741
2011:			
Overall	1.7592	1.2537	0.5055
Conflict	1.4517	0.9520	0.4994
Non-conflict	1.8487	1.3408	0.5078
Change	–0.3970	–0.3888	–0.0084
Raw difference-in-difference			
D-i-D1 (2003–1989)	–0.2776	–0.0923	–0.1854
D-i-D2 (2011–1989)	0.8791	0.9986	–0.1197

Notes: "Change" denotes the difference in outcomes between the conflict and non-conflict affected zones; see Table 2 for the relevant sample sizes used to compute the relevant summary statistics. D-i-D1 and D-i-D2 are the raw difference-in-differences between 2003/1989 and 2011/1989; the 2003 and 2011 expenditure values were based on a new currency code introduced in Sierra Leone, which replaced the previous denomination in cents to Leones (Le). The ISO 4217 code introduced the currency change from 100 cents to 1 Le. This accounts for the change in absolute magnitudes reported in 2003 and 2011 compared to 1989.

Table 2 Standard Deviation of Log of Household Expenditure by Conflict Exposure

	1989	2003	2011
Standard deviation:			
Overall	1.4596	0.7627	0.6121
Conflict	1.5661	0.6013	0.5602
Non-conflict	1.3997	0.8608	0.6230
Change	0.1664	−0.2595	−0.0628
Raw difference-in-difference			
D-i-D1 (2003–1989)	n/a	−0.4259	n/a
D-i-D2 (2011–1989)	n/a	n/a	−0.2292
Observations:	3439	3702	6763
Treatment	1167	1666	4041
Control	2272	2036	2722

Notes: "Change" denotes the difference in standard deviations between the conflict and non-conflict affected zones;
D-i-D1 and D-i-D2 are the raw differences-in-difference between 2003/1989 and 2011/1989 respectively; n/a denotes not applicable.

Table 3 Gini Coefficient for Household Expenditure by Conflict Exposure

	1989	2003	2011
Gini Coefficient:			
Overall	0.672***	0.442***	0.3380***
	(0.008)	(0.008)	(0.003)
Conflict	0.659***	0.377***	0.302***
	(0.009)	(0.012)	(0.005)
Non-conflict	0.677***	0.434***	0.344***
	(0.011)	(0.010)	(0.004)
Change	−0.017	−0.057***	−0.042***
	(0.014)	(0.016)	(0.006)
Difference-in-difference			
D-i-D1 (2003–1989)	n/a	−0.040**	n/a
		(0.021)	
D-i-D2 (2011–1989)	n/a	n/a	−0.025
			(0.015)
Observations:	3439	3702	6763
Treatment	1167	1666	4041
Control	2272	2036	2722

Notes: "Change" denotes the difference between conflict and non-conflict zones; bootstrapped standard errors with 250 replications are reported in parenthesis; D-i-D1 and D-i-D2 are the raw differences-in-difference between 2003/1989 and 2011/1989, respectively; n/a denotes not applicable; the significance levels are denoted as ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

distribution is also evident using the estimated Gini coefficients reported in Table 3. The overall Gini coefficient was estimated to be 0.67 prior to the conflict. Based on the Gini values, the chiefdoms that ultimately became the conflict-affected zones did not exhibit a statistically

different degree of inequality in 1989 compared to those located in what became the non-conflict zones. The conflict led to a sharp reduction in the Gini coefficient in chiefdoms experiencing protracted rebel occupation. In the immediate aftermath of the war, expenditure inequality fell by a statistically well determined 5 (Gini) percentage points. In addition, the raw difference-in-difference estimate between 1989 and 2003 suggests a contraction of about 4 percentage points in the Gini index, which is statistically significant. However, the leveling effects on inequality using the Gini index 10 years after the conflict appear to have dissipated with the corresponding raw difference-in-difference estimate between 1989 and 2011 failing to achieve statistical significance at a conventional level.

Table 4 reports the differentials in log expenditure at the mean and selected quantiles. Although there was no average difference statistically between what became the conflict and non-conflict zones before the civil war, the former zones had statistically higher expenditure levels at the top end of the distribution. This provides suggestive evidence that those households located at the top end of the welfare distribution in what ultimately were the conflict-affected zones were better off in welfare terms. However, those households at the bottom end of the distribution in areas that became the conflict zones were worse off prior to the conflict. This finding contrasts with that implied by the Gini coefficient estimate for the pre-conflict year and serves to highlight the well-established limitation of this statistic when potentially off-setting effects at the top and the bottom ends of the distribution are present. The key pattern evident from the table is that the largest reductions in household expenditure in the aftermath of the conflict were located at the top end of the distribution (i.e., at the 90th percentile), and these effects appear to be fairly persistent 10 years after the conflict concluded. Again, the nature of this particular finding is not detectable using the Gini coefficient

Table 4 Log Household Expenditure Differentials between Conflict and Non-conflict Zones at the Mean and Selected Quantiles

Mean and selected percentiles	1989	2003	2011
Mean	0.0526	−0.5447***	−0.3318***
	(0.0621)	(0.0502)	(0.0403)
10th	−0.2506***	−0.1923***	−0.0037
	(0.0611)	(0.0552)	(0.0026)
25th	−0.1037***	−0.3762***	−0.1453***
	(0.0649)	(0.0413)	(0.1806
50th	−0.0000	−0.4798***	−0.3444***
	(0.1028)	(0.0354)	(0.0193)
75th	0.3696***	−0.6325***	−0.4967***
	(0.0777)	(0.0375)	(0.0217)
90th	0.1589**	−0.7974***	−0.5485***
	(0.0813)	(0.0528)	(0.0317)
Observations:	3439	3702	6763
Treatment	1167	1666	4041
Control	2272	2036	2722

Notes: The significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$; see text for the definition of conflict zones used here.

Table 5 Summary Statistics of Household Characteristics by Conflict Exposure

	1989		2003		2011	
	Conflict	**Non-conflict**	**Conflict**	**Non-conflict**	**Conflict**	**Non-conflict**
Head's characteristics:						
Age	44.43	43.75	46.80	46.19	45.70	45.49
	(11.44)	(11.91)	13.99	14.29	14.68	13.83
Age squared	2104.39	2056.01	2386.05	2337.35	2304.35	2259.99
	(1119.90)	(1193.83)	1461.48	1483.03	1515.08	1409.94
Gender:						
Male	0.87	0.85	0.82	0.80	0.72	0.74
Female	0.13	0.15	0.18	0.20	0.26	0.24
Education:						
Primary	0.68	0.56	0.09	0.08	0.08	0.09
High	0.32	0.44	0.02	0.04	0.12	0.11
Secondary	-	-	0.12	0.20	0.05	0.21
No education	-	-	0.75	0.64	0.76	0.59
Marital Status:						
Married	0.92	0.92	0.84	0.79	0.81	0.77
Cohabit	0.04	0.06	0.01	0.01	0.01	0.01
Other status	0.05	0.09	0.15	0.16	0.15	0.15
Single	0.02	0.02	0.01	0.03	0.03	0.06
Tribes:						
Mende	-	-	0.38	0.37	-	-
Temne	-	-	0.24	0.23	-	-
Other tribes	-	-	0.38	0.40	-	-
Religion:						
Muslim	-	-	-	-	0.78	0.74
Christian	-	-	-	-	0.21	0.25
Other religions	-	-	-	-	0.01	0.01
Other Characteristics:						
Urban	0.33	0.35	0.30	0.40	0.17	0.48
Dependency ratio	0.99	0.91	0.95	0.94	1.08	1.15
	0.91	0.93	0.90	0.87	1.03	1.16
Household size	6.16	5.29	6.28	6.11	5.64	5.61
	4.05	3.34	2.61	2.85	2.47	2.67
Household size squared	54.37	39.14	46.28	45.43	37.98	38.76
	69.71	50.22	40.48	45.55	35.66	42.79
Sample size	1167	2272	1666	2036	2722	4041

Notes: Standard deviations for continuous variables reported in parenthesis; conflict exposure refers to whether a household is located within the conflict-affected chiefdoms, defined as being subject to >8 years of rebel occupation.

The household survey data also contain information on individual and household-level characteristics. These include, *inter alia*, the age of the household head, the head's educational level, the head's marital status and gender, the household dependency ratio, and the household's settlement type. Table 5 provides selected summary statistics for these variables by "treatment"

and "control" groups. These particular variables comprise the input variables for the empirical methodology used in this study to which attention now turns.

5 Econometric Methodology

The key objective of this study is to evaluate the impact of the civil war on household inequality. This is undertaken using a methodology that exploits the Recentred Influence Function (RIF). This approach was developed by Firpo et al. (2009) and utilizes the concept of the influence function. The RIF can be obtained for any distributional statistic. In particular, it can be used for inequality measures like the Gini index. Essamah-Nssah and Lambert (2011) outline how the RIF is derived for the Gini and it is expressed as follows:

$$\mathrm{RIF}(y;G) = -\frac{y}{\mu}G + 1 - \frac{y}{\mu} + \frac{2}{\mu}\int_0^y F(z)\,dz \tag{1}$$

where y is the household expenditure level, μ is the mean, and G is the Gini coefficient. The RIF-based Gini constructed above can then be expressed as a linear function of the conflict dummy as well as a set of household and other characteristics ($\mathbf{X}$) as follows:

$$E[\mathrm{RIF}(y_i; G)|\mathbf{X}, \mathrm{Conflict}] = \mathbf{X}_i'\boldsymbol{\beta} + \gamma \mathrm{Conflict}_i \tag{2}$$

The RIF regression is amenable to estimation by OLS (see Firpo et al., 2009). Eq. (2) comprises the regression specification for the RIF-based Gini with $\hat{\gamma}$ representing the estimated impact effect of conflict on the Gini coefficient.

In order to assess the robustness of the conflict estimate using the Gini coefficient, the RIF regression model described in Eq. (2) is estimated by least squares in three different ways: (i) as an unweighted regression model; (ii) as a least squares regression model weighted using propensity scores; and (iii) as an unweighted regression model with the propensity scores included as an additional regressor. In addition, the average treatment effects for the RIF-based Gini index using both a propensity score matching (PSM) technique and an inverse probability weighting (IPW) procedure are also computed.

A number of the foregoing empirical methods require estimation of a treatment assignment equation. The estimation of this equation as a binary logistic regression model provides the propensity scores used in estimation above (see Table A2.2 in Appendix II). The corresponding matching quality tests for the propensity scores are reported in Tables A2.3–A2.6 in Appendix II and confirm that the matching yields a satisfactory degree of balancing in the distribution of the covariates across "treatment" and "control" groups in all three years.

As already noted, a disadvantage of the Gini-based approach is that it fails to provide any insights into the impact of conflict at specific points of the unconditional expenditure distribution. An analysis of the conflict effect at different parts of the household expenditure distribution is likely to be more informative from a policy perspective. This can be achieved through estimating the effects of interest at different quantiles of the household expenditure distribution. Therefore, an unconditional quantile treatment effect on the treated (QTT) method is used to obtain the impact of conflict on the distribution of household expenditure at different quantiles. This approach permits the analysis to uncover any heterogeneous distributional

impacts on the outcome of interest not discernible using a Gini coefficient. In order to estimate the quantile treatment effects of the conflict on household expenditure, the probability of household conflict status is modeled. This requires denoting T = 1 if a household is in a chiefdom subject to protracted occupation by rebel groups, with T = 0 otherwise. The quantile treatment effect on the treated at quantile τ is expressed as follows:

$$\Delta^{\tau}=y_{1,\tau}\,|_{T=1}-y_{0,\tau}\,|_{T=1} \tag{3}$$

where $y_{1,\tau}\,|_{T=1}$ is the logged household expenditure outcome variable for conflict-affected households at quantile τ, while $y_{0,\tau}\,|_{T=1}$ is the outcome for the treated group in the absence of any conflict exposure. The latter is known in this setting as the counterfactual quantile for the treated sample and is unobserved. Given that we have observational data, the simulation of the counterfactual requires the creation of a distribution for the household welfare measure, which exploits inverse probability weighting (see below). Following Firpo (2007), the conflict is assumed exogenous conditional on household characteristics (thus invoking the "selection on observables" assumption). The densities of household expenditure for each conflict status outcome are estimated by weighted kernel estimators using the Epanechnikov kernel density in conjunction with the Silverman (1986) bandwidth. The weighting estimator for each quantile is given by a traditional (inverse) propensity score-weighting estimator expressed as:

$$\left(\widehat{\alpha},\widehat{\Delta}^{\tau}\right)=\arg\min_{\alpha,\Delta}\sum w_i^{f}\times\rho_{\tau}\left(y_i-\alpha-T_i\Delta^{\tau}\right) \tag{4}$$

where ρ_{τ} is the standard check function, α is a constant term, and Δ^{τ} is the quantile treatment effect described originally in Eq. (3) above. In addition, the weighting used here is defined as follows:

$$w_i^{f}=\frac{T_i}{(\Pr(T=1\,|\,X_i)}+\frac{1-T_i}{1-\Pr(T=1\,|\,X_i)} \tag{5}$$

The probability of being in a conflict-affected zone (as measured by protracted rebel occupation) based on observable characteristics (i.e., $\Pr(T=1|\mathbf{X}_i)$) is thus also required for the implementation of the above procedure. The modeling approach uses a local logistic regression model. The non-parametrically estimated propensity scores reflect the probability of a household being in the conflict zone (i.e., a chiefdom with protracted rebel rule). The selected (observable) controls contained in the treatment assignment equation help mitigate the selection bias assuming the included variables are highly correlated with any underlying unobservable confounders. The relevant input variables were briefly reviewed in the data section above (see Table 5 above). These controls are assumed not to be influenced by the conflict treatment itself. Table A2.7 in Appendix II reports the local logistic regression model estimates used to construct the propensity scores for the re-weighting procedure.[4] The distribution of the covariates between the "treatment" and "control" groups in the estimation of the quantile treatment effects are not found to systematically differ after re-weighting based on a set of relevant tests (see Table A2.8 in Appendix II).

4 The "ivqte" command in Stata is used for the estimation of the quantile treatment effects in this application (see Frölich and Melly, 2010). The authors are grateful to Markus Frölich for assistance in the use of this command. It should be noted that although the STATA routine is known as "ivqte," it does not require an instrumental variable for identification in the current case since selection here is based on (exogenous) observables.

The causal identification in this application primarily relies on the geographical pattern of invasion and rebel occupation that led to some chiefdoms being relatively safe and free from conflict (i.e., the "control" group) and other areas not (i.e., the "treatment" group). However, given the use of observational data, there are inevitable challenges to effective internal validity in the current application. First, the intensity of the civil war varied across chiefdoms and conflict years, leading to displacement or movement of the civilian population. Consequently, there may be potential spill-over effects due to a combination of voluntary migration and forced displacement. This would be particularly acute if the movement between control and treatment zones were sizeable. However, although migration and displacement may have been sizeable overall, the patterns reported in the SLIHS data from 2003 suggest such movement was largely confined to within, and not between, the treatment and control groups used here. The movement between the conflict and non-conflict areas accounted for 7% of households according to survey data for 2003. Households subject to movement across the "treatment" and "control" boundaries are thus excluded from the analysis in order to protect against potential contamination by "spill-over" effects.[5] Second, it is arguable the choice of cut-off for the treatment variable in terms of the length of rebel occupation is arbitrary. Therefore, the robustness of the chosen threshold is examined by reducing the cut-off occupation time period and also by using an alternative treatment measure based on the intensity of conflict-related deaths at chiefdom level. In addition, the robustness of the findings is also assessed using additional data based on self-reported responses on the effects of conflict at the household-level. Third, the causal identification here rests strongly on a central assumption that selection into treatment is based on observables, thus precluding an explicit role for "unobservables" in determining treatment assignment. The validity of this assumption requires that the set of observables included in the treatment assignment equation adequately absorbs and captures the influence of any potential unobservable confounder(s). This cannot be known *a priori* but difference-in-difference estimates are computed for some of the empirical analysis to remove the influence of unobservable confounders assuming their effects are constant over time.[6] A series of robustness checks informing the above issues as well as a number of other considerations are reported in the penultimate section of this paper.

6 Empirical Results

Table 6 presents the conflict estimates for the RIF-based Gini coefficient for the five different estimation procedures outlined earlier. Using the unweighted regression estimates, there is a statistically significant inverse relationship between a household in a rebel-occupied conflict chiefdom and the Gini coefficient in the immediate aftermath of the civil war. This effect is absent in all cases prior to the civil war. The results for the regression using the propensity scores as weights confirms the negative effect on household expenditure inequality in the short-run. On average and *ceteris paribus,* being in the conflict zone reduces the Gini coefficient by about 8 percentage points. This contraction in welfare dispersion dissipates in the long-run. The results for the propensity score matching technique support the negative impact

5 However, the exclusion of these households does not exert any meaningful effect on the key estimates reported here.

6 In particular, the analysis around the Gini index is amenable to the computation of average difference-in-difference estimates.

Table 6 The Impact of Conflict on the Distribution of Expenditure using the Gini Coefficient

	Conflict Exposure		
Estimation Methods	**1989**	**2003**	**2011**
(1) Unweighted	0.0039	−0.0908***	−0.0051
	(0.0156)	(0.0126)	(0.0050)
(2) Weighted	0.0025	−0.0804***	0.0037
	(0.0140)	(0.0125)	(0.0048)
(3) PS regressor	0.0039	−0.0912***	−0.0030
	(0.0197)	(0.0152)	(0.0050)
(4) Matching (ATT)	0.0108	−0.0552***	0.0048
	(0.0184)	(0.0183)	(0.0081)
(5) IPW (ATT)	0.0031	−0.0834***	−0.0001
	(0.0147)	(0.0125)	(0.0048)
Observations:	3439	3702	6763
Treatment	1167	1666	4041
Control	2272	2036	2722

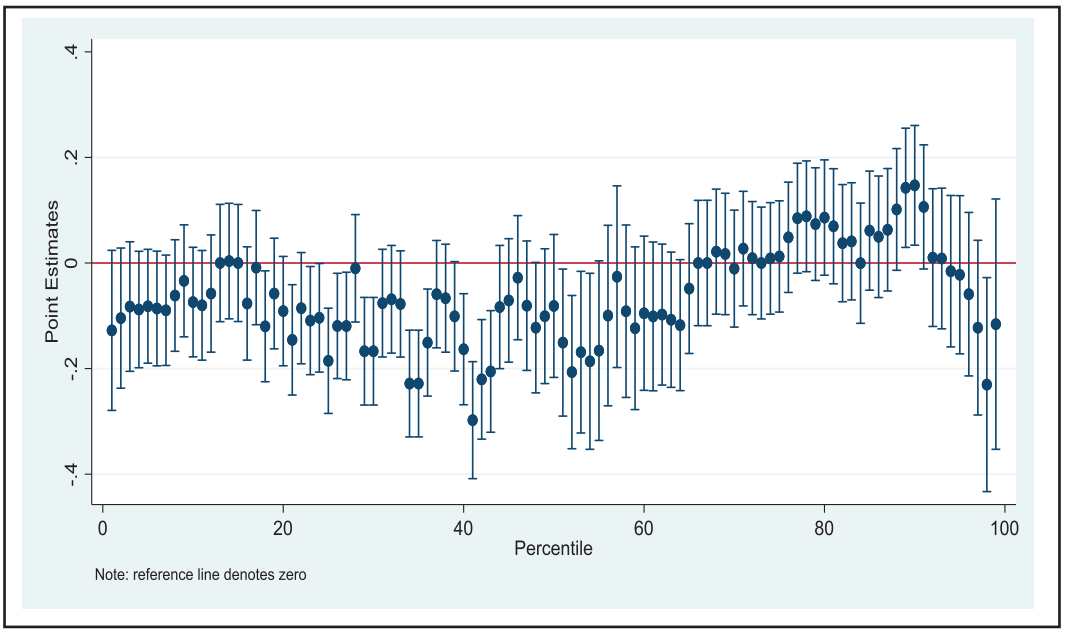
Notes: The estimates reported for (1) to (3) relate to the regression estimate $\hat{\gamma}$ from Eq. (2). Specifically, the different regression results are based on the following: (1) OLS without regression weights; (2) OLS with the propensity score as regression weights; (3) the propensity score is included as an additional covariate in the regression; (4) uses the propensity score matching technique with the RIF-based Gini; (5) uses the inverse probability weighting technique with the RIF-based Gini. Standard errors are reported in parentheses; the significance levels are defined as: ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

of the conflict on the RIF-based Gini coefficient, though the magnitude is slightly lower compared to the other estimates reported in this table. The matching technique suggests a reduction in expenditure inequality of about 6 (Gini) percentage points. The results using the inverse probability weighting procedure provide further evidence of a contraction in inequality in the immediate aftermath of the civil war (by 8 [Gini] percentage points). If we compute the difference-in-difference estimate between 1989 and 2003 based on the propensity score matching estimates, which are the smallest in absolute values, the estimated effect reveals a reduction of 6.6 (Gini) percentage points, which is well determined statistically. In contrast, none of the difference-in-difference estimates between 1989 and 2011 are found to be statistically significant. Overall, the empirical evidence here suggests the impact of conflict on inequality is sizeable in magnitude but may be that persistent. Overall, the empirical evidence here suggests the impact of conflict on inequality is sizeable in magnitude but may not be that persistent. Specifically, the conflict is only found to exert a significant levelling effect on inequality in the immediate aftermath of the war.

As already noted, a limitation of the Gini coefficient is that it does not provide an indication on where along the household expenditure distribution the inequality changes are most pronounced. In order to gain some deeper insight on this issue, the QTT effects are computed for each percentile. The point estimates and 95% confidence intervals for the estimated QTT effects for each year of the analysis are graphically depicted in Figures 4–6, respectively.

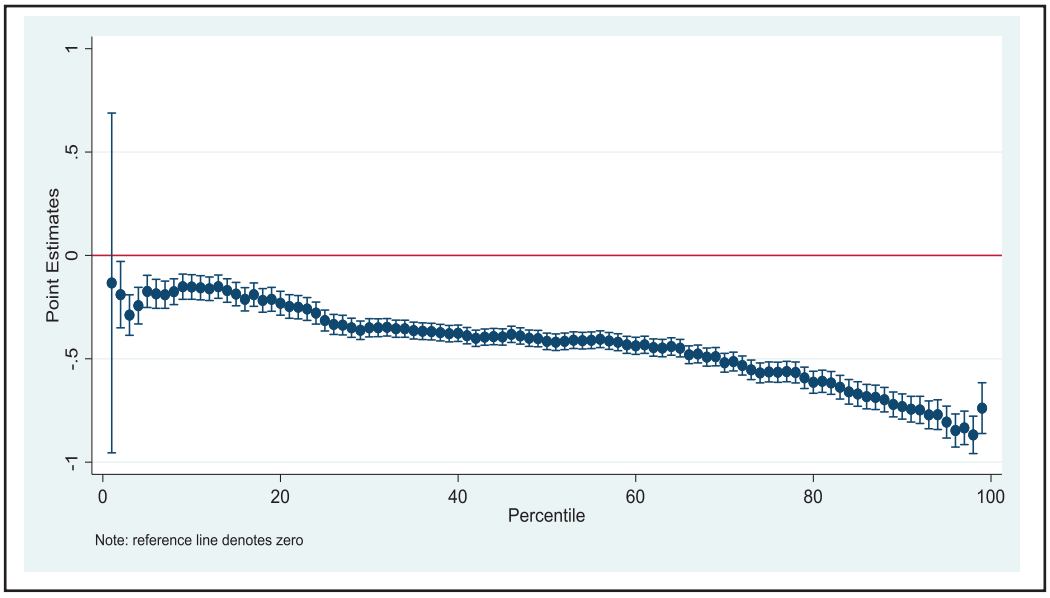
Prior to the civil war, Sierra Leone was characterized by a high degree of dispersion in household expenditure between what became the conflict and non-conflict zones.

Figure 4 Point Estimates and 95% Confidence Intervals for Quantile Conflict Treatment Effects (1989).



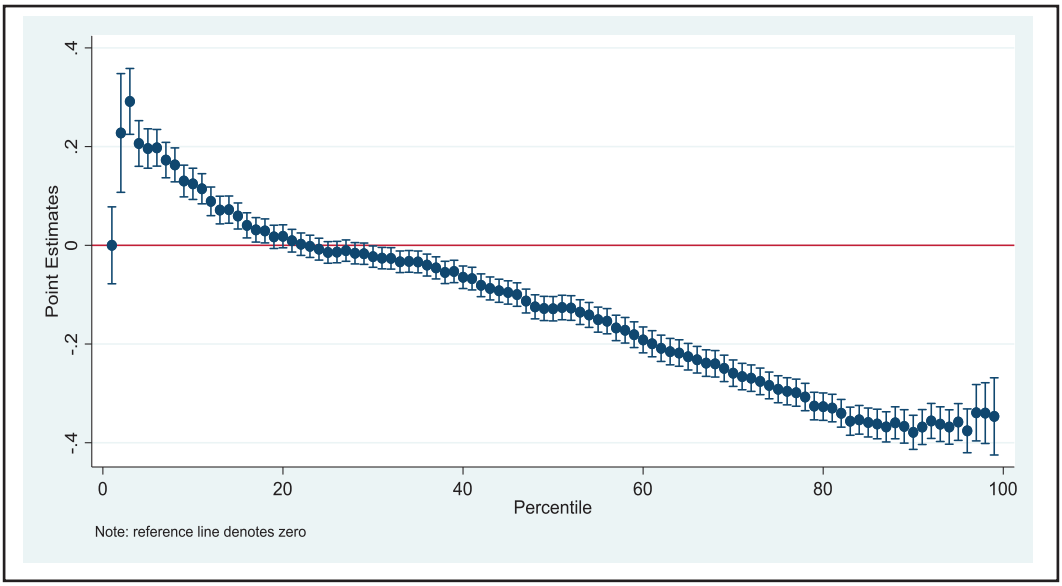
Notes: The QTT point estimates are derived using expression Eq. (4) in the text with the variables included in the local logistic treatment assignment equation described in the notes to Table 7. The 95% confidence intervals are based on bootstrapping with 250 replications. The mean estimate is obtained using a regression model containing the same set of covariates.

Figure 5 Point Estimates and 95% Confidence Intervals for Quantile Conflict Treatment Effects (2003).



Notes: The QTT point estimates are derived using the expression in Eq. (4) in the text with the variables included in the local logistic treatment assignment equation described in the notes to Table 7. The 95% confidence intervals are based on bootstrapping with 250 replications. The mean estimate is obtained using a regression model containing the same set of covariates.

Figure 6 Point Estimates and 95% Confidence Intervals for Quantile Conflict Treatment Effects (2011).



Notes: The QTT point estimates are derived using the expression in Eq. (4) in the text with the variables included in the local logistic treatment assignment equation described in the notes to Table 7. The 95% confidence intervals are based on bootstrapping with 250 replications. The mean estimate is obtained using a regression model containing the same set of covariates.

However, there is no clear or systematic pattern of a statistically significant gap at points of the distribution. In particular, there is little evidence of significant differentials between the non-conflict and what became the conflict zones from about the 60th percentile of the distribution onward (see Figure 4). However, immediately after the civil war, the expenditures for those households in the conflict zone exhibit a sharp contraction from about the 20th percentile onward (see Figure 5). The effect widens with progress along the log household expenditure distribution. Households located at the top end of the distribution incur the greatest conflict-related penalty. These negative effects exhibit a degree of long-run persistence up to 2011, though the magnitude is more modest in nature when compared to the earlier post-conflict year (see Figure 6).[7]

A set of individual estimates for the conflict effect at selected quantiles of log household expenditure is provided in Table 7. Prior to the start of the civil war, households in chiefdoms subsequently subjected to protracted rebel rule were, on average, neither better nor worse off than those in areas not subsequently subjected to rebel occupation. After the civil war, these chiefdoms experienced a sharp downturn as household expenditures contracted across most percentiles of the household distribution but particularly from the first quartile onward. However, households subject to conflict exposure at the 90th percentile exhibited a statistically significant reduction in expenditures of about 51% compared to comparable households in the unaffected zones. This negative distributional impact remains persistent up to the longer period but with a more modest contraction. There is evidence of some recovery at the bottom end of the household expenditure distribution. However, households

7 The scale of the estimated effects in Figure 6 is more modest than in Figure 5 (see the vertical axes), which is not entirely clear from a visual inspection of these two plots. In addition, the presence of an outlier in Figure 5 also gives an impression of greater precision in the percentile estimates than is actually the case.

Table 7 Mean and Quantile Treatment Effects using the Log of Household Expenditure

	Mean	10th	25th	50th	75th	90th
1989:						
Conflict exposure	−0.0831	−0.0560	−0.1853***	−0.0813	−0.0115	0.1183
	(0.0588)	(0.0825)	(0.0769)	(0.1476)	(0.0876)	(0.1213)
Observations	3,439	3,422	3422	3422	3422	3422
2003:						
Conflict exposure	−0.4437***	−0.1624***	−0.3065***	−0.3974***	−0.5515***	−0.6821***
	(0.0531)	(0.0547)	(0.0635)	(0.0392)	(0.0336)	(0.0579)
Observations	3702	3702	3702	3702	3702	3702
2011:						
Conflict exposure	−0.2601***	0.0786**	−0.0390**	−0.1401***	−0.2726***	−0.3013***
	(0.0498)	(0.0332)	(0.0189)	(0.0161)	(0.0269)	(0.0388)
Observations	6763	6763	6763	6763	6763	6763

Notes: Seventeen observations were trimmed from the QTT analysis for 1989 with propensity scores below 0.0001 and none from the two subsequent years. The treatment assignment equation contains the following controls: head of household age and its quadratic, head of household gender, head of household education and marital status, household size and it quadratic; household dependency ratio; the household's settlement type; and a selection of interaction variables (see Table A2.7 in Appendix II). Bootstrapped standard errors are reported in parentheses with 250 replications; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

located at the 90th percentile continue to incur a sizeable negative penalty. In particular, almost 10 years after the conflict ended, households located in chiefdoms that experienced protracted rule by the rebel groups still exhibited 26% lower household expenditure compared to those not subject to such occupation during the war. This important insight is concealed when the Gini coefficient is used to inform on the inequality effects of conflict.

7 Robustness and Other Checks

The robustness of the foregoing results is now investigated in a number of different ways. It is arguable that the "treatment" estimates may be sensitive to the construction of the conflict dummy variable, which is based on a rebel chiefdom occupation of ≥9 years. In order to investigate the robustness of the estimates using this definition, the conflict dummy is replaced by a measure based on ≥7 years of rebel occupation. Tables 8 and 9, respectively, report results for such an exercise for the Gini coefficient and the quantile treatment effects. In both cases, the key conclusions are found to be invariant to a treatment measure calibrated with respect to this shorter period of occupation. In addition, we also construct an alternative conflict dummy variable which equals 1 if the number of conflict-related deaths per 1,000 of the chiefdom population is above the median for the conflict overall, and equal to 0 otherwise. Tables 8 and 10 report the results for this exercise and the key short-run estimates are again found to be invariant to the use of a measure more explicitly based on the conflict fatality rate.[8] However, as opposed to the estimates based on rebel occupation, the fatality measure yields a number of statistically significant negative effects in terms of the Gini coefficient for 2011 in Table 8.

8 Not surprisingly, there is a very high correlation coefficient of 0.92 between the 9-year and 7-year measures of rebel occupation across chiefdoms. In addition, the correlation coefficient between the 9-year occupation treatment and the above median fatality rate treatment across chiefdoms used here is 0.81, though the percentage of households subject to the latter treatment increases from 45% to 53% in 2003.

Table 8 The Impact of Conflict on the Gini Coefficient using Alternative Conflict Measures

	Exposure (7 years cut-off)			Exposure (above median dummy)		
Estimation Methods	**1989**	**2003**	**2011**	**1989**	**2003**	**2011**
(1) Unweighted	0.0040	−0.0912***	−0.0055	0.0257	−0.0952***	−0.0147**
	(0.0157)	(0.0128)	(0.0052)	(0.0185)	(0.0141)	(0.0051)
(2) Weighted	0.0030	−0.0805***	0.0037	0.0263	−0.0811***	−0.0074
	(0.0141)	(0.0131)	(0.0038)	(0.0214)	(0.0138)	(0.0046)
(3) PS regressor	0.0041	−0.0924***	−0.0035	0.0254	−0.0954***	−0.0139*
	(0.0198)	(0.0157)	(0.0052)	(0.0189)	(0.0152)	(0.0050)
(4) Matching (ATT)	0.0109	−0.0563***	0.0051	0.0365	−0.0768***	−0.0758
	(0.0188)	(0.0189)	(0.0084)	(0.0194)	(0.0238)	(0.0571)
(5) IPW (ATT)	0.0031	−0.0845***	−0.0001	0.0253	−0.0827***	−0.0168**
	(0.0145)	(0.0132)	(0.0056)	(0.0174)	(0.0138)	(0.0053)
Observations:	3439	3702	6763	3439	3702	6763
Treatment	1167	1666	4041	1954	1965	4041
Control	2272	2036	2722	1485	1737	2722

Note: The conflict exposure measure is based on either an occupation of ≥7 years or whether or not the deaths per chiefdom were above the national median; the different regression results are based on the following: (1) OLS without regression weights; (2) OLS with the propensity scores as regression weights; (3) the propensity score is included as an additional covariate in the regression model; (4) uses the propensity score matching technique; (5) uses the inverse probability weighting technique. Robust standard errors are reported in parentheses; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

Table 9 OLS and Quantile Treatment Effects using Log Household Expenditure – Conflict Exposure (using ≥7 years of rebel occupation as the cut-off)

	Mean	**10th**	**25th**	**50th**	**75th**	**90th**
1989:						
Conflict exposure	−0.0841	−0.0520	−0.1803***	−0.0822	−0.0120	0.1180
	(0.0598)	(0.0885)	(0.0716)	(0.1480)	(0.0854)	(0.1214)
Observations	3439	3439	3439	3439	3439	3439
2003:						
Conflict exposure	−0.1468***	−0.0149	−0.0542	−0.0928***	−0.2208***	−0.4167***
	(0.0485)	(0.0500)	(0.0358)	(0.0318)	(0.0384)	(0.0512)
Observations	3702	3702	3702	3702	3702	370
2011:						
Conflict exposure	−0.1607***	−0.0974**	−0.0934***	−0.1065***	−0.1563***	−0.2119***
	(0.0377)	(0.0264)	(0.0265)	(0.0217)	(0.0285)	(0.0456)
Observations	6763	6763	6763	6763	6763	6763

Notes: The treatment assignment equation contains the following controls: head of household age and its quadratic, head of household gender, head of household education and marital status, household size and it quadratic; household dependency ratio; the household's settlement type; and a selection of interaction variables. Bootstrapped standard errors are reported in parentheses with 250 replications; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

Nevertheless, the estimated effects are considerably more modest in magnitude compared to those obtained for the period in the immediate aftermath of the civil war. In contrast, the estimated quantile treatment effects appear to be largely invariant to the use of either of these two alternative conflict measures (see Tables 9 and 10).[9]

As a second set of robustness checks, an alternative household-level "treatment" measure is also exploited in the empirical analysis. This uses information on households that self-report having directly suffered war-related events (e.g., family or relatives killed, limbs amputated, property destroyed or lost, household members raped or displaced). The information obtained for this measure is based on respondents' answers to questions asked about the conflict in the post-war integrated household survey from 2003.[10] This alternative conflict measure is constructed as a binary variable that equals 1 if an individual in a household (or the household itself) is reported to have suffered from any of the conflict-specific events stated above, and is defined as 0 otherwise. In essence, this construct captures whether or not a member (or members) of the household reports themselves as war victims. Table A2.9 in Appendix II, using data from 2003, contains the raw differentials for the household expenditure levels between those households that self-report being affected by the conflict and those that do not. The pattern observed in the reported raw differentials appears broadly consonant with those contained in

Table 10 OLS and Quantile Treatment Effects using Log Household Expenditure – Conflict Exposure using Conflict Deaths per Chiefdom Above the Median

	Mean	10th	25th	50th	75th	90th
1989:						
Conflict exposure	0.1043	−0.0505	0.0661	0.2283	0.4849***	0.2627***
	(0.0411)	(0.0692)	(0.0776)	(0.1421)	(0.0649)	(0.0763)
Observations	3439	3439	3439	3439	3439	3439
2003:						
Conflict exposure	−0.1468***	−0.0255	−0.0761	−0.1594***	−0.3416***	−0.5074***
	(0.0485)	(0.0481)	(0.0379)	(0.0309)	(0.0451)	(0.0517)
Observations	3702	3702	3702	3702	3702	3702
2011:						
Conflict exposure	−0.1607***	−0.0974**	−0.0934***	−0.1065***	−0.1563***	−0.2119***
	(0.0377)	(0.0264)	(0.0265)	(0.0217)	(0.0285)	(0.0456)
Observations	6763	6763	6763	6763	6763	6763

Notes: The treatment assignment equation contains the following controls: head of household age and its quadratic, head of household gender, head of household education and marital status, household size and it quadratic; household dependency ratio; the household's settlement type; and a selection of interaction variables. Bootstrapped standard errors are reported in parentheses with 250 replications; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

9 In addition, we also constructed another treatment variable that was based on interacting the nine-year occupation treatment dummy with a dummy for whether or not conflict fatalities were above the national median. This allows the effect of the occupation to be heterogeneous across areas exposed to an above-median intensity of conflict-related deaths. The estimates for this exercise are reported in Tables A2.13, A2.14 and A2.15 in Appendix II and again confirm the pattern originally reported for the core results in Tables 6 and 7.

10 The data for 2011 are not used for this purpose given the greater risk of recall error on the part of respondents due to the longer passage of time since the end of the war as compared to 2003. In addition, the availability of post-war support packages (as introduced in 2009 and noted in the text) may also have encouraged some households to claim they had been affected by the conflict when they had not.

Table 11 The Impact of Conflict on the Gini Coefficient using Self-reported Conflict Events

	Conflict Events
Estimation Methods	**2003**
(1) Unweighted	−0.0802***
	(0.0183)
(2) Weighted	−0.0751***
	(0.0214)
(3) PS regressor	−0.0800***
	(0.0169)
(4) Matching (ATT)	−0.0691***
	(0.0265)
(5) IPW (ATT)	−0.0736***
	(0.0395)
Observations:	3696
Treatment	1319
Control	2377

Note: The conflict measure is self-reported (see text). The estimates reported for (1) to (3) relate to the regression estimate $\hat{}$ from Eq. (2). Specifically, the different regression results are based on the following: (1) OLS without regression weights; (2) OLS with the propensity score as regression weights; (3) the propensity score is used as an additional covariate in the regression model; (4) uses the propensity score matching technique; (5) uses the inverse probability weighting technique. Standard errors in parentheses; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

Table 12 OLS and Quantile Treatment Effects of Conflict on Log Household Expenditure using Self-reported Conflict Events

	OLS	**10th**	**25th**	**50th**	**75th**	**90th**
2003:						
Conflict events	−0.446***	−0.1796***	−0.2906***	−0.3885***	−0.5469***	−0.6834***
	(0.0460)	(0.0561)	(0.0582)	(0.0375)	(0.0381)	(0.0576)
Observations	3696	3696	3696	3696	3696	3696

Notes: The conflict measure is self-reported (see text). The treatment assignment equation contains the following controls: head of household age and its quadratic, head of household gender, head of household education and marital status, household size and it quadratic; household dependency ratio; the household's settlement type; and a selection of interaction variables. Bootstrapped standard errors are reported in parentheses with 250 replications; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

Table 4. Tables 11 and 12 report the econometric results using the self-reported conflict measure for the Gini coefficient and the quantile treatment effects, respectively. The estimates for the Gini index are broadly comparable to those reported in Table 6 for 2003, while the quantile treatment effects confirm the sizeable contractions at the top end of the unconditional distribution for the same year.

Sierra Leone's capital Freetown was heavily protected by national and international forces during the war and so provided a relatively safe environment within which economic activities could occur in a largely uninterrupted fashion. During the conflict, it was the center for both

government and non-governmental agencies engaged in either military or relief operations. Therefore, the economic opportunities in Freetown were different from the rest of the "control" group within the country during the conflict. This creates the potential for a downward bias in the causal estimates reported here. In order to address this issue, the analysis is undertaken excluding Freetown. The results of this exercise are reported in Table A2.10 in Appendix II containing the Gini coefficient estimates using the inverse probability weighting exercise (to conserve space) and Table A2.11 in Appendix II containing the quantile treatment effects. The core finding of this exercise is that the key estimates originally reported in Tables 6 and 7 are in the same ball park as the estimated effects contained in Tables A2.10 and A2.11 in Appendix II, respectively. Thus, the estimates are not materially altered or affected by the exclusion of Freetown from the analysis.

The trajectory of household inequality after the civil war could also have been affected by the flow of aid and other forms of international assistance. The provision of such aid is generally intended for social reconstruction or providing a financial boost to government for its development policies. Post-conflict Sierra Leone witnessed an increase in international aid geared toward rebuilding and enhancing the lives of affected households and individuals. The effect of aid donor agencies took time to take effect after the end of the civil war. Since the immediate post-conflict data were collected just 1 year after the end of the civil war, the short-term effects are unlikely to have been driven by such aid disbursements as these were yet to be rolled out effectively. Thus, we do not believe aid transfer policies are likely to explain the inequality effects noted here in the immediate post-conflict period.

An estimated two million Sierra Leoneans were displaced during the civil war according to the 2004 NPWJ report. This accounted for about one-third of the Sierra Leone population in 2004 (Statistics Sierra Leone, 2004 Population and Housing Census report). A summary analysis of the survey data reveals that by the end of 2003, 93.5% of war-displaced households had returned to their place of origin. Internal displacement (within chiefdom or province) accounted for most displacements. We argue that the impact of returnees originally subject to displacement is unlikely to be problematic for our short-run analysis as the data were collected just 1 year after the conflict ended and it is unlikely that the effect of such returnees would be meaningfully reflected in economic activity by that time.

Finally, it was also noted earlier that the baseline survey from 1989 is comprised of data drawn from only 64 of Sierra Leone's 152 chiefdoms, while the post-conflict data are drawn from all 152 chiefdoms. Therefore, the analysis was undertaken restricting the data (both pre-conflict and post-conflict) to the original 64 chiefdoms. The relevant estimates for this exercise are reported in Table A2.12 for the Gini coefficient (using the inverse probability weighting procedure) and Table A2.13 (for the quantile treatment effects) in Appendix II. Although the short-run point estimates are larger in absolute terms when using the restricted data, the same pattern of effects emerge with a sizeable reduction in the Gini coefficient and sizeable contractions in the quantile treatment effects noted at the higher percentiles. Overall, the core empirical findings and the underlying narrative reported around the leveling effect of conflict on inequality appear robust to the use of data restricted to the 64 chiefdoms originally used in the 1989 survey.

8 Conclusions

This paper investigates the distributional impact on a household welfare metric of the Sierra Leone civil war. The study contributes to a relatively thin literature on the effect of the Sierra Leone conflict on socio-economic outcomes. Our analysis differs in terms of empirical methodology and research objectives from earlier work undertaken for this country. It uses household-level data and focuses on the distributional impact of the conflict on household expenditures rather than on social, political, behavioral and firm level outcomes – themes that have featured more prominently in the research agenda on conflict for this country.

The study used three household-level surveys in conjunction with geographical (i.e., chiefdom level) data on the conflict and finds that households in the rebel-occupied zones experienced a sharp reduction in household expenditure inequality in the short-run. Specifically, the level of inequality as measured by the Gini coefficient contracted by over 6 percentage points. Households at the top end of the expenditure distribution experienced the greatest reduction in welfare. This effect was most pronounced in the short-run but persisted 10 years after the conflict had concluded, though with smaller and more muted effects.

The nature of the impact on household inequality of the civil war in Sierra Leone can best be understood through the lens of the military tactics adopted by the rebels during the conflict. The "operations" conducted by the rebel groups and their accomplices were destructive in nature. These tactics were orchestrated and actively encouraged by the rebel leadership. Looting and theft from properties were among the activities engaged in by the rebels, as well as the destruction of private dwellings. These strategies were driven by acquisitive motives and also by a desire to drive fear into the populace to encourage community compliance with the occupation. The targeting of high-value assets by the rebels rendered the wealthier groups in these communities vulnerable to an expropriation of their assets and these households became the biggest losers during the conflict. The strategy thus followed a highly destructive pattern with looted wealth not re-directed to any meaningful or productive economic activity. Hence, those households at the top end of the welfare distribution incurred the greatest loss in the immediate post-conflict era with no obvious redistributive benefit to other households within the country.

The empirical evidence of a sharp decline in inequality immediately after the civil war is in comport with Scheidel's (2017) proposition that conflict is a catalyst for leveling or compressing vertical inequality. It is appreciated that the nature of conflict and the contextual experience of affected countries differ. However, a protracted civil war can lead to a breakdown in government effectiveness and the use of destructive strategies mostly affecting the wealthiest in society. Hence, the immediate impact is a reduction in overall welfare and declining inequality.

It is acknowledged the identification strategy exploited in this study to estimate the distributional effect of the civil war on household welfare using a conflict exposure measure based on rebel occupation is subject to criticism given a heavy reliance on selection based on observables. However, we have endeavored to demonstrate the robustness of the key estimates obtained in a number of different ways. As noted by Ruhm (2018), there is always a trade-off in applied work, particularly when using observational data, between the clean identification of key estimates and the need to seek answers to important questions (e.g., the distributional impact of the Sierra Leone war on households). Even if the identification strategy is considered weaker than

desirable and the evidence interpreted more as descriptive in nature, the findings point to an unambiguous reducing impact of conflict on household inequality in the immediate aftermath of the war. Thus, at the very least, this study should be interpreted as complementing a thin body of existing research on the distributional impact of conflict and, in so doing, highlighting the relative importance of such a focus for future studies in other conflict areas.

Declarations

Availability of Data and Materials

The data are available from the authors on request.

Competing Interests

There is no conflict of interest in regard to this research.

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Authors' Contributions

The authors made equal contributions to this paper.

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Appendix I

Table A1 Chiefdom Allocation to "Treatment" and "Control" Group

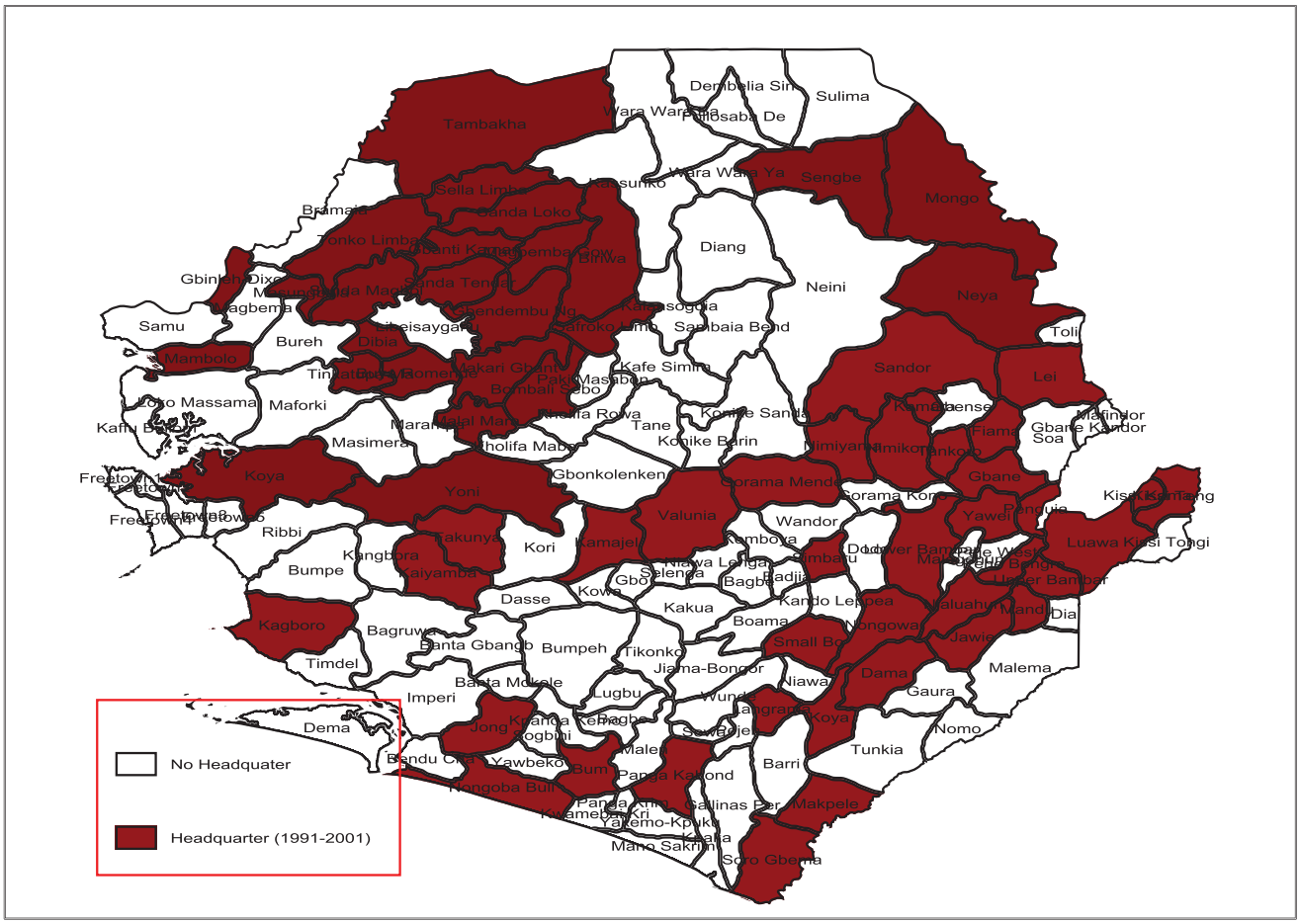
Years in Survey	Chiefdoms in Treatment Group	Chiefdoms in Control Group
1989, 2003, and 2011	Eastern Regions: Biriwa Bombali Shebro Bum Dama Fiama Jawie Mandu Lower Bambara Nimikoro Njaluahun Nongowa Simbaru Small Bo Tankoro Northern Region Gbanti-Kamaranka Gbendembu Ndowahun Gbinleh Dixing Southern Region: Jong Kaiyamba Panga Kabone Valunia Bumpeh Fakunya Northern Region: Koya Magbema Makari Gbanti Malal Mambolo Masungbala Sanda Loko Sella Limba	Eastern Region: Malegohun Gbense Gorama Kono Northern Region: Paki Masabong Samu Dembelia Sinkunia Follosaba Dembelia Sulima Wara Wara Yagala Kaffu Bullom Lokomasama Maforki Marampa Gbonkolenken Kholifa Mabang Kunike Barina Southern Region: Bagbo Baoma Jaiama Bongor Kakua Komboya Tikonko Imperi Kpanga Kemo Bumpeh Upper Banta Barri Western Area Mountain York Rural Waterloo Central 1 Central 2 East 1 East 2 East 3 West 1 West 2 West 3
2003 and 2011 only	Eastern Regions: Kissi Kama Luawa Penguia Yawei Gorama Mende	Eastern Regions: Kissi Tongi Kpeje Bongre Kpeje West Dodo Gaura

(*Continued*)

Table A1 Continued

Years in Survey	Chiefdoms in Treatment Group	Chiefdoms in Control Group
	Langrama	Kandu Lekpeama
	Gbane	Nomo
	Kamara	Tunkia
	Lei	Wandor
	Nimiyama	Mafindor
	Sandor	Soa
	Northern Region:	Malema
	Safroko Limba	Nomo
	Sanda Tendaren	Niawa
	Tambakka	Northern Region:
	Tonko Limba	Libeisaygahun
	Mongo	Magbaimba
	Neya	Ndorhahun
	Sengbe	Kasunko
	Bureh Kasseh	Nieni
	Buya Romende	Wara Wara Bafodia
	Dibia	Masimera
	Sanda Magbolontor	Kafe Simira
	Southern Region:	Kalansogoia
	Jong	Tane
	Nongoba Bullom	Paki Masonbong
	Kamajei	Braiama
	Kongbora	Diang
	Makpele	Southern region:
	Pejeh	Bumpe Ngawo
	Soro Gbema	Niawa Lenga
		Bendu Cha
		Sogbini
		Bagruwa
		Kagboro
		Kowa
		Lower Banta
		Timdale
		Gallinas Peri
		Mano Sakrim
		Yakemo Kpukumu Krim
		Badjia
		Bagbo
		Wunde
		Kwamebi Krim- Beduma
		Sittia- Yonni
		Yawbeko- Talia
		Dasse
		Kori
		Ribbi
		Kpaka
		Sowa

Figure A1 Conflict Exposure by Rebel Occupation based on the Presence of Rebel Headquarters by Chiefdom.



Appendix II

Table A2.1 Kolmogorov–Smirnov Tests for Equality of Distributions by Conflict Exposure

Years	Distance	Exact Prob-value
1989	0.0492	0.121
2003	0.2689	0.000
2011	0.2515	0.000

Notes: The null hypothesis is that the empirical distribution functions across treatment (conflict) and control (non-conflict) groups are equal. The "Distance" is the maximum vertical distance between the CDFs for the two groups and the prob-value is used to determine whether the distance is statistically significant.

Table A2.2 Logistic Treatment Assignment Model for Conflict Exposure and Conflict Events

	1989	2003		2011
	Conflict Exposure	Conflict Exposure	Conflict Events	Conflict Exposure
Age of head	0.00789	0.0183	0.0275*	−0.0364***
	(0.0199)	(0.0138)	(0.0159)	(0.0104)
Age of head square	−0.000157	−0.000162	−0.000195	0.000330***
	(0.000200)	(0.000131)	(0.000151)	(0.00010)
Head being male	0.206	−0.192	0.620***	−0.0641
	(0.126)	(0.154)	(0.185)	(0.0826)
Head married	−0.0147	−0.164	−0.568***	−0.0602
	(0.163)	(0.166)	(0.208)	(0.0991)
Dependency ratio	0.0241	0.0530	−0.0995*	−0.0231
	(0.0554)	(0.0499)	(0.0589)	(0.0308)
Urban	−0.118	−0.978***	−1.082***	−2.127***
	(0.149)	(0.246)	(0.284)	(0.201)
Head with prim educ	0.535***	−0.0175	0.882***	−0.228*
	(0.0804)	(0.160)	(0.224)	(0.125)
Head with higher educ	-	−0.469**	−0.478**	−0.0725
		(0.206)	(0.204)	(0.123)
Household size	−0.0322	0.210***	−0.275***	−0.00466
	(0.0376)	(0.0492)	(0.0601)	(0.0297)
Head with prim educ × urban	-	0.408*	−0.767**	0.0987
		(0.243)	(0.303)	(0.218)
Head male × urban	-	0.131	−1.142***	−0.310**
		(0.257)	(0.298)	(0.157)
Dependency ratio × urban	0.0530	−0.0706	−0.326***	−0.0557
	(0.0873)	(0.0799)	(0.0948)	(0.0545)
Household size square	0.00615***	−0.0114***	0.00863**	−0.00193
	(0.00219)	(0.00304)	(0.00352)	(0.00188)

(*Continued*)

Table A2.2 Continued

	1989	2003		2011
	Conflict Exposure	**Conflict Exposure**	**Conflict Events**	**Conflict Exposure**
Household size × urban	0.00229	−0.0409	0.0953***	0.0886***
	(0.0229)	(0.0268)	(0.0297)	(0.0225)
Head married × urban	−0.200	0.967***	1.552***	0.391**
	(0.326)	(0.262)	(0.311)	(0.170)
Head Muslim	-	0.330***	0.520***	−0.0841
		(0.0836)	(0.0940)	(0.0771)
Head × Temne tribe	-	−0.0129	−1.711***	-
		(0.0817)	(0.0911)	
Head × Muslim × urban	-	-	-	0.151
				(0.141)
Constant	−1.294***	−1.299***	1.449***	1.216***
	(0.486)	(0.393)	(0.465)	(0.274)
LRT	105.55	137.95	590.44	781.24
LRT prob-value	0.0000	0.00	0.00	0.000
McFadden R^2	0.0240	0.0271	0.129	0.0867
Observations	3,439	3,702	3,697	6,763

Notes: "Conflict exposure" is based on the period of rebel occupation of the chiefdom by time (see text); "Conflict event" is based on household self-reported status (see text); standard errors are reported in parentheses; significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

Table A2.3 Pre-war (1989) Covariate Balancing Tests Using Conflict Exposure

	Treated	**Control**	**%Bias**	**t-value**	**p > t**	**Variance Ratio**
Age of head	42.86	43.01	−1.20	−0.48	0.63	0.98
Age of head sq	1958.50	1971.20	−1.10	−0.45	0.65	1.07
Head male	0.86	0.87	−2.60	−0.98	0.33	0.99
Head cohabiting	0.93	0.93	−0.90	−0.34	0.73	1.02
Dependency ratio	0.90	0.88	1.90	0.84	0.40	1.13
Urban	0.34	0.36	−3.20	−1.17	0.24	1.00
Head with prim educ	0.57	0.59	−4.40	−1.55	0.12	0.97
Head with higher educ	0.43	0.41	4.50	1.55	0.12	0.97
Household size	5.41	5.44	−0.70	−0.28	0.78	1.01
Household size sq	41.52	41.65	−0.20	−0.09	0.93	1.07
Head with prim educ × urban	0.19	0.19	−1.20	−0.44	0.66	0.98
Head male × urban	0.29	0.31	−2.90	−1.06	0.29	0.99

Notes: % bias should lie in the interval [−5%, + 5%]; the variance ratio should lie within [0.5, 0.8) or (1.25, 2].

Table A2.4 Post-war (2003) Covariate Balancing Tests using Conflict Exposure

	Treated	Control	%Bias	t-value	p > t	Variance Ratio
Age of head	46.80	46.66	1.00	0.29	0.77	0.99
Age of head sq	2386.00	2374.70	0.80	0.22	0.82	0.99
Head male	0.82	0.83	−4.90	−1.47	0.14	0.87
Head married	0.84	0.86	−5.10	−1.58	0.11	1.11
Dependency ratio	0.95	0.94	1.50	0.44	0.66	1.10
Urban	0.30	0.30	−0.80	−0.24	0.81	0.99
Head with prim educ	0.09	0.09	0.30	0.09	0.93	1.01
Head with higher educ	0.02	0.02	0.20	0.06	0.95	1.01
Household size	6.28	6.25	1.30	0.40	0.69	1.01
Head prim educ × urban	0.04	0.04	0.70	0.22	0.83	1.04
Head being male × urban	0.25	0.25	−0.60	−0.17	0.86	0.98
Dependency ratio × urban	0.30	0.30	−0.20	−0.08	0.94	1.08
Household size sq	46.28	45.75	1.20	0.38	0.71	1.01
Household size × urban	1.87	1.90	−0.80	−0.24	0.81	0.99
Head married × urban	0.25	0.26	−1.60	−0.46	0.65	0.98
Head a Muslim	0.80	0.80	−0.10	−0.02	0.99	1.00
Head from Temne tribe	0.24	0.24	0.30	0.07	0.94	1.00

Notes: %bias should lie in the interval [−5%, + 5%]; the variance ratio should lie within [0.5, 0.8) or (1.25, 2].

Table A2.5 Post-war (2011) Covariate balancing Tests using Conflict Exposure

	Treated	Control	%Bias	t-value	p > t	Variance Ratio
Age of head	45.71	46.06	−2.40	−0.87	0.38	1.05
Head with primary educ	0.07	0.06	0.90	0.36	0.72	1.05
Head with higher educ	0.05	0.04	1.60	0.70	0.48	1.09
Head male	0.73	0.74	−2.20	−0.78	0.44	1.03
Head married	0.81	0.82	−2.40	−0.92	0.36	1.03
Dependency ratio	1.08	1.09	−0.80	−0.30	0.77	1.01
Household size	5.65	5.66	−0.40	−0.17	0.86	1.11
Age of head squared	2304.41	2320.10	−1.10	−0.38	0.70	1.06
Urban	0.17	0.17	−0.20	−0.09	0.93	0.99
Dependency ratio × urban	0.19	0.19	−0.40	−0.19	0.85	1.04
Head being married × urban	0.12	0.12	−0.30	−0.12	0.91	0.99
Head being male × urban	0.11	0.12	−0.80	−0.36	0.72	0.97
Head with prim educ × urban	0.02	0.02	−0.10	−0.06	0.96	0.99
Household size × urban	0.95	0.93	0.50	0.22	0.82	1.01
Household size sq	37.98	37.45	1.30	0.54	0.59	1.11
Head a Muslim	0.78	0.78	−1.10	−0.40	0.69	1.02
Head a Muslim × urban	0.12	0.12	0.00	0.01	0.99	1.00

Notes: %bias should lie in the interval [−5%, + 5%]; the variance ratio should lie within [0.5, 0.8) or (1.25, 2].

Table A2.6 Pre-war and Post-war Balancing Property Diagnostics

Years	Pseudo R^2	LRT Chi-squared	prob > Chi-squared	Mean Bias	Median Bias	B	R	%Concern	%Bad
1989:									
Unmatched	0.038	137.33	0.00	18.20	21.80	43.10*	2.52*	33.00	8.00
Matched	0.002	11.20	0.43	2.10	1.60	9.10	1.24	0.00	0.00
2003:									
Unmatched	0.149	661.03	0.00	18.40	14.00	97.6*	0.73	59.00	12.00
Matched	0.003	19.84	0.283	2.40	2.10	13.00	1.46	0.00	0.00
2011:									
Unmatched	0.128	1143.23	0.00	25.00	11.30	89.71*	1.03	35.00	24.00
Matched	0.001	10.79	0.866	1.20	0.80	7.40	1.15	0.00	0.00

Notes: Balancing property of "concern" if B > 25% with "bad" matching determined by whether *R* is outside the range [0.5; 2].

Table A2.7 Semi-parametric Local Logistic Treatment Assignment Regression Model – Quantile Treatment Effect Estimation for Conflict Exposure

Variables	1989	2003	2011
Head's age	0.0008615	0.00661**	−0.00220
	(0.022450)	(0.00290)	(0.0113)
Head's age sq	−0.000124***	-	−4.33e−05
	(3.93e−05)		(0.000104)
Head male	−0.171	0.626***	0.338***
	(0.146)	(0.186)	(0.0736)
Married head	0.0970	−0.657***	−0.294
	(0.182)	(0.210)	(0.261)
Dependency ratio	−0.122**	0.186	0.173**
	(0.0599)	(0.122)	(0.0779)
Urban settlement	0.0205	−1.974***	−3.046***
	(0.177)	(0.282)	(0.196)
Primary education	−0.670***	0.957***	0.472***
	(0.0944)	(0.235)	(0.165)
Higher education	-	0.790*	−0.493***
		(0.433)	(0.0752)
Household size	−0.0723*	−0.149***	−0.152***
	(0.0403)	(0.0570)	(0.0379)
Primary × urban	-	−0.867***	−0.270
		(0.306)	(0.216)
Head male × urban	-	−1.496***	
		(0.287)	
Household size squared	0.00192	0.00312	0.00336*
	(0.00225)	(0.00330)	(0.00196)
Household size × urban	−0.0245	0.161***	0.195***
	(0.0250)	(0.0291)	(0.0211)

(*Continued*)

Table A2.7 Continued

Variables	1989	2003	2011
Married × urban	-	1.843***	0.424***
		(0.297)	(0.142)
Muslim	-	0.545***	–0.724***
		(0.126)	(0.0999)
Temne tribe	-	–1.886***	-
		(0.0915)	
Muslim × urban	-	0.222	0.670***
		(0.179)	(0.136)
Higher education × urban	-	–1.727***	-
		(0.500)	
Dependency ratio × urban	0.0843		–0.234***
	(0.0945)		(0.0523)
Dependency ratio squared	-		0.00934
			(0.0131)
Constant	2.523***	1.651***	2.444***
	(0.227)	(0.310)	(0.348)
Observations	3439	3702	6763

Notes: "Conflict exposure" is based on the period of rebel occupation of the chiefdom by time (see text); standard errors are reported in parentheses; significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

Table A2.8 Overidentification Tests for the IPW Procedure

	Conflict Exposure	
Years	**Test Statistic**	**Prob-value**
1989	18.9261	0.1248
2003	29.9765	0.1187
2011	18.5819	0.3528

Notes: The null hypothesis is that the set of covariates are balanced across treatment and control groups.

Table A2.9 Log Household Expenditure Differentials between Conflict and Non-conflict Affected Households (Self-reported) at the Mean and Selected Quantiles

Mean and percentiles	**2003**
Mean	−0.5345***
	(0.0419)
10th	−0.2045***
	(0.0456)
25th	−0.3553***
	(0.0434)
50th	−0.4663***
	(0.0370)
75th	−0.6084***
	(0.0374)
90th	−0.7859***
	(0.0403)
Observations:	3696
Treatment	1319
Control	2377

Notes: The significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$; see text for the definition of conflict zones used here.

Table A2.10 The Impact of Conflict on the Gini Coefficient using the Inverse Probability Weighting Procedure (without Freetown)

	Conflict Exposure		
	1989	**2003**	**2011**
ATT	0.0031	−0.0780***	−0.0003
	(0.0147)	(0.0127)	(0.0047)
	3439	3582	6,656
Observations:			
Treatment	1167	1666	4041
Control	2272	1916	2615

Notes: Standard errors are reported in parentheses; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

Table A2.11 Quantile Treatment Effects on the Treated using Log Household Expenditure – Conflict Exposure (without Freetown)

	OLS	10th	25th	50th	75th	90th
1989:						
Conflict exposure	0.2066***	−0.0506	0.0661	0.2283	0.4849***	0.2627***
	(0.0482)	(0.0745)	(0.0817)	(0.1561)	(0.0631)	(0.0710)
Observations	3439	3439	3439	3439	3439	3439
2003:						
Conflict exposure	−0.3882***	−0.0872	−0.2025***	−0.3468**	−0.5469***	−0.6848***
	(0.0512)	(0.0594)	(0.0701)	(0.0474)	(0.0407)	(0.0796)
Observations	3582	3582	3582	3582	3582	3582
2011:						
Conflict exposure	−0.2537***	0.0903**	−0.0326	−0.1364***	−0.2692***	−0.3136***
	(0.0499)	(0.0328)	(0.0198)	(0.0167)	(0.0277)	(0.0344)
Observations	6656	6656	6656	6656	6656	6656

Notes: The treatment assignment equation contains the following controls: head of household age and its quadratic, head of household gender, head of household education and marital status, household size and it quadratic; household dependency ratio; the household's settlement type; and a selection of interaction variables. Bootstrapped standard errors are reported in parentheses with 250 replications; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

Table A2.12 The Impact of Conflict on the Gini Coefficient using Inverse Probability Weighting (With 64 Chiefdoms) based on Conflict Exposure

	Using 64 Chiefdoms		
	1989	2003	2011
ATT	0.0031	−0.0950***	−0.0016
	(0.0147)	(0.0193)	(0.0068)
Observations:	3439	2156	3730
Treatment	1167	894	2230
Control	2272	1262	1500

Notes: Standard errors are reported in parentheses; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

Table A2.13 Quantile Treatment Effects using Log Household Expenditure Based on Conflict Exposure with more than Eight Years of Rebel Occupation (with 64 chiefdoms)

	Mean	10th	25th	50th	75th	90th
1989:						
Conflict exposure	0.2066***	−0.0506	0.0661	0.2283	0.4849***	0.2627***
	(0.0482)	(0.0745)	(0.0817)	(0.1561)	(0.0631)	(0.0710)
Observations	3439	3439	3439	3439	3439	3439
2003:						
Conflict exposure	−0.3918***	−0.1013	−0.2222***	−0.2961**	−0.4577***	−0.6048***
	(0.0606)	(0.0675)	(0.0465)	(0.0404)	(0.0491)	(0.0532)
Observations	2156	2156	2156	2156	2156	2156
2011:						
Conflict exposure	−0.1625***	−0.0831**	−0.0976***	−0.1405***	−0.2576***	−0.3235***
	(0.0582)	(0.0367)	(0.0290)	(0.0253)	(0.0324)	(0.0452)
Observations	3778	3778	3778	3778	3778	3778

Notes: The treatment assignment equation contains the following controls: head of household age and its quadratic, head of household gender, head of household education and marital status, household size and it quadratic; household dependency ratio; the household's settlement type; and a selection of interaction variables. Bootstrapped standard errors are reported in parentheses with 250 replications; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

Table A2.14 The Impact of Conflict on the Gini Coefficient using Interaction between Main Conflict Exposure measure and Conflict Deaths per Chiefdom Above Median

	Conflict Exposure Interacted with the above Median Deaths Dummy		
Estimation Methods	**1989**	**2003**	**2011**
(1) Unweighted	0.0232	−0.0948***	−0.0148**
	(0.0195)	(0.0138)	(0.0050)
(2) Weighted	0.0252	−0.0810***	−0.0076
	(0.0224)	(0.0136)	(0.0041)
(3) PS regressor	0.0250	−0.0965***	−0.0139*
	(0.0191)	(0.0153)	(0.0050)
(4) Matching (ATT)	0.0361	−0.0772***	−0.0754
	(0.0193	(0.0241)	(0.0571)
(5) IPW (ATT)	0.0242	−0.0830***	−0.0170**
	(0.0184)	(0.0137)	(0.0052)
Observations:	3439	3702	6763
Treatment	1954	1965	4041
Control	1485	1737	2722

Note: The conflict exposure measure is based on a rebel occupation of ≥9 years interacted with whether or not the deaths per chiefdom were above the median; the different regression results are based on the following: (1) OLS without regression weights; (2) OLS with the propensity scores as regression weights; (3) the propensity score is included as an additional covariate in the regression model; (4) uses the propensity score matching technique; (5) uses the inverse probability weighting technique. Robust standard errors are reported in parentheses; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

Table A2.15 OLS and Quantile Treatment Effects using Log Household Expenditure – Interaction between Main Conflict Exposure measure and Conflict Deaths per Chiefdom Above Median

	Mean	10th	25th	50th	75th	90th
1989:						
Conflict exposure	0.1043	−0.0507	0.0664	0.2282	0.4757***	0.2630***
	(0.0411)	(0.0693)	(0.0778)	(0.1420)	(0.0651)	(0.0758)
Observations	3439	3439	3439	3439	3439	3439
2003:						
Conflict exposure	−0.1472***	−0.0265	−0.0762**	−0.1585***	−0.3421***	−0.5065***
	(0.0486)	(0.0483)	(0.0378)	(0.0310)	(0.0462)	(0.0517)
Observations	3702	3702	3702	3702	3702	3702
2011:						
Conflict exposure	−0.1612***	−0.0980**	−0.0933***	−0.1066***	−0.1562***	−0.2121***
	(0.0377)	(0.0271)	(0.0264)	(0.0218)	(0.0287)	(0.0447)
Observations	6763	6763	6763	6763	6763	6763

Notes: The treatment assignment equation contains the following controls: head of household age and its quadratic, head of household gender, head of household education and marital status, household size and it quadratic; household dependency ratio; the household's settlement type; and a selection of interaction variables. Bootstrapped standard errors are reported in parentheses with 250 replications; the significance levels are denoted by ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.