Firms amid Conflict: Performance, Production Inputs, and Market Competition *

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Abstract

We study the effect of conflict on firms' economic performance and explore the underlying mechanisms. Combining an original panel dataset of Libyan firms with geolocalized data on conflict events, we build a firm-specific measure of conflict exposure and use its within-firm variation to show that the relationship between conflict exposure and performance is convex. This is the result of two opposite mechanisms. Revenues decrease because of the conflict-induced lower availability of production inputs. At the same time, revenues tend to increase for surviving firms that face weaker market competition because of the conflict-induced reduction in the number of competitors.

Keywords: Firms, conflict, market competition, foreign workers, imported inputs, Libya

JEL classifications: C23, D22, D74, L20, O12

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1 Introduction

Firms in developing countries face a host of obstacles that hinder everyday operations. On top of these challenges, firms located in conflict-affected countries suffer from the adverse effects of violence and instability, which create additional impediments to long-term growth. Understanding these mechanisms is crucial to properly design policy measures for the survival of firms and for their post-conflict recovery.

Micro-level evidence on the economic impact of conflict and on the mechanisms through which conflict affects firms remains limited, however. Thus, despite its relevance, the study of firms in conflict-affected settings is a largely unexplored line of research due to severe data limitations. Firm-level data are still rarely available in conflict-affected countries and, even when there exist, often lack the longitudinal dimension which is necessary for a rigorous evaluation of the impact of conflict on firms' activities.

This paper studies the effect of conflict on firms' economic performance and explores the underlying mechanisms. We combine unique firm-level data on Libyan private firms collected through an original survey and geolocalized information on conflict events that occurred during the Second Libyan Civil War.

For a long time, the collection of data needed to assess the effect of conflict on Libyan firms has been impeded by an uncertain political environment, characterized by lack of governmental control over the territory, and by the intense conflict-related violence across the country. Since its inception in 2014, the Second Libyan Civil War has caused more than 12,000 fatalities and has become one of the geopolitically most relevant conflicts of our times (World Bank, 2020). Our data are the first and only firm-level data collected in Libya since the beginning of the conflict.

Two important features of our survey allow us to overcome some of the data challenges common to this type of studies. First, the survey collects detailed firm-level information on a large set of variables, including financial accounts, production inputs usage, and market share. These data have been collected from account books through in-person interviews conducted in all Libyan regions. Crucially, the survey also collects georeferenced information on the firm's location, which allows us to compute a *firm-specific* time-varying measure of conflict exposure. Second, thanks to the retrospective panel structure of the data, we are able to track the evolution of the firm's performance and exposure to conflict events over five years, i.e., the period 2013-2017, and use a within-firm empirical strategy to control for the observable and unobservable time-invariant firm's characteristics that may confound the estimates.

Our results show that conflict has a negative effect on firms' economic perfor-

mance. We document that this effect is nonlinear and that the relationship becomes convex for very high levels of conflict intensity. We provide suggestive evidence that this is due to the working of two opposite mechanisms: (1) the conflict-induced reduction in the availability of production inputs, which tends to reduce revenues, and (2) the conflict-induced reduction in the number of competitors of the firm, which tends to increase revenues. Our results indicate that - conditional on firm survival - the effect of conflict is heterogeneous and for some firms it may even turn out to be positive.

The empirical analysis proceeds in two steps. First, we use the within-firm variation in the *firm-specific* level of conflict exposure to identify the effect of conflict on firms' economic performance. We find that an increase in the number of conflict events that occurred in the 10 km radius of the firm's location during the last 12 months has a highly significant negative effect on revenues. The size of this effect is substantial: on average, 10 more conflict events during the year reduce revenues by 1.4%, or one unit increase in standard deviation leads to a 21% reduction in revenues. To validate our empirical analysis we discuss various threats to the identification strategy. We show that data-related issues - i.e., sample selection, systematic non-reporting, retrospective bias, and measurement error - are unlikely to seriously bias our results. Moreover, by relying on both direct and indirect evidence, we argue that our identification strategy is not invalidated by omitted-variable bias, reverse causality, and preconflict different trends in the outcome variable. Our results are also robust to a number of checks, such as the inclusion of sector-year and region-year fixed effects and their combinations, and an alternative data source to construct the measure of conflict exposure. Additional results show that the negative effect of conflict is larger the closer the violent event is to the firm and, while it is heterogeneous as for the identity of the perpetrator of the event, we do not find any differential impact if the firm is linked to the government. Finally, we document that the negative effect of conflict exposure on revenues is nonlinear as it becomes smaller when the number of conflict events increases. We provide suggestive evidence that the relationship between conflict and the firm's performance (as measured by revenues, labor productivity, and profits) becomes convex for very high levels of conflict intensity.

The second step in our analysis explores the possible mechanisms explaining the negative (nonlinear) effect of conflict exposure on firms' performance. At first, we analyze the conflict-induced change in the usage of factors of production - namely, intermediate inputs and labor. Conflict reduces the availability of intermediate inputs by decreasing the number of suppliers. We show that this is likely to occur primarily through the disruptions to international supply linkages which reduces intermediate imports, especially from foreign suppliers that are relatively small and produce low

value-added goods. The importing activity is instead less affected if the firm has a good reputation and well-established relationships with the exporters, and if the firm has access to credit. Conflict also reduces the number of employees and it reshapes the composition of the workforce by reducing the share of foreign workers. The conflict-induced reduction in the availability of production inputs, by reducing the firm's potential output, tends to have a negative effect on firms' revenues: we label this the *production inputs mechanism*.

The convex relationship between conflict exposure and revenues suggests, however, the existence of an additional mechanism at work, thereby contrasting the negative effect on revenues of the conflict-reduced availability of production inputs. Consistent with qualitative evidence from our survey, we document that this mechanism operates through a reduction in market competition. First, we show that higher conflict intensity reduces the number of competitors of the firm and that this effect is larger for firms located in areas characterized by high levels of conflict intensity. Second, we show that the lower the number of competitors of the firm, the less severe is the effect of conflict on revenues and market shares. We interpret this as a piece of evidence for a *market competition mechanism*: the conflict-induced change in the level of market competition (due to the reduction in the number of competitors) has a positive impact on the economic performance of surviving firms. Consistently, we document that the relationship between conflict intensity and the firm's market share is convex. We also find that the effect of higher conflict intensity on market shares is not different for the most productive firms.

Taken together these results suggest that the combination of the *production inputs mechanism* and of the *market competition mechanism* can largely account for the non-linear effect of conflict on firms' economic performance. On the one hand, revenues tend to decrease with conflict intensity because conflict reduces the availability of (imported) intermediate inputs and (foreign) workers. On the other hand, for high levels of conflict intensity, revenues tend to increase with conflict thanks to the conflict-induced reduction in the number of competitors. If the latter mechanism prevails, then the effect of conflict on revenues may even turn out to be positive. To corroborate these findings, we build a stylized conceptual framework - whose assumptions are based on both the characteristics of the Libyan economy and the empirical results - that describes the effect of conflict on the firm's output and price, and it formalizes the condition under which conflict can have a non-linear (convex) effect on economic performance.

Finally, we rule out possible alternative mechanisms explaining our main result, such as the conflict-induced change in consumer demand, oil production, corruption

and illegal requests of payments to firms.

Our paper contributes to three main strands of literature. The first is the one looking at the microeconomic consequences of conflict (Verwimp et al., 2019).[1] Previous studies focusing on the effect of conflict on firms have looked at stock market returns (Guidolin and La Ferrara, 2007), investment (de Roux and Martinez, 2020), firm exit (Collier and Duponchel, 2013; Camacho and Rodriguez, 2013; Blumenstock et al., 2018), firm productivity (Klapper et al., 2013), inputs misallocation (Amodio and Di Maio, 2018), export performance (Ksoll et al., 2021), within-in plant allocation efficiency (Hjort, 2014), trade flows (Korovkin and Makarin, 2020), and interfirm trade (Korovkin and Makarin, 2021).[2] Our paper complements this literature in three ways. First, by using the exact location of *both* firms and conflict events to construct a *firm-specific* measure of conflict exposure, we are able to properly account for the geographical dimension of the conflict in the analysis of its effects. Second, we document the existence of a nonlinear negative effect of conflict on the firm's performance and of a convex relationship for very high levels of conflict intensity. This is a novel finding with relevant implications for the analysis of the impact of conflict on aggregate economic activity. Third, we show that the effect of conflict on firms can result from the combination of different mechanisms, potentially having opposite effects on the firm's performance. In our setting, these are the conflict-induced reduction in the availability of intermediate inputs and workers, and the change in the level of market competition.

Our paper also relates to the literature documenting the relationship between imports and firms' productivity (Amiti and Konings, 2007; Topalova and Khandelwal, 2011; Halpern et al., 2015). Our findings adds to previous studies showing that negative shocks limiting the import of intermediate inputs reduce firms' output (Amodio and Di Maio, 2018; Boehm et al., 2019). We contribute to the understanding of the effect of conflict on international trade at the firm-level by providing suggestive evidence that access to credit and the existence of relational contracts mitigate the negative impact of conflict on importing firms, and that the conflict-induced import disruption affects relatively more small international suppliers.

Finally, our paper is related to the literature analyzing the link between firm characteristics, performance, and policy in developing countries (McKenzie and Paffhausen,

[1] A companion body of literature looks at the economic determinants of conflict including: price shocks (Dube and Vargas, 2013), natural resources (Berman et al., 2017), import restrictions (Amodio et al., 2021), and multinational enterprises (Sonno, 2020).

[2] A few papers document the effect of crime on economic activity. Pinotti (2015) studies the effect of mafia on economic activity in southern Italy. Rozo (2018) shows that an increase in the homicide rate in Colombia leads to a decline in firm's production, input and output prices. Utar (2020) analyzes how drug-related violence reduces output and employment of Mexican firms.

2019). Our analysis documents that the characteristics that allow firms to survive in a conflict are possibly different from those which favour economic performance in times of peace. At the same time, our results indicate that the effects of conflict are largely dependent on the specific characteristics of the conflict itself. These are two potentially important elements to be considered when designing policy interventions for private sector development in conflict-affected settings (Kapstein et al., 2018).

The rest of the paper is organized as follows. Section 2 provides a background on the Libyan private sector and on the Second Libyan Civil War. Section 3 describes the data. Section 4 presents the empirical strategy and Section 5 shows the results. Section 6 discusses the potential underlying mechanisms. Section 7 concludes.

2 Background

The Second Libyan Civil War The Second Libyan Civil War is one of the geopolitically most relevant conflicts of our times (Fitzgerald and Toaldo, 2016; Pack, 2019). This war began on May 16, 2014 with a large-scale military offensive against armed Islamist groups in Benghazi.[3] This marked a period of political instability and weak institutional control over the country (Eriksson, 2016). By the beginning of 2015, two rival governments were claiming authority over Libya, one (based in Tripoli) controlling the West of the country and the other (based in Tobruk) controlling the East part of the country. Each government was supported by rival militias fighting in various areas of the country with the objective of gaining the political and military control of the territory. At the end of 2015, the United Nations recognized the Al-Sarraj government (the one based in Tripoli) as the only legitimate one, and the international community was asked to interrupt all relations with the General Haftar government (the one based in Tobruk). In 2017, a cease-fire was reached and the parties agreed that a presidential election would be held in 2018. However, since then the election date has been postponed several times.

The Second Civil War is, above all, a struggle to control the territory (Fitzgerald and Toaldo, 2016). This conflict is characterized by fragmentation, with different types of armed actors taking part in the hostilities (Pedde, 2017).[4] The main fighting actors are to a large extent local militia that operate either independently or in larger

[3]The First Libyan Civil War started in February 2011 when a popular uprising against General Muammar Gaddafi led to a violent conflict between various rebel groups and Gaddafi's loyalist army. At the end of 2011, the rebels overthrew the four-decades-long dictatorship.

[4]Eriksson (2016) describes the Second Civil War as a multilayered conflict involving: (1) two competing governments, (2) numerous rival armed groups , (3) rivalry between nationalists and federalists, (4) societal tensions between villages and tribes, and (5) different Arab states.

coalitions. The conflict has been characterized by numerous shifts in the balance of power between the actors, a continued threat from ISIS, and an ongoing militarization of local groups in various parts of the country. The chaotic situation is the result of the absence of functioning state institutions, and the conflict-related confrontations have been intermittent rather than part of any clear offensive (Eriksson and Bohman, 2018). Battles have been fought street by street, with fighting taking place also in the residential neighborhoods and even in the city centers (Pack, 2019).

The Libyan private sector Three main features of the Libyan private sector are relevant to our analysis. First, the Libyan private sector is relatively small and mostly populated by micro and small, family-owned, non-exporting firms (World Bank, 2015a). In 2017, the Libyan private sector was estimated to be about 19% of GDP (World Bank, 2020).[5] The small size of the private sector is in part due to the large presence of the state in the economy during the Gaddafi regime and in part due to the fact that the activities in this sector have been constrained by policy unpredictability, corruption, and poor governance. As a result, Libya's private sector remains small and predominantly oriented to the domestic market, with very few firms able to export (OECD, 2016).

Second, the Libyan economy is largely dependent on imports: in the period 2013 - 2017, imports represent between 40% and 75% of GDP. In 2010 (the last year for which data exist), 15% of imports were consumer goods and 85% were raw materials and intermediate goods. The high level of imports is in part the result of Libya's oil dependency: a historically overvalued exchange rate, fueled by oil revenues, has favored importing over local sourcing of intermediate inputs. Libyan firms have traditionally relied on imports to meet the lack of domestic supply and flaws in manufacturing. This explains the weak linkages among domestic firms (World Bank, 2015a).

A third key feature of the Libyan economy is the strong reliance of the private sector on the foreign workforce. Libya has been for decades an attractive destination for workers from the Arab states and the Sub-Saharan African countries. Prior to the 2011 uprising, nearly 50% of Libya's labor force were foreigners, reaching an estimated 1.5 million workers (World Bank, 2015b). This was the result the Gaddafi regime policy, which encouraged workers from developing countries to move to Libya (ETF, 2014). One reason was the mismatch between the domestic workforce's skills and the labor demand. Thus, because of the shortage of high-skilled Libyan workers,

[5]Libya is an oil-dependent economy. In 2017, between 45% and 80% of Libyan GDP is estimated to be represented by the oil and gas sector. More than 50% of all oil reserves of the country are controlled by the government-owned National Oil Corporation (NOC). The sector provides about 86% of government revenue and represent 93% of exports (World Bank, 2020).

domestic firms have often resorted to foreign workers to fill qualified jobs positions, although a large number of foreign workers have also been employed in low-skilled and manual jobs that Libyans are culturally reluctant to take (World Bank, 2020).

3 Data

3.1 Firms

Our primary source of data is the Libya Enterprise Survey 2018 (World Bank, 2018), an original survey of 400 Libyan private formal firms. We designed the questionnaire and coordinated the data collection during the period July - October 2018. Surveyed firms broadly resemble the characteristics of Libyan private firms in terms of size, location, and sector of activity.[6] The survey provides detailed firm-level information on a large array of variables, including the firm's georeferenced location, financial accounts, production inputs usage, import activity, market share, etc. Crucially, our dataset is a retrospective panel: the survey includes questions that allow us to track the evolution of firms' characteristics and performance over five years of the conflict, that is the period 2013 - 2017.

Our sample includes the 383 firms for which geolocalization information is available. Almost all firms are domestic (98%), and only 3% of these are part of a group, either domestic or foreign. Around 38% of firms are located in the Western region, 28% in the Eastern region, 20% in the Middle region, and 14% in the South region (Figure A.1 shows the Libyan regions). As for the sector of activity, 40% of firms operate in service, 32% in trade, 14% in manufacturing, and 14% in construction. In terms of firm size, 78% of firms are small (employing less than 20 workers), with about one-third of firms being micro (employing less than 5 workers); 18% of firms are medium size (employing between 20 and 99 workers); and only 4% of firms are large (employing more than 100 workers). About 34% of firms are family-owned. There is a relatively high share of firms employing foreign workers (39%). Finally, more than 29% of firms have imported at least once over the period of analysis while

[6]Data on the Libyan economy are extremely limited. The Libyan Bureau of Statistics and Census (BSC) performed the last census of Libyan businesses in 2006. Official data on economic activity were collected only until 2011. After that, statistics on the Libyan economy have been largely unreliable because of the limited capacity of government services (World Bank, 2015a). The few official publications since then have primarily relied on estimates from these older data. The lack of data results in large differences in economic statistics across different sources (including estimates from World Bank and IMF) and in the absence of subnational sector or firm-level data. Without updated macro-level data, it was thus not possible to create a representative sample of the current Libyan private sector. Firms in the oil and the agriculture sectors were not included. Details on the survey, the questionnaire, and the methodology to build the sample are reported in Appendix A.3.

export is a rare activity. In our sample less than 1% of firms have ever exported. Summary statistics for all the firm-level variables used in the analysis are reported in Table 1 (panel A).

Unfortunately, we cannot compare our sample with the universe of Libyan firms because of the lack of these data (see footnote 6). Yet, we can exploit the information from the survey conducted in 2014 (World Bank, 2015a) to check whether our sample is biased in terms of some firm's characteristic. To this end, we compare the characteristics - revenues, employment, and intermediate inputs expenditure - of the 56 firms surveyed in both 2014 and 2018 with those only surveyed in 2014. Results indicate that, among firms in the 2014 sample, those included also in our sample are not statistically different from those that are not (Table A.1).

Furthermore, given the extremely difficult context in which data collection was conducted, two main data quality issues may affect our empirical analysis: (1) systematic non-reporting and (2) retrospective bias. Table A.2 shows that non-reporting is not negligible in our sample. This may bias our results if missing values are systematically correlated with firm characteristics or more numerous for firms located in low-conflict areas. Table A.3 shows that this is not the case for our main outcome: missing information on revenues is not correlated with firm characteristics while it is more likely for firms located in high-conflict areas. Similarly, we test for the existence of a retrospective bias using the information available on the 56 firms included in both our sample and in the 2014 sample. We exploit the fact that both surveys require information for the fiscal year 2013, allowing us to compare the answers given by the same firm in the two different surveys. Reported values are not statistically different except for revenues, which the firm tends to slightly over-report in our (more recent) survey (Table A.4). This result suggests that the recall bias - if anything - would downward bias our results.

3.2 Conflict events

Data on conflict events are sourced from the PRIO/Uppsala Armed Conflict and Location Event (ACLED) dataset. ACLED covers conflict events worldwide for the period 1997-2020, providing location, in terms of latitude and longitude, date, and characteristics of a wide range of conflict-related events.[7] Event records are derived from a variety of sources, including reports from war zones, humanitarian agencies,

[7]Conflict events in the ACLED dataset are categorized as follows: (1) battle (government regains territory); (2) battle (no change of territory); (3) battle (nonstate actor overtakes territory); (4) headquarters or base established; (5) nonviolent transfer of territory; (6) remote violence; (7) riots and protests; (8) strategic development; (9) violence against civilians.

and research publications. Information from local, national, and international media is reviewed daily (Raleigh et al., 2010). Between 2013 and 2017, ACLED reports 5,495 conflict events and 11,510 fatalities in Libya, with 2014 being the most violent year (1,600 events and 3,327 fatalities).[8] Figure 1 shows the location of all conflict events that occurred in the period 2013-2017.[9] Table A.5 lists the number of conflict events by type. Summary statistics for our various measures of conflict exposure are reported in Table 1 (panel B). Our main measure of conflict exposure is $Number\ Conflict\ Events_{10km}$, that is the number of conflict events that occurred in the 10 km radius of the firm's location during the corresponding year t (that is, between January and December of year t): the mean is 146, the standard deviation is 151, the first quartile, the median, and the third quartile are 26, 129, 204, respectively.[10]

Our measure of conflict exposure is potentially affected by measurement error. The ACLED dataset is, in fact, not immune to common weaknesses of large datasets compiled from multiple sources. One of these issues is the presence of duplicated events. We thus eliminate all events for which all characteristics (date, location, actors, etc.) are the same (1.7% of all events). Another possible source of measurement error is related to the fact that the reporting of the events may be biased toward certain areas. In our analysis, possible (time-invariant) geographical-related differences in reporting are captured by the firm fixed effects. Also, some locations - e.g., large cities - might have better international media coverage, leading to an upward bias in the results given that firms are more likely to be located in urban areas. As shown in Section 5.1.1, results are robust to the exclusion of conflict events reported by international publishers, and those occurred in major cities.

We additionally source information on the number of conflict-related events from the Integrated Crisis Early Warning System (ICEWS) dataset. The ICEWS dataset covers the period 1995-2020 and provides the geolocalization, the date, the source, and the target of any event of interaction (i.e., cooperative or hostile) between sociopolitical actors (individuals, groups, and nation states). By collecting *all* types of political-related events, the ICEWS dataset is informative of the general level of political violence in a given location, even if this does not result in any fatality (see Amodio et al., 2021). For our analysis, we select all events classified as hostile. The final dataset counts a total of 6,689 conflict-related events between 2013 and 2017 in Libya. Table A.6 shows the number of conflict events by type for the period of analy-

[8] Conflict events are widespread throughout the year, from a minimum number of 403 events in January to a maximum of 553 in November over the period 2013-2017.

[9] The low number of events in South is due to its desert nature (see Figure A.2). Figure A.3 shows the location of conflict events with fatalities.

[10] When measuring the distance between the firm's location and any event that occurred in the period 2013-2017, the pc10 is 6.5 km, the pc50 is 486.7 km and and the pc90 is 883.9 km.

sis. We cross-check data on conflict events in Libya as reported by the ACLED dataset with those from the ICEWS dataset. The correlation between the number of conflict events as recorded in the two datasets is high (see Figure A.4.) As we show in Section 5.1.1, all our main results hold when using the ICEWS dataset.

3.3 Other data

In our analysis, we also use two firm-level cross-section surveys previously conducted in Libya. The first is the 2008 World Bank Investment Climate Assessment (ICA) conducted in 2007 on 480 establishments in the manufacturing and the service sectors (World Bank, 2011). The second is a survey conducted by the World Bank in 2014 that collected data on 457 nonagricultural firms (World Bank, 2015a). Moreover, to explore the relationship between oil production, conflict, and firm performance, we use data from PETRODATA (Lujala et al., 2007). This dataset provides the geographic coordinates of hydrocarbon reserves at the world level. We use it to locate the 18 on-shore oil fields present on the Libyan territory. We also use Nighttime light (NTL) data from the Defense Meteorological Satellite Program (DMSP) and the Visible Infrared Imaging Radiometer Suite (VIIRS) (Li et al., 2020), to check for differences in preconflict local-level economic activities. Finally, to look at the effect of conflict on prices, we use monthly price data from 491 shops in 29 cities in Libya during the period June 2017-June 2018. These data are collected by REACH and include information on prices for 32 food and nonfood items (REACH, 2018).

4 Empirical Strategy

To estimate the impact of conflict exposure on firms' economic performance, we use retrospective panel data combined with geolocalized information on conflict events. Our baseline empirical model is:

$$Y_{it} = \alpha + \beta \, Conflict \; Exposure_{it} + \mu_i + \theta_t + \varepsilon_{it} \tag{1}$$

where Y_{it} is the firm-level outcome of interest for firm i in year t, including: revenues, labor productivity, profits, number of employees, wages, number of suppliers, value of imports, number of competitors, market share, and markup. $Conflict \; Exposure_{it}$ is the firm-specific measure of conflict exposure. In our baseline specification, it is computed as the number of conflict events that occurred in the 10 km radius of the firm's location during the corresponding year t (that is, between January and December of year

t) as reported in the ACLED dataset. We label this $Number\ Conflict\ Events_{10km,it}$.[11] μ_i indicates the firm fixed effects, which account for all time-invariant observed and unobserved characteristics of the firm (including location) that potentially could influence the outcome of interest. θ_t represents year fixed effects, which control for overall trends in economic activity. In robustness checks, we include the full set of region-year and sector-year fixed effects. The former controls for all time-varying location-specific determinants of firm performance, such as the availability of infrastructures, local labor market characteristics, etc. The latter instead nets out differential time trends across sectors, i.e., in terms of technology, factor prices, and input usage. Finally, in our more demanding specification, we include sector-region-year fixed effects. ε_{it} is the error term. In all specifications, we report robust standard errors clustered at the firm-level, the level at which we measure the intensity of conflict exposure. As a robustness check, we also compute Conley standard errors to account for both spatial correlation (across firms) and serial correlation (within firms, across time).

To explore the possibility of a nonlinear effect of conflict, we also consider a quadratic specification for eq. (1) (i.e. $Number\ Conflict\ Events_{10km,it}$ is included both as a linear and a quadratic term) and a more flexible semi-parametric specification. We estimate these models for various firm's economic outcomes including revenues, labor productivity, profits, market share, and markup.

Our identification relies on the assumption that - conditional on firm and time fixed effects - conflict events occurring close to the firm's location are uncorrelated with any latent determinant of its economic performance. Under this assumption, β captures the reduced-form effect of the firm-specific conflict exposure on the firm's economic performance. Section 5.1.1 provides evidence in support of this identification assumption.

5 Results

5.1 Conflict exposure and firm performance

Table 2 shows the estimates of the effect of conflict exposure on firms' revenues obtained using (1) with $Conflict\ Exposure_{it}$ proxied by $Number\ Conflict\ Events_{10km,it}$. Column 1 reports the results for the baseline specification - i.e., including only firm

[11] In our analysis, we also employ other measures of conflict exposure computed: (1) using different buffer distances from the firm's location; (2) using the number of conflict-related fatalities; (3) differentiating conflict events by type of perpetrators; (4) using a different data source for conflict events, namely the ICEWS dataset (see Section 5.2) .

and year fixed effects. An increase in the intensity of conflict exposure - as proxied by the number of conflict events that occurred in the 10 km radius of the firm's location during the corresponding year - has a highly significant negative effect on revenues. Column 2 shows that the results are unchanged when standard errors account for spatial autocorrelation *à la* Conley (1999).[12] The negative effect of conflict exposure on firms' revenues is also robust to the use of sampling weights (column 3).[13] Finally, in column 4, we include as additional controls a set of time-variant firm-level characteristics - namely, number of workers, value of fixed assets, and a dummy taking value one if the firm has any international trade activity (i.e., imports or exports). Despite the possibility that these may be *bad controls* and the reduced number of observations due to missing values, results indicate that the effect of conflict exposure on revenues is only slightly reduced with respect to our baseline specification and it remains statistically significant at 1%.[14]

Based on our preferred specification (column 3), the magnitude of the negative effect of conflict exposure on revenues is substantial: 10 more conflict events in the 10 km radius of the firm during the year reduces revenues by 1.4%.[15] This translates into a loss of US$850 with respect to the median sample revenue implying that each event costs the firm US$85.

5.1.1 Validating the empirical strategy

The firm-level fixed effects in regression model (1) account for all time-invariant firm, sector, and geographical characteristics. Our results are also robust to the addition of sector-year and region-year fixed effects controlling for all the time-varying sector and region characteristics (see Table A.7). Yet, our estimates may still be biased by some factor correlated with the number of conflict events and the firm's economic performance that varies across time at the subregion level. Two such factors discussed in previous studies are the trade-induced increase in unemployment (Dix-Carneiro et

[12] Using the geolocalization information, we estimate the distance between pairs of firms and derive the covariance matrix as a weighted average of spatial autocovariances. Weights start at 1 and decline linearly to 0 when the cutoff is reached. Reported results are obtained setting the distance cutoff at 10 km. Results (available upon requests) are robust to 50 and 100 km cutoffs.

[13] Weights are based on the most recent available figures on the private sector - namely, the 2006 Official Libyan Census. We compute the weight for firms in a (sector-region) cell as the ratio between the number of workers as reported in the Census and the number obtained using the firm-level data in our survey.

[14] It is unlikely that these estimates are biased by the presence of a propagation effect of conflict operating through the firm's network linkages (see, for instance, Korovkin and Makarin, 2021). Differently from firms in other conflict-affected settings, Libyan firms have very weak domestic forward and backward linkages (World Bank, 2020).

[15] A one standard deviation increase in the number of conflict events (152 events) leads to a 21% reduction in revenues.

al., 2018; Dell et al., 2019) and the presence of foreign workers (Klapper et al., 2013). These are unlikely to play a role in the context of Libya, as there had not been any major trade liberalization episode or change in trade flows before the conflict (World Bank, 2020) and the inception and the evolution of the conflict are not related in any way to the local number of foreign workers (Zway, 2017). We also exclude that our results are driven by local-level population dynamics: because data on population in Libya do not exist since 2011, we test for this by showing that our results are robust to the exclusion of the main cities (see Table A.14). More formally, to check for selection on unobservables, we perform the test proposed by Altonji et al., (2005) and further refined by Oster (2019). The test computes the share of variation that unobservables need to explain (relative to included control variables) in order to reduce the effect of interest to zero. A treatment effect is robust to selection on unobservables if this share, denoted by δ, does not change sign at $\delta = 1$. In Table A.8, we show that our main estimates (Table 2, column 3) do not change as we move from $\delta = 0.1$ to $\delta = 1$ (column 2-7). Table A.8 column 8 reports a value of (-3.36), indicating that unobservables need to be at least three times as important as the observables to make the effect null, which seems unlikely given the large number of fixed effects included in our regression.

Another potential threat to our identification strategy might arise if the control of oil fields is the driver of the location and intensity of conflict events.[16] In this case, firms located close to oil production sites would be exposed to more conflict events and thus more negatively affected by the conflict. This is unlikely to be the case in Libya. Firms in our sample are located far away from oil fields (see Figure A.5): average distance between firms and oil fields is 594 km, with a minimum of 93 km. In general, conflict events occurring close to an oil field or related to oil production are very few. As shown in Figure A.6, conflict events are relatively distant from any of the 18 oil fields in Libya. Moreover, during the period 2013-2017, only 186 events in the ACLED dataset report "oil" in the event description (3% of the events). Lastly, the yearly number of conflict events is negatively correlated with the level and value of oil production (0.80 and 0.65, respectively), while it is not correlated with oil price (-0.13, not significant).[17]

[16] Libya's economy is closely linked to oil production and, although control over the Libyan territory has changed repeatedly, all various fighting factions have refrained from damaging oil installations (United Nation Security Council, 2017). Authority over oil terminals has remained with the National Oil Corporation (NOC), which stayed neutral during the whole conflict period. The NOC is the only authorized enterprise to sell Libya's oil. The internationally agreed monopoly of NOC as supplier of Libyan oil has contributed to preventing oil fields from becoming the main targets of the fighting (Pack, 2019).

[17] These results are consistent with the interpretation of the Libyan conflict as being primarily a fight between various actors for the control of the government (see Section 2). In line with this view, OIES

The negative relationship between revenues and exposure to conflict-related events may be due to low performing firms being targeted because they are not able to pay for protection. There is no evidence suggesting that this is the case in Libya. In fact, unlike in other violence-ridden contexts, extortion or kidnapping is rare in the Libyan conflict (Zway, 2017).[18] In general, firms in our sample are unlikely to be the main target of conflict-related events. These are mostly small family-owned firms serving the domestic market, none of which is in the oil sector or has a government participation.[19] To provide additional evidence excluding the possibility of reverse causality, we test whether the economic performance of the firm determines the level of conflict intensity in its neighborhood. To this end, we regress the number of conflict events in the 10 km radius of the firm on the lagged value of firm revenues, controlling for firm, and region- and sector-year fixed effects. Table A.9 shows that past firm revenues do not predict the level of firm's exposure to conflict.

The validity of our identification strategy relies on the parallel trend assumption. We perform different exercises to provide support to this assumption. Preliminarily, we show that areas more affected by the conflict are not those more economic depressed in the past. We being by noting that there is a high degree of heterogeneity in conflict intensity in the Libyan regions during the period of analysis, as the East, West, Middle and South regions have 2654, 1590, 720, and 459 conflict events, respectively. To compute a proxy for the level of economic activity before the conflict, we use the only existing information - the World Bank Investment Climate Assessment (ICA) survey conducted in 2008 (World Bank, 2011). Table A.10 shows that before the conflict the level of private sector economic activity (proxied by firms' revenues) is not statistically different across regions. As an additional exercise, we show that economic trends before the Second Libyan Civil War are not different between areas exposed to a large number of conflict events and those that are not. Due to the lack of data, in this case we proxy economic activity using nightlights. Results are reported in Figure A.7. Overall, these findings - even if seriously limited by data availability - provide suggestive evidence excluding that the level and the trend of past economic activity are correlated with conflict intensity, which would violate the parallel trend assumption.

(2019) explains the reduction in oil production as a *consequence* of the conflict. This is also consistent with recent studies (Berman et al., 2021; Crost and Felter, 2020) documenting that the relationship between the (value of) natural resource and conflict depends on the characteristics of both the resource and the conflict.

[18]For Libya during the period of analysis, the ACLED dataset cites kidnapping 276 times, private violence 19, and extortion only once (on more than 5,000 events).

[19]In general, firms in resource sectors (e.g., oil, mining, or forestry) are more likely to be targeted for extortion and to generate conflict events (Berman et al., 2017; Sonno, 2020).

As an additional check, we re-estimate our baseline regression directly controlling for pre-trends in conflict intensity. To this end, we include year dummies interacted with the number of conflict events that occurred in the 10 km radius from the location of the firm in 2013.[20] Table A.14 column 7 shows that the effect of conflict exposure on revenues remains highly significant.

Finally, we check whether revenues are not already decreasing before the firm is exposed to any conflict event. In Figure A.8, the solid line plots an event-study graph for the 13 firms that are not exposed to conflict events in 2013 (the beginning of our period of analysis) and are exposed from 2014 onward. The (log of) average revenues for these firms do not change between 2013 and 2014 - when they are not exposed to conflict events - while they start declining when firms experience the first conflict event. As a comparison, the dashed line plots the (log of) average revenues for all other firms - those exposed to conflict events in 2013. Reassuringly, the graph also shows that firms exposed to more conflict events do not have lower revenues at the beginning of the period.

Robustness checks Our results are robust to various checks. Table A.7 shows the results when we add to our empirical model (1) sector-year (column 1) and region-year (column 2) fixed effects to account for all time-varying location-specific determinants of firm performance and differential time trends across sectors. The magnitude of the effect slightly increases, remaining significant at least at 10%, also when we include these fixed effects altogether (column 3). Finally, we include sector-region-year fixed effects to rule out all the confounding factors except those that are time-varying at a level of disaggregation finer than region-sector-year. Results in column 4 confirm that also for this most demanding specification higher conflict exposure reduces firm revenues.

Next, we run our baseline regression including conflict exposure lags and leads (Table A.11). Column 1 reports our preferred specification (column 3 of Table 2). Column 2 shows that our findings hold when including a lagged measure of conflict exposure. Column 3 shows that the effect of the number of conflict events that occurred in the following year is not statistically significant, while our main conflict variable does not change both in magnitude and significance with respect to our main result.

We further check that our results are robust to different spatial buffers used to compute the measure of conflict exposure. Table A.12 shows that conflict exposure

[20] Libya is under conflict since 2011 thus it is not possible to select a pre-conflict period. For this test, we use 2013 because it is the year before the beginning of the Second Libyan Civil War and it is also the one with lowest number of conflict events since 2011.

reduces revenues when we also consider the number of conflict events that occurred in a 50 km and 100 km radius from the firm's location (columns 2 and 3). Yet, as expected, the effect decreases with the size of the buffer (see column 1, our baseline). In any case, conflict events occurring in the 10 km radius from the firm's location are the most relevant ones (column 4).

Our results are also robust to the use of a different source for conflict events, i.e., the ICEWS dataset (see Section 3.2). Table A.13 replicates Table 2 with the only difference being that $Number\ Conflict\ Events_{10km,it}$ is now the number of conflict events that occurred in the 10 km radius from the firm's location as recorded in the ICEWS dataset. The effect of conflict exposure on revenues is negative and significant for all specifications.

Finally, Table A.14 reports a set of additional robustness checks. Our results do not change when we exclude outliers (99 pc) in the dependent variable (column 1); we restrict the analysis to the period post-2013 (i.e., after the beginning of the Second Libyan Civil War) (column 2); we exclude the two largest cities (Tripoli and Benghazi, column 3). Our results are also robust to: a measure of conflict exposure built excluding the events reported by foreign sources (see the discussion in Section 3.2) (column 4); the use of a balanced panel of firms - that is, those that report data for all five years (column 5); restricting the sample to firms that do not change location over the period of analysis (column 6). Finally, we estimate our regression including pre-trends in the level of conflict intensity before the beginning of the Second Civil War by interacting the year dummies with the number of violent events in the neighborhood of the firm in 2013 (column 7). Also in this case, the effect of conflict exposure on revenues remains statistically significant and the magnitude increases with respect to that of the baseline specification.

5.2 Additional results

Alternative economic performance measures Table A.15 shows the estimates for (1) using as dependent variable other measures of the firm's economic performance. Column 1 reports the effect of conflict exposure on labor productivity, defined as revenues over employment. The effect is negative and highly significant. Column 2 shows the effect of conflict exposure on profits, defined as revenues minus the sum of labor and intermediate inputs costs.[21] Also in this case the estimated coefficient is negative, albeit not significant.[22] Although using these alternative measures of performance greatly reduces the number of observations because of missing values, results

[21] Following MacKinnon and Magee (1990), we use an inverse hyperbolic sine transformation.
[22] Results are statistically significant when using a quadratic specification (see section 5.3).

are in line with the main finding of our analysis: higher conflict exposure worsens the performance of the firm.

Types of conflict events Table A.16 reports the results for different methodologies and datasets to build our proxy for conflict exposure. Columns 1 and 2 show the standardized effects of the number of conflict events and of the number of fatalities that occurred in the 10 km radius from the firm's location, as recorded in the ACLED dataset in the corresponding year, respectively. The latter effect is larger, suggesting that the higher the violence of the events that occurred in the neighborhood of the firm the more negative is the effect on revenues. Similar results are obtained when we use the ICEWS dataset to compute the same two proxies for conflict intensity (see columns 3 and 4).

We also explore the possible differential effect of conflict events by the identity of the perpetrator. Table A.17 shows that - with respect to conflict events - events caused by the terrorist group ISIS have a (slightly) larger negative effect (column 1), violent events against civilians have a smaller effect (column 2), while events caused by civil protesters do not have a statistically significant effect on revenues (column 3). These results indicate that an increase in violence *per-se* does not necessarily reduce the firm's economic performance, which instead is negatively affected by conflict-related events.

Finally, we analyze whether conflict events that occurred at different points in time during the year have a differential impact on revenues. In our case, conflict events are evenly distributed within a year, as each quarter accounts for about 25% of the yearly number of events. Results in Figure A.9 show that conflict events occurring in the first two quarters of the year tend to have a more negative impact on revenues.

Heterogeneity In Table A.18 we test whether our main result is heterogeneous across firm's characteristics. The effect of conflict on revenues is negative for firms operating in any sector, but for construction (column 1), and it is relatively larger for medium and large firms (column 2). The effect of conflict on revenues is smaller for family firms, though the difference with non-family firms is not statistically significant (column 3). We also explore the possible heterogeneous effect of conflict on firms' revenues according to the main type of buyers (column 4). Results show that there is no statistically difference in the effect of conflict between firms selling to consumers, to other firms, or the government. This finding rules out the possibility that firms with political connections might be more shielded from the economic consequences of conflict. Finally, column 5 indicates that the negative effect of conflict does not

vary with the firm's productivity level, suggesting that high productivity *per-se* does not shelter firms from the negative consequences of this type of negative shocks.[23]

5.3 Nonlinearities

Qualitative evidence from our survey suggests that conflict creates new economic opportunities for some firms which mitigate the adverse effect on revenues. To account for this possible positive effect of conflict on surviving firms, we consider alternative specifications for eq. (1) in which the effect of conflict exposure on revenues is non-linear. Results are reported in Table 3. Column 1 indicates that the negative effect of conflict is smaller for firms exposed to a number of conflict events above the median. Column 2 shows that the effects are less negative for firms exposed to a number of events in the top quartile of the number of conflict events distribution. Column 3 reports the estimates for a quadratic specification. Results are consistent with a convex relationship between revenues and conflict exposure, as the linear term is negative and the quadratic term is positive, both statistically significant.[24] A convex relationship between conflict exposure and revenues in confirmed by Figure 2, which employs a semiparametric specification to account in a more flexible way for the nonlinear relationship between the two variables.[25] The function reaches a minimum at 520 events, indicating that for a higher number of conflict events the relationship becomes non-negative. The convex relationship between conflict intensity and the firm's economic performance is also confirmed when the latter is proxied by labor productivity and profits. For both outcomes, we detect a convex relationship with conflict intensity, as the linear term is negative and the quadratic term is positive, both statistically significant (see Table 4).

[23] Since there are some violent events also in 2013 - before the beginning of the Second Civil War - we cannot compute a pre-conflict (baseline) productivity level that can be used to split the sample. For this reason, based on the observation that firms have been exposed to violent events in all years, we identify low *vs* high productivity firms using the overall distribution of firms' productivity during the entire period of analysis.

[24] The quadratic specification, however, cannot be considered the benchmark model for revenues because, while results hold to the exclusion of outliers, they are not robust to other checks, such as, the use of the balanced panel sample and the inclusion of region-year fixed effects.

[25] We employ a fixed-effects semi-parametric estimator which simultaneously allows for linear and non-linear effects of the explanatory variables, following the methodology in Baltagi and Li (2002). We use a B-spline regression model of order k = 4 and 4 knots based on the quartiles of the distribution of conflict events, using the procedure by Libois and Verardi (2013). The partial fit graph shows the functional form of the nonlinear part. The points are partial residuals for the variable *Revenues*, which is re-centered around its mean. Figure A.10 shows the results excluding outliers, trimming 5% of observations at both ends of the distribution.

6 Mechanisms

In this section, we discuss how the *production inputs mechanism* and the *market competition mechanism* can account for the nonlinearity in the effect of conflict exposure on the firm's economic performance.

6.1 Production inputs

The availability and usage of production inputs are often severely affected during a conflict. For instance, buildings, equipment, and machinery might be stolen or damaged; employees may be absent at work because are unable to reach the firm (being injured or killed) or have migrated to escape violence; intermediate inputs may become unavailable or extremely expensive to the firm (Amodio and Di Maio, 2018; Rozo, 2018; Utar, 2020; Ksoll et al., 2021).

Table 5 reports the estimated effects of conflict exposure on production inputs usage. Column 1 shows that higher conflict exposure reduces the total value of intermediate inputs used by the firm. At the same time, conflict reduces the firm's total labor cost [26] Instead, column 3 shows that the value of fixed assets is not affected by the number of conflict events to which the firm is exposed.

6.1.1 Intermediate inputs

Table 6 shows the effect of conflict exposure on the firm's use of intermediate inputs. Higher conflict exposure brings about a disruption in supplies (column 1), it reduces the number of intermediate inputs suppliers of the firm (column 2), but it does not change the firm's *per-supplier* expenditure (column 3). Taken together, these results suggest that conflict affects intermediate inputs usage through the extensive margin - i.e., it reduces the number of intermediate inputs the firm has access to.

The large majority of intermediate inputs used by Libyan firms are imported (World Bank, 2020).[27] Data limitations do not allow us to directly test the effect of conflict on the different (domestic vs. imported) source of intermediate inputs because input

[26] The finding that firms more exposed to conflict have lower input costs resonates with that of Rozo (2018), who documents that input-output linkages cause Colombian firms to face lower input prices when violence is high. Yet, in the Libyan context, the reduction in inputs expenditure is due to a quantity rather than to a price adjustment (see sections 6.1.1 and 6.1.2).

[27] Considering the total cost of intermediate inputs and raw materials (including oil and energy) in 2017, the firm-level median share of imported inputs costs is 60%. This share is larger for firms in the trade sector (86%) and for medium-large firms (65%). Moreover, our data show that only 10% of domestic firms sell to other firms (possibly as a supplier of intermediate inputs), while 90% sell to consumers. Finally, according to WITS data in 2010 (the latest year for which data exist) 15% of Libyan imports were consumer goods and about 85% raw materials and intermediate goods.

costs by origin are available only for 2017 and for few firms. However, details on the firms' overall import activity are available for all years. The correlation between the value of import and that of imported intermediate inputs in 2017 is .54 for the full sample, reaching .95 for manufacturing and .89 for medium-large firms. Based on this, we look at the effect of conflict exposure on import activity to gain insights on how conflict affects the access to imported intermediate inputs.[28]

Table 7 column 1 shows that conflict exposure reduces the firm's import activity. This effect is heterogeneous along various dimensions, the first being the location of the international supplier. The negative effect on import value is statistically significant only for firms whose main supplier is located in Europe or in the Middle East, while it is not for firms whose main supplier is located in the US or in Asia (column 2). One possible explanation for this result is that the geographical distance of the foreign supplier is correlated with both its size and the type of exported product (Chaney, 2018). In our sample, US and Asian suppliers tend to be larger firms with production of higher value products than those located in Europe or in the Middle East.[29] This evidence is thus consistent with the fact that the risks and costs associated with the exporting activities to Libya are more binding for smaller and lower value-added suppliers. Second, the differential effect of conflict on importing activity depends on the intensity of the firm's relationships with its suppliers. We proxy the latter with firm age under the assumption that older firms are likely to have engaged in more transactions with foreign suppliers and thus have had more time to create stable connections. If the uncertainty related to the conflict affects the terms of the contract between Libyan firms and their foreign suppliers, we expect these changes to affect older firms disproportionately less. Results reported in column 3 show that this is indeed the case: the negative effect of conflict exposure on import activity is significant only for young firms. Another element that influences the effect of conflict on imports is the access to international ports. We split firms according to which government (Al Sarraj or Haftar) controls the region the firm is located into (see Section 2). Column 4 shows that the negative effect of conflict on import is significant only for firms that at the time of the survey are located in the area under the control of the government

[28] Around 40% of firms operate in the service sector. Yet, most of them are likely to be highly dependent on foreign inputs given that they are active in "Accurate medical analysis", "Maintenance of machinery and heavy equipment", "Printing and publishing", etc., all activities that require technological equipment rarely produced in Libya.

[29] We run an on-line search of foreign suppliers based on names to collect information on their characteristics. Suppliers based in Europe are mostly small-medium firms producing homogeneous goods such as doors, materials for contraction, etc. (examples are Bauxt Doors (Italy); Elotex (Switzerland)). On the contrary, among suppliers located in the US and Asia there are large companies selling high-tech components and machinery (examples are Dell (US); Cisco (US); Hyundai (Korea); XGMA Machinery (China).

led by Haftar, which has no international recognition. Finally, the negative effect of conflict on imports is larger for firms that have no access to credit (column 5): without a credit line it is more difficult for the firm to anticipate any payment for the import or to obtain a bank guarantee to insure the supplier that the firm has the resources to honor the contract.

Taken together, these results indicate that conflict reduces the availability of intermediate inputs (especially imported ones), thus decreasing the firm's potential output.[30] Imported intermediate inputs decreases because conflict increases the costs associated to the exporting activity to Libya, especially for small foreign suppliers and those producing low value-added goods. These results also suggest that in times of conflict the possibility to import is less affected if the firm has a good reputation and a stable relationship with the foreign supplier, and if the firm has access to credit. These findings speak to the importance and economic value of reliability and stability in trade relationships, which are related to the existence of relational contracts and of (at least minimally) functioning legal system (Ksoll et al., 2021; Macchiavello and Morjaria, 2015).

6.1.2 Labor

Table 8 shows the effect of conflict exposure on labor. Conflict does not affect the average labor cost (column 1) nor the average wage (column 2). Since conflict exposure reduces the total labor cost (see Table 5, column 2), these results imply that conflict affects the labor market through quantity (rather than price) adjustments. This is confirmed by the result in column 3: a higher conflict exposure reduces the number of employees.[31]

Given that the number of employees decreases but the wage does not change, this implies that conflict affects *both* the supply and the demand of labor. Conflict is expected to reduce the labor supply because violence operates as a local disamenity shock, which tends to increase the reservation wage (Ksoll et al., 2021). For any given level of labor demand, the reduction in labor supply results in a lower number of employees and a higher wage. This effect is expected to be larger for firms employing workers for whom the conflict-induced increase in the reservation wage is more binding. At the same time, an increase in conflict exposure is expected to re-

[30] Because imported intermediate inputs increases firm productivity (Topalova and Khandelwal, 2011), when their access is hindered, economic performance is reduced (Amodio and Di Maio, 2018; Boehm et al., 2019; Carvalho et al., 2021).

[31] While the negative effect of violence on employment is a common result in the literature (e.g., Ksoll et al. 2021), the effect on wages is ambiguous. For instance, Rozo (2018) documents a reduction in wages while Utar (2020) reports a null effect.

duce labor demand because firms have limited access to production inputs.[32] For any given level of labor supply, the conflict-induced reduction in labor demand results in a lower number of employees and a lower wage. This effect is expected to be larger for firms employing workers more complementary to inputs whose supply is negatively affected by conflict.

These conjectures suggest the effect of conflict is heterogeneous across workers. For instance, we expect higher conflict intensity to reduce the relative labor supply of foreign workers because they face a lower cost to quit their job and migrate to a safer place.[33] At the same time, conflict is expected to reduce the relative demand for foreign workers because of their higher complementarity with imported inputs (Santacreu-Vasut and Teshima, 2016).[34] The combination of these effects would result in conflict having a negative effect on relative employment while the effect on wage is ambiguous. In line with these predictions, Table 9 shows that higher conflict exposure reduces the share of foreign workers (column 1) and the average wage only for firms with a high intensity of foreign workforce (column 2).[35]

In sum, these results document the negative effect of conflict on labor. Specifically, while the average wage is not affected, conflict reduces the availability of workers, mainly the foreign ones, reducing the firm's potential output. We label the conflict-induced reduction in the availability of labor and of intermediate inputs as the *production inputs mechanism*.

6.2 Market competition

One novel finding of our analysis is the nonlinear relationship between conflict intensity and firm's economic performance (see Section 5.3). We document that the marginal negative effect of conflict exposure on revenues is smaller when conflict intensity is already high (see Table 3). Moreover, for very high levels of conflict intensity, we detect suggestive evidence that the relationship between conflict and the firm's economic performance becomes convex (see Table 4). This finding is consistent with qualitative evidence from our survey indicating that for some firms conflict opens up new business opportunities, often due to competitors exiting the market (World Bank,

[32] Labor demand would contract also if consumer demand decreases. In section 6.3, we provide suggestive evidence that this is not the case in the Libya context.

[33] During the conflict, an estimated 1 million foreign workers (80% of the total) fled Libya (World Bank, 2015a).

[34] Indirect supporting evidence of a complementarity between intermediate inputs and foreign workers is the positive and significant correlation between the within firm-year number of suppliers and the share of foreign workers. Results available upon request.

[35] We cannot use the firm-level relative wage as an outcome because the survey does not include separate information on wages for foreign and domestic workers.

2020).[36] One plausible explanation for this nonlinearity is that conflict reduces market competition by forcing some firms out of the market with the surviving ones taking advantage of that.[37]

To test this mechanism, we look at the relationship between conflict intensity, number of competitors, revenues, and marker share. We begin by showing that conflict reduces the number of competitors.[38] Table A.19 column 1 indicates that higher (cumulated) conflict exposure increases the number of competitors exiting the market. The conflict-induced reduction in the number of competitors is significant only for firms located in areas characterized by high levels of conflict intensity (column 2).

Next, we show that the negative effect of conflict on firm performance is mitigated by the conflict-induced exit of competitors. Table 10 columns 1 and 2 indicate that - for a given level of conflict exposure - the negative effect of conflict on revenues decreases with the number of competitors exiting the market. The positive effect of the (conflict-induced) change in the level of market competition on economic performance is confirmed when we look at the firm's market share, used as a proxy for market competition: the higher the number of competitors that exit the market, the more *positive* is the effect of conflict intensity on market shares (Table 10 columns 3 and 4).[39] Although the number of observations is limited, we interpret this as suggestive evidence of the existence of a *market competition mechanism*: the conflict-induced change in the level of market competition (due to the reduction in the number of competitors) has a positive impact on the economic performance of surviving firms.

Table 11 further corroborates these findings by showing that the relationship between conflict exposure and market share is convex (see column 2), with a minimum for 498 conflict events.[40] We check the robustness of this result using: (1) different

[36] When asked the reason for the new business opportunities that emerged during the conflict, common replies are: "many companies left the market so we took their place", "there is no competition", and "lack of competitors".

[37] Since our dataset is a retrospective panel, we cannot directly analyze entry and exit dynamics because firms in our sample are, by construction, only those that survived. Yet, during the period of analysis, we observe the entry of 6 firms (1.5% of the sample). All these firms started their business in places and times of low conflict intensity: (1) none of these firms is located in the Eastern region (the most conflict-affected area); (2) the (median) number of conflict events that occurred in the 10 km radius from their location is 44 vs.129 for the full sample; (3) in the year of entry, the number of events that occurred in the 10 km radius from the firm's location is lower (median 58) than in any of the previous years (median 70).

[38] Firms exit due to exposure to conflict and violence is documented in Klapper et al. (2013), Camacho and Rodriguez (2013), Rozo (2018) and Blumenstock et al. (2018).

[39] Information on market shares is self-reported. The question on market share and that on revenues are asked in different sections of the questionnaire.

[40] The test developed by Lind and Mehlum (2010) confirms the quadratic relationship between conflict intensity and market shares. The convex relationship is robust to the use of the balanced panel, different measures of conflict exposure, and the ICEWS data (see Table A.20). Higher order polynomials (e.g., cubic) are instead not statistically significant.

measures of conflict intensity; (2) two alternative measures of market competition. Table A.20 shows that our finding is confirmed when we consider higher buffer distances (columns 1 and 2) and a measure of conflict intensity based on ICEWS data (column 3). Table A.21 employs as outcomes a revenue-based market share measure - namely, the share of the firm's revenues in total sector-year revenues, and markups, measured as the ratio between profits and total costs: the convex relationship is again confirmed.

We investigate further the convex relationship between conflict exposure and market share in Table 12. Columns 1 and 2 indicate that the convex relationship holds for firms that are small and family owned. Column 3 shows that high productivity firms are not more likely to increase their market shares when conflict is more intense. We interpret these results as indicating that firms gaining market shares when conflict intensity is very high are those whose characteristics make them able to quickly adapt to an uncertain and unstable environment even if they are not necessarily the most efficient ones.

Summing up The evidence discussed in this section suggests that the *production inputs mechanism* and the *market competition mechanism* can account for the nonlinear effect of conflict on the firm's economic performance (documented in Section 5.3). Revenues tend to decrease with conflict intensity because conflict reduces the firm's output by making it more difficult to access intermediate (imported) inputs and by reducing the number of (foreign) workers (see Section 6.1). At the same time, for high levels of conflict intensity, revenues tend to increase with conflict exposure because of the conflict-induced reduction in the number of competitors (see section 6.2). The stronger the market competition effect, the less severe will be the effect of conflict on revenues for surviving firms. Yet, the market competition effect kicks in only for very high levels of conflict intensity.[41] Moreover, we document that the positive effect of the market competition mechanism materializes only for firms that are able to adapt to the conflict environment, which are not necessarily the high productivity ones. This is implies that, at the aggregate level, the market competition mechanism cannot be expected to be productivity-enhancing.

Appendix A.4 presents a stylized conceptual framework - whose assumptions are based on the characteristics of the Libyan economy and on our empirical results - that

[41] Consistently with our argument, the level of conflict intensity beyond which the market share increases with conflict (498 events) is lower than the one for which the relationship between conflict and revenues becomes convex (520 events, see section 5.3). This is because an increase in the market share does not necessarily imply an increase in revenues unless its effect outweighs the negative effect of the production inputs mechanism.

rationalizes the nonlinear effect of conflict exposure on the firm's economic performance as the result of the working of the production inputs mechanism and of the market competition mechanism.

6.3 Other possible mechanisms

Demand Conflict may decrease revenues by reducing demand. While we cannot directly test this mechanism at the firm level, we look at the effect of conflict on consumer prices to gauge some sense of its possible effect on demand. Given the reduction in the supply we document in Section 6, if the main driver of our results is a reduction in demand, consumer prices necessarily have to decrease with conflict intensity. To test for this, we use detailed monthly price data for 32 food and nonfood items collected in 491 markets in 29 cities in Libya during the period June 2017-June 2018. These markets are representative of the general price level in the respective location (REACH, 2018). We regress the monthly city-level price index on conflict intensity at the city level, controlling for city and year fixed effects. Results are reported in Table A.22. In cities experiencing higher conflict intensity, consumer goods prices are higher (see column 1). This holds true both for food items (column 2) and nonfood items (column 3), therefore likely excluding composition effects. The positive association between conflict intensity and prices is robust to the use of city-year fixed effects (column 4), the removal of outliers (column 5), and the exclusion of the two largest cities (Tripoli and Benghazi) (column 6). Additional evidence is provided by the results in Table A.18 column 4, which shows that there is no statistically difference in the impact of conflict on revenues between firms selling to consumers, to other firms, or to the government. While data limitations do not allow us to entirely exclude a role for demand, taken together this evidence does not seem to support this mechanism as being the main driver explaining our results.

Oil production As discussed in Section 5.1.1, conflict negatively affects domestic oil production. It is thus possible that the reduction in revenues is due to a conflict-induced change in oil price and its availability as a production input. However, this seems not to be the case. In our data, the firm's expenditure for oil/gasoline represents only 5% of total median annual cost for raw materials and intermediate goods. Moreover, when we regress the firm-level value of oil used in production or its share in total input costs on conflict exposure, the effect is not significantly different from zero (see Table A.23). Another possibility is that the conflict-induced reduction in the oil sector activity may, through a demand channel, negatively impact domestic firms that are the suppliers of oil companies. While we do not have data on domestic transactions,

we argue that this effect is unlikely to have a significant impact on our sample, based on the observation that oil companies (both the NOC and the foreign ones) have no linkages with domestic firms (OIES, 2019).

Corruption and illegal activities Finally, we look at the possible role of the conflict-induced increase in corruption and illegal activities targeting firms. Corruption is seen as a severe constraint to operations by 29% of the firms in our sample. Yet, the extent to which corruption is considered an obstacle (in the current year and over the whole sample period) is not correlated with the level of conflict exposure (see Table A.24). There is also anecdotal evidence that conflict itself increases illegal activities. In particular, armed groups use illegal checkpoints to force some firms to pay to ensure security for goods delivery, increasing transportation costs. We test for the role of the conflict-related illegal activities in explaining our results in Table A.25. Column 1 shows that firms located in more conflict-affected areas are more likely to face a request for illicit payment by armed groups. Yet, the request for illegal payment is not correlated with the firm's revenues (column 2). Controlling for illegal payment request, the effect of conflict exposure on revenues remains negative and highly significant (column 3). We interpret these results as indicating that the conflict-induced increase in the probability of receiving an illicit payment request is unlikely to explain the negative effect of conflict exposure on revenues.

7 Conclusions

This paper combines unique data from an original firm-level survey with geolocalised data on conflict events to analyze the effect of the Second Civil War on private firms in Libya during the period 2013-2017.

Higher conflict exposure reduces firms' economic performance. Specifically, an increase in the number of conflict events that occurred in the 10 km radius of the firm's location during the previous 12 months has a highly significant negative effect on revenues. However, this negative effect is nonlinear as it decreases with the level of conflict intensity. We provide suggestive evidence that, for very high levels of conflict intensity, the relationship between conflict and firms' economic performance becomes convex. This result is consistent with two opposite mechanisms being at work. On the one hand, revenues tend to decrease because of the conflict-induced reduction in the availability of production inputs. Firms exposed to higher conflict intensity use fewer workers and intermediate inputs, resulting in a negative effect on the firm's output level. On the other, the conflict changes the level of market competition faced

by firms. The conflict-induced reduction in the number of competitors increases the market share for surviving firms, thus mitigating the negative effect of conflict on revenues. Taken together, these mechanisms account for the nonlinear (convex) effect of conflict exposure on firms' economic performance.

Our results have policy implications for the specific case of Libya and in general for firms in conflict-affected settings. We argue that policy measures aiming at mitigating the adverse effects of conflict on firms' performance in Libya should increase security for the workers and reduce the risks for the foreign suppliers of Libyan firms. More in general, our analysis provides support to the idea that policies targeting firms in conflict-affected settings need to be tailored to the specific context. For instance, we find that conflict hits harder those firms that are often the best performers in times of peace, as indicated by the result that the negative effect of conflict increases with the size of the firm. We also document that the firm's performance in a conflict context is not necessarily reflective of its economic efficiency, as we show that the conflict may not select the most productive firms. In this sense, our findings indicate that development strategies in conflict and post-conflict settings should not necessarily mimic those adopted in countries not affected by conflict. We interpret our results as providing a cautionary tale on policy interventions targeting firms in conflict and post-conflict settings. The mechanisms through which conflict affects the firm's economic activity depend on the characteristics of the conflict, of the economy, and of the specific firm. To be effective, policy interventions need to be designed taking into account all these dimensions.

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Tables

Table 1: Summary statistics

	Obs	Mean	Median	SD	Min	Max
A Firm-level:						
Log of revenues	952	11.73	11.51	1.77	6.21	18.06
Log of labor productivity	949	9.80	9.62	1.42	3.73	14.57
Log of employment	1,784	2.19	1.95	1.11	0.00	6.62
Log of fixed assets	1,307	11.49	11.35	2.03	5.01	18.83
Log of labor cost	1,164	10.55	10.49	1.45	6.55	15.20
Log of average labor cost	1,156	8.62	8.85	0.99	3.87	11.23
Log of wages	1412	8.84	8.79	0.65	7.09	10.87
Disruption of supplies (yes/no)	930	0.28	0.00	0.45	0.00	1.00
Log of number of suppliers	752	1.39	1.39	0.88	0.00	4.11
Log of intermediate cost	530	10.38	10.22	1.90	6.91	16.65
Log of *per-supplier* intermediate cost	209	9.46	9.39	1.65	5.01	13.12
Log of import	334	11.96	11.70	1.89	5.01	17.22
Credit (yes/no)	1,866	0.02	0.00	0.15	0.00	1.00
Market share (%)	917	26.87	20.00	25.71	0.00	100.00
Market share (revenue-based, %)	952	2.10	0.25	8.47	0.00	88.78
Log of number of exiting competitors	355	1.65	1.39	1.11	0.00	3.91
IHS of profits	434	0.94	8.29	11.47	-16.20	18.34
IHS of markups	434	0.20	0.06	0.85	-0.88	4.31
B Conflict:						
Number Conflict Events$_{10\ km}$ [ACLED]	1915	146.1	129.0	151.6	0	644
Number Conflict Events$_{50\ km}$ [ACLED]	1915	203.5	185.0	175.8	0	737
Number Conflict Events$_{100\ km}$ [ACLED]	1915	231.2	229.0	183.7	0	746
Number Fatalities$_{10\ km}$ [ACLED]	1915	248.9	85.0	368.6	0	1419
Number Fatalities$_{50\ km}$ [ACLED]	1915	387.9	193.0	456.9	0	1650
Number Fatalities$_{100\ km}$ [ACLED]	1915	456.8	295.0	467.4	0	1656
Number Conflict Events$_{10\ km}$ [ICEWS]	1915	279.5	161.0	316.5	0	932
Number Conflict Events$_{50\ km}$ [ICEWS]	1915	335.6	220.0	326.5	0	939
Number Conflict Events$_{100\ km}$ [ICEWS]	1915	348.7	240.0	330.7	0	972
Number High Intensity Conflict Events$_{10\ km}$ [ICEWS]	1915	107.6	57.0	124.4	0	414
Number High Intensity Conflict Events$_{50\ km}$ [ICEWS]	1915	126.4	59.0	126.6	0	414
Number High Intensity Conflict Events$_{100\ km}$ [ICEWS]	1915	134.2	65.0	128.6	0	415

Notes: IHS stands for inverse hyperbolic sine transformation. Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED; ICEWS.

Table 2: Conflict exposure and firm revenues

	Revenues			
	(1)	(2)	(3)	(4)
$Number\ Conflict\ Events_{10km}$	-0.015***	-0.015***	-0.014***	-0.011***
	(0.003)	(0.004)	(0.004)	(0.004)
Firm-level characteristics				Y
Firm FEs	Y	Y	Y	Y
Year FEs	Y	Y	Y	Y
Observations	952	952	952	841
Number of firms	241	241	241	218
Mean dependent variable	11.73	11.50	11.50	11.37
R-squared	0.935	0.935	0.938	0.941

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. Column (1) and (2) report regression results for unweighted observations. Column (3) and (4) report regression results using sampling weights. Robust standard errors in parenthesis clustered at the firm level in column (1), (3), and (4). Conley standard errors in parenthesis in column (2) are computed at the 10 km cutoff. *Firm-level characteristics* in column (4) are: number of employees, value of fixed assets, a dummy taking value 1 if the firm is an international trader (exporter or importer) in that year and 0 otherwise. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table 3: Conflict exposure and firm revenues: Non-linearity

	Revenues		
	(1)	(2)	(3)
$Number\ Conflict\ Events_{10km}$ [Median]			
Below	-0.102***		
	(0.028)		
Above	-0.016***		
	(0.004)		
$Number\ Conflict\ Events_{10km}$ [Quartile]			
I		-0.285**	
		(0.131)	
II		-0.167***	
		(0.038)	
III		-0.055	
		(0.037)	
IV		-0.014***	
		(0.004)	
$Number\ Conflict\ Events_{10km}$			-0.071***
			(0.018)
$(Number\ Conflict\ Events_{10km})^2$			0.001***
			(0.000)
Firm FEs	Y	Y	Y
Year FEs	Y	Y	Y
Observations	952	952	952
Number of firms	241	241	241
Mean dependent variable	11.50	11.50	11.50
R-squared	0.939	0.943	0.940

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. Indicator variables for median and quartile bins are included but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. *Median* and *Quartiles* are based on the entire distribution of conflict events. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table 4: Conflict exposure and alternative performance measures: Non linearity

	Labor productivity (1)	Profits (2)
Number Conflict Events$_{10\ km}$	-0.062***	-0.643*
	(0.017)	(0.373)
$(Number\ Conflict\ Events_{10km})^2$	0.001***	0.007*
	(0.000)	(0.004)
Firm FEs	Y	Y
Year FEs	Y	Y
Observations	949	434
Number of firms	241	121
Mean dependent variable	9.80	-0.635
R-squared	0.923	0.737

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. $Labor\ productivity = Revenues/Number\ of\ employees$. $Profits = Revenues - (Total\ wage\ bill + Intermediate\ costs)$ are computed using an inverse hyperbolic sine transformation. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table 5: Conflict exposure and production inputs

	Intermediate inputs cost (1)	Labor cost (2)	Fixed assets value (3)
$Number\ Conflict\ Events_{10km}$	-0.010**	-0.003**	0.001
	(0.005)	(0.001)	(0.001)
Firm FEs	Y	Y	Y
Year FEs	Y	Y	Y
Observations	530	1,164	1,307
Number of firms	149	277	285
Mean dependent variable	10.22	10.25	11.10
R-squared	0.949	0.966	0.984

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table 6: Conflict exposure and intermediate inputs

	Disruption of supplies (1)	Number of suppliers (2)	*Per-supplier* expenditure (3)
$Number\ Conflict\ Events_{10km}$	0.016***	-0.014***	0.001
	(0.002)	(0.004)	(0.010)
Firm FEs	Y	Y	Y
Year FEs	Y	Y	Y
Observations	930	752	209
Number of firms	186	197	68
Mean dependent variable	0.285	1.323	9.500
R-squared	0.340	0.740	0.950

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. Dependent variables (2) and (3) are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. *Disruption of supplies* is a dummy taking value 1 if the firm has experienced any disruptions in supplies due to conflict. *Per-supplier expenditure* is defined as *Intermediate inputs cost/Number of suppliers*. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table 7: Conflict exposure and import

	Import value				
	(1)	(2)	(3)	(4)	(5)
$Number\ Conflict\ Events_{10km}$	-0.010***				
	(0.004)				
$Number\ Conflict\ Events_{10km}$*Location main supplier*					
Asia		0.039			
		(0.112)			
EU		-0.169**			
		(0.062)			
MENA		-0.127**			
		(0.049)			
US		0.092			
		(0.317)			
$Number\ Conflict\ Events_{10km}$*Firm's age*					
Young			-0.011***		
			(0.004)		
Old			-0.008		
			(0.005)		
$Number\ Conflict\ Events_{10km}$*Government in control*					
Al-Sarraj				-0.054	
				(0.037)	
Haftar				-0.011***	
				(0.004)	
$Number\ Conflict\ Events_{10km}$*Credit*					
No access					-0.009**
					(0.004)
Access					0.000
					(0.037)
Credit					0.084
					(0.504)
Firm FEs	Y	Y	Y	Y	Y
Year FEs	Y	Y	Y	Y	Y
Observations	334	73	334	334	334
Number of firms	99	20	99	99	99
Mean dependent variable	11.71	12.24	11.71	11.71	11.71
R-squared	0.931	0.951	0.931	0.932	0.932

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. *Firm age* is a dummy equal to 1 if the firm's age is higher than the median (10 years), and 0 otherwise. *Credit* is a dummy equal to 1 if the firm has any credit line in that year, and 0 otherwise. *Location of main supplier* is a dummy available only for 2017. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table 8: Conflict exposure and labor

	Average labor cost (1)	Average wage (2)	Number of employees (3)
$Number\ Conflict\ Events_{10km}$	-0.000	-0.001	-0.008***
	(0.001)	(0.000)	(0.002)
Firm FEs	Y	Y	Y
Year FEs	Y	Y	Y
Observations	1,156	1,412	1,784
Number of firms	277	322	377
Mean dependent variable	10.25	8.755	2.005
R-squared	0.951	0.931	0.894

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. *Average Labor cost* is defined as *Labor cost/Number of employees*. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table 9: Conflict exposure, foreign workers, and wages

	Share of foreign workers	Average wage
	(1)	(2)
$Number\ Conflict\ Events_{10km}$	-0.001**	
	(0.000)	
$Number\ Conflict\ Events_{10km}$*Share of foreign workers*		
Low share		0.001
		(0.001)
High share		-0.003*
		(0.002)
Share of foreign workers		-0.004*
		(0.002)
Firm FEs	Y	Y
Year FEs	Y	Y
Observations	1,654	1,364
Number of firms	369	315
Mean dependent variable	0.175	8.744
R-squared	0.942	0.932

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. High (low) *Share of foreign workers* is defined according to the median value of the share of foreign workers and it is measured over the whole sample period. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table 10: Conflict exposure, number of competitors, revenues, and market share

	Revenues		Market Share	
	(1)	(2)	(3)	(4)
$Number\ Conflict\ Events_{10km}$	-0.131***	-0.123***	-0.586	-0.298
	(0.034)	(0.035)	(0.387)	(0.369)
$Number\ Conflict\ Events_{10km}$				
*Number competitors exited the market	0.039*		0.778**	
	(0.019)		(0.309)	
$Number\ Conflict\ Events_{10km}$				
*Large reduction number competitors (dummy)		0.077**		1.193*
		(0.618)		(0.035)
Year FEs	Y	Y	Y	Y
Firm FEs	Y	Y	Y	Y
Observations	143	143	109	109
Number of firms	36	36	28	28
Mean dependent variable	11.41	11.41	25.84	25.84
R-squared	0.947	0.967	0.901	0.925

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. *Revenues* are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. *Number competitors exited the market* is the answer to the survey question: "How many of your main Libyan competitors stop operations between 2013 and now?" reported in log. *Large reduction number competitors (dummy)* is a dummy that takes value 1 if the number of competitors that exited the market for the firm is higher than the median of the number of competitions that exited the market for the whole sample of firms, and zero otherwise. Sample used in columns 1-2 (Market Shares) is the same as the one used in columns 3-4 (Revenues). Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table 11: Conflict exposure and market share: Nonlinearity

	Market share	
	(1)	(2)
$Number\ Conflict\ Events_{10km}$	-0.145***	-0.793**
	(0.054)	(0.341)
$(Number\ Conflict\ Events_{10km})^2$		0.008**
		(0.004)
Year FEs	Y	Y
Firm FEs	Y	Y
Observations	917	917
Number of firms	215	215
Mean dependent variable	25.22	25.22
R-squared	0.840	0.843

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

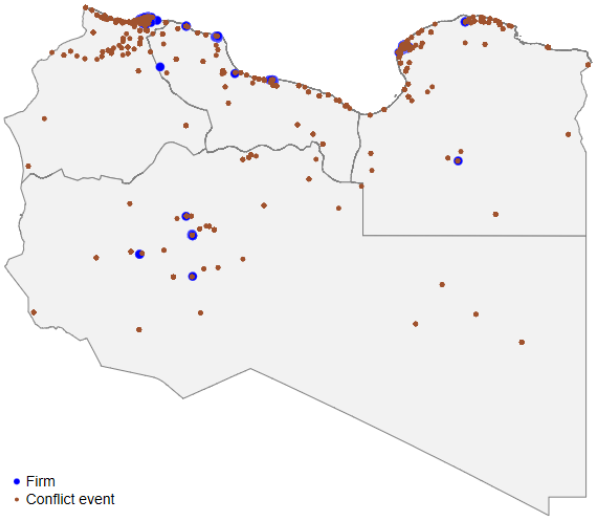
Table 12: Conflict exposure and market share: Heterogeneity

	Market share		
	(1)	(2)	(3)
$Number\ Conflict\ Events_{10km}$*Firm Size*			
Micro	-0.697		
	(0.445)		
Small	-0.999*		
	(0.540)		
Medium and Large	-0.550		
	(0.706)		
$(Number\ Conflict\ Events_{10km})^2$*Firm Size*			
Micro	0.006		
	(0.005)		
Small	0.011*		
	(0.006)		
Medium and Large	0.006		
	(0.008)		
$Number\ Conflict\ Events_{10km}$*Ownership*			
Family		-1.167**	
		(0.567)	
Non-Family		-0.495	
		(0.344)	
$(Number\ Conflict\ Events_{10km})^2$*Ownership*			
Family		0.012*	
		(0.006)	
Non-Family		0.004	
		(0.004)	
$Number\ Conflict\ Events_{10km}$*Labor productivity*			
High			0.088
			(0.472)
Low			0.195
			(0.417)
$(Number\ Conflict\ Events_{10km})^2$*Labor productivity*			
High			-0.002
			(0.006)
Low			-0.003
			(0.005)
Labor productivity			2.112
			(3.199)
Firm FEs	Y	Y	Y
Year FEs	Y	Y	Y
Observations	917	917	583
Number of firms	215	215	157
Mean dependent variable	25.22	25.22	26.85
R-squared	0.843	0.843	0.886

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. *Firm size* is defined as follows: micro (less than 5 employees), small (between 5 and 19 employees), medium and large (20 and above). *Ownership* is a dummy available only for 2017. *Labor productivity* is a dummy that takes value 1 if productivity is higher than the median (computed over the total distribution of firm-labor productivity) and 0 otherwise. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

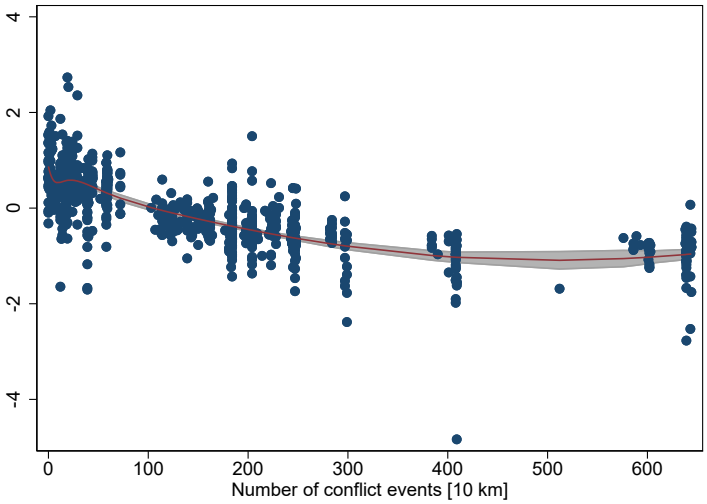
Figures

Figure 1: Firms and conflict events locations



Notes: Figure shows the location of firms in the sample (blue dots) and all conflict events that occurred during the period 2013-2017 (brown dots). (Source: World Bank Libya Enterprise Survey [LES] 2018; ACLED)

Figure 2: Nonlinearity between conflict exposure and firm revenues: Semi-parametric specification



Notes: Figure shows the functional form of the relationship between conflict exposure and firm revenues when using a fixed-effects semi-parametric estimator which simultaneously allows for linear and non-linear effects of the explanatory variables, following the methodology in Baltagi and Li (2002). We use a B-spline regression model of order k = 4 and 4 knots based on the quartiles of the distribution of conflict events, using the procedure by Libois and Verardi (2013). The points in the graph are partial residuals for revenues, which is re-centered around its mean. Shaded areas correspond to 95% confidence bands.

A Online Appendix

A.1 Tables not included in the main text

Table A.1: Sample selection: A test using the 2014 survey data

	Unmatched firms	Matched firms		
	Mean		p-value	Obs
Log of revenues	10.36	10.12	0.66	378
Log of employment	2.61	2.36	0.11	457
Log of intermediate input expenditure	9.37	8.51	0.10	339
Number of firms	401	56		

Notes: Unmatched firms are firms included in the 2014 Survey but not in the 2018 Survey. *Matched firms* are firms included in both the 2014 and the 2018 surveys. Source: World Bank 2014 Survey and World Bank Libya Enterprise Survey [LES] 2018.

Table A.2: Percentage of missing values by year: Selected variables

	Percentage missing values				
Variable	2013	2014	2015	2016	2017
Log of revenues	42	49	63	58	40
Log of employment	7	10	20	16	2
Log of labor cost	34	38	49	46	30
Log of number of suppliers	61	63	65	64	51
Log of intermediate inputs expenditure	67	75	81	77	62
Log of import	25	22	17	17	18

Source: World Bank Libya Enterprise Survey [LES] 2018

Table A.3: Firm characteristics, conflict exposure, and missing values

	Missing Revenues
$Number\ Conflict\ Events_{10km}$	0.003**
	(0.001)
Employment (number of workers)	0.053
	(0.040)
Fixed assets (value)	0.018
	(0.016)
Manufacturing sector	-0.048
	(0.076)
Construction sector	0.053
	(0.073)
Services sector	0.014
	(0.056)
Region FEs	Y
Year FEs	Y
Observations	1,247
R-squared	0.263

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. The dependent variable is a dummy taking value 1 if the value for revenues is missing and 0 otherwise. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. Robust standard errors in parenthesis clustered at the firm level. The omitted category for sector of activity is *Trade*. Observations are weighted using sampling weights. (Sources: World Bank Libya Enterprise Survey [LES] 2018).

Table A.4: Recall bias

	Values for FY 2013 as reported in the			
	Survey 2014	Survey 2018	p-value	Obs
Log of revenues	10.14	12.62	0.00	36
Log of employment	2.39	2.32	0.59	53
Log of intermediate cost	9.20	10.53	0.20	10

Notes: Displayed values are those reported by *matched firms* for the same question in the two surveys. Log of revenues in 2014 refers to (log of) sales. (Source: World Bank 2014 Survey and World Bank Libya Enterprise Survey [LES] 2018).

Table A.5: ACLED events

EVENT TYPE	Freq.	Percent	Cum.
Battle [No change of territory]	1,774	32.28	32.28
Remote violence	1,199	21.82	54.10
Violence against civilians	1,067	19.42	73.52
Riots/Protests	817	14.87	88.39
Strategic development	260	4.73	93.12
Battle [Government regains territory]	171	3.11	96.23
Battle [Non-state actor overtakes territory]	125	2.27	98.51
Non-violent transfer of territory	69	1.26	99.76
Headquarters or base established	13	0.24	100.00
Total	5,495	100.00	

Source: ACLED

Table A.6: ICEWS events

EVENT TYPE	Freq.	Percent	Cum.
Use unconventional violence	2,108	31.51	31.51
Use conventional military force	1,554	23.23	54.75
Arrest and detain	591	8.84	63.58
Employ aerial weapons	519	7.76	71.34
Occupy territory	479	7.16	78.50
Abduct, hijack, or take hostage	437	6.53	85.04
Fight with small arms and light weapons	354	5.29	90.33
Carry out suicide bombing	153	2.29	92.61
Expel or deport individuals	84	1.26	93.87
Conduct suicide, car, or other non-military actions	69	1.03	94.90
Impose administrative sanctions	64	0.96	95.86
Assassinate	54	0.81	96.67
Coerce	45	0.67	97.34
Kill by physical assault	34	0.51	97.85
Impose blockade, restrict movement	30	0.45	98.30
Confiscate property	21	0.31	98.61
Impose restrictions on political freedom	15	0.22	98.83
Sexually assault	13	0.19	99.03
fight with artillery and tanks	11	0.16	99.19
Physically assault	8	0.12	99.31
Use tactics of violent repression	8	0.12	99.43
Torture	7	0.10	99.54
Seize or damage property	6	0.09	99.63
Carry out car bombing	5	0.07	99.70
Impose state of emergency or martial law	5	0.07	99.78
Impose curfew	4	0.06	99.84
Destroy property	3	0.04	99.88
Engage in mass killings	3	0.04	99.93
Use as human shield	3	0.04	99.97
Engage in mass expulsion	2	0.03	100.00
Total	6,689	100.00	

Source: ICEWS

Table A.7: Conflict exposure and firm revenues: Additional Fixed Effects

	Revenues			
	(1)	(2)	(3)	(4)
$Number\ Conflict\ Events_{10km}$	-0.015***	-0.016*	-0.016*	-0.017*
	(0.004)	(0.009)	(0.009)	(0.010)
Year FEs	Y	Y	Y	Y
Firm FEs	Y	Y	Y	Y
Sector*Year FEs	Y		Y	
Region*Year FEs		Y	Y	
Region*Sector*Year FEs				Y
Observations	952	952	952	952
Number of firms	241	241	241	241
Mean of dependent variable	11.50	11.50	11.50	11.50
R-squared	0.939	0.944	0.945	0.948

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.8: Test for selection on unobservables

	Main results	$\delta = 0.1$	$\delta = 0.2$	$\delta = 0.4$	$\delta = 0.6$	$\delta = 0.8$	$\delta = 1$	δ for $\beta = 0$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Number\ Conflict\ Events_{10km}$	-.014	-.015	-.016	-.018	-.020	-.022	-.024	-3.36

Notes: The table shows how different degrees of correlation between observables and unobservables affect the main coefficients (Oster, 2019). The coefficient δ is the relative degree of selection on observed and unobserved variables. $\bar{R}$ is the R-squared in the regression that includes only observables (Table 2 column 3). (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.9: Reverse causality: Firm past revenues and conflict intensity

	$Number\ Conflict\ Events_{10km}$		
	(1)	(2)	(3)
$Revenues_{t-1}$	0.443	0.544	-0.985
	(0.532)	(0.557)	(0.856)
Year FEs	Y	Y	Y
Firm FEs			Y
Region FEs	Y	Y	
Sector FEs		Y	
Region FEs*Year FEs			Y
Sector FEs*Year FEs			Y
Observations	723	723	723
Number of firms	236	236	236
Mean of dependent variable	18.19	18.19	18.19
R-squared	0.711	0.713	0.977

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. A constant is included in the regression but not shown. The dependent variable - $Number\ Conflict\ Events_{10km}$ - is the number of conflict events that occurred in the 10 km radius of the firm. $Revenues_{t-1}$ is the log of firm revenues one year lagged. Standard errors clustered at the firm level in parenthesis. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.10: Economic activity in 2008: ANOVA and pair-wise tests across regions

Source	SS	df	MS	F	Prob > F
between region	16.60	3	5.53	1.79	0.148
within region	1154.15	374	3.09		
total	1170.75	377	3.11		
Bartlett's test for equal variances: chi2(3) = 4.034 Prob>chi2 = 0.258					

	Contrast	Std. Err.	t	P>t	[95% Conf.	Interval]
middle region vs east region	-0.034	0.294	-0.12	0.999	-0.793	0.725
south region vs east region	0.205	0.388	0.53	0.952	-0.797	1.207
west region vs east region	0.425	0.202	2.1	0.153	-0.096	0.945
south region vs middle region	0.239	0.439	0.54	0.948	-0.894	1.372
west region vs middle region	0.458	0.288	1.59	0.384	-0.284	1.201
west region vs south region	0.219	0.383	0.57	0.940	-0.770	1.209

Note: The upper panel shows the ANOVA test across regions. Results show that the level of the private sector economic activity (proxied by aggregate (log of) revenues) is not statistically different across regions before the conflict. The lower panel shows the ANOVA pair-wise tests. Results confirm that the level of private sector economic activity is not different between regions in 2008. (Source: World Bank ICA 2008)

Table A.11: Conflict exposure and firm revenues: Timing

	Revenues		
	(1)	(2)	(3)
Number Conflict Events$_{10\ km}$	-0.014***	-0.013***	-0.014***
	(0.004)	(0.004)	(0.004)
Number Conflict Events$_{10\ km(t-1)}$		-0.012***	
		(0.004)	
Number Conflict Events$_{10\ km(t+1)}$			0.000
			(0.003)
Firm FEs	Y	Y	Y
Year FEs	Y	Y	Y
Observations	952	952	952
Number of firms	241	241	241
Mean of dependent variable	11.50	11.50	11.50
R-squared	0.938	0.940	0.938

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.12: Conflict exposure and firm revenues: Different buffer distances for the conflict exposure measure

	Revenues			
	(1)	(2)	(3)	(4)
Number Conflict Events$_{(within\ 10\ km)}$	-0.014***			-0.013***
	(0.003)			(0.004)
Number Conflict Events$_{(within\ 50\ km)}$		-0.013***		
		(0.003)		
Number Conflict Events$_{(within\ 100\ km)}$			-0.012***	
			(0.003)	
Number Conflict Events$_{(between\ 10\ km\ and\ 50\ km)}$				-0.013
				(0.009)
Number Conflict Events$_{(between\ 50\ km\ and\ 100\ km)}$				0.002
				(0.016)
Firm FEs	Y	Y	Y	Y
Year FEs	Y	Y	Y	Y
Observations	952	952	952	952
Number of firms	241	241	241	241
Mean of dependent variable	11.50	11.50	11.50	11.50
R-squared	0.938	0.938	0.938	0.938

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$, $Number\ Conflict\ Events_{50\ km}$, $Number\ Conflict\ Events_{100\ km}$ are the firm-specific measures of conflict exposure defined as the total number of conflict events that occurred in the 10 km, 50 km and 100 km radius of the firm in the corresponding year, respectively. $Number\ Conflict\ Events_{between\ 10\ and\ 50\ km}$, and $Number\ Conflict\ Events_{between\ 50\ and\ 100\ km}$, are the firm-specific measures of conflict exposure defined as the total number of conflict events that occurred between 10 km and 50 km and 50 km and 100 km radius of the firm in the corresponding year excluding those at closer distances, respectively. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.13: Conflict exposure and firm revenues: Using the ICEWS dataset

	Revenues			
	(1)	(2)	(3)	(4)
$Number\ Conflict\ Events_{10\ km}[ICEWS]$	-0.004**	-0.004*	-0.004**	-0.004*
	(0.001)	(0.002)	(0.002)	(0.002)
Firm-level characteristics				Y
Firm FEs	Y	Y	Y	Y
Year FEs	Y	Y	Y	Y
Observations	952	952	952	841
Number of firms	241	241	241	218
Mean dependent variable	11.73	11.50	11.50	11.37
R-squared	0.932	0.932	0.935	0.940

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. Column (1) and (2) report regression results for unweighted observations. Column (3) and (4) report regression results using sampling weights. Robust standard errors in parenthesis clustered at the firm level in column (1), (3), and (4). Conley standard errors in parenthesis in column (2) are computed at the 10km cutoff. *Firm-level characteristics* in column (4) are: number of employees, value of fixed assets, a dummy taking value 1 if the firm is an international trader (exporter or importer) in that year and 0 otherwise. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ICEWS).

Table A.14: Conflict exposure and firm revenues: Robustness checks

	Revenues						
	Excluding 99pc (1)	After 2013 (II Civil War) (2)	No Tripoli and Benghazi (3)	No international publishers (4)	Balanced panel (5)	Excluding movers (6)	Pre-trends conflict intensity (7)
$Number\ Conflict\ Events_{10km}$	-0.014***	-0.015***	-0.069***	-0.017***	-0.008**	-0.015***	-0.023***
	(0.004)	(0.005)	(0.021)	(0.004)	(0.003)	(0.004)	(0.008)
Firm FEs	Y	Y	Y	Y	Y	Y	Y
Year FEs	Y	Y	Y	Y	Y	Y	Y
Observations	943	730	438	952	610	755	952
Number of firms	240	240	108	241	122	186	241
Mean dependent variable	11.47	11.42	10.98	11.50	11.30	11.43	11.50
R-squared	0.934	0.946	0.94	0.938	0.940	0.930	0.939

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. Robust standard errors in parenthesis clustered at the firm level. Column (1) excludes 99pc observations. Column (2) restricts the analysis to the period of the Second Libyan Civil War - i.e., since 2014. Column (3) excludes the two largest Libyan cities. Column (4) excludes events reported by international publishers. Column (5) makes use of a balanced panel of firms, i.e. those reporting all 5 years of data. Column (6) restricts the sample to firms that did not change location during the period 2013-2017. Column (7) the year dummies are interacted with the year 2013 $Number\ Conflict\ Events_{10km}$. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.15: Conflict exposure and alternative economic performance measures

	Labor productivity (1)	Profits (2)
Number Conflict Events$_{10\ km}$	-0.012***	-0.052
	(0.004)	(0.055)
Firm FEs	Y	Y
Year FEs	Y	Y
Observations	949	434
Number of firms	241	121
Mean dependent variable	9.80	-0.635
R-squared	0.921	0.732

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. $Labor\ productivity = Revenues/Number\ of\ employees$ is in log. $Profits = Revenues - (Total\ wage\ bill + Intermediate\ costs)$ are computed using an inverse hyperbolic sine transformation. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.16: Conflict exposure and firm revenues: Different measures of conflict intensity

	Revenues			
	(1)	(2)	(3)	(4)
Std. Number Conflict Events$_{10\ km}$ *[ACLED]*	-0.107***			
	(0.027)			
Std. Number Fatalities$_{10\ km}$ *[ACLED]*		-0.172***		
		(0.038)		
Std. Number Conflict Events$_{10\ km}$ *[ICEWS]*			-0.115**	
			(0.052)	
Std. Number High Intensity Conflict Events$_{10\ km}$ *[ICEWS]*				-0.128**
				(0.052)
Firm FEs	Y	Y	Y	Y
Year FEs	Y	Y	Y	Y
Observations	952	952	952	952
Number of firms	241	241	241	241
Mean of dependent variable	-0.134	-0.134	-0.134	-0.134
R-squared	0.938	0.939	0.935	0.936

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log and standardized. A constant is included in the regression but not shown. $Std.\ Number\ Conflict\ Events_{10\ km}[ACLED]$ and $Std.\ Number\ Fatalities_{10\ km}[ACLED]$ are the standardized firm-specific measure of conflict exposure defined respectively as the number of conflict events and the number of fatalities (as reported in ACLED) occured in the 10 km radius from the firm's location in the corresponding year. $Std.\ Number\ Conflict\ Events_{10\ km}[ICEWS]$ $Std.\ Number\ High\ Intensity\ Conflict\ Events_{10\ km}[ICEWS]$ are the standardized firm-specific measure of conflict exposure defined respectively as the number of conflict events and the number of high intensity conflict events (as reported in ICEWS) that occurred in the 10 km radius of the firm's location in the corresponding year. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED; ICEWS).

Table A.17: Conflict events by type of perpetrator and firm revenues

	Revenues		
	(1)	(2)	(3)
Std. Number Conflict Events$_{10\ km}$ [ISIS]	-0.108***		
	(0.026)		
Std. Number Conflict Events$_{10\ km}$ [violence against civilians]		-0.081***	
		(0.027)	
Std. Number Conflict Events$_{10\ km}$ [civilian protesters]			-0.040
			(0.031)
Firm FEs	Y	Y	Y
Year FEs	Y	Y	Y
Observations	952	952	952
Number of firms	241	241	241
Mean of dependent variable	-0.134	-0.134	-0.134
R-squared	0.935	0.936	0.934

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log and standardized. A constant is included in the regression but not shown. *Std. Number Conflict Events$_{10\ km}$ [ISIS]*, *Std. Number Conflict Events$_{10\ km}$ [violence against civilians]*, and *Std. Number Conflict Events$_{10\ km}$ [civilian protesters]* are the standardized firm-specific number of conflict events caused by ISIS, number of violent events against civilians, and number of violent events caused by civilian protesters, that occurred in the 10 km radius of the firm's location in the corresponding year, respectively. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.18: Conflict exposure and firm revenues: Heterogeneity

	Revenues				
	(1)	(2)	(3)	(4)	(5)
$Number\ Conflict\ Events_{10\ km}$* *Sector*					
Trade	-0.015***				
	(0.005)				
Manufacturing	-0.017*				
	(0.010)				
Construction	-0.008				
	(0.007)				
Services	-0.017***				
	(0.004)				
$Number\ Conflict\ Events_{10\ km}$*Firm size*					
Micro		-0.009**			
		(0.004)			
Small		-0.017***			
		(0.005)			
Medium and Large		-0.021***			
		(0.005)			
$Number\ Conflict\ Events_{10\ km}$*Type of ownership*					
Family			-0.011***		
			(0.003)		
Non-family			-0.016***		
			(0.005)		
$Number\ Conflict\ Events_{10\ km}$*Buyer*					
General public				-0.015**	
				(0.005)	
Other firms				-0.011*	
				(0.006)	
Government				-0.015***	
				(0.003)	
$Number\ Conflict\ Events_{10km}$*Labor productivity*					
High					-0.012**
					(0.019)
Low					-0.007*
					(0.089)
Labor productivity					1.040***
					(0.000)
Firm FEs	Y	Y	Y	Y	Y
Year FEs	Y	Y	Y	Y	Y
Observations	952	952	952	840	949
Number of firms	241	241	241	214	241
Mean of dependent variable	11.50	11.50	11.50	11.49	11.50
R-squared	0.938	0.938	0.938	0.933	0.950

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10\ km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. *Firm size* is defined as follows: micro (less than 5 employees), small (between 5 and 19 employees), medium and large (20 and above). *Buyer* is defined as to whether at least 50% of revenues in 2017 came from goods/services provided to the specific buyer. *Labor productivity* is a dummy that takes value 1 if productivity is higher than the median (computed over the total distribution of firm-labor productivity) and 0 otherwise. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.19: Conflict exposure and market competition

	Number of competitors exiting the market (in the last 5 years)	
	(1)	(2)
$Cumulated\ Number\ Conflict\ Events_{10\ km}$	0.015***	
	(0.004)	
$Cumulated\ Number\ Conflict\ Events_{10\ km}$ [Median]		
Below		0.006
		(0.009)
Above		0.032***
		(0.008)
Region FEs	Y	Y
Sector FEs	Y	Y
Observations	71	71
Number of firms	71	71
Mean of dependent variable	1.525	1.525
R-squared	0.275	0.309

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. All dependent variables are in log. A constant is included in the regression but not shown. *Number of competitors exiting the market* is the answer to the survey question: "How many of your main Libyan competitors stop operations between 2013 and now?". $Cumulated\ Number\ Conflict\ Events_{10\ km}$ is the cumulated number of conflict events that occurred in the 10 km radius of the firm over 2013-2017. Robust standard errors in parenthesis. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.20: Conflict exposure and market shares: Different measures of conflict intensity

	Market share		
	(1)	(2)	(3)
$Number\ Conflict\ Events_{50\ km}$	-0.857***		
	(0.268)		
$(Number\ Conflict\ Events_{50\ km})^2$	0.008***		
	(0.003)		
$Number\ Conflict\ Events_{100\ km}$		-0.805***	
		(0.251)	
$(Number\ Conflict\ Events_{100\ km})^2$		0.008***	
		(0.003)	
$Number\ Conflict\ Events_{10\ km}[ICEWS]$			-0.469**
			(0.184)
$(Number\ Conflict\ Events_{10\ km})^2[ICEWS]$			0.004***
			(0.002)
Firm FEs	Y	Y	Y
Year FEs	Y	Y	Y
Observations	917	917	917
Number of firms	215	215	215
Mean of dependent variable	25.22	25.22	25.22
R-squared	0.844	0.843	0.843

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. A constant is included in the regression but not shown. $Number\ Conflict\ Events$ is the firm-specific measure of conflict exposure defined as the total number of conflict events perpetrated by different groups that occurred in the 50 km and 100 km radius of the firm and using the ICEWS dataset in the corresponding year. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED; ICEWS).

Table A.21: Conflict exposure and market competition: Robustness

	Market share (revenue based) (1)	Markup (2)
$Number\ Conflict\ Events_{10km}$	-0.174**	-0.045**
	(0.079)	(0.022)
$(Number\ Conflict\ Events_{10km})^2$	0.002*	0.000*
	(0.001)	(0.000)
Year FEs	Y	Y
Firm FEs	Y	Y
Observations	952	433
Number of firms	241	121
Mean dependent variable	1.491	0.075
R-squared	0.914	0.742

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. A constant is included in the regression but not shown. $No.\ Conflict\ Events_{10\ km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. *Market share* is computed as firm level revenues over total sector-year revenues. *Mark up* is measured as the ratio between profits and total costs and computed using an inverse hyperbolic sine transformation.Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.22: Conflict exposure and prices

	Price Index	Food Price Index	Non-food Price Index	Price Index	Price Index (no 99pc)	Price Index (excluding Tripoli and Benghazi)
	(1)	(2)	(3)	(4)	(5)	(6)
$Number\ Conflict\ Events_{10km}$	0.037***	0.019**	0.056***	0.048***	0.037***	0.051***
	(0.011)	(0.009)	(0.017)	(0.014)	(0.013)	(0.007)
Dummy food items	Y			Y	Y	Y
City FEs	Y	Y	Y	Y	Y	Y
Year FEs	Y	Y	Y	Y	Y	Y
City*Year FEs				Y		
Observations	519	259	260	519	511	475
R-squared	0.934	0.645	0.378	0.939	0.942	0.934

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the city. A constant is included in the regression but not shown. $No.\ Conflict\ Events_{10\ km}$ is the city-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the centroid of the city in the corresponding month. Robust standard errors in parenthesis clustered at the city level. (Sources: REACH (2018); ACLED).

Table A.23: Conflict exposure and oil as production input

	Value of oil used as input (1)	Share of oil in total input costs (2)
$Number\ Conflict\ Events_{10km}$	-0.095	0.009
	(0.058)	(0.013)
Region FEs	Y	Y
Sector FEs	Y	Y
Observations	59	59
Number of firms	59	59
Mean of dependent variable	8.264	0.294
R-squared	0.255	0.313

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. *Value of oil used as input* is in log. *Share of oil in total input costs* is defined as the share of the cost of oil used in the production over total inputs costs. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. Data refers to 2017, the only year for which information is available. Robust standard errors in parenthesis. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

Table A.24: Conflict exposure and corruption

	Corruption is a severe obstacle (1)	Corruption has worsen in the last 5 years (2)
$Number\ Conflict\ Events_{10km}$	-0.024	
	(0.027)	
$Cumulated\ Number\ Conflict\ Events_{10\ km}$		-0.003
		(0.004)
Region FEs	Y	Y
Sector FEs	Y	Y
Observations	356	356
Number of firms	356	356
Mean of dependent variable	2.057	2.057
R-squared	0.277	0.277

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10\ km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. $Cumulated\ Number\ Conflict\ Events_{10\ km}$ is the cumulated number of conflict events that occurred in the 10 km radius of the firm over 2013-2017. *Corruption* takes values from 0 to 4, from less severe to more severe. Robust standard errors in parenthesis. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

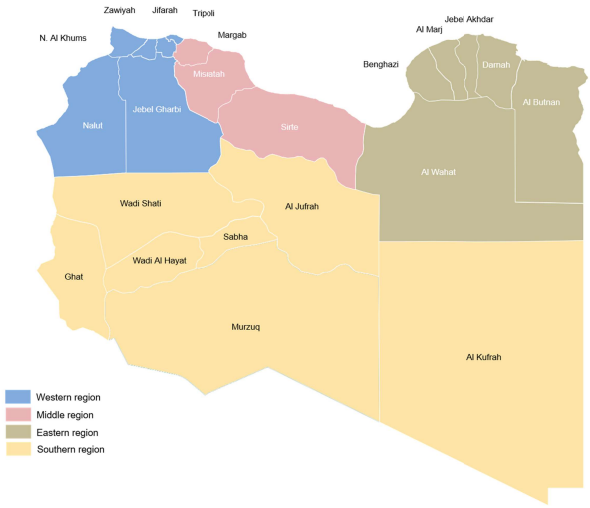
Table A.25: Conflict exposure, illegal payments, and firm revenues

	Illegal costs	Revenues	
	(1)	(2)	(3)
$Number\ Conflict\ Events_{10km}$	0.002*		-0.010***
	(0.001)		(0.003)
Illegal costs		0.191	0.212
		(0.159)	(0.155)
Firm FEs	Y	Y	Y
Year FEs	Y	Y	Y
Observations	1,475	709	709
Number of firms	372	232	232
Mean of dependent variable	0.371	11.46	11.46
R-squared	0.809	0.948	0.950

Notes: Significance levels: * p< 0.1; ** p<0.05; *** p<0.01. The unit of observation is the firm. A constant is included in the regression but not shown. $Number\ Conflict\ Events_{10\ km}$ is the firm-specific measure of conflict exposure defined as the total number of conflict events that occurred in the 10 km radius of the firm in the corresponding year. *Illegal costs* is a dummy taking value 1 if he firm has incurred in any illegal cost during the conflict, and 0 otherwise. Robust standard errors in parenthesis clustered at the firm level. (Sources: World Bank Libya Enterprise Survey [LES] 2018; ACLED).

A.2 Figures not included in the main text

Figure A.1: Libya map: Sampling regions



Notes: Sampling regions for World Bank 2018 Libya Enterprise Survey (World Bank, 2020).

Figure A.2: Libya physical map

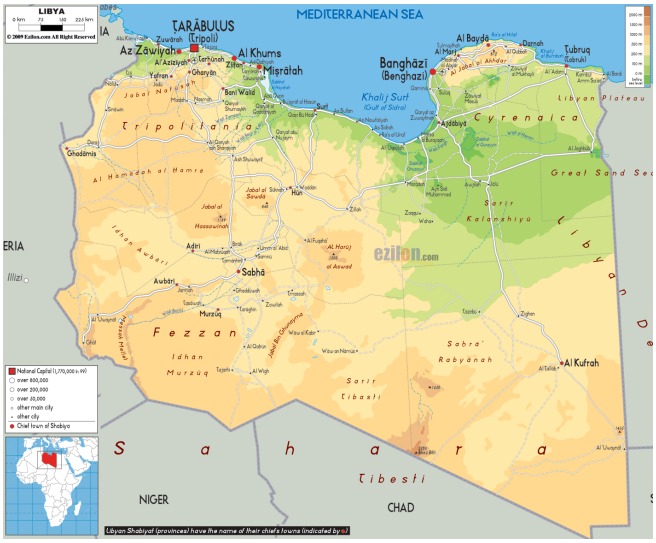
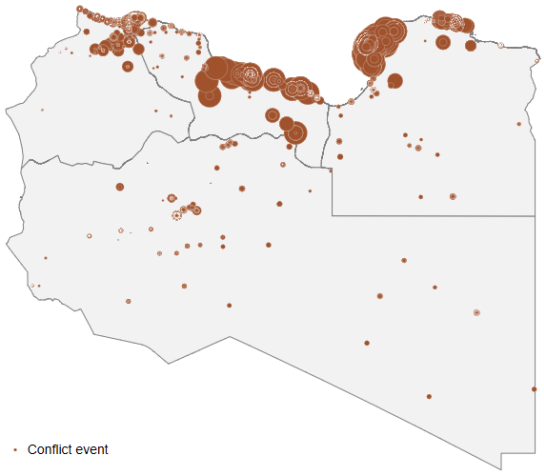
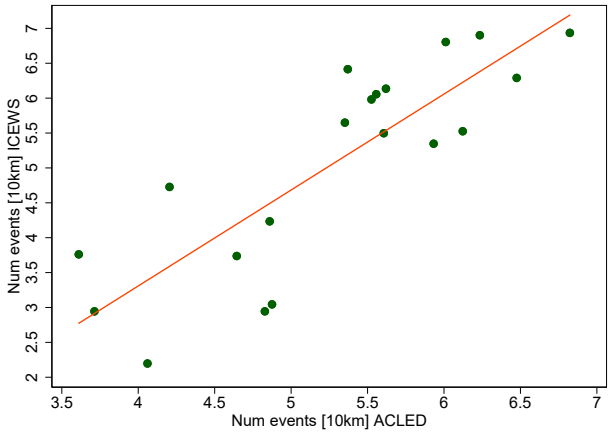


Figure A.3: Conflict-related events locations and number of fatalities



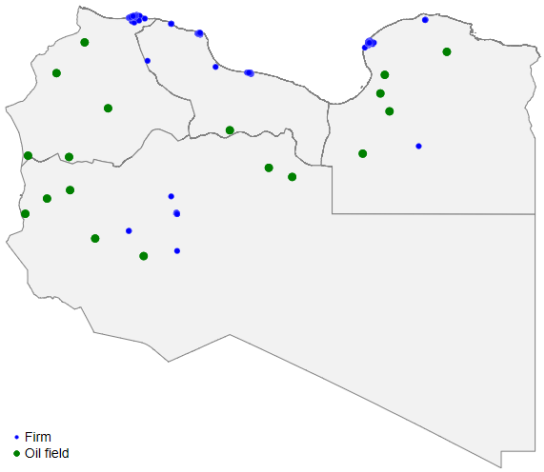
Notes: The size of the circle indicates the total number of conflict-related fatalities that occurred in that location during the period 2013-2017 (Source: ACLED).

Figure A.4: Regression fit of regional (log) number events from ACLED and ICEWS



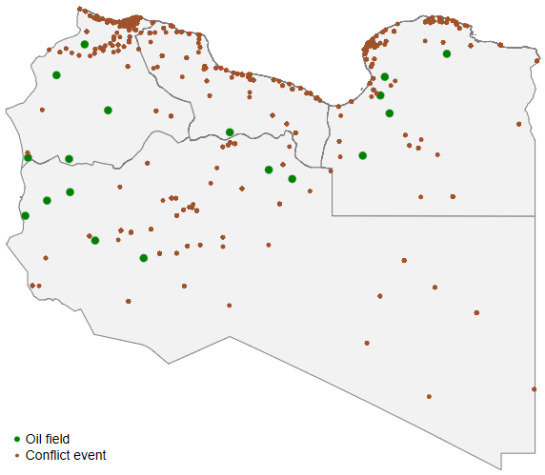
Notes: The graph plots the (log) regional number of ACLED events against the (log) regional number of ICEWS events for the period 2013-2017 (Source: ACLED, ICEWS).

Figure A.5: Firms and oil fields locations



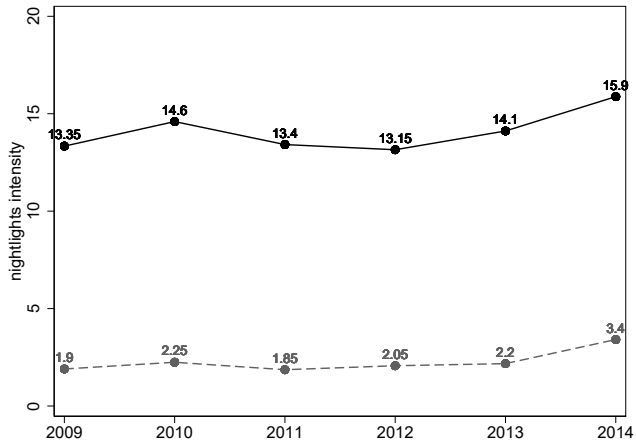
Notes: Figure shows the location of firms in the sample (blue dots) and oil fields (green dots) (Source: World Bank Libya Enterprise Survey [LES] 2018; PETRODATA).

Figure A.6: Oil fields and conflict events locations



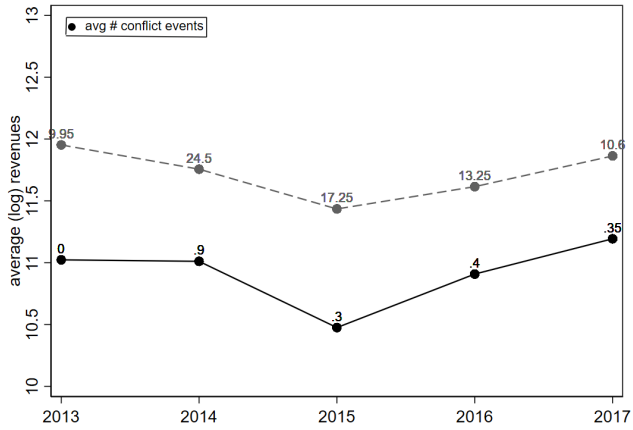
Notes: Figure shows the location of oil fields (green dots) and conflict events (brown dots) (Source: ACLED; PETRODATA).

Figure A.7: Nightlights for the period 2009-2014 by level of conflict intensity in the area during the Second Libyan Civil War



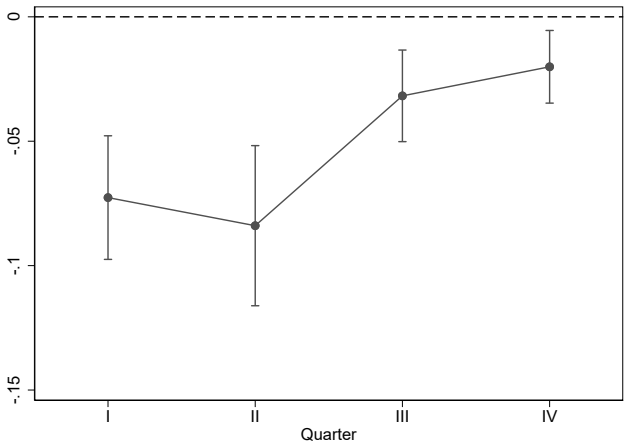
Notes: The graph compares the nightlights intensities for areas exposed to a high vs low number of conflict events during the Second Libyan Civil War. The continuous (dashed) line shows the average nightlights intensity for the areas above (below) the median number of conflict episodes during the period 2014-2017. Dots show the average nightlights intensity for the two groups in each year. (Source: DMSP and the VIIRS)

Figure A.8: Evolution of revenues by level of firm's exposure to violent events before the Second Libyan Civil War



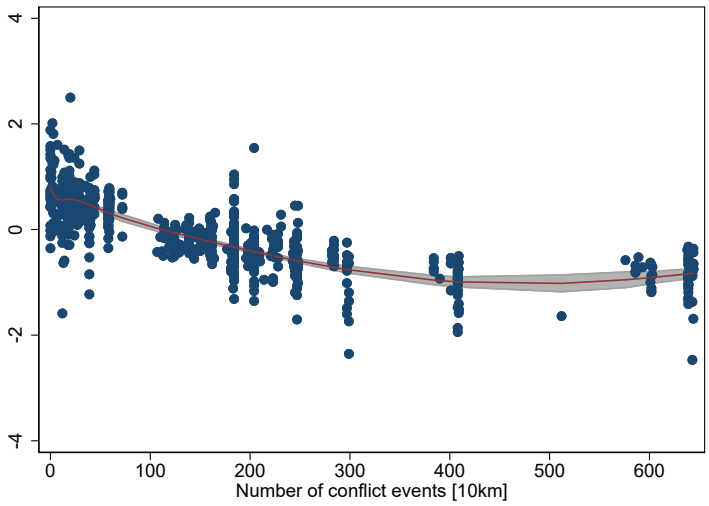
Notes: The graph compares revenues for firms not exposed to violent events in 2013 vs firms exposed to at least one event in 2013 (the first year of our analysis and the year before the beginning of the Second Libyan Civil War). The continuous line shows the average (log of) revenues for the 13 firms that were not exposed to violent episodes in 2013 but started to be exposed in 2014. The dashed line shows the (log of) average revenues for all other firms. Dots display the average number of events for the two group of firms in each year. (Source: World Bank Libya Enterprise Survey [LES] 2018; ACLED)

Figure A.9: Within year variation in conflict exposure and firm revenues



Notes: The graph shows the point estimates of eq.(1) of the $Number\ Conflict\ Events_{10\ km}$ considered at each quarter. 90% confidence intervals are reported.(Source: World Bank Libya Enterprise Survey [LES] 2018; ACLED)

Figure A.10: Nonlinearity between conflict exposure and firm revenues: Semi-parametric specification excluding outliers



Notes: Figure shows the functional form of the relationship between conflict exposure and firm revenues when using a fixed-effects semi-parametric estimator which simultaneously allows for linear and non-linear effects of the explanatory variables, following the methodology in Baltagi and Li (2002). We use a B-spline regression model of order k = 4 and 4 knots based on the quartiles of the distribution of conflict events, using the procedure by Libois and Verardi (2013). The points in the graph are partial residuals for revenues, which is re-centered around its mean. The sample excludes the observations in the bottom and top 5% of the revenues distribution. Shaded areas correspond to 95% confidence bands. (Source: World Bank Libya Enterprise Survey [LES] 2018; ACLED)

A.3 The survey, the questionnaire, and the sample construction

The survey The Libya Enterprise Survey 2018 [LES 2018] (World Bank, 2018) is an original survey of 400 Libyan private firms. Together with the Libya World Bank team, we designed the questionnaire and coordinated the data collection. Firm interviews were conducted in person during the period July - October 2018. Firms were interviewed in all regions of Libya and they broadly resemble the characteristics of Libyan private firms in terms of size, location, and sector of activity (see below). The survey also included 65 key informant in-person interviews conducted during the period September - October 2018. Key informant included the following categories of actors: government officials, business and sectoral leaders, young entrepreneurs, female entrepreneurs, banks and other representatives from the financial sector, stakeholders from outside Libya, smugglers and traffickers. These interviews were conducted by researchers both in Libya and Tunisia and were based on tailor-made questionnaires.

The questionnaire The questionnaire of the LES 2018 includes questions regarding a large array of variables such as financial accounts, production inputs usage, import activity, market share, etc. It also includes a question on the firm's georeferenced location. Crucially, our dataset is a retrospective panel: for the most important variables, the questionnaire asks to report data for each of the 5 years before the year of the survey. For each firms, this provides us with information for key variables during the period 2013 - 2017. Data on financial accounts and all other firm's characteristics are taken from account books.

Sample construction Data on the Libyan economy are extremely limited. The Libyan Bureau of Statistics and Census (BSC) performed the last census of Libyan businesses in 2006. Official data on economic activity were collected only until 2011, when the First Libyan Civil War began. After that, statistics on the Libyan economy have been largely unreliable because of the limited capacity of government services (World Bank, 2015a). The lack of data results in large differences in economic statistics across different sources (including estimates from World Bank and IMF) and in the absence of subnational sector or firm-level data. Without updated macro-level data, it was thus not possible to select a representative sample of firms in the Libyan private sector.

Given the lack of official data, the strategy adopted to select the sample of firms for the Libya Enterprise Survey was to exploit as much as possible all the available information from previous studies and to make reasonable choices in order to build a large and representative enough sample. To this end, we take different steps. First, we tried to reach all firms which were previous included in any study on the private sector in Libya. These are:

1. Simplified Enterprise Survey and Private Sector Mapping. World Bank, 2015: 457 firms
2. Youth Employment and Entrepreneurship. Expertise France, 2016: 75 entrepreneurs
3. Private Sector Research in Misrata and Benghazi. DFID, 2013: 314 firms

A total of 846 of firms which took part in these previous studies and for which contact details existed were contacted in July 2018. The objective of this pre-screening interview was to identify firms that were still operational as of the time of our survey and to plan an in-person interview with them. Of the 846 firms contacted, 183 participated in the pre-screening interview (22%). The other firms did not take part in the pre-screening interview because of inaccurate phone numbers, respondents not answering, and respondents not being available. Among participants, 141 firms stated that their businesses were still operational, among which 15 said they were not willing to be interviewed as part of a longer survey. Thus, a total of 126 firms which were interviewed in previous studies agreed to be part of the World Bank 2018 Libya Enterprise Survey. In a second phase, 129 additional firms accepted to be included to the sample. In total, 255 firms (among the 846) had agreed to participate in the World Bank 2018 Libya Enterprise Survey. However, when surveyor attempted to schedule interviews, some refused the

interview or constantly postponed. In the end, surveyors were able to interview 70 firms among those included in previous studies: 14 of these firms were interviewed in 2013 for the DFID project and 56 firms were interviewed at the end of 2014 for the 2015 World Bank Simplified Enterprise Survey.

Additional firms needed to complete the final sample of 400 firms have been identified adopting a snowball approach. Field teams were mobilized to visit companies randomly in several cities throughout the country and to collect contact details based on referral from other firms. Firms were then contacted to agree for an in-person interview. This methodology allowed us to identify and interview the remaining 330 firms need to reach the target number of firms for the survey.

Due to lack of reliable macro-level data and a comprehensive list of Libyan firms, it is not possible to ensure that our sample is representative of the Libyan private sector. Efforts were made to cover all regions and all sectors, to the exception of the agriculture and oil. In building the final sample, the following strata were considered:

- **Size**: micro-firms (less than 5 employees), small firms (between 5 and 19 employees), medium firms (between 20 and 99 employees) and large firms (above 100 employees).
- **Sectors of activity**: 4 broad sectors (manufacturing, trade, construction, service)
- **Geographical regions**: firms were interviewed in the following 4 regions (see Figure A.1):
  - *Western region and Tripoli*: comprising the main towns of the Western region, Tripoli, Zawiyah and Sabratah, as well as Sorman and Ajelat;
  - *Middle region*: comprising the coastal cities, the economic hub of Misratah as well as cities such as Zliten and Sirte, and the province of Waddan;
  - *Eastern region and Benghazi*: comprising the main economically relevant cities of Cyrenaica, Benghazi, Tobrouk, and Baydaas well as the province of Wahat;
  - *Southern region*: comprising mostly the area of Sebha, Obari, and Wadi Ashati.

These strata [size (number of employees), sector of activities, and regional location of the surveyed firms] were carefully tracked to broadly resemble Libya's private sector's key features according to previews studies, in particular World Bank (2015a).

A.4 A stylized conceptual framework

In this section, we present a stylized conceptual framework - whose assumptions are consistent with the characteristics of the Libyan economy and our empirical results - with the aim to rationalize the non-linear effect of conflict exposure on the firm's revenues (see Section 5.3).

We first describe a simple model capturing the main features of the Libyan economy. This, together with the results from our empirical analysis, serves to illustrate how we think about the effect of conflict on the firm's production, input markets, and market competition. Secondly, we present a graphical representation on: i) the effects of an increase in the level of conflict exposure on the firm's price and output; ii) how the combination of the production inputs mechanism and of the market competition mechanism (see Section 6) can account for the non-linear effect of conflict on the firm's revenues (see Table 3) and the convex relationship between conflict and the firm's economic performance (see Figure 2 and Table 4).

A.4.1 The economy

Consider a small open economy populated by N identical firms which compete *à la Cournot*. Demand is given by:

$$P = D(y_i + Y_{-i}) := a - b\left(y_i + \sum_{n \neq i}^{N} y_n\right) \tag{A.1}$$

where y_i is the output of firm i and $a, b > 0$. Each firm produces an homogeneous final good combining three factors of production, namely capital, labor, and intermediate inputs. Here, we restrict the analysis to the short period by assuming that the firm capital stock k_i is fixed and equal to $\bar{k}_i$, with rental rate of capital fixed and normalized to equal 1.[42] We define $f_i := r\bar{k}_i$ the fixed component of the total cost function. In the symmetric equilibrium, $\bar{k}_i = \bar{k}$ for all $i \in [0, N]$, implying that $f_i = f$. The firm' s output thus depends only on the availability of both labor and intermediate inputs. Upon paying the sunk cost f, the firm can get access to the common Cobb-Douglas production function:

$$y_i = x_i^{\alpha} l_i^{\beta} \tag{A.2}$$

where $\alpha + \beta = 1$, l_i is labor, $x_i = \int_0^j x_j dj$ with $j \in [0, J]$ a bundle of (domestic and imported) intermediate inputs.

Labor market Labor supply is a function of wage and conflict intensity. Workers are imperfectly mobile across locations due to heterogeneous mobility costs and/or their preferences. Conflict-related violence is a disamenity which reduces utility and depends on the level of conflict exposure of the worker. Conflict exposure is firm-specific and idiosyncratic. The effect of conflict intensity on equilibrium employment and wages is given by the combination of its impact on labor supply and labor demand. Conflict reduces the labor supply by inducing workers migration as a function of the intensity of violence to which the firm is exposed (Rozo, 2018) or by increasing absenteeism because of fear of violence (Ksoll et al., 2021). Under these assumptions, $\partial l^s / \partial \tau_i < 0$.[43] At the same time, because of the induced reduction in the availability of intermediate inputs (see below), conflict decreases the firm's labor demand, i.e., $\partial l^d / \partial \tau_i < 0$. Together these two effects imply that labor input availability decreases with conflict intensity, i.e. $\partial l / \partial \tau_i < 0$. The effect of conflict on wages is instead ambiguous and depends on the relative strength of the two quantity effects. Our empirical results (see Table 8) indicate that an increase in conflict intensity does not change the average equilibrium wage, i.e. $\partial w / \partial \tau_i = 0$

[42] We exclude capital from the analysis based on our empirical results which indicate that conflict does not affect the usage of capital input at the firm level (see Table 5 column 3).

[43] Heterogeneity across workers can be modeled noting that the latter effect is larger for foreign workers due to their lower mobility cost and for unskilled due to their lower reservation wage (Utar, 2020).

Intermediate inputs market Firms use a bundle of intermediate inputs, both domestic and imported. The supply of intermediate inputs is a decreasing function of conflict intensity, i.e., $\partial x^s/\partial \tau_i < 0$. As for the imported inputs, as long as the export cost captures the supplier's risk, higher conflict intensity tends to reduce supplies to firms located in conflict-affected areas (see for instance, Amodio and Di Maio, 2018).[44] At the same time, because of the conflict-induced reduction in the availability of the other production input (namely labor), the demand of intermediate inputs decreases with conflict intensity, i.e., $\partial x^d/\partial \tau_i < 0$. While the combination of these two effects has an ambiguous effect on the intermediate inputs price index P_x, it reduces the quantity of intermediate inputs available in the market, i.e., $\partial x/\partial \tau_i < 0$.[45] This is in line with the evidence that a higher conflict exposure reduces the number of foreign suppliers and thus the number of inputs the firms has access to (see Table 6).

Cost function The firm solves a short-term cost minimization problem of the form:

$$\langle l, x \rangle = \arg\min \left\{ w(\tau_i) l(\tau_i) + P_x(\tau_i) x(\tau_i) \right\}, \text{ sub to(A.2)},$$

The solution leads to the following total cost function:

$$\mathcal{C}_y \left(w, P_x, y_i, \tau_i \right) := f + \zeta \left(w, p_x, \tau_i \right) y_i(\tau_i) \tag{A.3}$$

where

$$\zeta \left(w, P_x, \tau_i \right) := \left(\frac{w(\tau_i)}{\beta} \right)^{\beta} \left(\frac{P_x(\tau_i)}{\alpha} \right)^{\alpha} \tag{A.4}$$

is obtained from cost minimization and is equal to the marginal cost.

From eq.(A.3) it follows that a conflict-induced reduction in output tends to reduce total cost as long as the effect on input prices remains below a certain threshold. While our data does not allow us to look directly at intermediate inputs prices, results in Table 8 indicate that wages do not change with conflict intensity suggesting that the price effect is unlikely to be large. Consistently with this characterization of the effect of conflict on costs, Table 5 shows that an increase in the number of conflict events reduces the firm's total labor costs and intermediate inputs expenditures.

Output and price of the final good Output is determined by input availability which in turn depends on the realized idiosyncratic level of conflict intensity to which the firm is exposed ($\hat{\tau}_i$). We denote the *cum conflict* output of firm i with $\hat{y}_i$. In practice, output for firm i is given by A.2 where $\hat{x}$ and $\hat{l}$ are the *cum conflict* input quantities, i.e., the equilibrium quantities of workers and intermediate inputs available to the firm given the level of conflict intensity. Formally, this implies $\hat{y}' \left(\tau_i \right) < 0$, which is the effect on output of the production inputs mechanism described in section 6.1.

The price level of the final good is determined from (A.1) as the residual demand function:

$$\hat{P} = D(y_i + Y_{-i}) = a - b \sum_{n \neq i}^{N} \hat{y}_n - b\hat{y}_i \tag{A.5}$$

where $\hat{P}$ and $\hat{y}$ are the *cum conflict* level of price and output, respectively.

The price of the final good increases with conflict intensity for two different mechanisms. First, the price increases because conflict reduces the output for *all* firms. This overall output reduction is the consequence of the conflict-induced reduction in the quantities of production inputs available to the firms operating in the sector. Second, the price of the final good increases - for a given level of

[44] The higher cost of exporting to firms in conflict-affected countries is related to the higher risk that the buyer becomes unable to pay, higher cost of transportation, higher cost of communication, etc.

[45] The conflict-induced reduction in the use of intermediate inputs is formalized similar to the negative effect of uncertainty on input choices as modeled in Handley et al. (2020). They show that uncertainty, by increasing import price, reduces the number of imported varieties and firm's import expenditure.

the firm's i output - because of the reduction in the degree of market competition firm i faces due to the decrease in the number of competitors. The latter effect can be conceptualized assuming that there is a firm-specific level of conflict intensity above which the firm is forced to exit the market because the quantity of inputs available becomes null. We formally capture this selection mechanism in our conceptual framework by imposing that $N'(\tau) < 0$.[46] The conflict-induced reduction in the number of competitors is consistent with the empirical results reported in Table A.19 showing that a high number of conflict events increases the number of competitors exiting the market during the conflict period.

This simple framework incorporates the two mechanisms outlined in our empirical analysis in Section 6. An increase in τ negatively affects revenues through a reduction in the availability of intermediate inputs x and of labor l, but it also positively impacts revenues through the reduction in the number of competitors N. As we discuss below, the combination of these two mechanisms can account for the non linearity in the effect of conflict on revenues and - for very high levels of conflict intensity - for the convex relationship between conflict and firm's economic performance that we document in our empirical analysis in Section 5.3.

A.4.2 The effect of conflict on revenues: A graphical representation

In what follows, we provide a graphical representation of the effect of a change in the level of conflict exposure on revenues. We begin showing the effect of an increase in conflict intensity on the two production inputs (intermediate inputs and labor) and how this affects the firm's production choices and revenues. Then we show that conflict affects revenues also by reducing the number of competitors and thus the level of market competition faced by the firm. Finally, we show that the combination of these mechanisms can account for the non-linear effect of conflict on the firm's revenues.

Production inputs mechanism Conflict affects the markets for production inputs. Higher conflict intensity makes more difficult for the firm to access intermediate inputs and workers. The conflict-induced limited availability of inputs reduces output and therefore revenues.

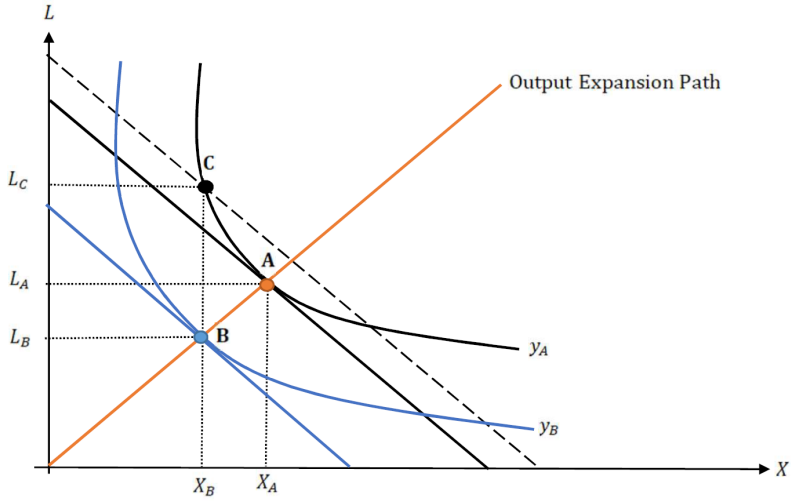
To see how this mechanism works, consider the initial input choices for firm i producing the optimal quantity of the final good y_A (see point A in Figure A.11).[47] Firm i produces y_A using the amount of intermediate x_A and labor l_A. As we discussed in section A.4.1, an increase in the number of conflicts ($\tau > 0$) reduces the availability of intermediate inputs. This is represented by a shift towards the origin along the horizontal axis, for instance from x_A to x_B. To produce the same amount of output, the firm should change the combination of intermediate inputs and labor from A to C, associated with a higher cost of production, as shown by the dashed isocost line of Figure A.11. In fact, the use of the production technique C is not feasible because it requires an increase in the quantity of labor from l_A to l_C. Yet, as discussed in section A.4.1, an increase in conflict intensity reduces the availability of workers. As long as the relative input prices do not change with conflict intensity, the firm minimizes costs choosing the level of l_B as to remain on the output expansion path. This implies that production decreases from y_A to y_B (see point B in Figure A.11).[48] In the new equilibrium B the firm still optimally chooses l and y, but both of them are lower in quantity than in the no-conflict situation. This implies that conflicts reduce both the total cost of production and the output level, in line with the results reported in Table 5.

[46] In line with the results in Table 12, we do not model this selection mechanism as influenced by firm's productivity. Instead we allow for the possibility that survival is associated to a context-specific firm's characteristic. Because the price effect for firm i increases with the change in the residual demand induced by the selection mechanism, this implies that the effect is larger the less this characteristic is correlated with low productivity, thus excluding that only inefficient firms exit the market.

[47] In the following, for the sake of simplicity, we suppress the index i.

[48] Our empirical results suggest that input prices do not change with conflict intensity (section 6.1). If the relative input price increases following the reduction in intermediate inputs availability, the total cost and output level would decrease less but the output level will still be lower than the pre-conflict one.

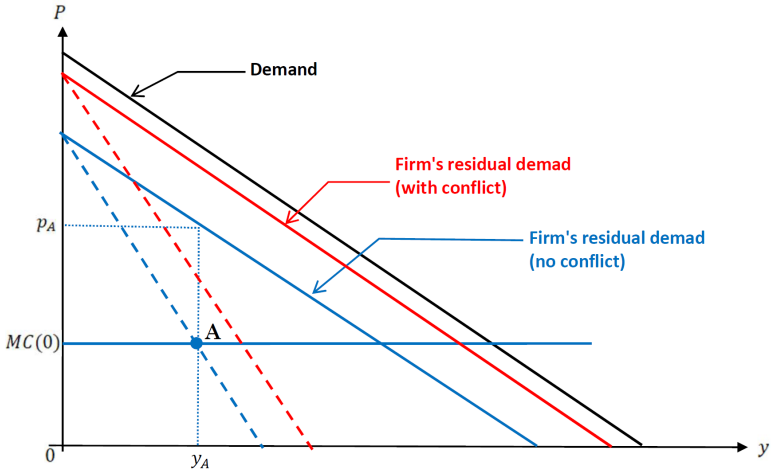
Figure A.11: The production inputs mechanism



Market competition mechanism Conflict reduces the number of competitors for the surviving firms. In practice, conflict decreases market competition by forcing some firms to exit the market with the surviving firms taking advantage of that. As we discussed in Section A.4, we formalize this mechanism by assuming that the equilibrium number of competitors when there is no conflict is $N(0) > 0$ and that N is a decreasing function of τ, i.e., $N'(\tau) < 0$. This assumption is in line with the results reported in Table A.19.

Figure A.12 shows the sectoral demand (the black thick line) and the firm's residual demand when there is no conflict (thin blue line), whose position depends on N. With no conflict, given the demand and the number of competitors, the optimal quantity y_A (which corresponds to point A in Figure A.11) is given by the intersect of the marginal revenues curve and the marginal cost curve. A conflict-induced decrease (increase) in N makes the residual demand and the marginal revenue function to shift rightward (leftward). This is represented by the red residual demand and the corresponding marginal revenues function in Figure A.12.

Figure A.12: The market competition mechanism



The total effect of conflict on firm's revenues

Consider an initial equilibrium with no conflict as described by point A of Figure A.13. An increase in conflict intensity has two main effects. First, it forces the firm to reduce output so as to accommodate

the reduction in the availability of intermediate inputs and labor, and minimize costs (see Figure A.11). Second, an increase in conflict intensity reduces the number of competitors. This shifts rightward the residual demand for the firm and the corresponding marginal revenue curve (see Figure A.12).

Figure A.13: The effect of conflict on firm's revenues

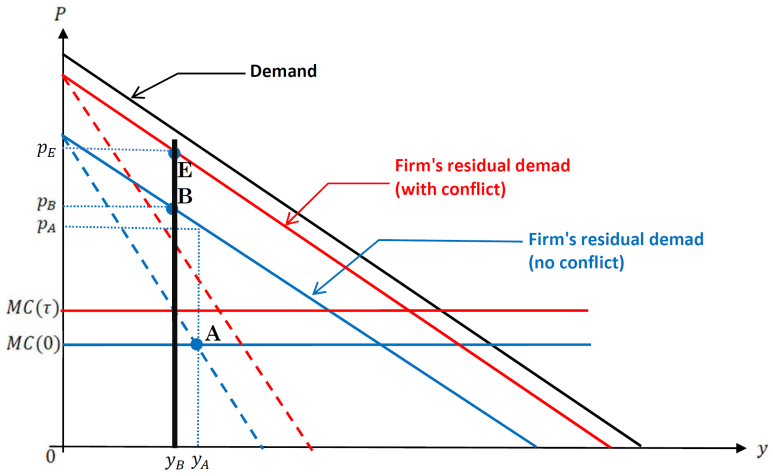


Figure A.13 shows the optimal reply for firm i to an increase in conflict intensity as the combination of both these effects. The blue lines represent the no-conflict situation. The vertical black line represents the (*cum conflict*) supply y_B (as obtained from the input market adjustments to an increase in conflict intensity described in Figure A.11). This is the maximum output level the firm is able to produce given the (limited) amount of inputs available amid the conflict. The bold red line represents the (*cum conflict*) residual demand curve, resulting from the reduction in the number of competitors in the market (see Figure A.12). The dotted red line indicates the corresponding (*cum conflict*) marginal revenues ($MR(\tau)$) and the red horizontal line the marginal cost ($MC(\tau)$) functions of the firm, respectively. Because output is constrained by input availability, given the residual demand, marginal revenues are determined by the (feasible) output level and do not need to equate marginal costs in the point of production. In fact, an increase in conflict intensity increases the (constant) marginal cost of the firm (see eq. A.4), but this does not affect the output level. Graphically, this implies that (constant) marginal cost curve of the firm (horizontal dashed line $MC(0)$ in Figure A.12) may shift upwards to any point between A and B. Note that this shift affects profits but not revenues.

We use Figure A.13 to understand the overall effect of an increase in conflict intensity on revenues by graphically distinguishing between the different components for the variation in total revenues. The first component is related to the production inputs mechanism. The magnitude of this component is given by the sum of a negative (*extra-marginal*) and a positive (*intra-marginal*) variation. The former is represented by the area $\Delta_{IM} := p_A (y_A - y_B) < 0$, measuring the loss of revenues due fall in the output level for individual firm i caused by the conflict-induced reduction in the available quantity of inputs (see equation A.2). The latter is represented by the area $\Delta_{EM1} := y_B (p_B - p_A) > 0$, measuring the increase in revenues due to the higher price for the final good induced by the reduction in total supply, resulting from the lower output for each of the N firms operating in the sector (see equation A.5). The net effect of these two variations on revenues depends on the shape of the demand function but - unless N is extremely small - it is likely to be negative. The second component is related to the market competition mechanism. This provides an additional positive (*intra-marginal*) variation in revenues represented by the area $\Delta_{EM2} := y_B (p_E - p_B) > 0$. This area measures the increase in revenues due to the conflict-induced increase in the price of the final good caused by the reduction in the number of competitors N (see eq. A.5). The movement of the residual demand outwards captures the conflict-induced change in the number of competitors and its positive effect on revenues which increases with the reduction in the number of competitors: this effect corresponds to the interaction

term in Table 10.

The combination of the two mechanisms, i.e., the production inputs mechanism and the market competition mechanism, leads to three different possible outcomes following an increase in conflict intensity :

1. $|\Delta_{IM}| > |\Delta_{EM1} + \Delta_{EM2}|$, implying that revenues decrease with conflict intensity

2. $|\Delta_{IM}| = |\Delta_{EM1} + \Delta_{EM2}|$, implying that revenues do not change with conflict intensity

3. $|\Delta_{IM}| < |\Delta_{EM1} + \Delta_{EM2}|$, implying that revenues increase with conflict intensity

Based on these results, we are now able to illustrate the conditions under which an increase in conflict intensity has a non-linear effect on the firm's revenues. When the number of conflicts is low, the intra-marginal component dominates the extra-marginal component (case 1), implying that the overall effects of an increase in τ on revenues is always negative. In fact, when conflict intensity is low, only the input mechanism is at work (competitors are unlikely to exit the market): conflict reduces input availability, the firm's output, and thus revenues. However, for higher levels of conflict intensity, the market competition mechanism becomes predominant. This implies that - as conflict intensity increases - the price of the final good increases not only because total output decreases but because the number of firms in the sector shrinks. It follows that there exists a certain threshold of conflict intensity $\tilde{\tau}$ above which the extra-marginal component dominates the intra-marginal component (case 3), with the result that a further increase in τ has a positive effect on firm's revenues.

Using a stylized conceptual framework capturing the main characteristics of the Libyan economy, we have shown that the combination of the production inputs and the market competition mechanisms can account for the non-linearity in the effect of conflict on revenues, i.e., the negative effect of conflict on revenues becomes smaller as conflict intensity increases, and for the evidence that - for very high levels of conflict intensity - the relationship between conflict and the firm's economic performance becomes convex, as discussed in Section 5.3 and shown in Table 3, Figure 2, and Table 4.