



# Near-real-time welfare and livelihood impacts of an active war: Evidence from Ethiopia

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## ABSTRACT

Ethiopia recently experienced a large-scale war that lasted for more than two years. Using unique High-Frequency Phone Survey (HFPS) data, which span several months before and after the outbreak of the war, this paper provides evidence on the immediate impacts of the conflict on households' food security. We also assess potential mechanisms and evaluate impacts on proximate outcomes, including on livelihood activities and access to food markets. We use difference-in-differences and two-way fixed effects estimation to compare trends across affected and unaffected regions (households) and before and after the outbreak of the war. Seven months into the conflict, we find that the war was associated with a 37 percentage points increase in the probability of moderate to severe food insecurity. Using the Armed Conflict Location and Event Data (ACLED), we show that exposure to an additional battle leads to a 1 percentage point increase in the probability of moderate or severe food insecurity. The conflict was associated with significant reduction in access to food through supply chain disruptions and by curtailing non-farm livelihood activities. Non-farm and wage related activities were affected the most, whereas farming activities were relatively more resilient. Our estimates, which likely underestimate the true average effects on the population, constitute novel evidence on the near-real-time impacts of large-scale conflict. Our work highlights the potential of HFPS to monitor active and large-scale conflicts, especially in contexts where conventional data sources are not immediately available.

## 1. Introduction

Armed conflicts continue to be major drivers of poverty, and they are on the rise in Africa (Collier et al., 2003; Corral et al., 2020; Shemyakina, 2022). About 48 percent of all the globally extreme poor people were living in conflict affected regions in 2018 and this is predicted to increase to 68 percent by 2030 (Corral et al., 2020). As part of this increasing trend in conflicts and political instabilities in Africa, Ethiopia recently experienced a large-scale war that affected millions. Political disagreements between the Ethiopian federal government and the Tigray regional state ensued into full-scale war on November 4, 2020. The conflict played out in most parts of Tigray while also spilling over into parts of Amhara and Afar regions. Despite some high-level

assessments (e.g., UNOCHA, 2021; WFP, 2022) and anecdotal accounts, to date there has not been any micro-level assessment of the welfare impacts of the armed conflict on affected households.<sup>1</sup> Using unique High-Frequency Phone Survey (HFPS) data, collected midway into the conflict, we provide fresh empirical evidence of the (near real-time) impacts of the conflict on households' food security. To assess potential mechanisms, we evaluate impacts on proximate outcomes, including on livelihood activities and access to food markets. We also evaluate the distributional patterns of these effects across economic sectors and geography.

Much of the earlier work on the impacts of violent conflict is cross-country in nature, examining macro-level relationships between conflict and economic growth and development outcomes (Collier et al.,

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<sup>1</sup> So far, the empirical studies on the impact of the war in Tigray have focused on implications on public health infrastructure and access to health services (e.g., Gesesew et al., 2021; Tesema and Kinfu, 2021; Favara et al., 2022; Abay et al., 2022).

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2003; Corral et al., 2020). Most of these cross-country studies find significant negative impacts of conflicts on macro-level economic outcomes (Barro, 1991; Gupta et al., 2004), some of which are transitory and are followed by quick recovery (Miguel and Roland, 2006; Justino and Verwimp, 2006; Chen et al., 2008; Cerra and Saxena, 2008), while in other cases negative consequences are found to persist over longer periods (Blattman and Miguel, 2010; de Groot et al., 2022; Shemyakina, 2022). Several studies document important heterogeneities in impacts of conflicts across countries and regions (Bove et al., 2017; de Groot et al., 2022).

The increased availability of household survey data in the last decade has led to proliferation of micro-level studies that examine the effects of violent conflict on welfare and economic outcomes of affected populations (e.g., Akresh and de Walque, 2008; Bundervoet et al., 2009; Akresh et al., 2011; Chamabagwala and Morán, 2011; Merrouche, 2011; Shemyakina, 2011; Akresh et al., 2012; León, 2012; Mansour and Rees, 2012; Akbulut-Yuksel, 2014; Grimard and Laszlo, 2014; Valente, 2014; Pivovarova and Swee, 2015; Brück et al., 2019; Martin-Shields and Stojetz, 2019; Verwimp et al., 2019). However, much of the micro studies on conflicts in African have typically examined delayed outcomes observed several years following a conflict. For example, Akresh (2008) and Kraehnert et al. (2019) examine the longer-term impacts of the Rwandan genocide on schooling and fertility outcomes.<sup>2</sup> Minoiu and Shemyakina (2012) find strong negative impacts of the 2002–2007 Cote d'Ivoire conflict on children's health status in subsequent years.<sup>3</sup> Similarly, studies of the impacts of the 1998–2000 Ethiopia-Eritrea border conflict find evidence of negative impacts on child health and schooling outcomes in subsequent years (Akresh et al., 2012; Weldeegzie, 2017). In northern Nigeria, Adelaja and George (2019) and George et al. (2020), respectively, find that increased intensity of Boko Haram attacks reduced agricultural productivity and increased food insecurity.<sup>4</sup>

Most micro-level studies evaluating the impact of violent conflict suffer from two major data related limitations. First, because the outbreak of violent conflicts disrupts traditional data collection efforts, evaluating the immediate impacts of an active violent conflict proves difficult. Second, tracking the trajectory of outcomes associated with violent conflict may require high-frequency data that are not usually collected in conflict settings. This is particularly crucial for large-scale high intensity violent conflicts that may evolve in ways that are difficult to foresee. Delays in data collection in conflict settings forces most micro-level studies to rely on recall information often going back several years and involving aggregations, which are prone to recall (e.g., Gibson and Kim, 2007; Beegle et al., 2012) and aggregation biases (Sharma and Gibson, 2019; Rockmore, 2017; Rockmore and Barrett, 2022). Besides, limiting our understandings of the nature and consequences of violent conflicts,<sup>5</sup> such data-related limitations are, among others, likely to hinder the speed and capacity of humanitarian organizations to target and deliver lifesaving humanitarian assistance to affected populations (Baker et al., 2020).

<sup>2</sup> Similarly, León (2012) and Bertoni et al. (2019) find negative impacts of conflict on human capital accumulation and schooling outcomes, respectively, in Peru and Nigeria; while Odozi and Oyelere (2019) examine the impacts of a broader range of conflicts on poverty.

<sup>3</sup> Dabalén and Paul (2014) find evidence of reduced dietary diversity for the same period.

<sup>4</sup> Other studies in Africa have focused on identifying causes of violent conflicts as in the case of increases in food prices levels and extreme climatic conditions leading to socio-political unrest (e.g., Hsiang et al., 2011; Hendrix and Salehyan, 2012; Smith, 2014; Maystadt and Ecker, 2014; van Weezel, 2019). For the case of Ethiopia, Akresh et al. (2012) and Weldeegzie (2017) use panel data to estimate impacts of the 1998–2000 Ethiopia-Eritrea border conflict on child health and schooling outcomes of children.

<sup>5</sup> For example, in the absence of real-time data, it may prove difficult to recover the immediate impacts of violent conflicts (e.g., transitory food insecurity) several years after conflicts occur.

To the best of our knowledge, we provide the first quantitative *ex durante* study of the microeconomic consequences of an active large-scale conflict using high-frequency phone survey data. This gives us important descriptive insights on the immediate effects of war on food security, livelihood activities and access to food markets. We discuss how such *ex durante* monitoring and analysis may inform post-conflict recovery and rebuilding efforts, an important endeavour Ethiopia is currently pursuing after a peace agreement was signed to end the war. Finally, we discuss how similar high-frequency phone surveys and related remote data collection efforts could best be mobilized to monitor future conflicts in similar settings elsewhere.

Our analysis combines HFPS with conflict events data to identify the impact of the conflict on welfare outcomes and proximate outcomes.<sup>6</sup> The HFPS are monthly phone surveys that cover all regions of Ethiopia and span between April 2020 and May 2021, with multiple waves before and after the outbreak of the war. The HFPS sample is drawn from a nationally representative face-to-face survey fielded in 2019 (the 4th round of the Ethiopian Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA)). These combined data offer several advantages and a unique opportunity to link households' welfare outcomes to exposure to conflict events. First, the spatiotemporal coverage of the HFPS data permits the construction of aggregate (affected versus unaffected regions) and disaggregated (household-level) measures of exposure to conflict. Importantly, because the HFPS surveys are georeferenced, we were able to merge the household data with granular conflict events data from the Armed Conflict Location and Event Data (ACLED) project. Second, the HFPS data also allow us to go beyond standard welfare measures that are typically assessed in conflict studies. In particular, we are able to investigate potential disruptions in economic activities and food market supply chains, mechanisms through which violent conflicts can affect food security and related welfare outcomes.<sup>7</sup>

As a main outcome of interest, we focus on household food security, measured using the Food Insecurity Experience Scale (FIES). To uncover some of the mechanisms, we explore impacts on two broad proximate determinants: (i) households' participation in major economic and livelihood activities (farming, non-farm business, and wage employment); and (ii) households' access to food and food markets. To quantify the impact of violent conflict on these ultimate and proximate outcomes, we use Difference-in-Differences (DID) and two-way fixed effects (TWFE) model and compare temporal trends in welfare across households with varying exposure to the conflict. The first stage of the war (November 2020 to June 2021) was mostly confined to Tigray, expanding to neighbouring Afar and Amhara regions thereafter. Thus, our analysis focuses on the first period of the war, so that we can precisely define the spatial extent of the conflict. To account for potential intermittent conflicts elsewhere, we relax this treatment assignment in the analysis by using monthly household-level exposure to conflict from the ACLED database. We follow recent advances in the DID/TWFE literature to show that our results are robust to corrections for treatment dynamics and heterogenous treatment effects (Callaway and Sant'Anna, 2021; Goodman-Bacon 2021; de Chaisemartin and D'Haultfœuille, 2020).

The high-frequency nature of the data facilitates our identification strategy in two useful ways. First, the monthly follow-up and hence

<sup>6</sup> The HFPS data is collected by the World Bank in partnership with the Central Statistical Agency of Ethiopia and were designed to monitor the local impacts of the COVID-19 pandemic. See Gourlay et al. (2021) for a description of this data collection effort. Gourlay et al. (2021) and Brück and Regassa (2023) discuss strengths and weaknesses of such data for addressing a broad range of questions about urban and rural populations.

<sup>7</sup> Other recent studies also use phone surveys to study food security in the context of the COVID-19 pandemic (e.g., Headey et al., 2022; Hirvonen et al., 2021; Abay et al., 2023).

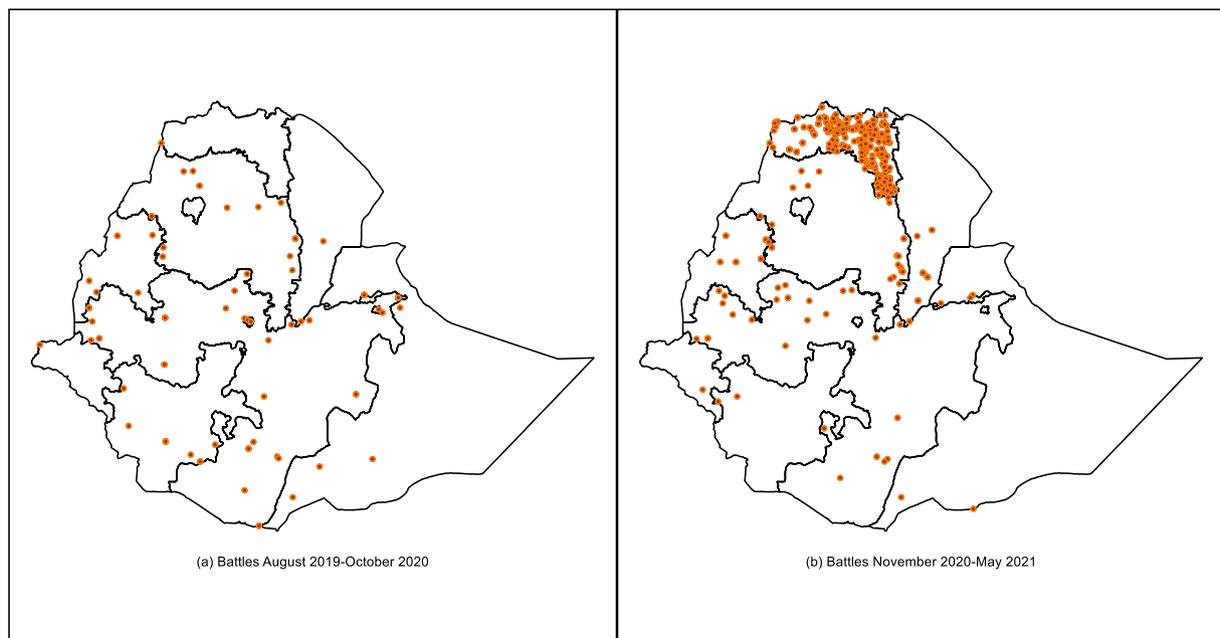


Fig. 1. Spatial distribution of violent conflicts before and after the outbreak of the war. Source: Authors' compilation based on ACLED data.

comparison of outcomes across affected and unaffected regions allows us to minimize compounding trends. The existence of multiple pre-war and post-war-onset waves also allow us to indirectly test for parallel trends, the main identifying assumption for a DID estimation strategy. Second, the relatively large sample size due to high-frequency data allows us to probe the robustness of our results using alternative definitions of control groups. For example, in some of our estimations, we restrict our sample to the Highland regions of the country, with Amhara, Oromia and SNNP regions serving as the controls.

We find that the outbreak of the war is associated with 37 percentage points increase in the probability of moderate or severe food insecurity. The prevalence of moderate or severe food insecurity in conflict-affected communities jumped from about 30 percent in the pre-war (October 2020) round to 67 percent in May 2021. This is a substantial impact, but not surprising given the scale of the war and the massive disruptions to livelihoods and services that ensued. Our analysis of the granular conflict data in the ACLED database indicates that exposure to an additional battle leads to 1 percentage point increase in the probability of moderate to severe food insecurity. Some of the ultimate effects on food security are driven by disruptions in markets and supply chains, destruction of livelihoods and income losses while some may have simply been consequences of the suspension of public services (e.g., banking, telecommunication, electricity, and transport services). Specifically, we find that the war has dramatically reduced households' access and ability to buy food while also significantly disrupting livelihoods of households in conflict affected areas. Non-farm and wage employment appear to be the most affected while farm activities were relatively more resilient. Similarly, economic activities in urban areas were much more affected than those in rural areas. This is partly because urban areas and main roads connecting towns continued to be heavily militarized even during periods of relative lull in fighting. These suggest that the ultimate impacts of the violent conflict, in addition to curtailment of livelihoods, were likely mediated through disruptions in the functioning of markets and supply chains in urban areas. Given the recent peace agreement between the parties to the conflict, these findings can inform rehabilitation and rebuilding efforts.

The rest of the paper is structured as follows. Section 2 describes the

geographic and political context of this study and data used. Section 3 summarizes trends in welfare outcomes. Section 4 outlines the empirical strategy while Section 5 presents our results and discussion. In Section 6, provides concluding remarks.

## 2. Context and data

### 2.1. Context

For over two decades, Ethiopia has been one of the world's fastest-growing economies and often nicknamed as the "hub of stability" in a volatile Horn of Africa region. This changed drastically in early November 2020 when war broke out in Tigray, causing massive loss of life and infrastructure damages. Initially, the war involved the Tigray regional forces, and an alliance of the federal army, regional forces from neighboring Amhara and Afar regions. The conflict escalated when neighboring Eritrean forces joined the alliance led by the Ethiopian federal army. Banking, telephone, electricity, transport, and other basic services were suspended in most parts of the region immediately after the war broke out. Most of Tigray was directly affected by the war and quickly became inaccessible to humanitarian assistance. After weeks of intense fighting, the federal and allied forces took control of large swaths of Tigray, including the regional capital Mekelle at the end of November 2020, which continued until June 2021. After capturing the regional capital Mekelle, the federal government installed a provisional regional government in Tigray and some public services such as telecommunication and electricity services were restored, and limited humanitarian assistance resumed in areas under the full control of the federal army. Most of these services were discontinued when the federal army and the provisional regional government left the capital in June 2021.

Internally displaced people (IDP) from various parts of Tigray swelled camps set up for IDPs in several towns, including the regional capital, Mekelle. While effects of the war remained largely unreported because of the restricted access to internet and telephone services, widespread disruptions, lootings, and civilian massacres were later confirmed, including by an investigation led by the Office of the United Nations High Commissioner for Human Rights (EHRC and OHCHR

**Table 1**  
Summary of Food Insecurity Measures and Indicators.

	Number of observations	Mean	Standard deviations
Moderate or severe food insecure	14,523	0.45	0.50
Food insecure	14,523	0.64	0.48
Raw FIES score	14,523	2.49	2.50
Worried	14,524	0.48	0.50
Healthy	14,524	0.51	0.50
FewFoods	14,524	0.48	0.50
Skipped	14,524	0.29	0.45
AteLess	14,524	0.34	0.47
RanOut	17,196	0.21	0.41
Hungry	17,196	0.12	0.33
WholeDay	17,196	0.10	0.30

Notes: households' classification into moderate or severe insecurity follows the parametric analysis and procedure outlined by FAO and using the analytical tool: <https://fies.shinyapps.io/ExtendedApp/>. This tool categorizes households' food insecurity status based on severity of food insecurity experience. We construct the second binary indicator, which assumes a value of 1 for those households experiencing one or more form of food insecurity and 0 otherwise, based on the raw FIES score. The third indicator is constructed by adding raw responses to the eight FIES questions. The remaining eight indicators come from responses to standard FIES questions on whether the respondent or household member (1) was *worried* about having enough food to eat, (2) ate only a *few kinds* of foods, (3) unable to eat *healthy* and nutritious foods, (4) *ate less* than should have eaten, (5) had *skipped* a meal, (6) *ran out* of food, (7) was *hungry* but did not eat, and (8) went without eating for a *whole day*. Summary statistics are weighted using the sampling weight discussed above.

2021). The conflict spilled over into neighboring Amhara and Afar regions when the Ethiopian federal army and allied forces were pushed out of Tigray in June 2021.<sup>8</sup> The expansion of the war into neighboring Amhara and Afar regions caused further economic and welfare damages in those regions. A recent assessment by the World Food Program shows that hunger had more than doubled in the Amhara region during the first months of the expansion of the war into the region (WFP, 2022). Thus far, the HFPS data cover the period until May 2021, forcing us to focus on impacts of the first phase of the conflict, which was confined to the Tigray region.<sup>9</sup>

Fig. 1 presents the distribution of violent conflicts, specifically battles, across all regions of Ethiopia before (August 2019–October 2020) and after the outbreak of the war (November 2020–May 2021). These figures are based on conflict event records in the ACLED data. Panel (a) shows that battles were sparsely and evenly distributed across regions before November 2020. Panel (b) confirms that during the November 2020–May 2021 period, there was dramatic spike in battle events, the vast majority of which were confined to Tigray, with little change in battle incidents elsewhere. This figure further highlights that these battles covered all parts of Tigray, due partly to the multiple warring parties involved in several fronts. In southern Tigray the armed conflict was between Tigray regional forces and the federal army and allied forces. In the north it was between Tigray regional forces and the Eritrean army. In western Tigray, the war involved the federal army (along with their allied Amhara regional forces and the Eritrean army) and the Tigray regional forces. Thus, most of Tigray was effectively an active war zone.

## 2.2. Data and data sources

We use the World Bank's HFPS data for Ethiopia, conducted between April 2020 and May 2021 to monitor the impacts of the COVID-19 pandemic (World Bank, 2020).<sup>10</sup> The phone survey sample is a

<sup>8</sup> Though the war subsided in some parts of Tigray, the region remained without communication, electricity and banking services and a dire humanitarian crisis continues to unfold (WFP, 2022).

<sup>9</sup> For a narrative overview of the war, readers may refer to collections at major news sites including the BBC (<https://www.bbc.com/news/world-africa-54964378>) and Aljazeera (<https://www.aljazeera.com/news/2022/11/10/two-years-of-ethiopia-tigray-conflict-a-timeline>), as well as the Global Conflict Tracker (<https://www.cfr.org/global-conflict-tracker/conflict/conflict-ethiopia>).

<sup>10</sup> Dataset can be downloaded from <https://www.worldbank.org/en/programs/lsmis/initiatives/lsmis-isa#2>.

subsample of households drawn from both urban and rural areas in all regions of Ethiopia surveyed face-to-face in the LSMS-ISA in 2019. The 2019 LSMS-ISA Ethiopia data are nationally representative sample of 6,770 households. Of these, 5,374 (79.3 percent) reported phone ownership and were used as sampling frame for the phone survey in 2020. The actual sample size for the phone survey was set at 3,300 households of which 3,247 of them were successfully interviewed in the first phone survey in April 2020 (Wieser et al., 2020). These households were re-interviewed every 3–4 weeks, for eleven rounds, until May 2021, allowing high-frequency monitoring of changes in key outcomes of interest including labor market participation and food security. We combine the 2019 face-to-face survey data with these HFPS data.

The 2019 baseline data provide detailed characteristics of households, including GPS coordinates of the household allowing merging these data with the ACLED database. The ACLED database records event-based information for different types of conflicts, including battles, attacks against civilians, remote violence, and protests and riots and is a widely used database to study the consequences of conflicts in different settings. We focus on the number of battles because the Ethiopian war that broke out on November 4, 2020, involved intense battles that caused mass casualties and displacements. More than half of the incidents recorded by ACLED during our sample period (August 2019–May 2021) represent battles. The remaining represent attacks against civilians and remote violence. We construct household-level measure of exposure to battles by counting the number of battles within a 10, 20, 30, 40 and 50 km radius around the households' location. We compute cumulative number of battles in the preceding months up until the end of the survey month. Based on the cumulative number of battles we also generate a binary indicator of extensive margin of exposure to one or more battles. Table A1 shows that the number of battles has tripled after November 2020.<sup>11</sup>

The HFPS sample continually declined in the follow-up rounds due to non-response to calls and attrition. Furthermore, the Tigray sample was especially affected by the war itself and disruptions in telecommunication services in the region, further reducing the sample to 1,982 households in May 2021 (Table A2). Our analysis is, therefore, based on unbalanced panel of households interviewed in the pre-war and post-war-onset phone surveys between April 2020 and May 2021. Though the pre-pandemic (and pre-conflict) sample of the LSMS-ISA survey in Ethiopia is randomly selected from urban and rural households in each

<sup>11</sup> Before November 2020, such events consisted of low intensity armed conflicts between state police or special regional armed forces and ethnic militias, typically reflecting localized political grievances.

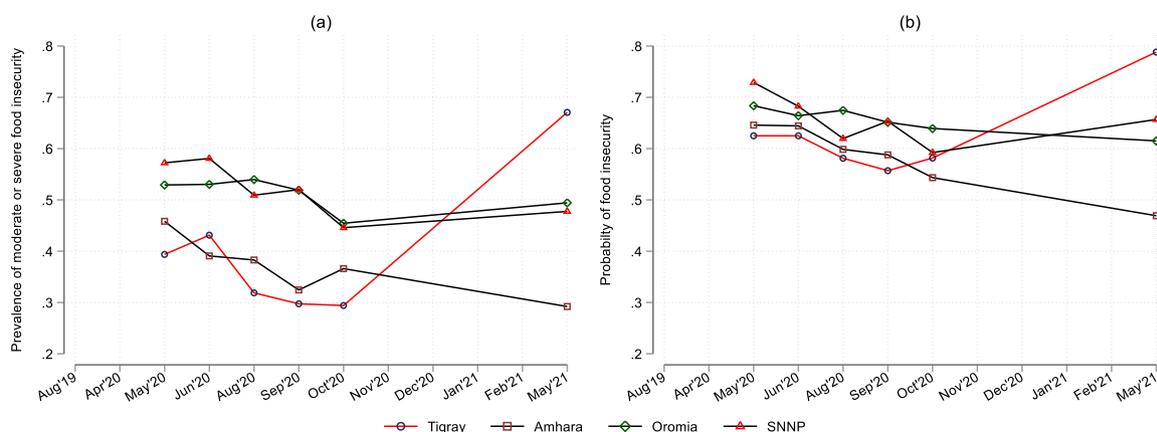


Fig. 2. Trends in prevalence of food insecurity.

district, the follow-up phone surveys are subject to two levels of non-random selection issues.

First, the phone sample may differ in systematic ways from the original 2019 sample, partly because ownership of mobile phones may be correlated with wealth (see Table A3). Second, phone surveys in conflict hotspot areas are likely to suffer from pervasive non-response, partly because of inaccessibility and network problems. The prospect of being contacted in the phone surveys is likely to be greater for those who are relatively better off economically, as well as those located in areas with better access to telecommunication services (due to better infrastructure or less destruction by the war). Table A3 shows that sample attrition increases with the presence of armed conflicts with the response rate being lower for Tigray (due to the intensity of the war) than for the rest of the regions. Telecommunication and electricity services were disrupted in much of Tigray following the breakout of the war. These services were later restored in areas that came under the control of the federal government and provisional regional government in Tigray, which enabled reaching households by phone.

To account for these systematic non-responses in the phone surveys, we constructed inverse probability sampling weights which we used in our subsequent analysis. Our final sample consists of those households appearing (at least once) in the pre-war and post-war-onset phone survey rounds, implying that the weights need to be constructed considering attrition and non-responses in both phases.<sup>12</sup> We use a rich set of household and location characteristics collected in the 2019 survey to characterize and predict the (joint) probability of response in the pre-war and post-war-onset phone surveys using a logit model. Table A3 characterizes the probability of response in: (i) at least one pre-war phone survey, (ii) at least in one post-war-onset phone survey, and (iii) both pre-war and post-war-onset phone surveys. These results generally confirm some of the above hypotheses – better off households (educated and wealthier) are less likely to attrit from the sample and this pattern remained similar across the pre-war and post-war rounds. Furthermore, attrition rate significantly increased in the conflict affected Tigray region. Applying the weights markedly reduces the differences between the unweighted and weighted mean differences in the observable characteristics of the sample (Table A4). More specifically, Table A4 shows that applying the sampling weights makes observable characteristics of the phone survey sample comparable to that of the full sample. These weights were applied in all our analyses to address potential biases due to systematic sample attrition and non-response

<sup>12</sup> Households appearing only either in the pre-war or post-war phone surveys were dropped from the analysis and assumed as nonresponses in constructing the sample weights.

(Wooldridge, 2007; Korinek et al., 2007). Nonetheless, to the extent that our results fail to control this bias, our results may be taken as lower bounds of the actual impacts of the conflict.

### 2.3. Measuring key outcomes

The paper focuses on three broad categories of outcomes that are observed both in the pre-war and post-war-onset phone surveys. These are: (i) the household food insecurity experience, (ii) participation in labor market and livelihood activities, and (iii) Households' access to food markets. The 2019 face-to-face survey collected a wealth of information on household food security, employment and labor market participation, consumption, and other socio-economic characteristics that serve as baseline for the phone surveys. The phone surveys also covered these topics which are of interest in this study, particularly household food security and participation in various livelihood activities. Because phone surveys generally tend to be shorter for data quality reasons, the HFPS implemented similar questionnaires across rounds but followed a modular approach – some modules were dropped, while others were kept or added in different rounds. Thus, we observe food security and labor market outcome indicators across multiple pre-war and post-war-onset rounds but not necessarily across all twelve rounds.

#### 2.3.1. Food insecurity

Food insecurity is measured using the Food Insecurity Experience Scale (FIES), an experience-based food insecurity metric developed by the Food and Agriculture Organization (FAO) of the United Nations that is widely applied to measure prevalence of food insecurity (FAO, 2014a).<sup>13</sup> The FIES relies on respondents' direct responses to an eight-question survey module, referring to experiences of difficulties to access sufficient and nutritious food in the last 30 days. The FIES elicits responses based on whether the respondent or another household member (1) was worried about having enough food to eat, (2) ate only a few kinds of foods, (3) unable to eat healthy and nutritious foods, (4) ate less than should have eaten, (5) had skipped a meal, (6) ran out of food, (7) was hungry but did not eat, and (8) went without eating for a whole day. A binary variable is coded for each question that takes the value of 1 if the answer is "yes" and zero if otherwise, and these responses are used to construct various food insecurity indicators. An advantage of FIES is that it generates a direct composite estimate of food insecurity summarized from a set of easy-to-understand questions, convenient to include in high-frequency surveys. It, thus, allows comparability across

<sup>13</sup> <https://www.fao.org/in-action/voices-of-the-hungry/background/en/>.

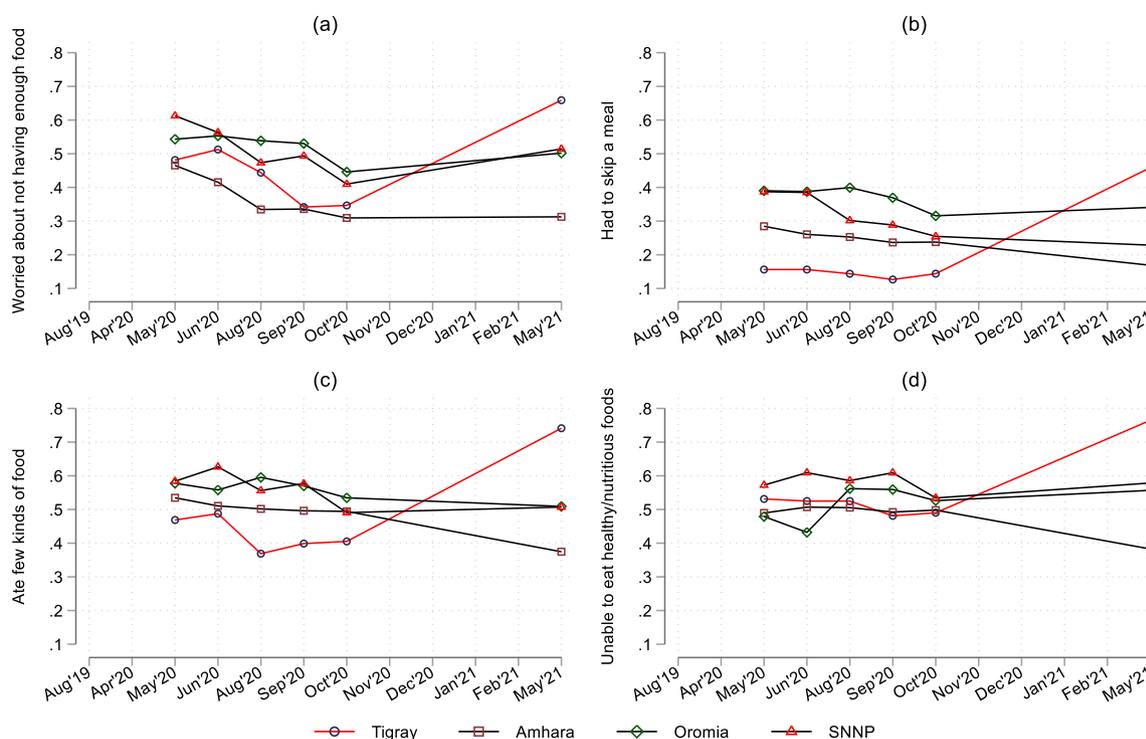


Fig. 3. Disaggregate Food Insecurity Experience.

time and space. This standard module was included in many of the high-frequency phone surveys, with reference period for the last 30 days preceding the survey date.

Based on the above FIES questions, we adopt two approaches to measure food insecurity. First, we use the raw values of the responses and associated “raw score” which we generate by summing the responses to the eight questions. The raw value of these responses assumes binary nature while the raw score assumes a value between zero and eight. By this definition, those households reporting experience of food insecurity across one or more of the eight dimensions are assumed to be facing food insecurity.

Second, data from this module is analyzed further, following procedures detailed by the FAO, to generate a food insecurity metric based on responses provided to each of the FIES questions (FAO, 2014b).<sup>14</sup> The analysis involves parameter estimation, statistical validation against global standards, and calculation of individual and population-level food insecurity prevalence rates.<sup>15</sup> For this purpose, we follow the following steps: First, we compile all binary responses for each of the eight FIES questions above (this requires specific ordering and naming of variables) along with appropriate weights. We retain this file and export it to.csv format. Second, we upload the.csv file to the FIES Shiny App: <https://fies.shinyapps.io/ExtendedApp/>, which is developed and managed by the FAO. Third, we follow the analyses, exclusion and inclusion steps described by FAO for generating respondent-level, model-based food insecurity indicators. In particular, this analysis generates several important indicators of food insecurity, including: (i) raw score that is simply generated by adding the raw values of responses to the eight FIES questions, (ii) severity of food insecurity, an interval score ranging between zero and eight which is used to classify households’ severity of food insecurity (into moderate or severe food insecurity)

<sup>14</sup> See detailed procedures and definitions at: <https://www.fao.org/3/i7835e/i7835e.pdf>.

<sup>15</sup> See detailed procedures at: <https://www.fao.org/3/ca9318en/ca9318en.pdf>.

(FAO, 2014b).<sup>16</sup> (iii) probability of moderate or severe food insecurity, and (iv) probability of severe food insecurity. We finally downloaded and merged these indicators with our main sample.

Based on these alternative approaches, we end up with four sets of food insecurity indicators: (i) raw responses to each of the eight questions, (ii) raw score across the eight questions, (iii) a binary indicator of experience of moderate or severe food insecurity based on severity of food insecurity, and (iv) binary indicator of experience of food insecurity (assuming a value of 1 for those households with raw score above zero and 0 otherwise). Table 1 presents the weighted pooled summary statistics and shows that 45 percent of households experienced moderate or severe food insecurity. These are comparable with other recent studies from Ethiopia and other African countries (e.g., Josephson et al., 2021). About 64 percent of households report experiencing at least one of the eight dimensions of food insecurity that constitute the FIES.<sup>17</sup>

#### 2.4. Participation in labor market and livelihood activities

Both the 2019 face-to-face survey and the 2020–2021 phone surveys collected detailed household-level data on labor market participation in income-generating activities, including farming, non-farm family businesses, and wage employment. The data on households’ participation in various livelihood activities are available for most rounds, but with slight differences across rounds. First, the data on farming and non-farm activities are available for all rounds, but wage-related activities were dropped in some rounds (August 2020, February 2021, and May 2021) of the phone surveys. These wage-related data are available for two rounds after the outbreak of the war (December 2020 and January 2021), allowing us to assess labor market participation effects of the war in the immediate aftermath of the outbreak of the war.

<sup>16</sup> Details of the implementation of procedures this analysis is given in FAO, 2014a, b and Josephson et al. (2021).

<sup>17</sup> See Fig. 2 (in Section 3) for the temporal evolution of these outcomes across survey rounds and across conflict affected and unaffected regions.

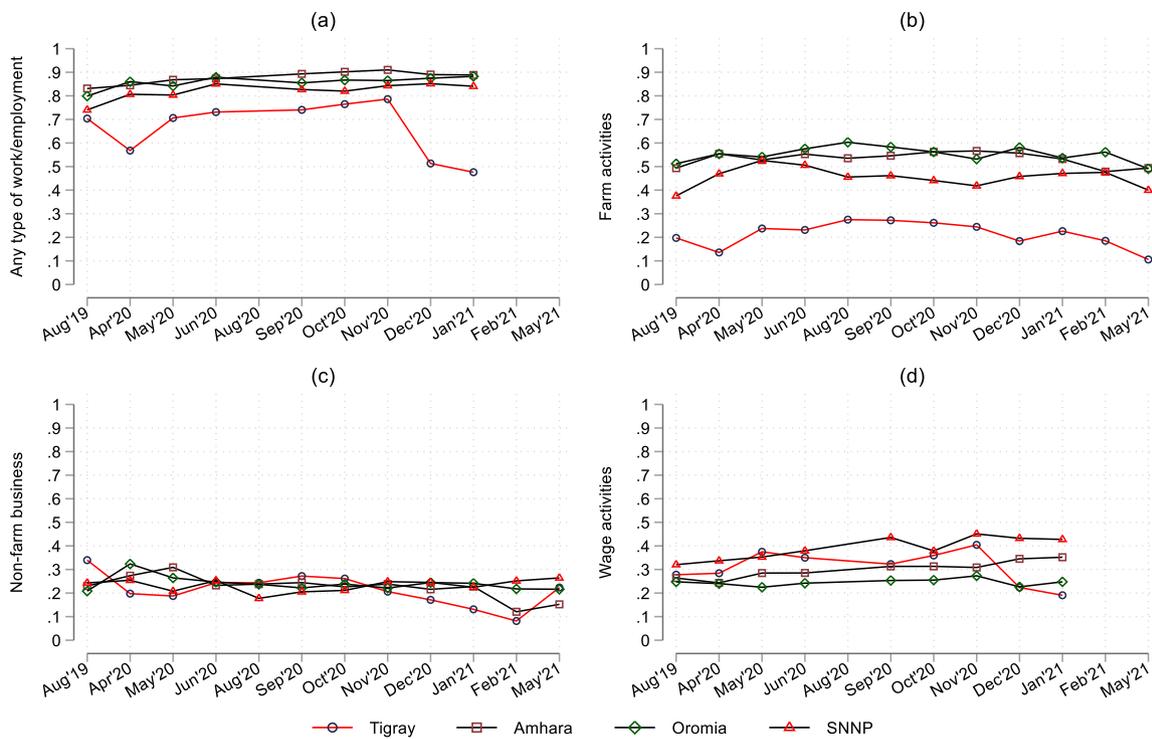


Fig. 4. Trends in labor market participation.

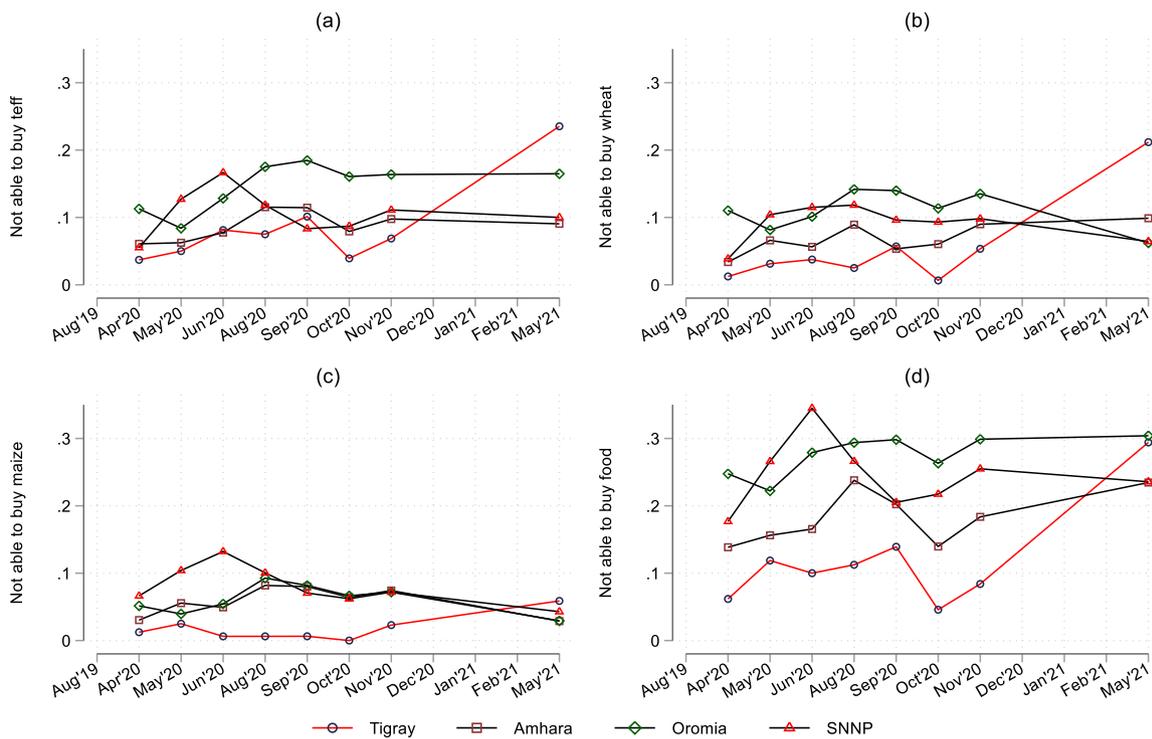


Fig. 5. Access to food and food market.

**Table 2**  
The Impact of violent conflict on aggregate measures of food insecurity.

	(1) Moderate or severe food insecurity	(2) Food insecurity	(3) Raw score
Round 4	-0.017 (0.013)	-0.009 (0.013)	-0.217*** (0.074)
Round 5	-0.038*** (0.015)	-0.036** (0.016)	-0.258*** (0.076)
Round 6	-0.068*** (0.018)	-0.028 (0.018)	-0.364*** (0.102)
Round 7	-0.107*** (0.020)	-0.072*** (0.020)	-0.589*** (0.115)
Round 12	-0.059*** (0.020)	-0.053*** (0.019)	-0.351*** (0.124)
Round 4 × Tigray	0.039 (0.074)	-0.050 (0.066)	0.104 (0.297)
Round 5 × Tigray	-0.082 (0.063)	-0.080 (0.054)	-0.390* (0.228)
Round 6 × Tigray	-0.072 (0.057)	-0.129** (0.058)	-0.450** (0.192)
Round 7 × Tigray	0.026 (0.078)	-0.037 (0.054)	0.036 (0.269)
Round 12 × Tigray	0.366*** (0.070)	0.202*** (0.043)	1.464*** (0.312)
Household fixed effects	Yes	Yes	Yes
R-squared	0.023	0.011	0.025
Mean dep. Var (pre-war)	0.361	0.557	2.054
No. observations	14,523	14,523	14,523

Notes: The outcome variable in the first column is a binary indicator assuming a value of 1 for households classified as moderate or severe food insecure based on the severity of food insecurity generated from the eight FIES questions. The dependent variable in the second column is a binary indicator assuming a value 1 for households experiencing one or more types of food insecurity and 0 otherwise. The outcome variable in the last column stands for raw sum of the responses to the eight FIES questions. All estimations use sampling weights to capture systematic non-response and attrition in phone surveys. Standard errors, clustered at district (woreda) level, are given in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Second, there was a slight change in the reference period across rounds. In the August 2019 face-to-face survey, the labor market participation of household members was collected for the last 7 days preceding the survey. But the reference period and framing of the questions were slightly changed for the phone surveys. More specifically, at the start of the phone surveys in April 2020, respondents were asked to report on whether household members were able to perform farming and non-farm activities since the outbreak of the COVID-19 pandemic (March 2020).<sup>18</sup> In the follow-up phone surveys (from May 2020 to May 2021), the above labor market participation questions were asked with reference to the last call (survey), which is approximately one month.<sup>19</sup> As long as the effects of changes in the reference period on responses are uniform across all regions, inclusion of round dummies in our estimations should take care of these concerns.

We define three indicator variables for each of the major employment activities, taking a value of 1 if any member of the household participated in farming, non-farm own business, and wage employment, respectively, and 0 otherwise. We also generate an indicator variable for participation in any of these livelihood activities.<sup>20</sup> Fig. 5 (in Section 3) provides temporally and spatially disaggregated trends in households' participation in these activities.

<sup>18</sup> For wage-related activities this continued to be one week (since last week).

<sup>19</sup> The specific labor market participation questions are: (i) since last call, did you or any member of your household work on a family farm growing crops or raising livestock? (ii) since last call, did you or any member of your household operate a non-farm family business? (iii) in the last week, were you able to do your wage/salary job as usual either from place of work or work from home?, and (iv) In the last week, were you able to do your wage/salary job as usual either from place of work or work from home?

<sup>20</sup> It is thus important to note that our estimations on labor market participation aim to quantify the implication of the war on the extensive margins of the outcomes.

## 2.5. Households' access to food and food markets

Besides the ultimate food insecurity experience, the HFPS elicited responses related to households' access to food and food markets. Households were asked whether they were able to buy enough staple foods (e.g., *teff/ injera*, wheat/ bread, maize and cooking oil) in the previous week. These questions are important to capture households' physical access to and affordability of food, and hence allow us to investigate the ways in which the conflict may have impacted food systems and livelihoods. In one hand, the outbreak of the war has directly affected access to food by impeding the functioning of markets, especially in conflict hotspot areas. On the other hand, the war curtailed livelihood activities, leading to reductions in income and food affordability. Thus, the outbreak of the war is expected to directly impact both access to and affordability of food. Table A5 shows pooled summary statistics of these measures and proxies for accessibility and affordability of food and food markets.

## 3. Descriptive trends in welfare outcomes and livelihood activities

### 3.1. Food insecurity

We start by describing trends in household level aggregate food security outcomes. Fig. 2 reports trends in overall prevalence of food insecurity across survey rounds and the four major highland regions in Ethiopia: Amhara, Oromia, SNNP and Tigray. The two measures of food insecurity – prevalence of moderate or severe food insecurity and probability of food insecurity – were constructed using the eight FIES questions as described in Section 2.3. Panel (a) shows that prevalence of moderate or severe food insecurity (experienced during the previous month) more than doubled in Tigray after the outbreak of the war, jumping from 30 percent in the last pre-war (October 2020) round to 67 percent in May 2021. In comparison, food insecurity slightly declined in

**Table 3**  
Impact of violent conflict on experience of food insecurity: disaggregated results.

	(1) Worried not enough food	(2) Unable to eat healthy foods	(3) Ate few kinds of food	(4) Skipped meal	(5) Ate less food	(6) Ran out of food	(7) Hungry but did not eat	(8) Did not eat all day
Round 4	-0.004 (0.013)	-0.017 (0.016)	-0.023 (0.019)	-0.012 (0.015)	-0.005 (0.013)	-0.085*** (0.026)	-0.164*** (0.028)	-0.116*** (0.028)
Round 5	-0.058*** (0.014)	0.026 (0.018)	0.046** (0.022)	-0.050*** (0.017)	-0.096*** (0.020)	-0.060** (0.024)	-0.155*** (0.028)	-0.108*** (0.025)
Round 6	-0.060*** (0.016)	0.025 (0.018)	0.043* (0.022)	-0.108*** (0.025)	-0.126*** (0.027)	-0.073*** (0.028)	-0.143*** (0.029)	-0.113*** (0.027)
Round 7	-0.114*** (0.016)	-0.021 (0.020)	-0.004 (0.024)	-0.125*** (0.024)	-0.163*** (0.030)	-0.077*** (0.028)	-0.157*** (0.029)	-0.120*** (0.029)
Round 12	-0.050** (0.019)	0.003 (0.021)	0.015 (0.029)	-0.105*** (0.020)	-0.128*** (0.025)	-0.065** (0.031)	-0.136*** (0.026)	-0.077*** (0.027)
Round 4 × Tigray	-0.007 (0.072)	-0.075 (0.062)	0.010 (0.059)	0.043 (0.055)	0.031 (0.061)	0.159** (0.068)	0.097 (0.065)	0.235*** (0.061)
Round 5 × Tigray	-0.048 (0.071)	-0.069 (0.085)	-0.199*** (0.068)	0.021 (0.035)	0.026 (0.035)	-0.007 (0.045)	0.088 (0.065)	0.177*** (0.047)
Round 6 × Tigray	-0.173** (0.072)	-0.136** (0.064)	-0.191*** (0.070)	0.047 (0.056)	0.052 (0.045)	0.036 (0.035)	0.095 (0.059)	0.193*** (0.053)
Round 7 × Tigray	-0.055 (0.064)	-0.059 (0.084)	-0.073 (0.053)	0.146** (0.059)	0.074* (0.040)	0.083* (0.046)	0.101 (0.067)	0.195*** (0.060)
Round 12 × Tigray	0.194*** (0.062)	0.277*** (0.086)	0.254*** (0.067)	0.437*** (0.097)	0.398*** (0.104)	0.042 (0.049)	0.126** (0.055)	0.113** (0.048)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.023	0.010	0.014	0.033	0.040	0.011	0.042	0.030
Mean dep. Var (pre-war)	0.384	0.427	0.425	0.218	0.284	0.181	0.097	0.062
No. observations	14,524	14,524	14,524	14,524	14,524	17,196	17,196	17,196

Notes: the outcome variables in this table are raw responses to standard FIES questions on whether the respondent or household member (1) was worried about having enough food to eat, (2) ate only a few kinds of foods, (3) unable to eat healthy and nutritious foods, (4) ate less than should have eaten, (5) had skipped a meal, (6) run out of food, (7) was hungry but did not eat, (8) went without eating for a whole day. All estimations use sampling weights to capture systematic non-response and attrition in phone surveys. Standard errors, clustered at district (woreda) level, are given in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Amhara (from 37 percent to 29 percent) but slightly increased in Oromia and SNNP (from 45 percent to 49 percent, and from 45 percent to 48 percent, respectively).<sup>21</sup>

Similarly, panel (b) shows that the share of households experiencing food insecurity increased by 25 percentage points (from 55 percent to 80 percent). This is consistent with the recent assessment by the World Food Program, which reported that 83 percent of people in Tigray were food insecure (WFP, 2022). On the other hand, trends in the other major regions remained relatively stable. To put this in context, immediately before the war, the trends in the overall prevalence of food insecurity were broadly comparable across regions (with similar trends in Tigray and Amhara), but by May 2021 the prevalence and probability of food insecurity sharply increased in Tigray while the corresponding trends for the other regions remained about the same.

Fig. 3 further disaggregates the patterns of food insecurity experiences using some of the questions included in the FIES module. Panel (a) shows that the percentage of households who reported worrying about not having enough food during the previous 30 days. The figures remained reasonably stable between May 2020 and October 2020, after which the share of households who respond in the affirmative increased from 35 percent to 66 percent in Tigray.<sup>22</sup> For the other regions, the corresponding trends changed little. In panel (b), relative to the pre-war period, the share of households in Tigray who reported having to skip a meal in the last 30 days has shown a sharp rise from 14 percent to 46 percent – an increase of 32 percentage points. Panel (c) shows the share of households who reported consuming less varieties of food. Compared

to October 2020, the decline in food varieties consumed after the outbreak of the war is significantly higher in Tigray (increased from 41 percent to 74 percent) than in the other three regions. Panel (d) shows the percentage of households who reported not being able to consume healthy and nutritious foods. In Tigray, the figure jumped from 49 percent in October 2020 to 76 percent in May 2021. For the other regions, the corresponding figures changed little (51 percent in October 2020 and 50 percent in May 2021). Overall, the results shown in Figs. 2 and 3, attest to the dramatic deterioration in food security in Tigray in the aftermath of the breakout of war in November 2020.

### 3.2. Participation in labor market and livelihood activities

In this section, we report descriptive results on households' participation in labor market and livelihood activities between August 2019 and May 2021. Fig. 4 presents temporal trends in overall participation in livelihood activities for the four weeks preceding survey interviews. Three important trends in these outcomes emerge. First, compared to the other regions, the proportion of households that participated in any economic activity was slightly lower in Tigray both before and after the war broke out. Second, the share of households who reported engaging in non-farm and wage related activities in Tigray is comparable to the other three major regions, while that of those who engage in farming was much less. Three, in the aftermath of the start of the war, there was a significant drop in participation in economic activities in Tigray compared to the other regions.

As shown in panel (a), the share of households that reported being engaged in any employment activity was stable in Amhara, Oromia and SNNP. In Tigray, on the other hand, the patterns of participation in any activity dramatically dropped following the onset of the war in November 2020. About 95 percent of the interviews for the November

<sup>21</sup> Note that the war expanded to Amhara and Afar regions after late June 2021. This period is not covered by this study.

<sup>22</sup> Compared to May 2020, there are 18 percent more households reporting being worried about having enough food.

**Table 4**  
The Impact of violent conflict on labor market and livelihood activities.

	(1) Any activity	(2) Farm activity	(3) Non-farm business	(4) Wage related activities
Round 2	0.049** (0.021)	0.041** (0.019)	0.057*** (0.020)	0.067*** (0.023)
Round 3	0.053** (0.025)	0.068*** (0.018)	0.033* (0.019)	0.049** (0.023)
Round 4	0.087*** (0.021)	0.084*** (0.018)	0.022 (0.020)	0.045** (0.022)
Round 6	0.081*** (0.020)	0.062*** (0.017)	0.008 (0.017)	0.057*** (0.019)
Round 7	0.086*** (0.020)	0.055*** (0.015)	0.016 (0.019)	0.063*** (0.017)
Round 8	0.080*** (0.021)	0.041** (0.017)	0.011 (0.018)	0.077*** (0.022)
Round 9	0.071*** (0.023)	0.036** (0.017)	0.022 (0.017)	0.070*** (0.021)
Round 10	0.083*** (0.021)	0.034** (0.017)	0.025 (0.017)	0.072*** (0.021)
Round 2 × Tigray	-0.294*** (0.083)	-0.219*** (0.072)	-0.184*** (0.060)	-0.102 (0.075)
Round 3 × Tigray	-0.094 (0.058)	-0.047 (0.030)	-0.170*** (0.062)	-0.031 (0.082)
Round 4 × Tigray	-0.112* (0.062)	-0.073** (0.034)	-0.112 (0.079)	-0.038 (0.080)
Round 6 × Tigray	-0.066 (0.047)	-0.005 (0.028)	-0.058 (0.080)	-0.066 (0.080)
Round 7 × Tigray	-0.060 (0.047)	0.002 (0.028)	-0.115* (0.059)	-0.053 (0.074)
Round 8 × Tigray	-0.079 (0.058)	-0.020 (0.034)	-0.180*** (0.060)	-0.026 (0.078)
Round 9 × Tigray	-0.197*** (0.062)	0.016 (0.028)	-0.200*** (0.052)	-0.193*** (0.067)
Round 10 × Tigray	-0.210*** (0.070)	0.044 (0.034)	-0.219*** (0.056)	-0.202*** (0.062)
Household fixed effect	Yes	Yes	Yes	Yes
R-squared	0.001	0.003	0.002	0.003
Mean dep. Var (pre-war)	0.801	0.313	0.241	0.417
No. observations	21,940	28,558	28,558	21,940

Notes: The outcome variable in the first two columns is a dummy variable for participation in any economic activity. The variables in columns 3–8 are binary indicators assuming a value of 1 for those households participating in these activities. All estimations use sampling weights to capture systematic non-response and attrition in phone surveys. Standard errors, clustered at district (woreda) level, are given in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

2020 round had been completed before the outbreak of the war (November 4). Thus, we do not expect dramatic declines in livelihood activities in the November 2020 round. However, the share of households participating in any activity in Tigray declined sharply from 78 percent in October 2020 to 48 percent in January 2021. Much of this decrease is associated with a decline in non-farm employment (panel (c)) and wage employment (panel (d)). The change in patterns of non-farm business activities appears slightly nuanced, however. After the war broke out, the share of households who reported employment in non-farm business decreased from 29 percent in October 2020 to 8 percent in February 2021, before bouncing back to 23 percent in May 2021. In the other three regions, both non-farm employment and wage employment remained somewhat stable or increased. Farm activities were much more resilient. The share of households who engaged in farming activities in Tigray changed little immediately after the start of the war, though it decreased considerably in the May 2021 round (15 percentage points less than the October 2020 levels).<sup>23</sup>

Much of the observed decline in labor market participation in Tigray was primarily driven by the sharp falls in employment in urban areas (see Fig. A1 in the Appendix A). The share of households who reported participation in any economic activity in urban areas of Tigray declined by 48 percentage points from 72 percent in October 2020 to 38 percent

in January 2021. In rural areas, on the other hand, employment quickly recovered after a brief dip in November 2021 to the pre-war levels by January 2021. The latter is related to the return of farm households to cultivate their land albeit at a high security risk.

### 3.3. Access to food and food markets

We next examine how access to food and the functioning of food markets were affected by the conflict. Fig. 5 presents the trends in households' ability to purchase staple food from the market. Panels (a)–(c) show temporal trends in households' ability to buy *teff*, wheat and maize, respectively, in the four main highland regions of Ethiopia.<sup>24</sup> In all three panels, access to food markets remained stable for Amhara, Oromia and SNNP regions. The story is completely different for Tigray. Between October 2020 and May 2021, the share of households that reported not being able to purchase *teff* increased from 5 percent to 23 percent and the corresponding figure for wheat increased from 2 percent to 21 percent. The reported change in the ability to buy maize was relatively modest. Households were asked to report major causes for their inability to buy these food items. The main reasons for households' inability to buy *teff* were increase in prices (61 percent) and decrease in incomes (37 percent). Likewise, among those who reported not being

<sup>23</sup> When compared to the April/May 2020 levels, this drop is between 3 and 13 percentage points.

<sup>24</sup> *Teff* is the most grown and most important staple food in Ethiopia (Minten et al., 2018).

**Table 5**  
The Impact of violent conflict on households' access to food and market.

	(1) Unable to buy teff	(2) Unable to buy wheat	(3) Unable to buy maize	(4) Unable to buy oil	(5) Unable to buy food
Round 2	0.063** (0.026)	-0.053*** (0.018)	-0.018** (0.009)	-0.035* (0.021)	0.000 (0.025)
Round 3	0.113*** (0.033)	0.039* (0.021)	0.003 (0.009)	-0.009 (0.019)	0.049** (0.023)
Round 4	0.050** (0.020)	-0.031* (0.016)	0.015 (0.011)	0.049*** (0.017)	0.055*** (0.017)
Round 5	0.028** (0.012)	-0.004 (0.018)	0.013 (0.011)	0.019 (0.014)	0.023 (0.015)
Round 6	0.017* (0.010)	-0.019 (0.014)	0.010 (0.010)	-0.000 (0.015)	-0.008 (0.017)
Round 7	-0.008 (0.009)	-0.023** (0.011)	0.000 (0.010)	-0.011 (0.016)	-0.042** (0.017)
Round 12	0.013 (0.015)	0.025 (0.019)	0.006 (0.012)	0.062** (0.022)	0.060*** (0.022)
Round 2 × Tigray	-0.110*** (0.039)	-0.029 (0.059)	-0.044 (0.047)	0.025 (0.028)	-0.043 (0.046)
Round 3 × Tigray	-0.130*** (0.042)	-0.075** (0.036)	-0.016 (0.022)	0.120* (0.061)	0.022 (0.070)
Round 4 × Tigray	-0.033 (0.033)	-0.030 (0.050)	-0.083* (0.047)	-0.026 (0.029)	-0.040 (0.033)
Round 5 × Tigray	0.002 (0.023)	-0.066 (0.059)	-0.080* (0.045)	0.039 (0.029)	0.036 (0.031)
Round 6 × Tigray	0.038 (0.026)	0.005 (0.029)	-0.077* (0.045)	0.044 (0.047)	0.072** (0.030)
Round 7 × Tigray	-0.018 (0.021)	-0.072 (0.059)	-0.074 (0.047)	0.004 (0.026)	0.007 (0.030)
Round 12 × Tigray	0.263*** (0.098)	0.197* (0.108)	-0.007 (0.044)	0.166 (0.108)	0.268*** (0.101)
Household fixed effect	Yes	Yes	Yes	Yes	Yes
R-squared	0.025	0.019	0.005	0.014	0.016
Mean dep. Var (pre-war)	0.082	0.064	0.037	0.103	0.164
No. observations	19,495	19,495	19,495	19,495	19,495

Notes: The outcome variables in this table come from a series of questions eliciting whether a household was not able to buy each of the above staple foods. All estimations use sampling weights to capture systematic non-response and attrition in phone surveys. Standard errors, clustered at district (woreda) level, are given in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

able to buy wheat, increase in prices and decrease in incomes were the main reason for 51 percent and 44 percent of households, respectively.

Finally, panel (d) shows trends in broader access to food items. Prior to the start of the war, households in Tigray had slightly better access to food, with the lowest share of households reporting inability to buy food among the four major regions. After the war broke out, this figure increased by 24 percentage points, from 5 percent in October 2020 to 29 percent in May 2021. The four panels in Fig. 4 paint a grim picture of food access and affordability in Tigray following the outbreak of the war.

#### 4. Empirical strategy

The monthly nature of our data allows us to use alternative empirical strategies to identify the impact of the conflict on affected households. To evaluate the impact of conflict on food security and livelihood outcomes, we use two empirical approaches: First, we employ a Difference-in-Differences strategy with region and survey round dummies, and their interactions. Second, we use the ACLED database to generate granular time-varying exposure to violent conflict and estimate TWFE models. The availability of multiple pre- and post-war-onset round data allows us to test the parallel trends assumption needed for the validity of our DID estimation. We estimate the following DID specification:

$$Y_{hrm} = \alpha_h + \alpha_m + \sum_{m=1}^{M1} \delta_m Tigray_r \times 1(D = m) + \sum_{m=M1+1}^{M2} \gamma_m Tigray_r \times 1(D = m) + \varepsilon_{hrm} \quad (1)$$

where  $Y_{hrm}$  is a measure of food insecurity and related outcomes associated with household  $h$  living in region  $r$  observed in month  $m$ ,  $\alpha_h$

represents household-specific fixed effects, and  $\alpha_m$  is a vector of month/round dummies. Pre-war survey rounds range from 1 to  $M1$  while post-war-onset rounds range from  $M1 + 1$  to  $M2$ .  $Tigray_r$  represents an indicator variable for households living in Tigray region and hence those affected by the violent conflict. Because the first stage of the war, which lasted between November 2020 to June 2021, took place in Tigray, it is the region affected in the first phase of the war.<sup>25</sup> The other regions of Ethiopia, which were not affected by the first phase of the war, serve as controls. As a robustness exercise, we restrict the control sample to the three highland regions of Ethiopia (i.e., Amhara, Oromia, and SNNP) given their similarities to Tigray in both agroecological and livelihood contexts. As shown in Section 3, these regions share comparable trends in food security and participation in livelihood activities before the war.

The third (interaction) term in equation (1) captures Tigray specific pre-war trends and hence the parameters associated with this term serve us to indirectly test the parallel trends assumption. The fourth (interaction) term in equation (1) captures Tigray specific trends following the outbreak of the war in November 2020. The key parameters of interest are, thus, stacked in  $\gamma_m$ , the interaction effects of being from the affected region and the post-war round dummies. If the identifying parallel trends assumption holds in our context, the parameters associated with the interaction term,  $\gamma_m$ , identify the impact of the war on food security and livelihood outcomes. The error term,  $\varepsilon_{hrm}$ , captures other

<sup>25</sup> The final round of the HFPS data was in May 2021, a month before the war spilled over to the neighboring regions, which limits our study to the period in which the conflict was within Tigray. As a result, we are unable to estimate the impact of the war in the neighboring regions.

**Table 6**  
Exposure to battles and food security.

	(1) Moderate or severe food insecurity	(2) Moderate or severe food insecurity	(3) Food insecurity	(4) Food insecurity	(5) Raw score	(6) Raw score
Panel A: Extensive margin of exposure to battle(s)						
Exposure to battle(s) within 10 km	0.138*** (0.048)		0.097** (0.045)		0.599*** (0.218)	
Exposure to battle(s) within 20 km		0.164*** (0.045)		0.078* (0.045)		0.592*** (0.212)
Panel B: Intensive margin of exposure to battle						
Number of battles within 10 km	0.018*** (0.003)		0.012*** (0.002)		0.072*** (0.014)	
Number of battles within 20 km		0.010*** (0.001)		0.007*** (0.001)		0.040*** (0.007)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep. Var (pre-war)	0.362	0.362	0.557	0.557	2.057	2.057
No. observations	14,374	14,374	14,374	14,374	14,374	14,374

Notes: Panel A reports results for the extensive margin of exposure to battle(s) while Panel B contains results for the intensive margin of exposure to an additional battle. The outcome variable in the first two columns is a binary indicator assuming a value of 1 for those households experiencing moderate or severe food insecurity based on the severity of food insecurity constructed from the eight FIES questions. The dependent variable in columns 3–4 is binary indicator assuming a value 1 for those households experiencing one or more types of food insecurity and 0 otherwise. The outcome variable in the last two columns stands for raw sum of the responses to the eight FIES questions. All estimations use sampling weights to capture systematic non-response and attrition in phone surveys. Standard errors, clustered at district (woreda) level, are given in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

unobservable factors that may affect food security and livelihood activities.

Since the HFPS data follows households for multiple rounds, unobserved effects (error terms) can be correlated over time and across households living in the same district. As a result, we cluster standard errors at the district (*woreda*) level. We also consider alternative definitions of conflict exposure and control group assignments as noted above. Thus, we estimate equation (1) for the full sample as well as for a restricted sample consisting of households from the highland regions of Ethiopia.

Our first approach, which considers Tigray as the treatment region and the rest of the country as a comparison group, assumes that all survey households from Tigray have been affected by the war. Given the first phase of the war was concentrated in Tigray (see Fig. 1), this is a reasonable assumption. However, some survey households may have been completely immune from impacts of the war. With exposure to the war as defined above, our estimates measure intention to treat (ITT) impacts. If households who were not affected by the conflict were rather erroneously considered to have been impacted by it, these estimates would be smaller than the average treatment effect (ATE) of the war.

We generate more granular measures of exposure to violent conflict using battle events from the ACLED database for the August 2019 – May 2021 period, which coincides with our pre-war and post-war-onset HFPS data. Because of the expansive nature of the war, we computed exposure by counting the number of battles that took place within 10 km and 20 km radius around the homestead of households. Defining exposure as such allows us to identify potential heterogeneities in impacts associated with the intensity of exposure to battles. It also serves to probe the robustness of our main results. We, thus, estimate the following TWFE specifications:

$$Y_{hrt} = \alpha_n + \alpha_m + \varphi_1 \text{Battles}_{hrt} + \omega_{hrt} \quad (2)$$

where  $\text{Battles}_{hrt}$  stands for either a binary indicator measuring exposure to battle within 10 km or 20 km radius from households' residence or a continuous cumulative number of battles experienced within 10 km or 20 km radius from households' residence. All other terms are as defined before.

Unlike the coarse measure of exposure to conflict in equation (1), which is based on region of residence at the time of the survey, the granular measures of exposure defined based on distance between location of battle events and households' residence is less likely to suffer from misclassification of households into affected and comparison

groups. More specifically, it is highly likely that battles that take place close to a household's residence would be more relevant to the household's food security and livelihoods. Given these are not exact measures of exposure at the household level, technically our estimates remain ITT. However, we argue that for the short distance buffers based on which exposure is defined, it is unlikely that these ITT estimates differ much from ATE.

Despite these alternative specifications, our analysis is constrained by some remaining shortcomings, which merit discussion. First, while the pre-conflict (pre-pandemic) sample of the LSMS-ISA in Ethiopia is randomly selected from urban and rural households in each district, the follow-up phone surveys are prone to systematic non-response and attrition. To account for these systematic non-responses in the phone survey, we construct and employ sampling weights as discussed in Section 2. These sampling weights can help to recover appropriate and representative statistics if the observable characteristics we use to construct our weights sufficiently capture the systematic non-response and attrition in the data (Wooldridge, 2007; Korinek et al., 2007). To the extent that they fail to control this bias, our results may be taken as a lower bound of the actual impacts of the conflict.

Second, COVID-19 related economic restrictions may interact with the effects of the war. Most mobility restrictions and pandemic-related policies in Ethiopia had been relaxed long before the outbreak of the war. Our maintained assumption is that these are additive effects which may be captured by the time dummies or household fixed effects. However, it is possible that violent conflict largely substitutes for economic restrictions.<sup>26</sup> If this is the case, then we might worry that economic or mobility restrictions are only imposed (or enforced) in areas not affected by the war. In such a case, our estimates are also lower bound estimates of the true effects of the conflict.

Finally, we note that equation (2) estimates the impact of battles happening throughout the country, including those outside of Tigray. Thus, besides the overall impacts of the war, households living in different parts of Ethiopia were exposed to localized battle events at different times. Application of TWFE models to staggered treatment (exposure to war in our case) may introduce identification challenges due to potential heterogeneity in treatment effect and temporal

<sup>26</sup> Although the Ethiopian war was unrelated to the pandemic, recent studies show that the spread of COVID-19 reduced conflicts (e.g., Bloem and Salemi, 2021).

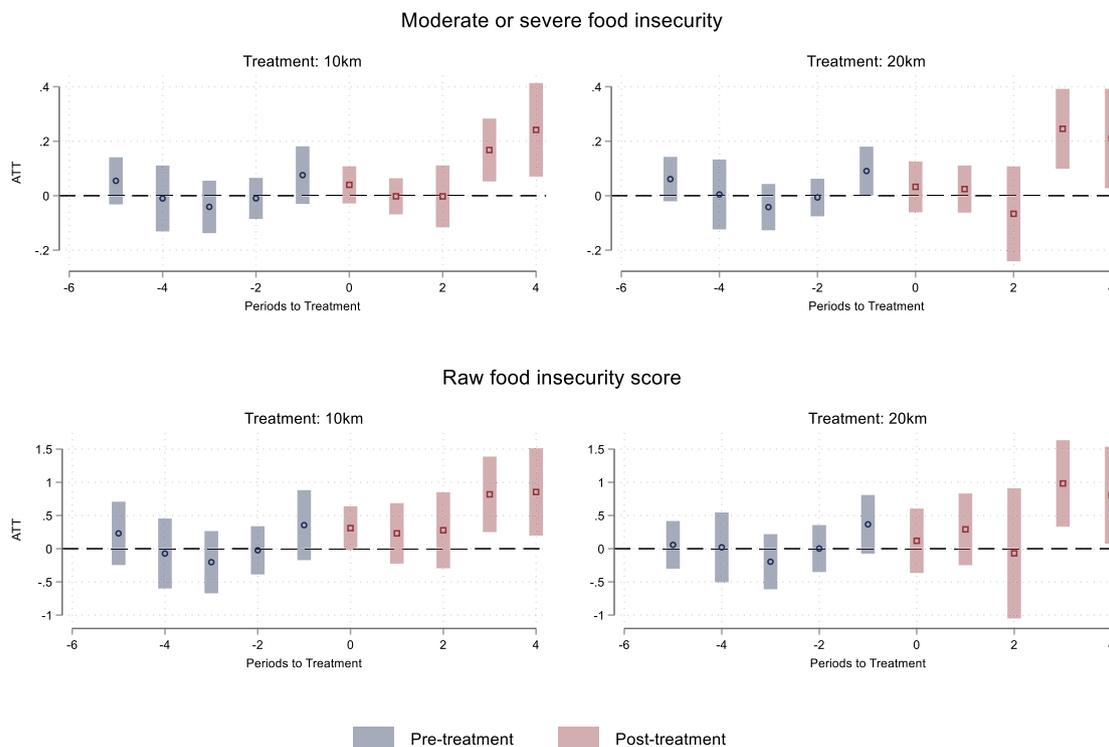


Fig. 6. Staggered Difference in Differences estimates of food insecurity.

Table 7

Exposure to battles and food security: using all components of the FIES.

	(1) Worried not enough food	(2) Unable to eat healthy foods	(3) Ate few kinds of food	(4) Skipped meal	(5) Ate less food	(6) Ran out of food	(7) Hungry but did not eat	(8) Didn't eat all day
<i>Panel A: Using extensive margin of exposure to battle(s) within 20 km</i>								
Exposure to battle(s) within 20 km	0.097 <sup>+</sup> (0.042)	0.119 <sup>**</sup> (0.051)	0.119 <sup>**</sup> (0.049)	0.166 <sup>***</sup> (0.046)	0.181 <sup>***</sup> (0.049)	0.005 (0.027)	0.023 (0.021)	-0.035 (0.031)
<i>Panel B: Using intensive margin of exposure to battle(s) within 20 km</i>								
Number of battles within 20 km	0.006 <sup>***</sup> (0.001)	0.009 <sup>***</sup> (0.002)	0.009 <sup>***</sup> (0.001)	0.010 <sup>***</sup> (0.002)	0.010 <sup>***</sup> (0.003)	-0.001 (0.001)	0.000 (0.001)	-0.002 (0.001)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep. var (pre- war)	0.387	0.429	0.427	0.221	0.287	0.183	0.098	0.062
No. observations	14,375	14,375	14,375	14,375	14,375	17,018	17,018	17,018

Notes: Panel A and B report results using extensive and intensive margin of exposure to battles within 20 km radius around households' residence. The outcome variables in this table are raw responses to standard FIES questions on whether the respondent or household member (1) was worried about having enough food to eat, (2) ate only a few kinds of foods, (3) unable to eat healthy and nutritious foods, (4) ate less than should have eaten, (5) had skipped a meal, (6) run out of food, (7) was hungry but did not eat, (8) went without eating for a whole day. Exposure to conflict is measured by counting the number of battles within 20 km and 30 km of place of residence by the survey time. All estimations use sampling weights to capture systematic non-response and attrition in phone surveys. Standard errors, clustered at district (woreda) level, are given in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

dynamics in treatment effects (Callaway and Sant'Anna, 2021; Goodman-Bacon 2021; de Chaisemartin and D'Haultfœuille, 2020). The TWFE estimator is a weighted average of group-time average treatment effects. In the presence of dynamic and/or heterogenous treatment effects, some of the group-time weights can be negative, resulting in negative overall treatment effect even though the individual group-time treatment effects are positive. To probe whether these patterns drive our main results, we apply the correction proposed in Callaway and Sant'Anna (2021) to our second specification using ACLED conflict events data.

### 5. Results and discussion

In this section, we present two sets of results based on the approaches outlined in Section 4: DID estimates and ACLED-based TWFE results. In all our estimations, we apply the sampling weights constructed using the procedure described in Section 2.<sup>27</sup>

<sup>27</sup> We estimated both weighted and unweighted regressions for each outcome variable. However, there is little difference between the weighted and unweighted results, suggesting that our results are robust to applying sampling weights. Thus, we present results based on the weighted regressions and the unweighted results are available upon request.

**Table 8**  
Armed conflict and livelihood activities.

	(1) Any activity	(2) Farm activity	(3) Non-farm business	(8) Wage related activities
<i>Panel A: Using extensive margin of exposure to battle(s) within 20 km</i>				
Exposure to battle(s) within 20 km	-0.047** (0.023)	-0.006 (0.014)	-0.041** (0.017)	-0.057** (0.025)
<i>Panel B: Using intensive margin of exposure to battle(s) within 20 km</i>				
Number of battles within 20 km	-0.005*** (0.002)	0.000 (0.001)	-0.002** (0.001)	-0.005*** (0.001)
Household fixed effects	Yes	Yes	Yes	Yes
Mean dep. var (pre-war)	0.800	0.314	0.239	0.416
No. observations	21,704	28,247	28,247	21,704

Notes: The outcome variable in the first column is a dummy variable for participation in any economic activity. The outcome variable in the second and third columns stand for dummy variables capturing participation in farm activities non-farm business activities, respectively, while the dependent variable in the last column represents an indicator variable for engagement in wage-related activities. All estimations use sampling weights to capture systematic non-response and attrition in phone surveys. Standard errors, clustered at district (woreda) level, are given in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

5.1. Main DID results

The first set of results focus on three aggregate food insecurity measures constructed from FIES questions – prevalence of moderate or severe food insecurity, probability of experiencing food insecurity and raw food insecurity score (Table 2). The availability of multiple pre- and post-war-onset survey rounds enables estimation of a disaggregated DID model using round dummies instead of before and after indicators. This uncovers potential temporal heterogeneities in the impact of the conflict while also allowing testing pre-war trends in food security and labor market outcomes. Table 2 provides estimates of disaggregated impacts of the conflict on overall food insecurity. The full set of FIES questions were first introduced in the May 2020 round, dropped in rounds 8–11, and then reintroduced in round 12 (May 2021). Thus, the third round serves as a base period and round 12 as the post-war-onset period. The key measure of the impact of the war on food security outcomes is thus the interaction term of round 12 and Tigray dummy.

Relative to the base period, food insecurity has been declining in

most of Ethiopia. Prior to the outbreak of the war, the overall trends in food security outcomes had been similar across Tigray and the rest of Ethiopia, as shown by the statistically insignificant Tigray specific time trends in Table 2. More specifically, the coefficients associated with the interaction terms between the Tigray dummy and pre-war survey rounds confirm that the parallel trend assumption holds for almost all cases. However, after the outbreak of the war, Tigray experienced a statistically significant differential trend in food insecurity. Compared to the May 2020 round, households in Tigray reported 37 percentage points higher probability of experiencing moderate or severe food insecurity in the May 2021 round. This amounts to 103 percent increase, relative to the average prevalence rate in the pre-war period.

Column 2 of Table 2 presents similar results for the probability of being food insecure. Households from Tigray report 20 percentage point higher probability of experiencing food insecurity after the outbreak of the war, which is a 37 percent increase from the pre-war average prevalence rate. The corresponding results for the raw food insecurity index calculated from the eight FIES questions are shown in column 3.

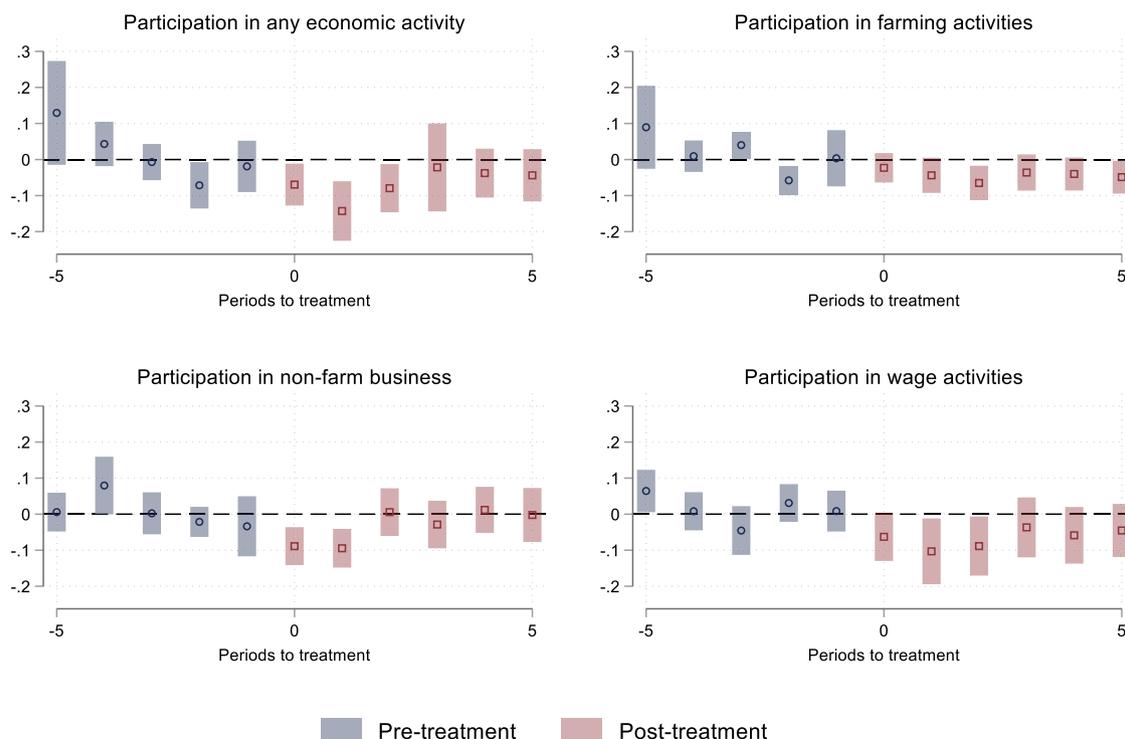


Fig. 7. Staggered Difference in Differences estimates of livelihood activities.

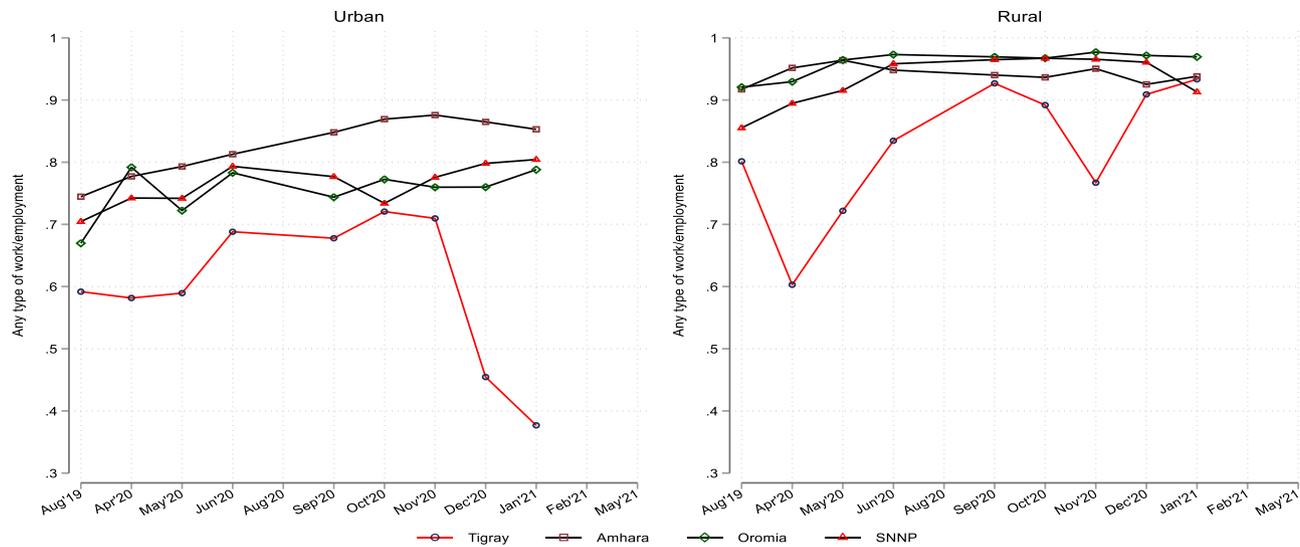


Fig. A1. Labor market participation of household head by rural and urban areas.

**Table A1**  
Number of battles and battle-related fatalities, pre-and post-war-onset.

Spatial resolution	Pre-war			Post-war-onset		
	No. obs.	Mean	SD	No. obs.	Mean	SD
Exposure to battle within 10 km	20,006	0.25	0.43	8,250	0.39	0.49
Exposure to battle within 20 km	20,006	0.35	0.48	8,250	0.51	0.50
Exposure to battle within 30 km	20,006	0.51	0.50	8,250	0.69	0.46
Exposure to battle within 40 km	20,006	0.55	0.50	8,250	0.75	0.43
Exposure to battle within 50 km	20,006	0.59	0.49	8,250	0.80	0.40
Number of battles 10 km	20,006	0.46	0.96	8,250	1.42	3.61
Number of battles 20 km	20,006	0.88	1.51	8,250	2.80	7.03
Number of battles 30 km	20,006	1.14	1.69	8,250	3.65	8.91
Number of battles 40 km	20,006	1.31	2.07	8,250	4.94	13.30
Number of battles 50 km	20,006	1.55	2.43	8,250	6.25	16.88

Notes: This table provides pooled summary statistics on the number of battles (and hence extensive and intensive margin of exposure to battles) using the ACLED data.

**Table A2**  
Sample of households interviewed across survey rounds.

Round	Time/month	All regions	Outside Tigray region	Tigray region
Baseline	19-Aug	6770	6094	676
1	20-Apr	3,247	2,915	332
2	20-May	3,105	2,782	323
3	20-Jun	3,056	2,737	319
4	20-Aug	2,876	2,569	307
5	20-Sep	2,768	2,465	303
6	20-Oct	2,702	2,412	290
7	20-Nov	2,535	2,277	258
8	20-Dec	2,221	2,144	77
9	21-Jan	2,076	1,992	84
10	21-Feb	2,176	2,041	135
11	21-May	1,982	1,896	86

Notes: This table presents the number of households surveyed in the August 2019 baseline and the follow up phone surveys in HFPS between April 2020 and May 2021.

The results are consistent with those obtained for the other two aggregate food insecurity measures. In Tigray, the war associated with 1.5 units increase in the number of dimensions of food insecurity reported by households. These large effects are plausible given the massive humanitarian crises the war has created in the region (see WFP, 2022).

Next, we report impacts of the armed conflict on the eight FIES variables that constitute the aggregate indices shown in Table 2. Besides uncovering the statistically indistinguishable pre-war trends in food insecurity experience between Tigray and the rest of the country, the results in Table 3 confirm the main results in Table 2. The coefficients of the interaction terms between pre-war round dummies and Tigray establish the overall statistically similar trends in Tigray and the other regions of Ethiopia.<sup>28</sup> A clear divergent trend emerges in Tigray in the post-war-onset period as evidenced by the coefficients of Round 12 × Tigray. We find that the war was associated with a significant increase in households’ experience of alternative forms of food insecurity (Table 3). For example, the share of households who skipped meals increased by 44 percentage points and those that reduced food consumption by 40 percentage points. Likewise, the share of households who were unable to eat healthy/nutritious foods also increased by 28 percentage points.

Table 4 reports the impacts of the violent conflict on livelihood activities, mainly on the overall labor market participation of households and participation in farm, non-farm business and wage employment. We use data from rounds 1–10 of the surveys for this analysis, where rounds 1–8 represent the pre-war and rounds 9–10 represent the post-war-onset periods. Again, these results confirm that pre-war trends of participation in various labor market and livelihood activities are generally statistically similar across households affected and unaffected by the armed conflict, as evidenced by the coefficients of the interaction between Round 2 – Round 8 dummies and the indicator for Tigray region. Immediately after the outbreak of the war, households from Tigray experienced a significant reduction in economic activities, with the war reducing participation in any economic activity by 20 – 21 percentage points. However, the impacts vary by type of livelihood activity. Relative to the baseline, households from Tigray experienced 20 – 22

<sup>28</sup> There seems to be a Tigray specific pre-war trend for the raw indicator for “did not eat all day” in column 8. This may be due to an already deteriorating political environment in the months leading up to the war which resulted in restriction of trade on the main transportation corridors to Tigray through neighboring regions.

**Table A3**  
Modeling the probability of response in pre-war, post-war-onset and both phone surveys: logit estimates.

Explanatory variables	Pre-war	Post-war-onset	Both
Household head age in years	0.004 (0.002)	0.004 (0.002)	0.004 (0.002)
Household head is female	0.047 (0.068)	0.057 (0.069)	0.055 (0.069)
Education of household head: Upper primary	0.096 (0.087)	0.027 (0.089)	0.026 (0.089)
Education of head: Secondary or higher	0.315*** (0.089)	0.318*** (0.088)	0.318*** (0.088)
Household size	-0.015 (0.020)	-0.011 (0.021)	-0.012 (0.021)
Adult household members size	0.039 (0.033)	0.044 (0.034)	0.047 (0.034)
Household head engaged in agriculture	-0.062 (0.162)	-0.022 (0.161)	-0.020 (0.161)
Household head engaged in wage earning	0.018 (0.149)	0.016 (0.148)	0.020 (0.148)
Household head engaged in non-farm business	-0.056 (0.143)	-0.110 (0.142)	-0.105 (0.142)
Asset quintile: Second	0.128 (0.095)	0.193* (0.104)	0.187* (0.104)
Asset quintile: Third	0.372*** (0.107)	0.469*** (0.115)	0.474*** (0.115)
Asset quintile: Fourth	0.787*** (0.121)	0.829*** (0.127)	0.833*** (0.127)
Asset quintile: Fifth	0.841*** (0.145)	0.877*** (0.149)	0.876*** (0.149)
Household located in rural area	0.128 (0.093)	-0.080 (0.095)	-0.081 (0.095)
Household participated in Productive Safety Net Program (PSNP)	0.062 (0.101)	0.008 (0.108)	0.012 (0.108)
Log household consumption Per Adult Equivalent (PAE) per year	0.088* (0.050)	0.125** (0.052)	0.125** (0.052)
Household owns a mobile phone	1.330*** (0.098)	1.377*** (0.102)	1.385*** (0.103)
Number of mobiles available in the household	0.149*** (0.048)	0.137*** (0.046)	0.132*** (0.046)
Household has access to electricity	0.239** (0.100)	0.080 (0.104)	0.062 (0.104)
Log (distance to nearest market, in KM)	-0.028 (0.041)	-0.116*** (0.041)	-0.112*** (0.041)
Log (distance to nearest town, in KM)	-0.084** (0.042)	0.015 (0.042)	0.008 (0.042)
Region dummy: Afar	-0.385*** (0.141)	0.769*** (0.149)	0.777*** (0.149)
Region dummy: Amhara	0.119 (0.128)	1.251*** (0.138)	1.253*** (0.138)
Region dummy: Oromia	0.738*** (0.129)	1.838*** (0.138)	1.840*** (0.138)
Region dummy: Somali	-0.644*** (0.146)	-0.022 (0.165)	-0.024 (0.165)
Region dummy: Benishangul Gumuz	0.524*** (0.163)	1.429*** (0.170)	1.443*** (0.170)
Region dummy: SNNP	-0.590*** (0.135)	0.607*** (0.146)	0.615*** (0.146)
Region dummy: Gambela	-0.547*** (0.151)	0.414*** (0.159)	0.429*** (0.159)
Region dummy: Harar	-0.401** (0.156)	0.712*** (0.158)	0.719*** (0.158)
Region dummy: Addis Ababa	-0.279* (0.144)	0.560*** (0.142)	0.581*** (0.142)
Region dummy: Dire Dawa	-0.582*** (0.150)	0.400*** (0.153)	0.417*** (0.153)
Number of observations	6664	6664	6664

Notes: This table reports coefficients from a logit regression. The base education is those below upper primary education. The base asset quintile is the first

quintile, and the base region is Tigray. Standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

percentage point reduction in participation in non-farm business activities in the aftermath of outbreak of the armed conflict (December 2020 and January 2021). Similarly, war-affected households reported 19 – 20 percentage point reduction in participation in wage-related activities in the first two months after the outbreak of the conflict.<sup>29</sup>

Besides the overall impact on livelihood, sectoral differences in the resilience of different sectors are evident. As shown in column 2, participation in farm activities remained unaffected.<sup>30</sup> This may be because battles mainly took place in areas around the main highways in the region, where incidentally all larger urban centers are located. To sum up, this supports evolving evidence showing that agriculture in general and smallholder farming can be relatively more resilient to covariate shocks such as armed conflict and pandemic. For example, some recent macro and micro-level studies show that farming activities are relatively resilient to the COVID-19 pandemic and associated mobility restrictions (e.g., Amare et al., 2021; Josephson et al., 2021; Khamis, 2021). These findings appear to suggest that the war led to wide-ranging economic decline in Tigray, especially in urban areas where non-farm business and wage employment are concentrated. These developments may have lasting dire implications to Ethiopia's overall economic transformation that was taking shape over the last few decades (e.g., Bachewe et al., 2018).

Table 5 presents results on the impacts of the war on access to food as measured by households' ability to purchase a variety of foods. In columns 1–4, we show results for commonly consumed staples and oil followed by results for more broadly defined access to food in column 5. Compared to the immediate pre-war month, the results in columns 1–2 show that the war led to 26 and 20 percentage points increase in households' inability to buy *teff*, and wheat, respectively. The dramatic deterioration in access to staples in a short amount of time reflects one of the key aspects of the war – the disruption of trade between Tigray and the rest of the country. On the other hand, households' access and ability to buy maize, a locally produced and traded staple, remained unaffected. This is consistent with recent studies showing differential impacts of conflicts on locally produced items and regionally traded and imported items (Hastings et al., 2022). We do not find statistically significant effect on households' ability to purchase oil – although the coefficient is relatively large, it is imprecisely estimated. In column 5, we find similar results for broader access to food. In the aftermath of the war, the share of households who report being unable to buy food (either of the staples in columns 1–4) increased by 26 percentage points.

Note that these are net impacts and combine the effects due to unavailability of these staples on the market as well as reduced purchasing power of households due to lost income and increase in the prices of these staples. In fact, as discussed in Section 3.2, most households report that increase in prices, supply shortages, and reduction in incomes are the main reasons for their inability to purchase *teff* and wheat.

<sup>29</sup> We note that the parallel trends assumption does not appear to hold for non-farm activities, with pre-war trends in Tigray indicating an already deteriorating environment. This may have to do with an increasingly worsening security situation on highways leading to Tigray with vigilante groups reportedly confiscating goods being transported to Tigray through Amhara region prior to the start of the war in November 2020.

<sup>30</sup> These findings are intuitive because relative to smallholder farming, the war has led to massive destruction of business enterprises, infrastructure, and disruptions of major public services (electricity, telephone, banking and transport services), which are essential inputs running non-farm and wage-related activities.

**Table A4**  
Descriptive statistics of the sample, by sample weights.

	Unweighted full sample (1)	Unweighted phone survey (2)	Weighted phone survey (3)
Household head age in years	42.19	40.99	42.34
Household head is female	0.32	0.30	0.32
Education of household head: Lower primary	0.56	0.39	0.56
Upper primary	0.16	0.18	0.16
Secondary or higher	0.28	0.42	0.29
Household size	4.36	4.09	4.37
Adult household members size	2.45	2.51	2.45
Household head engaged in agriculture	0.56	0.47	0.56
Household head engaged in wage earning	0.30	0.36	0.29
Household head engaged in non-farm business	0.18	0.22	0.19
Asset quintiles: First quintile	0.20	0.10	0.19
Second quintile	0.24	0.14	0.23
Third quintile	0.16	0.14	0.17
Fourth quintile	0.20	0.28	0.20
Fifth quintile	0.20	0.33	0.21
Household located in rural area	0.46	0.28	0.46
Household participated in PSNP	0.13	0.08	0.13
Household consumption PAE per year	21880.51	25982.92	22071.15
Log household consumption PAE per year	9.68	9.91	9.72
Household owns a mobile phone	0.67	0.90	0.67
Number of mobiles available in the household	1.14	1.66	1.16
Household has access to electricity	0.52	0.72	0.53
Distance to market in KM	54.98	37.66	52.69
Distance to nearest town in KM	26.75	18.59	25.78
Log (distance to market in KM)	3.23	2.75	3.21
Log (distance to nearest town in KM)	2.66	2.27	2.62
Tigray	0.10	0.06	0.09
Afar	0.08	0.06	0.07
Amhara	0.11	0.11	0.11
Oromia	0.11	0.15	0.12
Somali	0.09	0.04	0.13
Benishangul Gumuz	0.05	0.06	0.05
SNNP	0.10	0.06	0.09
Gambella	0.07	0.06	0.07
Harar	0.08	0.10	0.08
Addis Ababa	0.11	0.19	0.12
Dire Dawa	0.09	0.10	0.07
Other highland regions	0.32	0.32	0.32
Other regions	0.90	0.94	0.91
Number of observations	6770	2677	2677

## 5.2. Results based on ACLED data

We triangulate our results based on interaction between post-war-onset dummies and the war-affected region dummy by running TWFE regression of the same set of outcome variables on exposure to battles near the household's residence. More specifically, we construct both binary indicators of exposure to battle(s) as well as measures of intensity of exposure to battles taking place within 10 km and 20 km of the household's residence. The measures of intensity of exposure to battles are constructed by computing the cumulative number of battles that have taken place within 10 km and 20 km radius of the residence of households prior to each survey round. The 10 km and 20 km distance buffers were chosen to ensure that battles are close enough to have

**Table A5**  
Summary of households' access to food.

Access to food	No. observations	Weighted values	
		Mean	Standard deviations
Not able to buy teff/injera	19,495	0.11	0.32
Not able to buy wheat	19,495	0.10	0.30
Not able to buy maize	19,495	0.05	0.22
Not able to buy edible oil	19,495	0.15	0.36
Not able to buy food	19,495	0.24	0.43

Notes: These values come from a series of questions eliciting whether a household was not able to buy each of the above staple foods and essential goods.

**Table A6**  
The Impact of violent conflict on aggregate measures of food insecurity: sample restricted to highland regions.

	(1) Moderate or severe food insecurity	(2) Food insecurity	(3) Raw score
Round 4	-0.034 (0.022)	-0.019 (0.025)	-0.226* (0.125)
Round 5	-0.036 (0.023)	-0.042* (0.024)	-0.287*** (0.108)
Round 6	-0.053* (0.027)	-0.043 (0.027)	-0.261* (0.137)
Round 7	-0.072*** (0.027)	-0.058* (0.030)	-0.399*** (0.146)
Round 12	-0.089** (0.037)	-0.104*** (0.032)	-0.670*** (0.219)
Round 4 × Tigray	0.057 (0.076)	-0.040 (0.069)	0.113 (0.315)
Round 5 × Tigray	-0.085 (0.066)	-0.074 (0.057)	-0.361 (0.241)
Round 6 × Tigray	-0.087 (0.061)	-0.114* (0.061)	-0.553** (0.213)
Round 7 × Tigray	-0.008 (0.080)	-0.051 (0.058)	-0.154 (0.285)
Round 12 × Tigray	0.396*** (0.076)	0.252*** (0.051)	1.783*** (0.361)
Household fixed effects	Yes	Yes	Yes
R-squared	0.033	0.021	0.035
Mean dep. Var (pre-war)	0.454	0.634	2.598
No. observations	5580	5580	5580

Notes: The outcome variable in the first column stands for a binary indicator assuming a value of 1 for those households classified as moderate or severe food insecure based on the severity of food insecurity generated from the eight FIES questions. The dependent variable in the second column stands for binary indicator assuming a value 1 for those households experiencing one or more types of food insecurity and 0 otherwise. The outcomes variable in the last column stands for raw sum of the responses to the eight FIES questions. All estimations use sampling weights to capture systematic non-response and attrition in phone surveys. Standard errors, clustered at district (woreda) level, are given in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

impacts on our outcome variables. The extensive margin of exposure to conflict assumes a value of 1 for those households experiencing one or more battles and 0 for those not exposed to any battles within 10 km or 20 km radius of their residence. The coefficients associated with the extensive margin of exposure captures the effect of being exposed to one or more battles while the coefficients associated with the intensive margin of exposure capture the effect of exposure to an additional battle event on household food security and labor market outcomes.

Table 6 presents the impact of exposure to battle(s) that occurred within 10 and 20 km distance from households' residence on food insecurity. Panel A shows impacts associated with the extensive margin of exposure to battle(s) while Panel B shows results associated with the intensive margin of exposure and hence impact of exposure to an additional battle. For all three measures of food insecurity, exposure to

**Table A7**  
Impact of violent conflict on experience of food insecurity: sample restricted to highland regions.

	(1) Worried not enough food	(2) Unable to eat healthy foods	(3) Ate few kinds of food	(4) Skipped meal	(5) Ate less food	(6) Ran out of food	(7) Hungry but did not eat	(8) Did not eat all day
Round 4	-0.022 (0.025)	0.000 (0.026)	-0.017 (0.025)	-0.029 (0.023)	-0.033 (0.021)	0.021 (0.025)	-0.058** (0.027)	0.001 (0.026)
Round 5	-0.062** (0.024)	0.038 (0.027)	0.004 (0.021)	-0.045* (0.026)	-0.086*** (0.024)	0.018 (0.023)	-0.060** (0.026)	-0.010 (0.024)
Round 6	-0.065** (0.029)	0.044 (0.027)	-0.001 (0.028)	-0.069*** (0.026)	-0.082*** (0.025)	0.044 (0.033)	-0.035 (0.027)	-0.006 (0.021)
Round 7	-0.113*** (0.029)	0.029 (0.031)	-0.018 (0.029)	-0.071*** (0.023)	-0.100*** (0.029)	0.030 (0.031)	-0.055** (0.026)	-0.007 (0.025)
Round 12	-0.080** (0.034)	-0.019 (0.035)	-0.075** (0.037)	-0.109*** (0.037)	-0.165*** (0.036)	-0.010 (0.039)	-0.091*** (0.034)	-0.032 (0.032)
Round 4 × Tigray	0.011 (0.075)	-0.092 (0.066)	0.004 (0.061)	0.060 (0.058)	0.059 (0.063)	0.054 (0.067)	-0.009 (0.065)	0.118* (0.060)
Round 5 × Tigray	-0.044 (0.074)	-0.081 (0.087)	-0.157** (0.068)	0.015 (0.040)	0.016 (0.038)	-0.084* (0.044)	-0.007 (0.065)	0.078* (0.047)
Round 6 × Tigray	-0.169** (0.076)	-0.154** (0.067)	-0.147** (0.072)	0.008 (0.057)	0.008 (0.044)	-0.082** (0.039)	-0.014 (0.058)	0.086* (0.051)
Round 7 × Tigray	-0.055 (0.069)	-0.108 (0.088)	-0.059 (0.056)	0.092 (0.059)	0.011 (0.039)	-0.024 (0.048)	-0.001 (0.066)	0.083 (0.058)
Round 12 × Tigray	0.225*** (0.068)	0.299*** (0.091)	0.343*** (0.072)	0.441*** (0.102)	0.435*** (0.108)	-0.012 (0.054)	0.081 (0.060)	0.068 (0.050)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.032	0.021	0.027	0.028	0.036	0.013	0.011	0.008
Mean dep. Var (pre-war)	0.465	0.518	0.527	0.295	0.383	0.193	0.138	0.083
No. observations	5580	5580	5580	5580	5580	6609	6609	6609

Notes: The outcome variables in this table are raw responses to standard FIES questions on whether the respondent or household member (1) was *worried* about having enough food to eat, (2) ate only a *few kinds* of foods, (3) unable to eat *healthy* and nutritious foods, (4) *ate less* than should have eaten, (5) had *skipped* a meal, (6) *run out* of food, (7) was *hungry* but did not eat, (8) went without eating for a *whole day*. The base round is the month immediately before the outbreak of the conflict. All estimations use sampling weights to capture systematic non-response and attrition in phone surveys. Standard errors, clustered at district (woreda) level, are given in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

battle(s) was associated with an increase in food insecurity. For example, column 2 shows that the probability of moderate or severe food insecurity increases by 16 percentage points with exposure to one or more battles within 20 km of household residence. The results in Panel B indicate that each additional battle that took place within 20 km of residence is associated with a 1 percentage point increase in the probability of moderate or severe food insecurity. In column 4, we show that exposure to one or more battle(s) within a 20 km radius increases probability of experiencing food insecurity by 8 percentage points and an additional battle leads to a 1 percentage point increase in the probability of food insecurity. The results for the raw food insecurity index are similar. We have also estimated our specification for 30, 40 and 50 km distance buffers, and find broadly consistent results, with impacts decreasing with distance. For the remaining estimations we report those based on 20 km.<sup>31</sup>

As we are considering the impact of battles that have taken place throughout Ethiopia, it is important to note that localized exposure to battle events has been staggered, with certain areas experiencing battles at earlier periods than others. To account for potential biases due to temporal treatment effect dynamics and treatment heterogeneity arising from staggered treatment, we follow the approach proposed in Callaway and Sant'Anna (2021). Fig. 6 presents estimates for two food insecurity measures – experiences of moderate or severe food insecurity and raw FIES food insecurity score – for battles within 10 km and 20 km distance buffers. As in our previous results, exposure to one or more battle(s) is associated with increase in food insecurity, though these impacts seem to have delayed onset, which suggests that households were able to mitigate some of the adverse effects of the war by drawing down their food stock for the first few months. However, such conditions could not

be sustained without access to food markets, which is reflected in the heightened food insecurity in the ensuing months. The overall treatment effects for moderate or severe food insecurity and raw food insecurity score at 10 km and 20 km distance buffers, respectively, (0.125 and -0.136; 0.570 and 0.542) are consistent with those reported in Table 6.

Table 7 reports results associated with the impacts of exposure to battle(s) on the eight FIES outcomes. Panel A report results using extensive margin of exposure to battles within 20 km radius while Panel B reports estimates using intensive margin of exposure to an additional battle within 20 km buffer around households' residence. For most outcomes, exposure to one or more battle(s) is associated with increased food insecurity. For example, exposure to one or more battles is associated with a 17 percentage points increase in the probability of skipping meal (Panel A). The share of households who report being worried about getting enough food, unable to eat healthy foods or ate few food varieties increased by approximately 1 percentage points with an additional battle event within 20 km of the residence of the household. The impact on the share of households who skip a meal or eat less food is similar – one more battle event is associated with about 1 percentage points increase in these coping strategies.

The impacts of the war on labor market and livelihoods estimated using households' exposure to battles within 20 km are consistent with the DID findings reported earlier. Exposure to one or more battle(s) is associated with about 5 percentage point reduction in participation in any livelihood activity (Panel A of Table 8). An additional battle leads to about 0.5 percentage points reduction in participation in any livelihood activity (Panel B of Table 8). The fall in economic activity was primarily due to a decrease in non-farm business and wage-earning activities. An additional battle is associated with 0.2 and 0.5 percentage points decrease in participation in non-farm business and wage activities, respectively. There was, however, no impact on farm activities, signifying the resilience of the agriculture sector to the stresses of armed

<sup>31</sup> Results based on 30, 40 and 50 km buffer are available upon request.

**Table A8**

The Impact of violent conflict on labor market and livelihood activities: dropping the 2019 round and using different reference period.

	(1) Any activity	(2) Farm activity	(3) Non-farm business	(4) Wage related activities
Round 2	-0.029** (0.014)	-0.001 (0.018)	0.048** (0.022)	-0.008 (0.016)
Round 3	-0.025 (0.016)	0.026** (0.011)	0.023 (0.022)	-0.026** (0.011)
Round 4	0.009 (0.012)	0.043*** (0.011)	0.012 (0.013)	-0.029*** (0.010)
Round 6	0.001 (0.010)	0.020** (0.009)	-0.002 (0.009)	-0.018** (0.009)
Round 7	0.009 (0.009)	0.015* (0.009)	0.007 (0.009)	-0.014 (0.009)
Round 9	-0.006 (0.011)	-0.005 (0.011)	0.012* (0.007)	-0.007 (0.006)
Round 10	0.005 (0.011)	-0.007 (0.012)	0.015 (0.011)	-0.006 (0.009)
Round 2 × Tigray	-0.219*** (0.078)	-0.201*** (0.075)	-0.008 (0.043)	-0.080*** (0.027)
Round 3 × Tigray	-0.016 (0.048)	-0.028 (0.027)	0.006 (0.041)	-0.008 (0.039)
Round 4 × Tigray	-0.036 (0.046)	-0.054* (0.028)	0.065 (0.051)	-0.016 (0.029)
Round 6 × Tigray	0.011 (0.049)	0.014 (0.020)	0.117** (0.055)	-0.041 (0.032)
Round 7 × Tigray	0.013 (0.046)	0.019 (0.022)	0.062* (0.036)	-0.028 (0.024)
Round 9 × Tigray	-0.123* (0.075)	0.036 (0.033)	-0.029 (0.040)	-0.163*** (0.053)
Round 10 × Tigray	-0.134* (0.077)	0.063** (0.030)	-0.048* (0.027)	-0.173*** (0.048)
Household fixed effect	Yes	Yes	Yes	Yes
R-squared	0.014	0.022	0.009	0.005
Mean dep. Var (pre-war)	0.810	0.319	0.242	0.425
No. observations	19,268	25,886	25,886	19,268

Notes: The outcome variable in the first two columns is a dummy variable for participation in any economic activity. The variables in columns 3–8 are binary indicators assuming a value of 1 for those households participating in these activities. The base round is the month immediately before the outbreak of the conflict. All estimations use sampling weights to capture systematic non-response and attrition in phone surveys. Standard errors, clustered at district (woreda) level, are given in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

conflict. These results are consistent with those estimated using the difference-in-difference approach (Table 4).

Fig. 7 shows estimates of the extensive margin impact of exposure to battle events within 20 km of homestead following Callaway and Sant'Anna (2021). For all outcome variables, exposure to war is associated with decline in livelihood activities. Participation in overall economic activity, non-farm business and wage employment declined immediately following experience of battles nearby. Consistent with the patterns in Fig. 4, some of the activities have recovered after about three months. The overall effects of the war on any economic activity, farming, non-farm business and wage activities were  $-0.07$ ,  $-0.033$ ,  $-0.031$ , and  $-0.072$ , respectively, which are consistent with those reported in Table 8. The fact that the estimates using the Callaway and Sant'Anna (2021) approach reported in Figs. 6 and 7 are similar to those reported in Tables 6 and 8, respectively, gives us confidence that our main estimates are less likely to be biased due to dynamic treatment effects and treatment heterogeneity.

### 5.3. Robustness tests

We run several empirical tests to prob the robustness of our results. Most importantly, our main estimations consider the rest of Ethiopia except Tigray as control group. However, households living in the

highland regions (Amhara, Oromia, Tigray and SNNP) and lowland regions engage in slightly different livelihood activities.<sup>32</sup> Similarly, households living in some of the major urban centers (e.g., Addis Ababa) have markedly different economic conditions and sources of livelihood. To reduce potential differences in the impacts of the war due to differences in livelihood activities between Tigray and the control group, we restricted the sample to the four highland regions, with households from the three regions (Amhara, Oromia, and SNNP) serving as control group. We then run all our estimations on this restricted and significantly smaller sample. Despite the change in the sample size, the results in Tables A6–A7 show remarkably similar impacts to those reported using the full sample.

Table A6 shows the impact of the war on the share of households who are moderately or severely food insecure and the probability of food insecurity for the reduced four-region sample. The results associated with food insecurity prevalence are similar to the full sample (40 vs 37 percentage points). Similarly, the impacts on probability of food insecurity compare well with the full sample (25 vs 20 percentage points). If anything, these estimates appear to indicate that effect of the violent conflict on food security is likely higher than that established in Table 2. As the first round was collected using face-to-face interview while the remaining rounds were collected through phone surveys, we also estimated some of our specifications by dropping the first round. As shown

<sup>32</sup> For example, households in Ethiopian highlands are likely to practice mixed farming while those in the lowlands (arid and semi-arid lands of Ethiopia) practice animal husbandry as dominant source of livelihood (e.g., Abay and Jensen, 2020).

in Table A8, dropping the face-to-face survey round and changing the reference period generates similar findings.

## 6. Concluding remarks and policy implications

A large-scale war that broke out in the Tigray region of Ethiopia in late 2020 caused significant human suffering and economic disruptions. To make matters worse, besides the direct effects of the war on lives and livelihoods, the disruption and blockade of public services in war affected areas has limited our understanding of the breadth and consequences of the armed conflict. One fortuitous aspect of this situation, however, has been the opportunity to repurpose a high frequency phone survey (HFPS), originally developed by the LSMS-ISA program at the World Bank to monitor the COVID-19 situation and related impacts in Ethiopia, which continued to monitor household food security and economic activities amidst an armed conflict.

Using these HFPS data, combined with the Armed Conflict Location and Events Data (ACLED), we show evidence of significant disruptions to livelihoods, with adverse impacts on household food security and access to food in the first few months of the war covered by the HFPS data. We find that, as a result of the conflict, moderate or severe food insecurity increased by 37 percentage points, from 30 percent at baseline (pre-war) to 67 percent in May 2021. Using the ACLED data on households' exposure to violent conflict, we show that exposure to an additional battle within 20 km radius is associated with a 1 percentage point increase in the probability of moderate to severe food insecurity. Similarly, affected households report 20–22 percentage point reduction in non-farm activities and 19–20 percentage point reduction in wage employment within two months of the start of the war. Farming, on the other hand, was notably resilient to impacts of the war, with participation in farm activities remaining relatively steady.

These results corroborate calls for urgent large-scale humanitarian assistance while also highlighting that the war may have lasting dire implications on affected populations. Moreover, these results are likely to have worsened as the war continued until the signing of the cessation of hostilities agreements in November 2022. The combined effects may thus reverse the progresses of the last two decades in the Ethiopian economy, especially in reducing poverty and the share of agriculture in GDP and employment. In the short-term, these findings can inform rehabilitation and rebuilding efforts in Ethiopia. With the recent signing of the peace agreement, these results can contribute to ongoing discussions on rebuilding and rehabilitation of conflict-affected areas. For example, these results can inform prioritization of sectors and value chains that deserve immediate attention.

The HFPS sample is a subsample of a nationally representative sample of households drawn for an in-person survey in 2019. It covers households who reported phone ownership in the in-person survey. Due to this non-random sample and additional complication of war related nonresponse and displacements of households during the survey period, the survey is likely to include those who are relatively less exposed and less vulnerable to the vicissitudes of the war. While we try to account for systematic non-response and attrition using sample weights constructed using a long list of observables, the actual negative impacts of the conflict are likely to be larger on average, and it is difficult to fully quantify the extent to which this is the case. Moreover, we note that these impacts refer to the first few months after the onset of the crisis but also in months relatively closer to the harvest season. We know that even in normal times, food insecurity worsens closer to the lean season (Berhane et al., 2011).

Given the intensity of the war, these results are not surprising – human suffering has been widely reported in contexts of war. In fact, the share of affected people who report continuing work is perhaps surprisingly high, given the circumstances, and even after allowing for selection bias. For example, despite the war, some households continued participation in various farm and non-farm activities. This reflects the exigencies of feeding one's family, even under conditions where the

pursuit of livelihoods is fraught with danger. By the same token, our results may be taken as indicators of the resilience of some livelihood sectors and of ordinary people to maintain their livelihoods despite the challenges of an active conflict. Some of these patterns, including those related to differential responses and participation rates across various economic activities and associated resilience are broadly consistent with previously documented coping strategies to conflict (e.g., Brück et al., 2019; Shemyakina, 2022).

Our insights about the overall impact of the war are limited by the ways the war and associated government responses unfolded as well as by the ways in which information was elicited in the surveys. For example, as the war in Tigray was compounded by suspension of public services and blockade of trade, it is difficult to disentangle the impact of the war itself with impacts of the government war-time policies. Furthermore, given that the war continued for more than a year after the last round of the HFPS and expanded to neighboring Amhara and Afar regions, our results cannot provide a complete picture on the overall impact of the large-scale war in Ethiopia. Similarly, due to the limitations associated with phone surveys, we have focused on welfare outcomes that can be easily captured in short surveys. For example, while we observe the extensive margin of economic activity (i.e., whether or not labor was allocated to a particular activity in the reference period), we are unable to directly observe the intensive margin (e.g., as the number of hours worked). A final caveat is in our measures of conflict exposure. We have shown that our regional-dummy approach generates results which are consistent with those obtained from point location estimates of battle events derived from media reports (via the ACLED database). However, future studies may complement this using additional sources of data, including by asking respondents to indicate their exposure to conflict via survey instruments.

These caveats notwithstanding, our analysis indicates enormous potential for using high-frequency phone surveys and related remote data collection methods – ideally associated with a baseline sample of respondents – to monitor the impacts of active conflicts, and to quickly devise post-conflict responses that are tailored to geographical and household heterogeneity in impacts suffered. The ability to quickly mobilize such surveys in new areas would facilitate this, and would be a worthy target of the international community.<sup>33</sup> This corroborates recent efforts and innovations in remote data collection in fragile states (e.g., Dabalen et al., 2016; Verwimp et al., 2019; Hoogeveen and Utz, 2020). To facilitate effective use of remote data collection methods, it would be useful to maintain access to a much larger database of potential telephone survey respondents, designed for maximum geographical and socioeconomic representativeness, given the constraints of household-level phone access and regional ICT infrastructure.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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<sup>33</sup> Brück and Regassa (2023) have noted that the current set of high-frequency phone surveys covers a relatively limited set of countries, which possibly signals capacity gaps in potential national partner institutions.

this paper are those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development /World Bank Group, IFPRI and CIMMYT.

## Appendix A

See Fig. A1 and Tables A1-A8.

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