1. Introduction

Understanding the effects of civil conflict has become an integral component of the study of economic development (Serneels & Verpoorten, 2013). From a theoretical perspective there is little consensus about the impact that conflict has on economic performance. While neoclassical models predict that recovery from conflict should be relatively quick, others such as Barro & Sala-i-Martin (2004) and Sachs (2006) argue that recovery will be extremely slow or even trapped in a low level equilibrium. Empirical analyses have borne no clear answers either as results on the economic ramifications of civil war vary depending on the cases and time periods included (Kang & Meernik, 2005).

Further, few in the literature have sought to explain puzzling cases of domestic armed conflicts that have little impact on macroeconomic growth. Nigeria and Cameroon, for instance, have both been engaged in violent conflict with Boko Haram, a group of militants determined to establish an Islamic state in West Africa. In Nigeria, the death toll has steadily risen since 2011; the Council on Foreign Relations estimates that the conflict had resulted in over 40,000 casualties by mid-2015 (Council on Foreign Relations, 2015). However, Boko Haram primarily operates in the rural and relatively less populated north-eastern regions of Nigeria and Cameroon. During this conflict, both countries have enjoyed steady economic growth. When Nigeria rebased its economy in 2014, it overtook South Africa as the continent's largest economy.

Mexico has been engaged in a drug war since December 2006 and the number of deaths stemming from this civil conflict have only increased since that time. Yet, even as fatalities due to the drug war reached new peaks in 2012, Vikram Pandit of Citigroup cited Mexico as being extremely well poised for growth and projected that its economy may surpass that of its much larger regional rival, Brazil, within a decade (Vardi, 2012). In that same year, *Barron's* ran a headline titled, "Is Mexico the New China?" (Kapadia, 2012). This contrasts greatly with the economic fortunes of other countries in the midst of civil war

where economies have plummeted. Collier et al. (2003), for instance, describe civil war as "development in reverse." "The overall economic and political legacy from civil war," they write, "is thus sufficiently adverse that rapid recovery is unlikely."

Explaining variation in macroeconomic outcomes for countries enmeshed in internal conflict requires a better understanding of not only the spatial mechanisms through which conflict can affect growth but also the process of economic growth. Much of the economic development literature in the past few decades has stressed the importance of cities and towns as drivers of economic growth and development (Hanson, 2005). Venables (2005) notes that the process of development and urbanization exists in virtually all countries and especially in the case of modern developing countries. Henderson (2000) finds that even a simple correlation across countries between the level of urbanization and GDP per capita is greater than 0.8. The key theme in this literature is that the spatial positioning of production is a central process through which economic prosperity is created (Krugman, 1991a).

What happens when cities themselves are threatened? In this paper, we bridge the economic development literature on the importance of cities with extant literature on the effect of armed conflict to provide a novel explanation for the paradox of high macroeconomic growth in conflict-ridden countries. Specifically, we argue that to explain variation in economic performance between countries in the midst of civil war, it is necessary to account for the spatial location of the conflict relative to major urban centers. Much of the extant literature has focused on examining the effect of conflict on economic growth at the national level. The implicit assumption of these approaches is that all civil wars are alike, whether they occur right outside the capital or on the fringes of the country. We argue that the location of conflicts relative to major cities and capitals will determine the effect of civil conflict on economic performance, and that conflicts only significantly dampen economic performance if they are proximate to urban centers.

The rest of the paper proceeds as follows. We begin with a review of the literature on the relationship between economic growth and civil war. In section 3, we explain the mechanisms of our hypothesis through a number of descriptive cases. In section 4, we describe how we construct our measures capturing distance of conflicts between major economic and population centers and lay out our estimation approach. Finally, we discuss the findings of our analysis and end with next steps.

2. Literature on Conflict and Growth

2.1. **Civil War → Economic Performance.** Collier (1999) identifies five avenues through which civil conflict can impede economic performance: through the *destruction* of resources, through *disruption* of social and economic activity, through *diversion* of resources to the war effort, through *dissaving*, and through *portfolio substitution* or divestment. Of course, these mechanisms are related to one another; portfolio substitution may be exacerbated by the destruction of resources or the disruption of socioeconomic activity. Overall, Collier finds that civil wars correspond to a 2.2 percent decrease in annual economic growth. While he suspects that the impact will differ across economic sectors, reliable and disaggregated data was not available to test this hypothesis thoroughly. However, preliminary evidence for this is found in their analysis of the National Accounts data of Uganda before, during, and after its civil war.

Instead of disaggregating economic outcomes, Imai & Weinstein (2000) instead disaggregate conflict itself. They distinguish between those conflicts that cover larger or smaller geographic areas and hypothesize that larger conflicts (in terms of geographical spread) will result in worse economic performance. Using a variety of regression techniques, they find that there is a negative correlation between the geographical spread of conflict and the decade average of economic growth for each country. Widespread conflicts, they argue, are more likely to result in damage to infrastructure, divestment from normal state spending, and capital flight. Their results suggest that widespread civil wars are five times more

costly than those fought over a narrower geographic area and can reduce GDP growth by 1.25% annually.

That civil wars negatively impact economic performance, while in line with the "war ruin" hypothesis, runs counter to the "war renewal" hypothesis. Some scholars have argued that wars, international wars in particular, can spur economic development[1]. The prevailing wisdom with regard to civil war, however, is that outcomes of this nature are the exception rather than the rule. In a test of economic and social determinants of post-conflict recovery in the context of civil war, Kang & Meernik (2005) find that these conflicts can lead, under different conditions, to either rapid or stagnant economic recovery. They conclude that the long-term economic impacts of civil war are largely dependent on post-war governance and foreign assistance. They also find that aggregate estimates of conflict destructiveness are negatively correlated with long-term growth.

Not only do several studies link civil war to domestic economic performance, there is also evidence that civil wars have regional economic consequences. Murdoch & Sandler (2002b) find evidence that states neighboring civil war states are more likely to experience poor short-term economic performance. They attribute this effect to the disruption of trade and uncertainty about the potential for conflict to spread across the border. In a follow up study, Murdoch & Sandler (2002a) suggest that the spatial dispersion of economic effects from civil conflict differ from region to region.

2.2. **Economic Performance → Civil War.** Much work has been done on the causal effects of economic performance on civil war. Indeed, there is likely an endogenous relationship between economic performance and civil war. While our work here sidesteps this argument by focusing exclusively on instances of civil war, we will briefly review the relevant literature. In a report for the World Bank by Collier et al. (2005), the authors describe what they term the *conflict trap*. States that find themselves in the *conflict*

[1]For a review of this discussion, see Rasler & Thompson (1985)

trap are those that have experienced civil war, are subsequently affected by its economic and social consequences, and are therefore more likely to experience further civil conflict. During civil wars, resources are diverted from productive economic activity to destructive activity. These diverted resources act to stall progress during the conflict and are often used to destroy the infrastructure necessary for growth afterwards. These changes to economic performance, as well as structural changes to the economy itself, make the resurgence of war more likely.

In accordance with this theory, Fearon & Laitin (2003) argue that poor economic growth is the primary condition conducive for civil war. More specifically, they believe that strong economic growth proxies for robust governance and that states with low GDP growth likely have infrastructures that are unable to implement counter-insurgent policies. In an effort to parse out the causal effect of economic shocks on civil war, Miguel et al. (2004) instrument income growth with rainfall. They find that rainfall is strongly correlated with income in sub-Saharan Africa, a region also prone to civil conflict in recent decades. Using a two-stage estimation approach, they conclude that income is correlated with the likelihood of civil war.

2.3. **Disaggregating Civil Wars.** Recently, scholars have begun to spatially disaggregate civil conflicts. New data allows researchers to focus on how the geography of internal conflict varies. Pierskalla & Hollenbach (2013) use subnational data on African states to asses the role cell phone coverage plays in facilitating violent conflict. They theorize that cell phone coverage will enhance the collective action capabilities of rebel groups by improving coordination, communication, and in-group monitoring. A series of empirical tests confirm this hypothesis and indicate that cell phone coverage corresponds to a 50%-300% increase in conflict likelihood for a given area (depending on the estimation strategy used).

Berman & Couttenier (2013) explore another sub-state determinant of civil conflict. Recognizing that economic shocks are associated with changes to the probability of civil conflict,[2] they seek to determine where conflict will emerge when these shocks occur. Given an external economic shock in a trading partner, Berman and Couttenier expect that states should be at an increased risk of experiencing conflict. However, not all locations within a state will feel the effects equally. Those areas most directly connected to the trading partner will be more likely to experience violent conflict than those areas that are less dependent on the trading partner. They operationalize this measure of dependence, or "remoteness," as distance from a seaport. Indeed, they find that conflicts are more likely to arise near seaports following an economic shock than they are further away.

Buhaug (2010) argues that the geography of conflict is a function of rebel strength. In particular, strong rebel groups are able to conduct military operations near capital cities while weak ones are not. These weaker groups are only able to survive in areas more distant from capitals. In our analysis, we control for the intensity and duration of conflict to account for this potential confound.

3. Spatial Distribution of Cities and Violence

The extant literature has made important strides in explaining the relationship between economic growth and civil conflict. Yet, none to our knowledge have explored the effects of subnational overlaps in the spatial distribution of cities and conflicts. We argue that this overlap is key to explaining variation in macroeconomic performance during civil conflict.

Our argument on the proximity of conflict to cities should not be confused with arguments focusing on simply the area covered by a conflict. Our argument explicitly differs in the hypothesized mechanism through which conflict affects economic performance. We

[2]For more, see Miguel et al. (2004) and Vargas & Dube (2013).

do not disagree that the spread of a conflict could impact state economic prospects, but we argue that a large conflict area is not a necessary condition for poor economic performance. Conflict area is only one possible proxy for overall destructiveness. However, conflicts with smaller spatial areas can be similarly disruptive if they are centered near urban centers. In fact, we anticipate measures of conflict proximity relative to cities rather than spread to be more appropriate to test the macroeconomic effects of conflict.

3.1. **Cities and Economic Growth.** That cities are central to national economic performance is well supported in the relevant literature. Myrdal & Sitohang (1957) were among the first to argue that once cities reach a certain size through the process of urbanization, they tend to become self-reinforcing growth centers through a process Myrdal termed as "cumulative causation". Chenery & Syrquin (1975) provided support for this idea by showing that sharp declines in fertility and substantial increases in growth per capita typically follow cases of urbanization. Jane Jacobs, a progenitor of the move towards focusing on urban centers, went farther than most in her time by arguing that cities are the primary motivators of state economies and should be given primacy over the nation state in economic analysis (Jacobs, 1969, 1984).

In the past three decades, as the pace of urbanization has accelerated, economists have devoted even more energy to investigating the role of city-level economic drivers (Lucas, 1988; Ciccone & Hall, 1996; Begg, 1999; Henderson & Wang, 2007). Most notably Krugman, in his seminal 1991 article, "Increasing Returns and Economic Geography", convincingly showed the importance of studying economic outcomes within a spatial context. A key finding of Krugman's work on economic geography has been the importance of agglomeration effects, the idea that "activities tend to cluster where markets are large and markets become larger where activities cluster" (Krugman, 1997). Henderson (2000) provides empirical evidence for why these agglomeration effects would manifest by showing that spatial clustering promotes economic efficiency in a variety of ways from simply

enabling savings in transport costs to producing more efficiently functioning labor markets.

In addition to agglomeration effects, there is an even simpler story, which can be traced back to Marshall (1920), that states geographic clustering of firms promotes valuable learning and exchange between actors. Lucas (1988) provides a formal treatment of this argument and shows that the accumulation of human capital generates positive spillovers, where if even one worker acquires a new skill then spatially proximate workers would all become more productive. Empirical estimates of agglomeration effects indicate that a doubling of employment density corresponds to a 5% increase in labor productivity (Ciccone & Hall, 1996; Ciccone, 2002). Glaeser et al. (1992) examine this problem empirically and show that cities are important for economic growth precisely because they lead to the knowledge spillovers that are important for innovation. Similar empirical results have been found by many others and have led to a growing consensus that cities can serve as important knowledge hubs for national economies (Jaffe et al., 1993; Glaeser, 1994; Firestone, 2010).

3.2. **Cities and Conflict.** The econometric evidence on the importance of cities has crucial implications for our understanding of the spatial structure of subnational economies. Specifically, at the subnational level, the economy can be thought of as consisting of "lumps" of productivity and swaths of areas that contribute little to macroeconomic growth (Venables, 2005). This implies that subnational conflicts will have heterogeneous effects on economic growth given their spatial proximity to economically relevant centers such as cities.

Glaeser & Shapiro (2002) discuss the historic role of cities in warfare and their current role with respect to terrorism. Cities, they argue, once provided safe haven in the midst of conflict; defense of a concentrated population is easier than defense of a dispersed population. However, as the tactics of warfare have shifted over the centuries, the relationship

between violent conflict and cities has become more complex. Dense populations also tempt belligerents and maximize the impact to cost ratio of a given violent action.

Additionally, warfare destroys transportation infrastructure, which can interfere both with commerce and with rebuilding during a conflict. In particular, conflict affects a citizen's ability and willingness to participate in commerce. When major population centers are threatened by violence, residents will be less likely to engage in economically productive activities. Violence near major population centers not only threatens residents directly, but impedes business by threatening trade between the population center and other cities or rural areas.

We extend this line of research by conceptualizing civil war not as a homogeneous national phenomenon, but as a diverse class of violent conflict with properties that distinguish the effects of one conflict from another. Since urban economies are responsible for a disproportionate share of national economic performance, civil conflicts in or near these engines of commerce should likewise exert a disproportionate influence on state performance.

3.3. **Descriptive Cases.** This hypothesis does not seem unknown to armed actors. The guerilla group Fuerzas Armadas Revolucionarios de Colombia (FARC) appears to have internalized these mechanisms. In 1998 and 1999, the organization moved its violent operations from mostly rural areas of Colombia into major cities and near to the capital (Petras and Brescia 2000). This coincided with economic strain caused by the implementation of an IMF/World Bank structural readjustment program. However, the timing was likely not coincidental. FARC advocates a number of political and economic reforms and chooses targets strategically related to these objectives. Figure 1 shows the spatial distribution of violence in Colombia from 1989 to 2008, where Bogotá is designated by a black diamond and major cities by black triangles. To determine the centroid locations of conflict we use the PRIO conflict site database developed by Hallberg (2012).

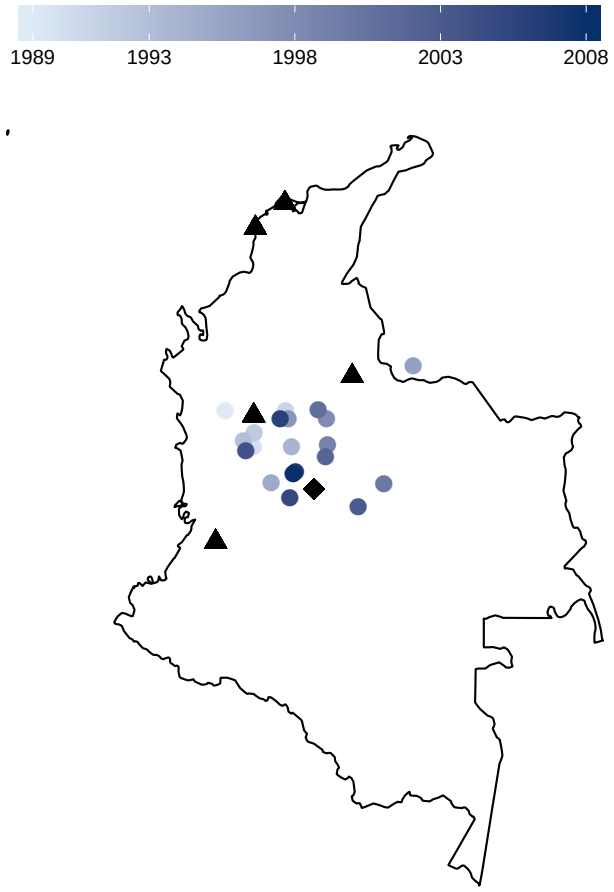


Figure 1. This map illustrates the geographic distribution of all conflict centroids in Colombia, according to the PRIO Conflict Site Dataset, and major cities from 1989 to 2008.

Forbes magazine, reporting on peace talks between FARC guerillas and the Colombian government in 2012, wrote:

> FARC's strategy and [beliefs have] always been to make economic pressure on both, multinational companies and the Colombian government. This has been done by attacking oil and natural gas infrastructure affecting companies such as Pacific Rubiales Energy, Oxy and Ecopetrol. For non-fuel related international companies with subsidiaries in Colombia, such as Goodyear, Nestle, Microsoft, Toyota, among others, FARCs modus

> operandi was mainly racketeering, kidnappings and extortion. (Flannery 2012)

By targeting economic centers and resource infrastructure, FARC can strain Colombia's economy, frighten investors, and bolster support from poor and rural workers sensitive to wealth disparity in the country. Rabasa & Chalk (2001) identify a three-pronged strategy pursued by FARC in the 1990s: to consolidate power in coca-growing regions, to conduct military operations in economically valuable areas, and to isolate major cities from the rest of the country by limiting communication and travel between them.

More recently, economic productivity in Syria has ground to a halt due to its ongoing civil war. Fighting in Syria has been widespread with particularly bloody battles of attrition fought over some of the country's largest cities. Both Aleppo and Damascus have been divided neighborhood-by-neighborhood by the Assad regime and various armed groups vying for control of the cities. Simultaneously, Syria's economy has shrunk dramatically. While FARC and insurgent groups in Syria seem to exploit their ability to target areas of economic importance including cities, other insurgencies tend to be more peripheral. India, for instance, has faced challenges by armed groups in its north-east for half a century. However, this area of India is remote, primarily agrarian, and relatively less populous than other parts of India. Indeed, for much of this period, India has experienced relatively robust economic growth. In figure 2, we show the geographic distribution of conflict in India from 1989 to 2007 again using the PRIO conflict site database. The story from this map is clearly quite stark from that of Colombia. Whereas in Colombia conflict had come right to the gates of major cities, in India conflict has been primarily confined to the periphery.

Nigeria and Cameroon have battled Boko Haram in a bloody conflict in their rural northern regions for half a decade. For the period between 2009 and 2013, the National Consortium for the Study of Terrorism and Responses to Terrorism (START) described

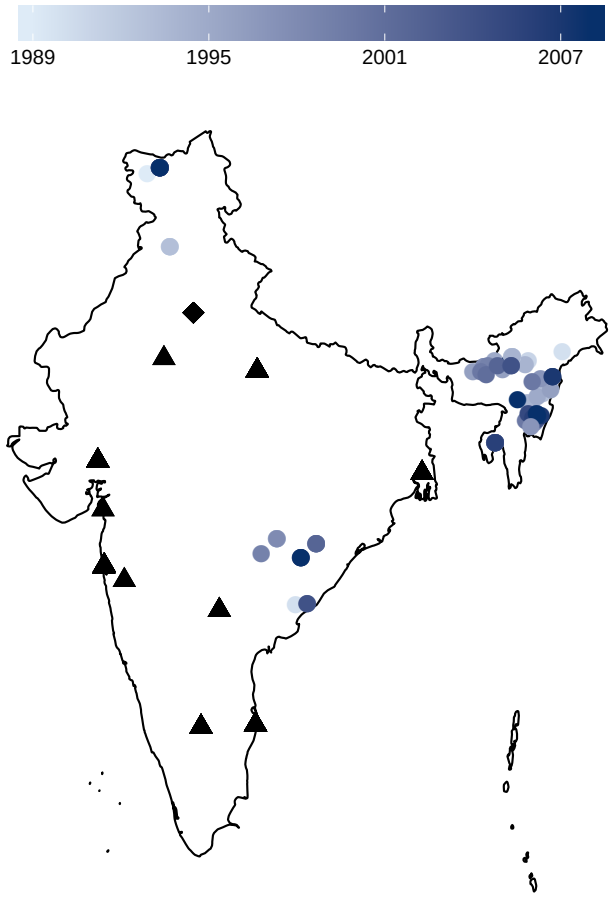


Figure 2. This map illustrates the geographic distribution of all conflict centroids in India, according to the PRIO Conflict Site Dataset, and major cities from 1989 to 2007.

Boko Haram as "among the deadliest [terrorist groups] in the world" (Pate et al., 2014). The group's tactics range from car and suicide bombings to direct assaults to mass kidnappings. Nonetheless, Nigeria and Cameroon have both maintained strong economic growth during this period. The African Development Bank Group (AFDB) described Nigeria's economic growth from 2004 to 2014 as "robust" and projected "moderate" growth of 5% for 2015 (AFDB "Nigeria" 2015). On Cameroon, the AFDB said "despite the security and humanitarian crisis in the region, Cameroonian growth remains strong at above 5%" (AFDB "Cameroon" 2015) .

It is important to note that Mexico does not appear in the civil war dataset chosen for this study. The UCDP definition of civil war requires that the conflict be fought over an "incompatibility that concerns government and/or territory," a criteria not strictly met by the organized crime violence experienced by the country (Themner, 2014, p.1). Nonetheless, we want to reiterate that this instance of armed conflict, of the magnitude typically associated with civil war, conforms to the expectations of our theory. Mexico, now nearly a decade into a violent and complicated conflict between several organized criminal enterprises and the federal government, has maintained healthy economic performance. For much of this time, the cartel violence generally occurred in rural areas along drug trafficking routes and not within major cities. Beittel (2011) writes that "drug trafficking-related killings remain concentrated in a relatively few cities." Meanwhile, several majors cities including the capital, Mexico City, have experienced relatively low levels of cartel violence.

The examples cited here seemingly break from the mold by prospering economically while facing high levels of internal violence. A common characteristic of these cases is the geographic distribution of conflict; violent armed groups operate primarily in rural areas away from major cities.

4. Data and Sample

4.1. **Measuring Spatial Proximity.** Our theoretical framework centers around the argument that variation in macroeconomic growth amongst countries in the midst of civil war can be explained by the spatial proximity between civil conflicts and urban centers. In constructing our dataset, we thus restrict the cases we include to only those country-years in which there was an internal armed conflict. Additionally, the unit of observation for this analysis is the country-year. This enables us to directly explore whether variation in growth amongst countries experiencing internal conflict can be explained by the proximity of conflict to cities.

To measure macroeconomic performance, we focus on annual percent change in GDP from the World Development Indicators. We adopt this parameterization of our dependent variable because we expect that conflicts proximate to urban centers will generate abrupt changes in macroeconomic growth. Much of the extant literature linking internal armed conflict and economic growth has approached this instead using five or ten year averages of GDP growth. However, averaging over an arbitrary set of years may obfuscate meaningful variation in GDP growth over short temporal spans.

We collect information on the location of conflicts from the PRIO Conflict Site Dataset (Hallberg, 2012). This dataset contains information on the geographical centers of armed conflict events and the area covered by each conflict at a yearly level from 1989 to 2008. In recent years, other geo-referenced datasets have been developed that go beyond just providing information on conflict centroids and area to providing an actual spatial grid structure representing high-resolution spatial distributions of conflict (Tollefsen et al., 2012). However, these data are not available globally and would therefore unnecessarily limit the external validity of the current analysis.[3] Other machine coded event datasets, while providing detailed coverage of events on a global scale, often approximate event locations based on descriptors in the source material or by the location of the reporting news agency itself. Because the location of conflict is critical for this analysis, the urban bias of disaggregated event data is unacceptable.

To construct a time-series cross-sectional database of urban centers, we turn to yearly editions of *The World Alamanac*. More refined subnational data listing urban centers by their contribution to economic output would be the most direct way to test our hypothesis; however, cross-national data such as this over the time period of our analysis, especially for developing countries, is simply not available. *The World Alamanac* lists the major cities in a country by population, thus providing us with a second best approximation of

[3]Nonetheless, we conduct a robustness test of our primary models using data from the Armed Conflict Location and Event Data (ACLED) Project. The results described here hold with the new data. A description of the ACLED modeling strategy and results can be found in the Appendix.

the urban centers that are most relevant for a particular national economy. Typically, the *Almanacs* list at least three major cities, including the capital, for each country and year from 1989 to 2008. Because the *Almanacs* are not perfectly consistent from year to year, we opted to code cities with a five year rolling window. That is, cities listed in the 1995 *Almanac* are also included in our dataset for years 1993-1997. In doing so, we hope to minimize the effect of coding inconsistencies on the part of *The World Almanac*. Also, as a more conservative test of our hypothesis, we replicate our models using the distance of conflict from each capital city rather than our preferred measure of minimum distance to a major urban center. While our hypothesis is most accurately represented by distance from any major urban centers, distance from capital cities provides an appealing and consistent alternative measure. Every country has a capital city in our sample so using this alternative measure does not rely on differing population or density thresholds across countries that must be used in coding major cities.

In figure 3, we show the geographic distribution of conflicts and cities. The centroid locations of conflicts are shown by red dots. Not surprisingly, in many cases conflict locations are clustered within specific parts of a country. In most cases, this clustering is indicative of the same conflict moving within the geographic boundaries of a country over time. The blue diamonds in figure 3 denote the locations of major cities from 1989 to 2008. Countries shaded in grey are those for which no armed conflict took place in this period according to the PRIO dataset.

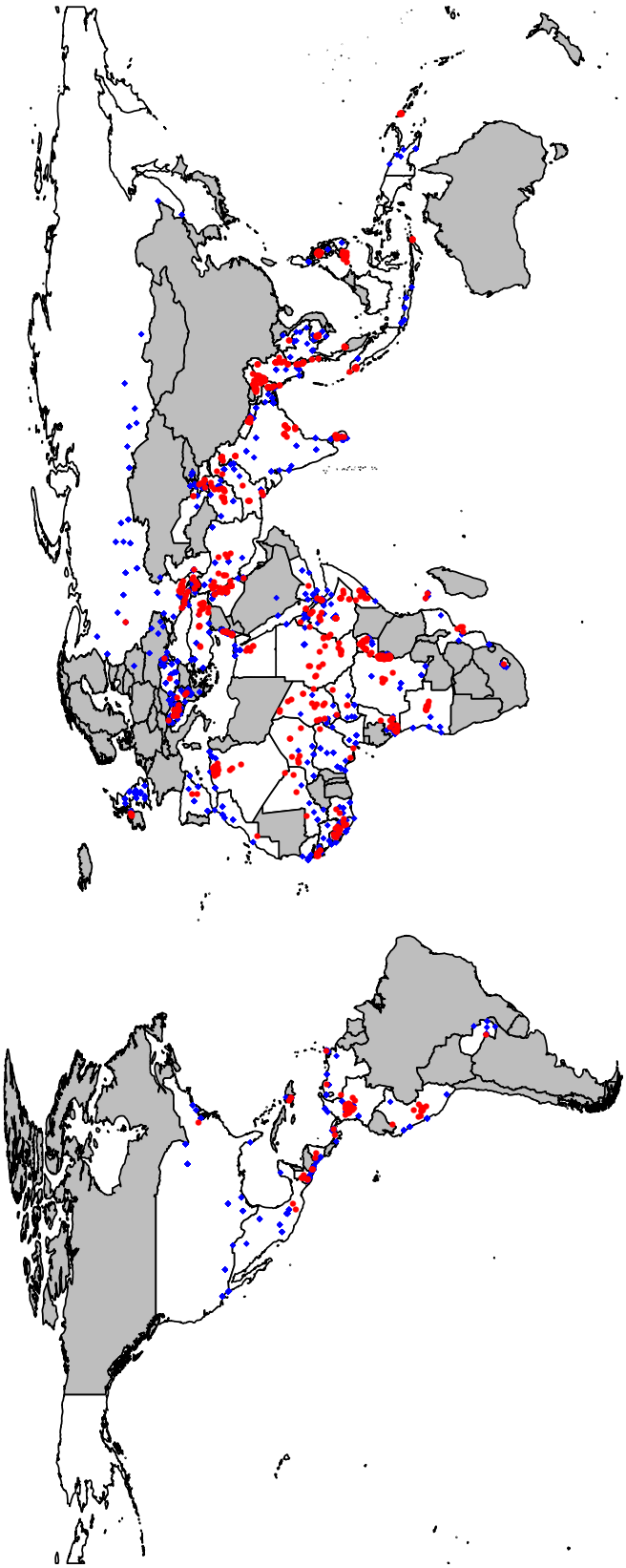


Figure 3. This map illustrates the geographic distribution of all internal armed conflicts and major cities from 1989 to 2008. Countries for which no armed conflicts are recorded are shaded in grey.

Using our geo-referenced conflict and urban center data, we proceed to compute the proximity of every domestic armed conflict in a country-year to every urban center listed in that year.[4] Since our unit of analysis is the country-year, we aggregate the distance between conflicts and major cities by calculating the minimum logged distance any conflict is from a major city. For example, if a country faces four conflicts in a year, the datapoint for that country-year would be the minimum distance any conflict centroid is from any city centroid. In addition to identifying the minimum distance a conflict is from any city, we also create a variable that measures minimum distance of any conflict from the capital of the country. Given the importance of cities as drivers of macroeconomic growth, the proximity of conflict to even one city should have at least a noticeable short-term impact on growth. Thus this choice of aggregation conforms closest to our theoretical claims about how macroeconomic growth can be severely disrupted in cases where conflicts are proximate to major cities.[5]

Figure 4 provides a cursory illustration of the relationship between GDP growth and our spatial proximity variables. Each bar on the leftmost panel represents the average GDP growth rate across country-years for which the minimum distance between the centroid of the conflict and capital city fell within a certain quartile range across our full sample. Clearly, as the minimum distance from a conflict to capital city declines, there is a sharp decline in average growth rates for the following year. On the rightmost panel of this figure, the same relationship holds when we test the effect of the minimum distance of conflict from any major urban center.

4.2. **Empirical Model.** Next, we move beyond this cursory illustration and explicate our full modeling strategy. Given how we constructed our spatial proximity of conflict

[4]Distances between centroid locations were computed using an iterative method of distance calculation proposed by Vincenty (1975).

[5]We ran robustness tests using an alternative aggregation method for conflict distance. Rather than selecting the minimum distance of any conflict to any city in a given year, we took the average minimum distance of each conflict to the nearest city. The results were statistically significant and substantively similar across parameterizations.

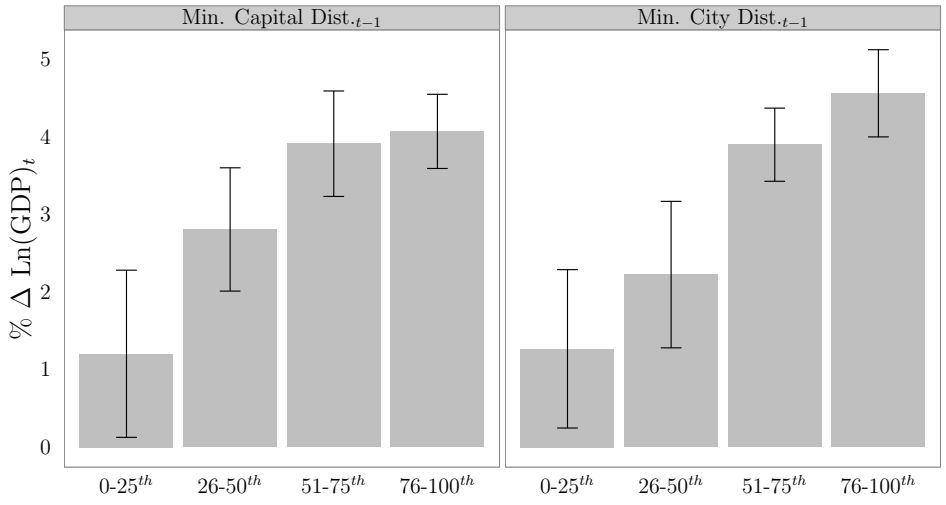


Figure 4. Average percent change in GDP growth at time t by distance from conflict to capital city on rightmost panel at time $t-1$, and from conflict to any city on the leftmost. The error bars represent the 95% confidence interval around the mean.

variables, it would make little sense to include both capital distance and city distance within one model. The obvious problem we would run into is that there would be cases for which the minimum distance of a conflict to any city would be the same as the minimum distance to the capital. Thus we estimate two separate models, one where we include the minimum distance from a conflict to the capital and the other where we include the minimum distance to any urban center. In addition to the inclusion of our spatial proximity covariates we include a number of control measures to account for extant explanations of how civil war dynamics affect GDP growth and to mitigate omitted variable bias.

From the PRIO Armed Conflict dataset we bring in additional information about conflict intensity, duration, the area covered by the conflict, and the number of conflicts (Themnér & Wallensteen, 2014). Conflict intensity is a binary that distinguishes between minor armed conflicts (between 25 and 999 annual battle deaths) and wars (at least 1000 annual battle deaths), and we set this equal to one if any of the conflicts in a country year

were classified as a war and zero if not.[6] In aggregating conflict duration to the country year level, we bring in the duration (measured in years) of the longest lasting conflict by a certain country-year. Conflict area measures the conflict zone in square kilometers. To include this in our country-year model, we sum up the area covered by each conflict being fought and divide by the total land area of the country. Finally, the number of conflicts is simply a count of the number of ongoing internal armed conflicts in a country-year according to the PRIO dataset.

Aggregating each of the PRIO conflict descriptive measures in this way is to help account for those countries in which conflicts are especially intense, cover large areas, have been long-lasting, or are one of many ongoing conflicts. Given the findings in the extant literature, our expectation is that each of these measures should have a negative effect on economic growth. Though we also expect that the substantive implications of any one of these measures will matter less than the adverse effect to economic growth accounted for by the spatial proximity of conflict to urban centers.

We also include a number of variables that help to capture structural and institutional aspects of the country itself. First, we include binary indicators for whether the country is classified as upper income by the World Bank and for the level of inflation in the country. Second, we control for the level of democracy in the country using the polity index (Marshall et al., 2013). We also control for the proportion of a country's GDP that is made up of natural resource rents. This is a particularly important variable to control for as countries that draw a large share of their GDP from natural resource rents likely rely less on urban centers to serve as drivers of growth. Finally, given that the time frame of our sample overlaps with the occurrence of two major global economic crises, the 1997 Asian financial crisis and the 2008 financial crisis, we add a control for the average GDP growth across all countries in the world.

[6]We also conduct robustness tests in which high intensity and low intensity subsets of the data are modeled separately. These can be found in Table 4 of the Appendix.

To estimate variation in growth rates, we use a random effects model clustered on countries. A random effects specification is preferred to using fixed effects here as we are not interested in estimating the change in GDP within units over time; rather our purpose is to explain variation between units. However, to ensure that it is also statistically justifiable to make this choice we run a Hausman specification test (Greene, 2008). For both the minimum conflict distance to any and to capital city specifications we fail to reject the null hypothesis at both the 90 and 95% confidence intervals, providing at least some initial evidence that we are justified in our choice. However, as Clark & Linzer (2015) note, the Hausman test should not be the sole determinant for choosing between fixed or random effects. We utilize their more nuanced typology for further arbitrating between fixed and random effects, and again we find that random effects are preferred in this case.[7]

Another reason why we choose to employ a random effects framework is because of our concerns with the unchanging and time invariant nature of where conflict is taking place relative to major urban centers. In Thailand, for example, the distance between conflict and urban centers in our dataset just ranges from approximately 790 to 810 kilometers, which basically indicates that conflicts are simply isolated to a specific part of the country. If we employed a fixed effects model to test our hypothesis we would in essence be removing many of these types of countries from our sample, or as Beck & Katz (2001) would put it "throwing out the baby with the bathwater".[8]

[7]We take into consideration the size of the dataset (both number of units, in this case countries, and number of observations per unit, conflict instances) and the level of correlation between the regressor and unit effects. In our case, we have over 70 countries but for over half of those we only have five conflict instances or less. Given such a data structure, Clark & Linzer (2015) recommend to examine the level of correlation between the regressor and unit effects to determine the appropriate modeling framework. For both our distance models, the level of correlation between the regressor and unit effects is less than 0.20, which accords with a random effects recommendation under the framework described by Clark & Linzer (2015).

[8]This same patterns holds for many other countries in our sample such as Mozambique (range: $\approx$ 705 - 860 km), Bangladesh (range: $\approx$ 198 - 237 km), and Cambodia (range: $\approx$ 131 - 197 km). These ranges become even further compressed when we log them for use in our regression analysis.

For this analysis we have 505 country-year cases of civil war from 68 different countries during the period between 1989 to 2008. The model formula (omitting error terms) is shown below, where $Ln(Min.\ Conflict\ Dist.)_{i,t-1}$ is a placeholder for $Ln(Min.\ Capital\ Dist.)_{i,t-1}$ and $Ln(Min.\ City\ Dist.)_{i,t-1}$:

$$\begin{aligned}
\%\Delta GDP_{i,t} = {} & \beta_1(Ln(Min.\ Conflict\ Dist.)_{i,t-1}) \\
& + \beta_2(Conflict\ Intensity_{i,t-1}) + \beta_3(Conflict\ Duration_{i,t-1}) \\
& + \beta_4(Conflict\ Area_{i,t-1} \,/\, Land\ Area_{i,t-1}) \\
& + \beta_5(Number\ of\ Conflicts_{i,t-1}) + \beta_6(Upper\ Income_{i,t}) \\
& + \beta_7(Inflation_{i,t-1}) + \beta_8(Democracy_{i,t-1}) \\
& + \beta_9(Resource\ Rents/GDP_{t-1}) + \beta_{10}(World\ GDP\ Growth_t)
\end{aligned}$$

4.3. **Baseline Effect of Civil Conflict on Growth.** Before we move to discussing the results of the model specification that we have described above, we estimate a simple baseline model to assess the effect of any civil conflict on growth. For this model we use a specification as similar as possible to the one we explicated in the previous section, with the key difference being that this baseline model is estimated using a full country-year panel with fixed effects.[9] The dependent variable is again annual percent change in GDP from the World Development Indicators, and the key independent variable here is whether or not the country was engaged in a civil war in the previous year according to the PRIO Armed Conflict dataset. Since we are using a full country-year panel, we have to omit the PRIO conflict specific variables (e.g., conflict intensity, conflict duration) as they are undefined for country-year observations in which no conflict was taking place.

[9]In choosing between fixed and random effects, we again began by running a Hausman test and followed the recommendations set out in Clark & Linzer (2015). In this case we found that the fixed effects specification was preferred.

The rest of the independent variables are similar to the model specified in the previous section. Specifically, we include: whether or not the country is classified as upper income, the lagged version of inflation, the lagged version of polity, the lagged version of resource rents as a proportion of GDP, and the average GDP growth across all countries in the world.

We will eschew discussing the controls since the primary purpose of this analysis is to determine a baseline effect for civil war. Additionally, for the sake of space we do not show the full results from this regression, but they are available in section 1 of the Appendix. The key result pertains to the civil war variable for which we estimate a regression coefficient of approximately -2.568 with a standard error of 0.502.[10]

To assess the substantive significance of this variable we turn to a simulation-based analysis. We simulate two scenarios, one in which a civil war occurred and another in which there is no civil war. All of the other parameters are set to their median value. Next, we conduct 1,000 random draws from a multivariate normal distribution to obtain a distribution of point estimates for each regression coefficient. Last, we simply matrix multiply the draws from the multivariate normal with the transposed scenario matrices to obtain expected values of GDP growth given the two scenarios. The resulting distributions are shown in figure 5.

[10]This estimate corresponds closely to the result found by Collier (1999).

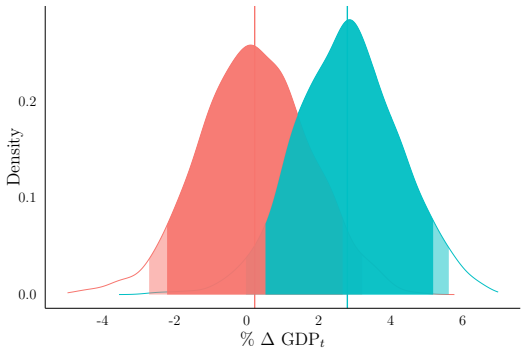
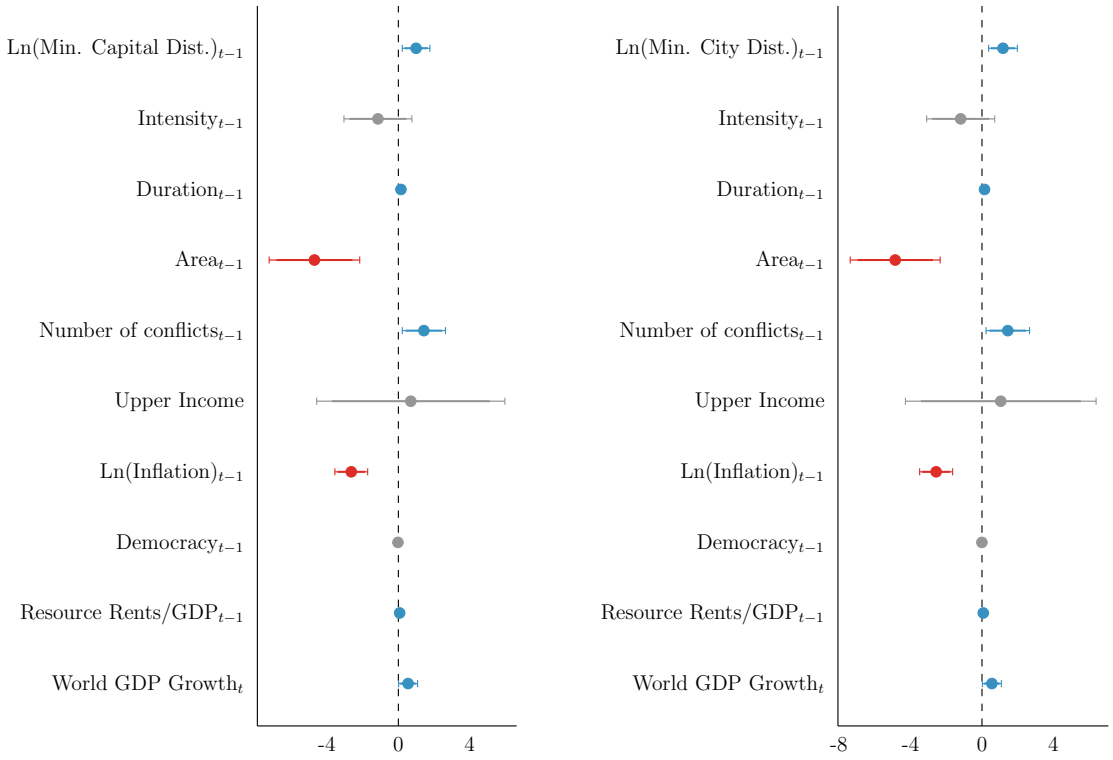


Figure 5. Distributions of expected values for GDP growth based on whether or not a country experienced a civil war in the previous year. The distribution in red designates the scenarios for which a civil war occurred and in blue if a civil war did not occur. The 90% interval of each distribution is shaded in a dark blue or red color and the 95% in a lighter color.

The analysis here highlights that, while there is a noticeable substantive difference in the expected GDP growth of civil war and non-civil war countries, there is also a large amount of inferential uncertainty in these estimates. We argue that this is because the effect of civil conflict on economic growth becomes particularly relevant when that conflict is proximate to economic points of interest such as capital cities and major urban centers. In other words, the heterogeneity of civil war leads to a diversity of economic outcomes for affected states.

5. Results

We depict the results of our conflict distance models in figures 6a and 6b. The results across the two models are broadly consistent, so we will discuss them in tandem. Surprisingly, conflict duration and the number of conflicts a country is facing do not relate to GDP growth in the direction that we expected. The intensity of a conflict aligns in the direction that we would expect though its effect is marginal. Additionally, the effect of having a high proportion of a country's land area immersed in conflict is sharply negative and aligns with the findings in the extant literature. As expected, inflation has a sharp



(a) Capital City **(b)** Any Major City

Figure 6. Regression results using conflict distance from capital city on the left, and the chart on the right shows regression results using minimum conflict distance from any major city. Darker colors indicates that the coefficient estimate is significantly different from zero at a 95% CI, while lighter the same for a 90% CI. Grey indicates that the estimate is not significantly different from zero at either of those intervals.

negative effect on GDP growth. Countries deriving greater shares of their GDP from natural resource rents see slighlty higher levels of growth, and, not surprisingly, the average of world GDP growth is positively related to our dependent variable.

Turning to our hypothesis, we find strong support for the argument that spatial proximity of conflict to either a capital city or any major urban center is associated with lower levels of GDP growth. The positive coefficient on the logged minimum conflict distance variables indicates that conflicts closer to major cities have an adverse effect on economic growth.

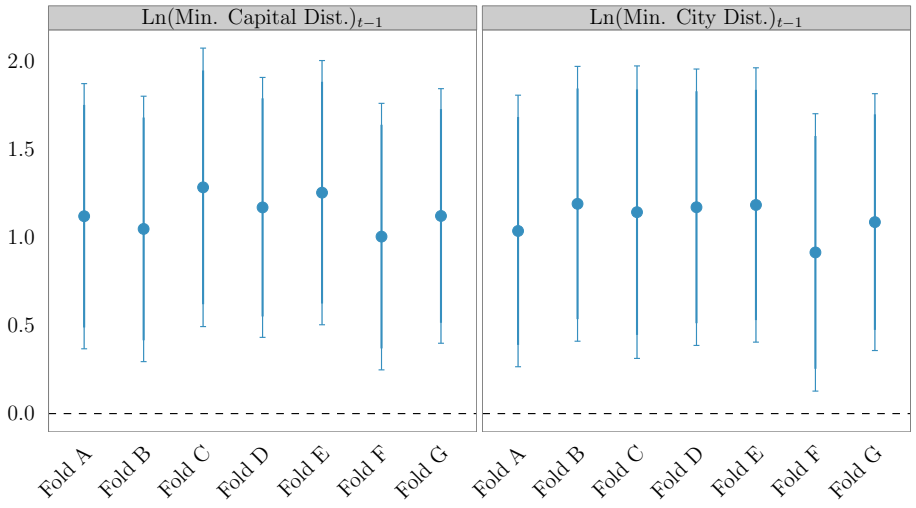
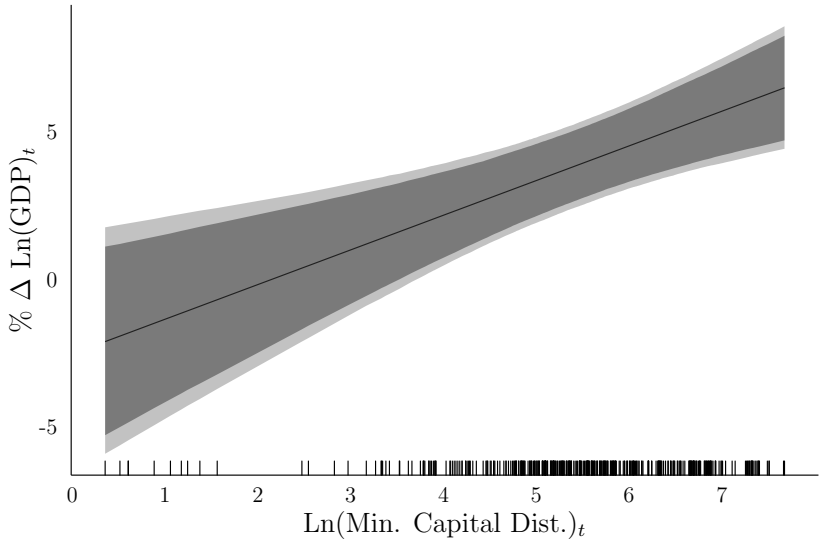


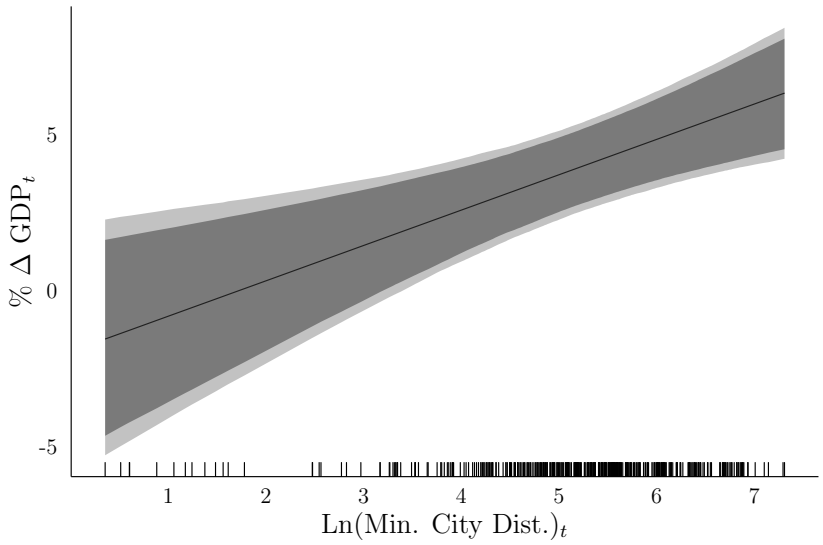
Figure 7. Each line here in the left panel shows the coefficient estimate of $Ln(Min.\ Capital\ Dist.)_{i,t-1}$ from rerunning the model on six random subsamples within the dataset. The panel on the right shows the same for $Ln(Min.\ City\ Dist.)_{i,t-1}$. All the covariates used in the initial model shown in figure 6 were included as well.

To ensure that our parameter estimates are robust to changes in our sample, we run a six-fold cross-validation. This analysis helps us to understand whether some of the subsets in our dataset follow a different pattern than what is in the broader set (Beck, 2008). To conduct the cross-validation, we randomly split the 68 country observations in our dataset into seven approximately equal subsets. Each subset ends up containing a minimum of approximately 65 cases. We then run each model shown in figure 6 seven times, where in each iteration we left out one subsample. The results of this analysis are depicted in 7, and we can clearly see that the parameter estimates for our two spatial proximity variables remain consistent across the exclusion of any of the folds.

To assess the substantive effect of these results, we conduct a number of simulations. We set up scenarios where we hold all variables to their medians except for logged minimum conflict distance, which we range from its minimum to maximum value. Next, we conduct 1,000 random draws from a multivariate normal to obtain distributions for the point estimates of each of the regression coefficients. After obtaining these distributions, we



(a) Capital City



(b) Any City

Figure 8. Expected values for GDP growth based on scenarios where all variables are held to their constants but Ln(Min. Conflict Dist.) varies from its minimum to maximum. The 90% interval of each distribution is shaded in dark grey and the 95% in a lighter color.

calculate the predicted value of GDP growth based on the conditions set by the scenarios. We plot the results of this analysis in figures 8a and 8b.

The simulation results for both $Ln(Min.\ Capital\ Dist.)_{i,t-1}$ and $Ln(Min.\ City\ Dist.)_{i,t-1}$ are quite similar. In both cases, conflicts located farther away from major cities have almost no adverse impact on economic growth, and, in fact, are likely to still see positive growth. As the proximity of conflicts to urban centers increases, however, we can clearly see substantive declines in growth rates. Thus, through utilizing these spatial proximity measures, we can begin to explain why there is such meaningful variation in economic performance amongst countries facing internal armed conflict.

6. Conclusion

This piece of research has sought to explain observed discrepancies in the economic impact of civil conflict. Violent intrastate conflicts have occurred in one third of countries in just the past several decades. While civil wars seem to primarily afflict developing states, their actual economic impacts are still subject to debate. Some states weather civil conflict for years or even decades while simultaneously prospering economically. Other states see their economies stall and suffer substantial declines in growth. Despite this heterogeneity observed among civil war states, the individual characteristics of civil conflict that lead to disparate outcomes have only recently been subject to academic scrutiny. In this first step of a larger project to distinguish the geography of civil conflict, we have contributed to our understanding of why some civil conflicts impact economic performance more severely than others. To do this, we have used a novel approach in the study of civil conflict to distinguish between spatially dissimilar events and shown that this new measure of interest, the minimum distance between conflict epicenters and major population centers, is a substantive determinant of economic growth. While the proximity of conflict to major cities helps us to better understand how domestic armed conflict produces disparate economic outcomes across countries, one can imagine a number of other hypotheses that derive from this research.

Population centers are critical to economic performance, but still tell only a part of the story. States rely on various natural resources as well as critical infrastructure to prosper. Trade depends on safe and reliable access to ports, airports, and railways. Businesses rely on safe and reliable access to natural resources. Foreign direct investment relies on the investor's perception of state stability. While there is a large literature on natural resources and conflict at the state level, little work has disaggregated this data and explored the micro-relationship between conflict and resources. Future work in this line of inquiry will explore each of these hypotheses using geospatial data on the economic assets of interest. One additional question that springs from our work here is whether only certain rebel groups are able to initiate conflicts near urban centers. Specifically, it could be the case that only the strongest, richest rebel groups are able to survive and initiate conflicts proximate to the capital or other major cities. In future research, it would certainly be interesting and valuable to determine whether there are certain rebel group characteristics that relate to the geolocation of conflicts relative to points of economic interest.

Looking beyond aggregate measures of state economic performance, we hope to further explore how the geography of conflict impacts the surrounding region. A growing body of work suggests that civil conflict is, in and of itself, contagious. However, the precise mechanisms that determine contagion risk are still unclear. We propose that looking at the location of conflict within a state will shed light on how conflicts and their economic effects spread across borders. The same logic that applies to the hypotheses presented in this paper applies to neighboring states as well. Resources and population centers that are near the border between a peaceful state and a civil war state may be impacted in the same way that resources and cities within the conflict state are. This may help to explain the disparate regional economic effects of civil war observed by Murdoch & Sandler (2002a).

7. Appendix

7.1. **Baseline Effect of Civil Conflict on Growth.** In Table 1 below, we show the fixed effects regression results for the model in which we utilize a full country year panel in order to define a baseline effect of civil war on economic growth.

Table 1. This table shows the results of a country fixed effects regression in which we are utilizing a full country year dataset.

	Dependent variable:
	Δ GDP$_t$
Civil War$_{t-1}$	-2.568^{***}
	(0.502)
Ln(Inflation)$_{t-1}$	-3.040^{***}
	(0.228)
Democracy$_{t-1}$	0.043
	(0.045)
Resource Rents/GDP$_{t-1}$	0.115^{***}
	(0.018)
World GDP Growth$_t$	0.673^{***}
	(0.081)
Countries	160
Observations	3,002
Note:	*p<0.1; **p<0.05; ***p<0.01

7.2. **Conflict Distance Models in Tabular Format.** Here we present the results of our models measuring the effect of conflict distance in a tabular format, results for distance from the capital city are shown in Table 2 and for any major city in Table 3 below. The first column in each of the tables below is a simple linear model regressing the conflict distance parameter on GDP Growth, in the second we add our controls, in the third we include random effects, varying intercepts, for country, in the fourth random effects for year, and in the last random effects for both country and year.

Table 2. Table below depicts a tabular version of the regression results that we depicted through a coefficient plot in figure 6a. Additionally, this table shows the results of running the regression in a piecewise fashion.

	Dependent variable:				
	Δ GDP$_t$				
	(1)	(2)	(3)	(4)	(5)
Ln(Min. Cap. Dist.)$_{t-1}$	1.193***	1.242***	0.994**	1.242***	0.994**
	(0.347)	(0.338)	(0.394)	(0.338)	(0.394)
Intensity$_{t-1}$		−0.921	−1.146	−0.921	−1.146
		(0.925)	(0.971)	(0.925)	(0.971)
Duration$_{t-1}$		0.147***	0.144***	0.147***	0.144***
		(0.030)	(0.037)	(0.030)	(0.037)
Area$_{t-1}$		−2.696**	−4.704***	−2.696**	−4.704***
		(1.141)	(1.295)	(1.141)	(1.295)
Number of conflicts$_{t-1}$		1.177***	1.431**	1.177***	1.431**
		(0.418)	(0.617)	(0.418)	(0.617)
Upper Income		1.136	0.696	1.136	0.696
		(1.904)	(2.691)	(1.904)	(2.691)
Ln(Inflation)$_{t-1}$		−2.533***	−2.639***	−2.533***	−2.639***
		(0.427)	(0.469)	(0.427)	(0.469)
Democracy$_{t-1}$		−0.043	−0.024	−0.043	−0.024
		(0.072)	(0.090)	(0.072)	(0.090)
Resource Rents/GDP$_{t-1}$		0.054*	0.072**	0.054*	0.072**
		(0.029)	(0.036)	(0.029)	(0.036)
World GDP Growth$_t$_l0		0.584**	0.543**	0.584**	0.543**
		(0.272)	(0.272)	(0.272)	(0.272)
Intercept	−3.297*	0.451	2.453	0.451	2.453
	(1.928)	(2.887)	(3.349)	(2.887)	(3.349)
Countries	71	69	69	69	69
Observations	519	505	505	505	505
Random Effects	None	None	Country	Year	Country + Year
Note:	*p<0.1; **p<0.05; ***p<0.01				

Table 3. Table below depicts a tabular version of the regression results that we depicted through a coefficient plot in figure 6b. Additionally, this table shows the results of running the regression in a piecewise fashion.

	Dependent variable:				
	Δ GDP$_t$				
	(1)	(2)	(3)	(4)	(5)
Ln(Min. City Dist.)$_{t-1}$	1.326***	1.363***	1.174***	1.363***	1.174***
	(0.366)	(0.357)	(0.410)	(0.357)	(0.410)
Intensity$_{t-1}$		−0.981	−1.190	−0.981	−1.190
		(0.925)	(0.970)	(0.925)	(0.970)
Duration$_{t-1}$		0.146***	0.143***	0.146***	0.143***
		(0.030)	(0.037)	(0.030)	(0.037)
Area$_{t-1}$		−2.920***	−4.853***	−2.920***	−4.853***
		(1.121)	(1.283)	(1.121)	(1.283)
Number of conflicts$_{t-1}$		1.180***	1.444**	1.180***	1.444**
		(0.417)	(0.620)	(0.417)	(0.620)
Upper Income		1.605	1.051	1.605	1.051
		(1.927)	(2.720)	(1.927)	(2.720)
Ln(Inflation)$_{t-1}$		−2.433***	−2.564***	−2.433***	−2.564***
		(0.427)	(0.471)	(0.427)	(0.471)
Democracy$_{t-1}$		−0.018	−0.003	−0.018	−0.003
		(0.071)	(0.091)	(0.071)	(0.091)
Resource Rents/GDP$_{t-1}$		0.053*	0.072**	0.053*	0.072**
		(0.029)	(0.036)	(0.029)	(0.036)
World GDP Growth$_t$_l0		0.616**	0.554**	0.616**	0.554**
		(0.271)	(0.271)	(0.271)	(0.271)
Intercept	−3.575*	−0.407	1.360	−0.407	1.360
	(1.913)	(2.984)	(3.438)	(2.984)	(3.438)
Countries	71	69	69	69	69
Observations	519	505	505	505	505
Random Effects	None	None	Country	Year	Country + Year
Note:	*p<0.1; **p<0.05; ***p<0.01				

7.3. **Estimating Models Separately for High and Low Intensity Conflicts.** Here instead of treating conflict intensity as a control, we re-do our primary models estimating the effect of distance on growth, but restricting to the civil conflicts coded as wars and then a separate model for civil conflicts coded as low intensity events. In both low intensity and high intensity cases we find that the conflict distance variables remain significant and in the expected direction, but the β estimate of our distance variables is noticeably higher when using high intensity versus low intensity civil conflict cases. The results are presented in Table 4 below.

Table 4. The table below shows the results of four different regressions using random effects clustered on countries. The first column shows the results for a regression using only conflicts described as low intensity according to PRIO on Δ GDP$_t$ using the Ln(Min. City Dist.)$_{t-1}$ variable along with the full set of controls, with the exception of the intensity variable. The second column runs a similar regression but using only conflicts described as high intensity. The latter two columns repeat this analysis for the Ln(Min. Cap. Dist.)$_{t-1}$ variable.

	Dependent variable:			
	Δ GDP$_t$			
	(Low Intensity)	(High Intensity)	(Low Intensity)	(High Intensity)
Ln(Min. City Dist.)$_{t-1}$	1.163***	2.281**		
	(0.409)	(1.130)		
Ln(Min. Cap. Dist.)$_{t-1}$			1.009***	2.884***
			(0.385)	(1.104)
Duration$_{t-1}$	0.151***	0.227**	0.153***	0.204**
	(0.035)	(0.091)	(0.035)	(0.090)
Area$_{t-1}$	−3.794***	−8.995***	−3.603***	−7.606***
	(1.345)	(2.636)	(1.366)	(2.703)
Number of conflicts$_{t-1}$	1.367**	1.262	1.332**	1.406
	(0.573)	(3.599)	(0.573)	(3.556)
Upper Income	2.176	−1.637	1.741	−0.390
	(2.342)	(9.430)	(2.300)	(9.316)
Ln(Inflation)$_{t-1}$	−2.020***	−2.984***	−2.087***	−3.030***
	(0.499)	(0.727)	(0.497)	(0.713)
Democracy$_{t-1}$	−0.051	0.117	−0.073	0.118
	(0.089)	(0.214)	(0.089)	(0.211)
Resource Rents/GDP$_{t-1}$	0.106***	−0.034	0.107***	−0.052
	(0.036)	(0.067)	(0.036)	(0.067)
World GDP Growth$_t$	0.560*	0.461	0.546*	0.422
	(0.299)	(0.482)	(0.300)	(0.476)
Intercept	−1.315	−3.701	−0.387	−7.567
	(3.504)	(9.592)	(3.395)	(9.453)
Countries	66	30	66	30
Observations	403	131	403	131
Note:	*p<0.1; **p<0.05; ***p<0.01			

7.4. **ACLED Analysis.** The Armed Conflict Location and Event Dataset provides an alternative source of information on the subnational spatial distribution of armed conflict (Raleigh et al., 2010). This dataset is, at the time of writing, limited to Africa and therefore was not selected for the primary analysis presented in the text. It does, however, offer us a valuable opportunity to validate our results. Here, we have replicated the primary model described in Section 4.

In order to match our existing data structure, it was necessary to aggregate the ACLED data to the country-year level. We did this by first subsetting ACLED to the years 1989-2008 and then selecting only conflict sites with at least 25 fatalities in each given year. The 25 fatalities threshold is intended to mirror the PRIO coding criteria and to prevent very low-fatality events from biasing our estimates of conflict location toward high-population areas. Covariates created with PRIO but unavailable in ACLED are omitted. The analysis procedure then continues as described in Section 4: the minimum distance measure is calculated as the natural logarithm of the average distance in kilometers from any conflict site to the nearest major city (or capital). The results are presented in Table 5 below.

Table 5. The table below shows the results of two regressions using random effects clustered on countries. The first column shows the results using conflict proximity from any major city and the second conflict proximity from the capital. Conflict data here is based on ACLED.

	Dependent variable:	
	Δ GDP$_t$	
	(1)	(2)
Ln(Min. City Dist.)$_{t-1}$	0.585**	
	(0.254)	
Ln(Min. Cap. Dist.)$_{t-1}$		0.660**
		(0.259)
Number of conflicts$_{t-1}$	9.091***	9.291***
	(1.834)	(1.832)
Ln(Inflation)$_{t-1}$	1.167	0.921
	(0.851)	(0.815)
Democracy$_{t-1}$	0.147	0.116
	(0.217)	(0.217)
Resource Rents/GDP$_{t-1}$	−0.0001	0.004
	(0.048)	(0.048)
World GDP Growth$_t$	1.034**	0.877**
	(0.442)	(0.439)
Intercept	−19.308***	−18.398***
	(5.477)	(5.252)
Countries	22	22
Observations	101	101
Note:	*p<0.1; **p<0.05; ***p<0.01	

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