Military Conflict and the Economic Rise of Urban Europe*

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Abstract

We present new city-level evidence about the military origins of Europe's economic "backbone," the prosperous urban belt that runs from the Low Countries to northern Italy. Military conflict was a defining feature of pre-industrial Europe. The destructive effects of warfare were worse in the countryside, leading rural inhabitants under the threat of conflict to relocate behind urban fortifications. Conflict-related city population growth in turn had long-run economic consequences. Using GIS software, we construct a novel conflict exposure measure that computes city distances from 231 major conflicts from 1300 to 1799. We find a significant, positive, and robust relationship between conflict exposure and historical city population growth. Next, we use luminosity data to construct a novel measure of current city-level economic activity. We show evidence that the economic legacy of historical conflict exposure endures to the present day.

Keywords: conflict, city populations, historical legacy, economic development, GIS
JEL codes: C20, O10, N40, N90, P48, R11

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1 Introduction

Scholars argue that cities played a central role in the economic and political rise of Europe from medieval backwater to dominant modern power. Weber's (1922, p. 1223) labeling of the city as the "fusion of fortress and market" succinctly describes two key historical functions: security and commerce.[1] Relative to the undefended countryside, city fortifications enabled individuals to better protect themselves and their property from the threat of military conflict. Meanwhile, cities facilitated economic activity through a wide variety of mechanisms.

This paper performs an econometric analysis of the city-level links between historical conflict exposure, city population growth, and long-run development. To the best of our knowledge, it is among the first to systematically examine these linkages. Our argument proceeds as follows. Different regions saw different amounts of military conflict in pre-industrial Europe. The destructive effects of warfare were worse in the countryside, leading rural inhabitants under the threat of conflict to relocate behind the relative safety of city walls. Conflict-related city population growth in turn had long-run development consequences through mechanisms including state building, social capital, technological change and human capital, and agglomeration effects. We further discuss our hypotheses and provide historical background in Section 2.

To rigorously test our argument, we assemble a novel city-level database that spans the medieval period to the present day. We first collect data on historical conflicts according to Bradbury (2004) and Clodfelter (2002), two comprehensive military sources. We identify the geographic locations of all major conflicts fought on land from 1300 to 1799 in Continental Europe, England, and the Ottoman Empire. In total, our data include 231 conflicts.

We take historical city population data from Bairoch et al. (1988). Our benchmark sample is balanced and includes 308 cities in Continental Europe with populations observed at century intervals from 1300 to 1800. To expand the breadth of our analysis, we also use an alternative sample that adds 20 cities for England.

Current city-level GDP data are not available for over two-thirds of sample cities. To complete our database, we collect satellite image data on light intensity at night from the U.S. Defense Meteorological Satellite Program's Operational Linescan System. This unique data source provides a concise measure of city-level economic activity that is widely available. There is a strong positive correlation between luminosity and income levels (Henderson et al., 2011). To complement the city-level luminosity measure, we use the

[1] We thank David Stasavage for alerting us to Weber's remark.

available data on alternative economic outcomes from the Urban Audit of Eurostat (2013). Sections 3 and 6 describe our database at length.

We use our database to evaluate our argument in two steps. We first test for the relationship between conflict exposure and city population growth in pre-industrial Europe. Our variable of interest measures city exposure to military conflicts per century. To construct this measure, we geographically code the locations of all sample conflicts and cities. Next, we use GIS software to compute vectors that measure the distance from each sample city to each sample conflict for each century. We then sort each vector by shortest city distance from a conflict to longest and compute cutoff distances. Finally, we sum the number of conflicts that took place within and outside the cutoff distances each century for each sample city. We further discuss the conflict exposure variable in Section 4.

Our panel regression analysis models historical city population growth as a function of conflict exposure, city fixed effects that account for unobserved time-invariant city-level heterogeneity including geographical features and initial economic and social conditions, time fixed effects that account for common shocks, time-variant controls, and city-specific time trends that account for unobservable features that changed smoothly but differently across cities. The results show a significant positive relationship between conflict exposure and city population growth in pre-industrial Europe, with the magnitudes of the point estimates falling the farther away conflict locations were. These results are robust to a wide range of specifications, controls, and samples.

The second part of our analysis tests for the long-run economic legacy of historical conflict exposure. To construct our variable of interest, which measures total city exposure to military conflicts from 1300 to 1799, we aggregate the per-century conflict exposure variable as described above. This measure indicates that there is a strong positive relationship between the top historical conflict zones and the prosperous urban belt, also known as the economic "backbone" of Europe, that runs from the Low Countries through western Germany to northern Italy.

Our cross-sectional regression analysis models current urban economic activity as a function of historical conflict exposure, city-level geographical and historical controls, and country fixed effects that account for unobserved but constant country-level heterogeneity. The results suggest that the economic consequences of historical conflict exposure persist over time. There is a positive and highly significant relationship between historical conflict exposure and current economic activity. These results are again robust to a wide range of specifications and controls.

The cross-sectional results accounts for many city-level features. However, there could still be omitted variables that affect both historical conflict exposure and current city-level economic outcomes. To address this possibility, we conduct a sensitivity analysis based on Altonji et al. (2005), Bellows and Miguel (2009), and Nunn and Wantchekon (2011) that estimates how much greater the influence of omitted variables would have to be, relative to the observed controls, to fully explain away the positive relationship between historical conflict exposure and current city-level economic activity. This analysis indicates that the influence of unobservable features would have to be more than five times greater on average. Thus, it is unlikely that unobservables fully drive our cross-sectional estimates.

As an alterative strategy, we perform an IV analysis based on Stasavage (2011, ch. 5) that exploits the ninth-century break-up of Charlemagne's empire. We argue that it is possible to view the way in which the Carolingian Empire was partitioned as the outcome of a set of historical "accidents" and use this partitioning to derive a potential source of exogenous variation in historical conflict exposure. Section 7 describes our IV approach at length. The 2SLS results indicate that the relationship between historical conflict exposure and current economic activity is significant, positive, and robust. This analysis provides further evidence that the economic consequences of historical conflict exposure are persistent.

Our paper belongs to the literature that examines the historical roots of current economic outcomes (e.g., Acemoglu et al., 2001; Nunn, 2009, provides an overview). Specifically, our paper is related the literature that examines the legacy of warfare in European history. To explain the emergence of modern European states, Tilly (1990) emphasizes the role of military competition. Besley and Persson (2009) and Gennaioli and Voth (2012) develop and test formal models that link warfare and state capacity, while Hoffman (2011) relates military competition in Europe to global hegemony. O'Brien (2011) argues that the early rise of the British fiscal state, established for security reasons, was an important precursor to the Industrial Revolution.[2] Our paper complements this literature by testing the relationship between historical conflict exposure and long-run economic performance in Europe at the city level.[3]

In this respect, two close antecedents to our paper are Rosenthal and Wong (2011) and

[2]Also see Brewer (1989). Dincecco and Katz (2013) show evidence for a significant positive relationship between greater state capacity and economic performance in European history.

[3]Recent works that examine the long-run legacy of historical warfare in other contexts include Dincecco and Prado (2012), which uses nineteenth-century country-level conflict data to instrument for the effect of fiscal capacity on current economic performance, and Besley and Reynal-Querol (2012), which uses pre-colonial African country and within-country conflict data to test the relationship between past conflicts and current socioeconomic outcomes. Scheve and Stasavage (2010, 2012) perform cross-country tests for the relationship between nineteenth- and twentieth-century mass war mobilizations and redistributive taxation, while Aghion et al. (2012) test the relationship between military rivalry and educational investments from the nineteenth century onward. Ticchi and Vindigni (2008) provide a theoretical analysis of the relationship between external military threats and democratization.

Voigtländer and Voth (2012, 2013). Both works link historical warfare and city population growth to economic outcomes in pre-industrial Europe vis-à-vis China. Rosenthal and Wong (2011) argue that military conflicts gave rise to city-based manufacturing, because capital goods were safer behind city walls. Voigtländer and Voth (2012) argue that the increase in wages after the fourteenth-century Black Death became permanent due to dynamic interactions between frequent wars, disease outbreaks, and city growth. Our paper complements these works in at least two ways. First, we focus our quantitative analysis at the city level rather than at more aggregate levels. Second, we assemble novel data for historical conflict exposure and current luminosity.

Finally, our paper is related to the literature that takes the city as the unit of analysis to explain long-run economic and political development in Europe. These works include Bairoch (1988), Guiso et al. (2008), Dittmar (2011a), van Zanden et al. (2012), Bosker et al. (2013), Cantoni and Yuchtman (2012), Abramson and Boix (2013), and Stasavage (2013). We complement this literature by bringing the role of military conflicts to bear on long-run city-level outcomes.[4]

The rest of the paper proceeds as follows. The next section describes our hypotheses and provides historical background. Section 3 presents the historical conflict and city population data and descriptive statistics. Section 4 describes the panel econometric methodology. Section 5 presents the results for the relationship between conflict exposure and city population growth in pre-industrial Europe. Sections 6 and 7 test for the long-run economic legacy of historical conflict exposure. Section 8 concludes.

2 Historical Overview

We claim that historical conflict promoted city population growth, which had key implications for long-run economic outcomes. In this section, we develop these hypotheses. We first discuss the relationship between conflict exposure and city population growth in pre-industrial Europe, and then the potential long-run economic consequences of conflict-related city population growth.

[4]Glaeser and Shapiro (2002) perform a theoretical and empirical analysis of the historical and modern links between mass violence and cities. They show cross-country evidence for a significant positive relationship between terrorism and urbanization over the 1970s.

2.1 Conflict Exposure and City Population Growth

Urban fortifications enabled rural populations to escape some of the most destructive consequences of traditional warfare. Glaeser and Shapiro (2002, p. 208) describe this "safe harbor" effect as follows:

> The first, and probably most important, interaction between warfare and urban development is that historically cities have provided protection against land-based attackers. Cities have the dual advantages of large numbers and walls and thus, holding the size of the attack constant, it is much better to be in a city than alone in the hinterland. Indeed, the role of cities in protecting their residents against outside attackers is one of the main reasons why many cities developed over time.

There is ample evidence for the "safe harbor" effect in pre-industrial Europe. Rural abandonment due to the threat of conflict was widespread in Italy (Lane, 1999, p. 130, Caferro, 2008, p. 187). Similarly, the threat of conflict induced peasants to flee the countryside in France (Meuvret, 1946, Fowler, 1971, p. 13, Bois, 1984). The threat of conflict also led to rural depopulation in the Low Countries and in parts of Germany (e.g., Van der Wee, 1963, p. 269, Parker, 1975, pp. 50-2).[5]

Military campaigns could inflict numerous costs on rural populations.[6] There was the potential for manpower losses in the fields, first because many peasants were possible war recruits and second due to campaign-related deaths (Gutmann, 1980, p. 75). There was also the potential for destruction to crops, farms, and homes, typically because of arson. Peasants not only had to bear larger tax burdens during wars, but were held responsible for repair costs for damages to physical infrastructure like bridges (Caferro, 2008, p. 187). Peacetime preparations for future campaigns were also burdensome, because peasants typically had to billet soldiers (Hale, 1985, p. 197).

The siege, a main tactic of traditional military campaigns which could last months or years, was particularly harmful to rural populations. Opposition soldiers confiscated livestock and grain for food and straw and wood from buildings as energy sources (Hale, 1985, p. 191). Urban defenders themselves would strip the countryside of crops in a preemptive measure to deprive attackers (Bachrach, 1994, p. 125). To secure a clear line of vision and fire, urban defenders would also destroy property (e.g., farms, mills, orchards)

[5] Glaeser and Shapiro (2002) also describe a "target" effect that made larger cities more attractive targets for attackers. Our econometric analysis addresses this concern.

[6] Voigtländer and Voth (2012) argue that the economic costs of military conflict were small overall. What is important for our hypothesis is that the destructive effects of conflict were generally worse in the countryside than in cities.

within several miles of the city (Hale, 1985, p. 192). Finally, malnutrition and disease were two consequences of siege warfare (and historical warfare more generally) whose negative effects on rural populations could endure long after campaigns were over (Hale, 1985, p. 193, Landers, 2003).

Although scholars have noted the positive relationship between the threat of military conflict and city population growth in pre-industrial Europe, to the best of our knowledge there has been no systematic test of it. Our first contribution will be to perform such an analysis ahead.[7]

2.2 Long-Run Economic Consequences

Our account suggests that historical conflict promoted city population growth in pre-industrial Europe. We now describe four potential mechanisms through which conflict-related city population growth could have had long-run economic consequences: state building, social capital, technological change and human capital, and agglomeration effects.

State Building

A large literature including Mann (1986), Brewer (1989), Tilly (1990), Downing (1992), Ertman (1997), Hoffman and Rosenthal (1997), Hoffman (2011), O'Brien (2011), and Gennaioli and Voth (2012) argues that military competition in pre-industrial Europe gave rise to more effective government, as states made fiscal innovations to gather new revenues and win wars. Besley and Persson (2009) and Dincecco and Prado (2012) show evidence that current state capacity is greater for countries that fought more past wars. Fiscal innovations at the city level were often precursors to country-level innovations. Stasavage (2011, ch. 2) shows evidence that city-states were the first to develop markets for long-term public debt. Similarly, Karaman and Pamuk (2013) find a strong relationship between war pressures and state capacity for urbanized economies.

Social Capital

Beyond state capacity, cities may have also promoted the development of cultural and social capital. Greif and Tabellini (2010, 2012) argue that, to sustain wide-scale cooperation, cities in European history promoted a form of generalized morality that went beyond

[7] Beyond conflict threats, there were other potential incentives to relocate to cities, including a greater variety of consumer goods and higher wages (Voigtländer and Voth, 2012). We discuss urban-rural wage differences in the next subsection.

kin relations. They show evidence that historical urbanization rates were low in regions where extended families were common. Similarly, Guiso et al. (2008) find that the medieval establishment of free cities had long-run consequences for differences in social capital between northern and southern Italy. Also in the Italian context, Bigoni et al. (2013) show experimental evidence that links current North-South differences in social trust to historical levels of conflict exposure.

Technological Change and Human Capital

Rosenthal and Wong (2011, ch. 4) argue that military conflict affected the location of manufacturing activities, because their consequences were more destructive in the countryside. Armies, bandits, and warlords could appropriate moveable capital (e.g., equipment, supplies, workers) during political instability. Although military conflict could also affect cities through plunder or trade disruption, urban populations could construct fortifications (e.g., city walls) that reduced potential expropriation. Thus, military conflict increased capital costs by greater amounts in the countryside than in cities. Furthermore, unlike farming, manufacturing was not strictly bound to the land.

This argument has two implications. In regions that saw more military conflict, the threshold level of capital at which producers chose to locate in cities should have been lower than in peaceful regions. Thus, military conflict not only led to greater city population growth, but also to an urban bias in manufacturing.[8] Furthermore, factor cost differences should have induced urban manufacturers to become more capital-intensive over time. Wages were higher in cities, because of both a higher risk of disease and higher food prices. Meanwhile, capital costs were lower, since the difficulty of monitoring increased rural borrowing costs.[9] Thus, to minimize production costs, urban manufacturers had an incentive to substitute capital for labor. This incentive created the basis for technological change, whereby cost-minimizing urban manufacturers came to rely to ever greater extents on innovations to machinery.[10]

Demand for new and better technologies may have created demand for better skilled workers, who in turn may have been better able to generate further technological innova-

[8] Coleman (1983) and Voigtländer and Voth (2012) also highlight the urban concentration of manufacturing in early modern Europe.

[9] Voigtländer and Voth (2012) also argue that urban wages were typically higher, which they claim was an important incentive to move to cities. For urban mortality data, see Woods (2003) and Clark and Cummins (2009). For rural-urban capital cost differences, see Hoffman et al. (2011).

[10] On the other hand, urban manufacturing success could have been short-lived. Stasavage (2013) argues that, due to new barriers of entry established by oligarchies, politically autonomous cities in early modern Europe eventually stagnated.

tions (Acemoglu, 2009, ch. 10). Better skilled workers may have also been more suited to cope with the changes and disruptions brought by new technologies (Nelson and Phelps, 1966). van Zanden (2009, pp. 85-8) argues that there was rapid growth in human capital in early modern Europe, and that literacy rates were highest among urban populations.[11]

Agglomeration Effects

Producers can benefit when they locate near one another in cities (Glaeser, 2010).[12] The sources of agglomeration are savings on the costs of exchange for goods, labor, and ideas. Agglomeration decreases the costs of transporting goods across space (Krugman, 1991). For example, if an input supplier locates near a final goods producer, then both firms increase productivity by saving on transport costs. Similarly, urban labor markets can be advantageous (Marshall, 1890). When local labor markets are thick, workers can more efficiently find jobs at productive firms and change them if firm productivity changes. Thick labor markets can also promote efficient matches between workers and firms in terms of skill and experience levels. Finally, interactions among knowledgable neighbors can facilitate the formation and spread of ideas. Bairoch (1988, pp. 323-9) argues that cities played a leading role in technological innovation and diffusion in pre-industrial Europe.

Summary

In summary, we identify two key implications that will guide our empirical analysis. First, population growth in pre-industrial Europe should have been greater for cities that were more exposed to conflict. Second, greater historical conflict should have had long-run economic consequences at the city level through a variety of mechanisms.

3 Data

3.1 Construction Methods

Our historical urban population data are from Bairoch et al. (1988), which provides population data for all European cities that ever reached 5,000 inhabitants at century intervals for 800 to 1700 and half-century intervals for 1750 to 1850.[13] The Bairoch et al. data are

[11] Similarly, formal education was more prevalent in cities than in the countryside (Bairoch, 1988, pp. 189-92). This period also saw the establishment of the first universities (Cantoni and Yuchtman, 2012).

[12] Ciccone (2002) finds large agglomeration effects for Western European countries.

[13] The Bairoch et al. data include populations for urban neighborhoods that were directly adjacent to historical city centers. For further details, see Dittmar (2011a).

unbalanced. Less than 40 cities are included in 800, while more than 2,100 are included by 1800.[14] To enable comparisons among similar cities, we focus on balanced panels. Similarly, to maintain estimation intervals of equal length, we focus our analysis on century (rather than the half-century) intervals. Our sample period runs from 1300 to 1800.[15] We linearly interpolate, but never extrapolate, missing observations. To account for city-level political, cultural, economic, religious, and educational characteristics, we merge the 1300-1800 sample with data from Bosker et al. (2013), which leaves us with 308 sample cities for Continental Europe (we describe the Bosker et al. data in the next section).[16] Given the focus of our historical overview in Section 2, we designate this city sample as our benchmark. To expand the breadth of our analysis, we use an alternative sample that adds 20 cities for England.

Our historical conflict data are from Bradbury (2004) and Clodfelter (2002), two comprehensive sources for factual material on historical military conflicts. Bradbury (2004) provides data on all military conflicts in the medieval West. The Bradbury data span the whole geographical area of medieval Europe including Eastern Europe, along with military conflicts outside of Europe including Byzantine warfare, horde invasions, and the Crusades. These data are organized into chapters, each of which covers a different geographical area of medieval warfare. Within each chapter, there is a concise summary of each military conflict fought, including a description of the conflict's location, approximate date, and type (e.g., siege). The Bradbury data end in 1525. For the sixteenth century onward, we use military conflict data from Clodfelter (2002), which is organized into chapters by century and geographical area (the Clodfelter data start in 1500). We focus on military conflicts fought in Continental Europe, England, and the Ottoman Empire. Like the Bradbury data, the Clodfelter data include factual information about each conflict (i.e., location, date, type).

Differences in conflict magnitudes could have had diverse impacts on city population growth. Although it would be ideal to use detailed fiscal or conflict data (e.g., military expenditures, government debts, battle casualties) to measure conflict magnitudes, historical data that would enable us to perform this task are not systematically available. To address this concern, we restrict our benchmark conflict sample to military conflicts listed as major

[14] De Vries (1984) is an alternative data source for European historical urban populations. However, the De Vries data do not start until 1500.

[15] The logic of warfare changed over the nineteenth century due to improvements in transport and communications technologies and the rise of the mass army, severely reducing the traditional safe harbor advantage of cities (Glaeser and Shapiro, 2002, Onorato et al., 2013). For this reason, we end our sample period in 1800.

[16] We revised the Bairoch et al. data according to Bosker et al. (2013, data appendix) for some years for Bruges, Cordoba, London, Palermo, and Paris.

land battles or sieges by Bradbury (2004, pp. 359-66) for 1300 to 1499 and by Clodfelter (2002, pp. 7-27, 35-61, 71-116) in his war summaries for 1500 to 1799.[17] As an alternative, we restrict our sample to major battles and exclude sieges.[18]

Historical accounts are not specific enough to pinpoint the exact geographical location of each military conflict. We thus approximate the location of each military conflict by the settlement (hamlet, village, town, city) nearest to where it took place. This method is not only feasible, given the lack of available historical information, but is also intuitive, since battles were typically named after nearby settlements. To illustrate, we use the Battle of Mons-en-Pévèle, fought on 18 July 1304 between Philip IV of France and William of Jülich of Flanders. This eponymously-named battle took place within the confines of the commune of Mons-en-Pévèle in the far north of France. We thus assigned the geographical coordinates of Mons-en-Pévèle to it (50° 28′ 49.08″ N, 3° 6′ 11.16″ E).

While the Bradbury data typically list individual conflicts along with their approximate locations, the Clodfelter data typically list wars, which could span wide geographical areas. To identify the approximate locations in which wars were fought, we decomposed all wars into the individual conflicts that comprised them. Table 1 displays an example using the Thirty Years' War (1618-48), which was comprised of 20 major conflicts. The first listed conflict, the Battle of White Hill, was fought on 8 November 1620 between Catholic and Protestant forces at White Hill near Prague. Since White Hill is now part of Prague, we assigned the geographical coordinates for Prague to it (50° 5′ 0″ N, 14° 25′ 0″ E).

3.2 Descriptive Statistics

Table 2 summarizes the historical conflict data. Panel A displays the descriptive statistics for military conflicts per country and century from 1300 to 1800 for Continental Europe, and Panel B for England. The last line reports the combined totals for Panels A to B. The descriptive statistics indicate that warfare was a key feature of European history. 231 major land conflicts were fought from 1300 to 1799, of which 88 percent took place in Continental

[17] Tilly (1990) and Jaques (2007) are two other sources for historical conflict data. However, Tilly (1990, p. 72, table 3.1) presents wars rather than individual conflicts. Although Jaques (2007) lists individual conflicts, he does not distinguish between major and minor conflicts (p. xi). He also includes naval conflicts (p. xiv), which we exclude, because it is not clear how the relationship between conflict exposure and city population growth as described in Section 2 should apply in the naval context. Gennaioli and Voth (2012) use the Jaques data. The descriptive statistics for our historical conflict data, which we describe ahead, differ from the Gennaioli-Voth descriptive statistics, in part because we exclude minor conflicts and naval conflicts, both of which they include. However, both sets of descriptive statistics strongly support the argument that, in line with Tilly (1990), warfare was a defining feature of pre-industrial European history.

[18] Our main results in Section 5 are also similar to those reported if we include minor conflicts, of which there were over 500 from 1300 to 1800, or restrict our sample to sieges only.

Europe and 12 percent in England. On average, there were 41 major conflicts per century in Continental Europe. The total number of major conflicts grew century by century from the fifteenth century onward. The fifteenth century saw the least warfare, with 13 major conflicts, while the eighteenth century saw the most, with 123. Germany and Italy had the largest shares of major conflicts at 19 percent each, or an average of 7.60 major conflicts per century, followed by France (18 percent share, 7.20 average) and the Low Countries of Belgium and the Netherlands (17 percent share, 6.80 average). Thus, the top conflict zones coincided with Europe's urban belt as described in Section 2. England also saw a large amount of major conflicts, with a total of 27, or an average of 5.40 per century. Figure 1 maps the locations of military conflicts in Continental Europe from 1300 to 1799. The locus of conflicts in the Low Countries, northern France, and northern Italy largely overlaps with the urban belt.

How about historical city population growth? Table 3 displays urban populations (in thousands) per country and century using our balanced panel of 308 Continental European sample cities from 1300 to 1800. Similar to major conflicts, total urban inhabitants grew century by century from the fifteenth century onward, from 4.6 million in 1400 to 9.7 million in 1800, a 111 percent increase.[19] Likewise, average city size more than doubled over this period from 15,000 to 31,000. Italy had the largest urban population by 1800, at 2.6 million, followed by France (2.2 million), Germany (1.2 million), Spain (1.1 million), and the Low Countries (783,0000). This set of countries largely overlaps with Europe's urban belt. Significant city population growth also took place in England, which had an urban population of 1.6 million by 1800.

Overall, the descriptive statistics highlight the positive relationship between military conflicts and city population growth in pre-industrial Europe. To provide a rigorous test of this relationship that controls for observable and unobservable factors, we now perform an econometric analysis.

4 Econometric Methodology

The linear equation that we estimate is

$$\Delta P_{i,t} = \alpha + \zeta P_{i,t-1} + \sum_{n=1}^{2} \beta_n C_{i,t}^{n,j(t)} + \gamma' \mathbf{X_{i,t}} + \mu_i + \lambda_t + \epsilon_{i,t}, \tag{1}$$

[19] Although we cannot compute urbanization rates because country-level population data (e.g., from Maddison, 2010) are not always available for the 1300-1800 period, it is unlikely that country-level population growth alone accounts for larger urban populations. For example, Voigtländer and Voth (2012, fig. 4) show a clear increase in the urbanization rate for Europe from around 3 percent to 9 percent in the three centuries that followed the Black Death. Also see Bairoch (1988, table 11.2).

where $\Delta P_{i,t}$ is log population growth between century $t-1$ and t for city i (for example, between 1400 and 1500), $\Delta P_{i,t} = ln(\frac{P_{i,t}}{P_{i,t-1}})$, $P_{i,t-1}$ is log city population at $t-1$ (in this example, in 1400), $C_{i,t}^{n,j(t)}$ is the number of military conflicts between the minimum distance and the median cutoff distance j of city i for $n=1$ and between the median cutoff distance j and the maximum cutoff distance for $n=2$ over the previous century (in this example, from 1400 to 1499), $\mathbf{X_{i,t}}$ is a vector of city-level controls, μ_i and λ_t are fixed effects by city and century, and $\epsilon_{i,t}$ is a random error term. We cluster standard errors by city to account for any within-city correlations in the error term that may bias our estimates.[20]

We construct our variable of interest, $C_{i,t}^{n,j(t)}$, which measures city exposure to military conflicts per century, as follows. As described in the previous section, we geographically code the locations of all sample conflicts and cities. Using geographical information system (GIS) software, we then compute vectors that measure the geodesic or "as the crow flies" distance in kilometers from each sample city to each sample conflict for each century.[21] Next, we sort each vector by shortest city distance from a conflict to longest. We then compute cutoff distances for each century. Our benchmark measures use the median cutoff distance to delineate between "nearer" ($\leq$ p50) and "farther away" conflict exposure ($>$ p50, $\leq$ p90) each century. As an alternative, we divide our conflict exposure measures into four, rather than two, categories: "nearest" ($\leq$ p25), "near" ($>$ p25, $\leq$ p50), "farther" ($>$ p50, $\leq$ p75), and "farthest" ($>$ p75, $\leq$ p90). Finally, we sum the number of major conflicts that took place within ($\leq$ p50) and outside ($>$ p50, $\leq$ p90) the median cutoff distances each century for each sample city. For example, of the 123 total major conflicts fought over the 1700s, Zurich was exposed to 104 that fell within the median cutoff (0-906 km away) and 15 that fell outside (906-1,813 km away). By contrast, Lisbon was only exposed to 7 major conflicts that fell within the median cutoff distance, but 59 outside. Thus, according to our measure, Zurich was more exposed to major conflicts than Lisbon over the 1700s. Our econometric analysis uses the natural logarithm of the conflict exposure measure and adds a small number $C_{i,t}^{n,j(t)} = \log(1 + Conflict\ exposure_{i,t}^{n,j(t)})$, since some city-conflict observations take the value of zero for some cutoff categories. This transformation not only enables us to include all observations, but also attenuates any extreme variability in the city-conflict data and facilitates the interpretation of the results.[22] Table 4 presents the descriptive statistics for our conflict exposure measure.

[20]The main results remain similar in magnitude and significance if we cluster standard errors by region or country.

[21]For robustness, we also tested city-conflict distances weighted by terrain slopes for a variety of cost-penalty schemes according to the R package gdistance (van Etten, 2012). The main results were very similar to those reported in Sections 5 and 6.

[22]Our main results are also robust to adding an even smaller number (e.g., 0.01).

To explain the emergence of the urban belt in pre-industrial Europe that ran from the Low Countries through western Germany to northern Italy, Rokkan (1975) and Tilly (1990) emphasize initial economic conditions. Rokkan (1975) argues that important river trade routes promoted early urbanization, while Tilly (1990) highlights the role of early commercial activities. Similarly, Abramson and Boix (2013) emphasize agricultural productivity, arguing that urban clusters formed in areas that could support non-farming populations, who then specialized in proto-manufacturing. By contrast, Stasavage (2011, ch. 5) emphasizes initial political conditions, focusing on the ninth-century collapse of the Carolingian Empire and its subsequent division into three kingdoms. He argues that the political fragmentation that resulted, which was greatest in the former Carolingian heartland known as Lotharingia, spurred the growth of cities as local power bases. Indeed, Lotharingia corresponds with the territory that would later comprise Europe's urban belt. Finally, Greif and Tabellini (2010, 2012) emphasize initial social and cultural conditions over the Middle Ages. They argue that weak kinship-based relations led to the emergence of self-governed cities to sustain wide-scale cooperation and provide public goods.

Initial conditions may have influenced the patterns of military conflicts that we observe. For example, cities and regions that were initially rich may have been exposed to more conflicts, both because there were enough resources available to mount new attacks and because victory led to greater spoils (Glaeser and Shapiro, 2002). Our city fixed effects control for initial economic conditions. City fixed effects also account for other economic, geographic, agricultural, and political features of cities, including whether they were ocean, sea, or river ports or islands, hubs located at Roman road crossings, elevations and ruggedness, and political status following the Carolingian partition. Likewise, city fixed effects control for initial local social, cultural, and linguistic structures (Greif and Tabellini, 2012, use time-invariant regional-level characteristics to measure kin structures).

Beyond time-invariant city-specific features, we also account for common macro-level shocks across time. Voigtländer and Voth (2012) argue that the Black Death, which killed up to one-half of Europe's population from 1348 to 1350, was a widespread population shock that had important implications for the demand for manufactured goods and urbanization. Similarly, Hoffman (2011) and Gennaioli and Voth (2012) argue that the military revolution, a broad set of technological and organizational changes over the sixteenth and seventeenth centuries that led to costlier and longer conflicts, had major political and economic consequences. Our use of time fixed effects enables us to control for large, century-specific shocks like the Black Death and the military revolution.

In addition to fixed effects, we control for time-variant cultural, economic, educational, political, and religious city features. It is possible that cities with larger or smaller populations grew at different rates due to resource constraints, such as the city's ability to obtain greater food supplies (Dittmar, 2011b, Stasavage, 2013). To control for convergence dynamics, we always include the city's population level at time $t-1$ (in logs).[23] De Long and Shleifer (1993), Acemoglu et al. (2001), and van Zanden et al. (2012) claim that representative government had positive economic consequences. By contrast, Stasavage (2013) argues that, due to their oligarchic structures, self-governing cities had ambiguous or even negative economic consequences. To account for city autonomy, we include a binary variable that takes the value 1 for each century that a city was a self-governing commune. This control also addresses the argument by Greif and Tabellini (2010, 2012) about city autonomy and the evolution of generalized morality. Cantoni and Yuchtman (2012) argue that medieval universities trained lawyers that developed legal and administrative infrastructures that reduced trade costs. To account for higher education, we include a binary variable that takes the value of 1 for each century that a city hosted a university. To control for a city's place in the political hierarchy, we include a binary variable equal to the value 1 for each century that a city was a sovereign capital. To account for ecclesiastical importance, we include a binary variable that takes the value 1 for each century that a city was a bishop or archbishop seat. Finally, to control for religious orientation, we include a binary variable equal to the value 1 for each century that a city was under Muslim rule. We code the commune, university, capital, bishop, and Muslim variables according to Bosker et al. (2013). Panel A of Table 5 displays the descriptive statistics for the panel regression variables.

Our modeling approach controls for unobserved cultural, economic, educational, geographic, political, and social factors that were constant for each city and across each century. We also account for time-varying observable factors. However, the model assumptions can still be violated in a manner that generates correlations between our variable of interest and the error term and biases our results.

One concern is omitted variable bias. There may still be unobserved factors that had time-varying, city-specific consequences that also affected urbanization patterns. We address this concern in several ways. First, we modify our benchmark model to include city-specific time trends, which control for unobservable factors that changed smoothly but differently across cities. For example, city-specific time trends help us to account for the potential divergence in city population growth related to the rise of Atlantic trade and colonialism (Acemoglu et al., 2005), and the advent of new technologies (e.g., printing press, agricultural innovations). As a further way to control for underlying trends,

[23]For robustness, our econometric analysis also uses GMM to instrument for this variable (Arellano and Bond, 1991).

we include measures of "lagged" and "future" conflict exposure. Finally, to mitigate the possibility that unobserved factors affected the total amounts of major conflicts to which sample cities were exposed, we recode the conflict exposure measure as a binary variable.

A second concern is reverse causation. (Glaeser and Shapiro, 2002) describe a "target" effect whereby larger or faster-growing cities may have been exposed to more major conflicts and not vice versa. To address this concern, we perform a robustness check that regresses conflict exposure on lagged city population levels or growth.

5 Estimation Results

5.1 Main Specifications

Table 6 presents our estimates for the relationship between conflict exposure and city population growth in pre-industrial Europe. We focus on our benchmark sample of Continental European city populations from 1300 to 1800. The first three columns report the results for our benchmark conflict sample for major battles and sieges. Column 1 shows the estimates for the parsimonious specification with fixed effects by city and century. There is a significant positive relationship between conflict exposure and city population growth. From the mean value (equal to 20), a one standard deviation increase in the number of "nearer" major conflicts ($\leq$ p50) to cities (equal to 28) was associated with a 10 percent average increase in city population *growth* per century.[24] Over the long run, this estimate suggests that a one standard deviation increase in the number of "nearer" major conflicts was associated with an average increase in city population *levels* of 20 percent. While the coefficient on "farther away" conflict exposure ($>$ p50, $\leq$ p90) is positive, the magnitude falls by more than one-half, and it is not significant. As predicted, the variable for lagged city population levels has a significant negative coefficient, which indicates that larger cities grew more slowly.

Column 2 adds the time-variant city-level controls. The estimate for "nearer" conflict exposure is roughly the same in magnitude as before and remains highly significant. Although being a sovereign capital has a significant positive coefficient, this result is not robust across specifications.

Column 3 adds city-specific time trends. The magnitude and significance of the coefficient for "nearer" conflict exposure is similar as before. Being a self-governing commune

[24] We may interpret this magnitude as "net" of all conflict-related casualties. For example, Voigtländer and Voth (2013) claim that the Wars of Religion (1562-98) in France and the Thirty Years' War (1618-48) in Germany killed roughly one-fifth and one-third of the total populations, respectively.

typically has a significant positive coefficient in this specification and others that include city-specific time trends.

Columns 4 to 6 repeat the previous three specifications for the alternative conflict sample that restricts the data to major battles, of which there were 152, and excludes sieges. The results are very similar in magnitude and significance to the standard case.

5.2 Robustness

To bolster our analysis, Tables 7 to 11 present the results for a variety of robustness checks. Each robustness check repeats the three standard specifications from before (i.e., Columns 1 to 3 of Table 6). Unless otherwise stated, we focus on our benchmark sample of Continental European city populations and major conflicts from 1300 to 1800.

City fixed effects account for geographical features of cities including latitudes and longitudes. To further test whether centrally located cities drive our results, Columns 1 to 3 of Table 7 restrict the sample to cities that lay *outside* the urban belt.[25] The coefficients for "nearer" conflict exposure are similar in size to the standard case and are always highly significant. As an alternative way to test the relationship between "nearer" conflicts and city population growth, Columns 4 to 6 exclude the variable for "farther away" conflict exposure. The coefficients for "nearer" conflict exposure fall somewhat in magnitude relative to the standard case, but always remain highly significant.[26]

Columns 1 to 3 of Table 8 use our alternative cutoff distances that divide our conflict exposure measure into four categories: "nearest" ($\leq$ p25), "near" ($>$ p25, $\leq$ p50), "farther" ($>$ p50, $\leq$ p75), and "farthest" ($>$ p75, $\leq$ p90). While all four categories of conflict exposure display positive coefficients, only the coefficients for "nearest" and "near" conflicts are typically significant. As predicted, the magnitudes of the point estimates typically fall for conflict locations that were farther away.

Recall from Section 4 that our conflict measure sums the number of major conflicts that took place within or outside the median cutoff distances each century for each sample city. It is possible that unobserved factors affected the total amounts of major conflicts to which sample cities were exposed. To address this concern, Columns 4 to 6 recode $C_{i,t}^{n,j(t)}, n = 1, 2$ as two binary variables that take the value of 1 for each century that sample cities saw at least one major conflict that fell within ($\leq$ p50) and outside ($>$ p50, $\leq$ p90) the median

[25]We exclude all cities in Belgium, the Netherlands, France, Germany, Austria, Switzerland, and northern Italy.

[26]The main results are also very similar in if we include the measure of urban potential from Bosker et al. (2013), which calculates for each sample city the distance-weighted sum of the populations of all other sample cities.

cutoff distance, respectively. The coefficients for "nearer" conflict exposure always remain highly significant, with magnitudes that are typically larger than for the standard case.

City-specific time trends help to account for time-varying unobservable features. As a further way to test whether unobserved underlying trends related to conflict exposure and city population growth influence our results, Columns 1 to 3 of Table 9 include measures of "lagged" and "future" conflict exposure that control for the potential impacts of conflicts at $t-1$ (for example, from 1300 to 1399) and $t+1$ (in this example, from 1500 to 1599) on city population growth between $t-1$ and t (in this example, between 1400 and 1500). The coefficients for "nearer" conflict exposure are typically larger in magnitude than for the standard case. These estimates are typically highly significant. "Lagged" and "future" conflict exposure never have significant coefficients.

Columns 4 to 6 use the GMM model that instruments for city population levels at $t-1$ (in logs) with past values (Arellano and Bond, 1991). The coefficients for "nearer" conflict exposure are always highly significant, and the magnitudes are larger than for the standard case.

Table 10 presents the results for two more alternative samples. The eighteenth century saw the most major conflicts, with 123 fought on Continental Europe (Table 2). To further test (beyond century fixed effects) whether eighteenth-century conflicts drive our results, Columns 1 to 3 restrict the sample to major conflicts from 1300 to 1700. The relationship between "nearer" conflict exposure and city population growth not only remains highly significant, but the coefficients are larger for the first two specifications than for the standard case.

Columns 4 to 6 include English city populations and conflicts. Given our focus on pre-industrial Europe, we again use the 1300-1700 sample, because the Industrial Revolution took place in Britain from 1750 onward (Mokyr, 1999).[27] The coefficients for "nearer" conflict exposure on city population growth are similar in magnitude and significance to the standard case.

As described in Section 4, we always include lagged log city population levels, $P_{i,t-1}$, to control for conditional convergence. Still, there could have been a "target" effect that made larger cities more attractive targets for attackers (Glaeser and Shapiro, 2002). To test whether more populated cities were exposed to more major conflicts, we use a modified version of Equation 1 which regresses the conflict exposure measure $C_{i,t}^{n,j(t)}$ on $P_{i,t-1}$. Columns 1 to 3 of Table 11 show the results of this exercise for the three standard specifications using "nearer" conflict exposure as the dependent variable. The coefficients for

[27]The main results are broadly similar if we include eighteenth-century conflicts.

$P_{i,t-1}$ are never significant. To whether faster-growing cities were exposed to more major conflicts, Columns 4 to 6 replace $P_{i,t-1}$ with lagged log city population growth, $\Delta P_{i,t-1}$. The results are again never significant. This robustness check provides evidence that larger or faster-growing cities did not engender greater exposure to major conflicts.

Overall, the results described in these two subsections show an important role for conflict exposure in city population growth in pre-industrial Europe, with the nearest conflicts typically associated with the largest coefficients. These results are robust to a wide range of specifications, controls, and samples.

6 Economic Legacy of Conflict Exposure

6.1 Methodology

We now test for the long-run economic legacy of historical conflict exposure. The linear equation that we estimate is

$$Y_i = \alpha + \beta C_i^j + \boldsymbol{\gamma}' \mathbf{X_i} + \delta_c + \epsilon_i, \tag{2}$$

where Y_i is current economic activity in city i, C_i^j is the number of military conflicts between the minimum distance and the median cutoff distance j of city i from 1300 to 1799, $\mathbf{X_i}$ is a vector of city-level controls, δ_c are country fixed effects, and ϵ_i is a random error term.

City-Level Economic Activity

To measure current city-level economic activity, it would be ideal to use detailed city-level GDP data. Although the Urban Audit of Eurostat (2013) provides GDP data for around 180 European cities, less than 100 of these cities overlap with our set of sample cities. Furthermore, the Urban Audit data do not always measure GDP for cities themselves, but rather for broader regional units (e.g., departments in France or provinces in Italy). As an alternative, we use satellite image data on light intensity at night. This unique data source provides a concise measure of city-level economic activity that is widely available. Our use of luminosity data follows Henderson et al. (2011) and related works (e.g., Michalopoulos and Papaioannou, 2013, Alesina et al., 2012) that show that there is a strong positive correlation between luminosity and income levels.

To construct the luminosity measure, we collected data from the U.S. Defense Meteorological Satellite Program's Operational Linescan System or DMSP-OLS. This system reports night images of the earth recorded from 20:00 to 21:30 local time. The luminosity measure is a six-bit digital number that is calculated for every 30-second area pixel, or roughly 1 square kilometer. These values are averaged over all raw input pixels that overlap for all evenings per year. The luminosity index runs from 0, which indicates no light or a degree that is so low that satellite sensors cannot capture it, to 63, a common value for capital cities in wealthy nations. We compute yearly mean values of the digital numbers of luminosity across pixels that fall within city boundaries according to Eurostat for each year from 2000 to 2010.[28] We then compute the overall mean and median values for this period. Our econometric analysis uses the natural logarithm of the luminosity measure (Henderson et al., 2011, Alesina et al., 2012). In total, our luminosity measure is available for 287 Continental European sample cities.

Figure 2 maps mean luminosity for our benchmark city sample. We shade luminosity on a grayscale from light to dark according to quartiles, with the first quartile for the lowest values (4.03-22.97), the second quartile for the second-lowest (22.98-38.67), the third quartile for the second-highest (38.68-56.54), and the fourth quartile for the highest (56.55-63.00). As predicted, this figure suggests that current city-level economic activity is highest (darkest) in Europe's economic "backbone", the prosperous urban belt that runs from the Low Countries through western Germany to northern Italy.

To complement the luminosity measure, we use the available Urban Audit data for three alternative economic outcomes: median disposable annual household income (in euros), the economic activity rate, and the unemployment rate.[29] We average each variable over the 1999-2012 period. As described, small sample size is the key limitation of the Urban Audit data.

Historical Conflict Exposure

We construct our variable of interest, C_i^j, which measures total city exposure to major conflicts from 1300 to 1799, by aggregating the per-century conflict exposure variable as described in Section 4. For each sample city, we count the number of major conflicts that fell within the median cutoff distance each century. We then sum them over the 1300-1799 period. As before, our econometric analysis uses the natural logarithm of the historical conflict exposure measure. To illustrate this methodology, we refer back to Zurich and Lisbon, the two example cities from Section 4. Zurich saw 11 conflicts that fell within the

[28] To expand our sample size, we supplemented the Eurostat data with data from national statistical offices for some cases.

[29] We use median income rather than average income because the median income data are available for around 20 more sample cities.

median cutoff distance over the 1300s, 10 over the 1400s, 20 over the 1500s, 30 over the 1600s, and 104 over the 1700s, for a total of 175. By contrast, Lisbon only saw 10 conflicts that fell within the median cutoff distance over the 1300-1799 period. Thus, our aggregate measure indicates that Zurich was more exposed to major historical conflicts than Lisbon.

Table 12 ranks sample cities according to historical conflict exposure for our benchmark sample of 308 Continental European cities and conflicts from 1300 to 1800. Panel A ranks the top 40 cities, and Panel B the bottom 40.[30] Germany has the most cities in the top 40, at 27, followed by Italy (6), France (5), Switzerland (2), and Austria, Belgium, and the Netherlands (1 each). Nearly all German cities are located in the prosperous states in the country's west and south: 8 in Bavaria, 5 in Baden-Württemberg, 4 each in North Rhine-Westphalia and Rhineland-Palatinate, 2 in Lower Saxony, and 1 in Hesse. These states account for nearly 70 percent of total German GDP (Federal Statistical Office of Germany, 2012). Similarly, all but one of the top Italian cities are located in the wealthy northern region of Lombardy, and all but one of the top French cities in the wealthy eastern regions of Alsace and Lorraine. By contrast, nearly all of the cities in the bottom 40 for historical conflict exposure are located in the poorest parts of Europe in the south and east: 12 in Sicily, 8 in Bulgaria, 7 in Spain (of which 6 are in Andalusia and 1 in Extremadura), 6 in Greece (of which 5 are on the mainland), 4 in Portugal, and 1 each in Macedonia, Malta, Norway, and Romania.

To complete this description, Figure 3 maps historical conflict exposure for all 308 cities in our benchmark sample. We shade conflict exposure on a grayscale from light to dark according to quartiles, with the first quartile for the lowest exposure (2-26), the second quartile for the second-lowest (27-125), the third quartile for the second-highest (126-162), and the fourth quartile for the highest (163-177). Taken together with Figure 2 about current city-level economic activity, Figure 3 suggests that historical conflict exposure was highest (darkest) in the prosperous urban belt.

Our econometric analysis accounts for city-level characteristics according to Bosker et al. (2013). To control for geographical features, we include binary variables that take the value 1 for cities that are sea or river ports or located at hubs where at least two Roman roads crossed. Similarly, we account for city elevations above sea level (in meters) and ruggedness. To control for historical cultural, economic, educational, political, and religious urban features beyond military conflicts, we include controls for the share of centuries from 1300 to 1800 for which cities were self-governing communes, university hosts, sovereign capitals, bishop or archbishop seats, or under Muslim rule. To account for ini-

[30] To allow for ties in conflict exposure rank, we include 43 (41) cities for the top (bottom).

tial economic conditions, we include log city populations in 1300 for each city. Finally, to complement the city-level controls, we include country fixed effects that account for constant but unobserved characteristics at the national level.[31] Panel B of Table 5 displays the descriptive statistics for the cross-sectional regression variables.

6.2 Estimation Results

Table 13 presents our estimates for the long-run relationship between historical conflict exposure and current city-level economic activity as measured by luminosity levels from 2000 to 2010. We focus on our benchmark sample of Continental European city populations and major conflicts from 1300 to 1800. To save space, we only report the results for the full specifications that include the city-level geographical and historical controls and country fixed effects.

Column 1 reports the results for the benchmark conflict sample for major battles and sieges. There is a positive and highly significant relationship between historical conflict exposure and current economic activity. From the mean value (equal to 101), a one standard deviation increase in the number of major historical conflicts below the median cutoff distance ("nearer") to cities (equal to 64) is associated with a 11 percent average increase in current city-level economic activity. To illustrate, this magnitude corresponds to the difference in current economic activity as measured by mean luminosity between the similarly-sized cities of Florence in the center-north of Italy and Bari in the south.

Column 2 repeats this specification for the alternative conflict sample that restricts the data to major battles and excludes sieges. The coefficient on historical conflict exposure is roughly the same in magnitude as before and remains highly significant. Columns 3 and 4 repeat the first two specifications for our first alternative dependent variable, log median luminosity. Again, there is always a positive and highly significant relationship between historical conflict exposure and current economic activity. Now a one standard deviation increase in the number of "nearer" historical conflicts is associated with a 14 percent average increase in current city-level economic activity.[32]

Table 14 presents the results for the alternative economic outcomes using the Urban Audit data. We repeat the two specifications from before (i.e., Columns 1 and 2 of Table 13) for each alternative. Recall from the previous subsection that small sample size is the key limitation of the Urban Audit data: the number of sample cities falls from 287 to 85

[31] The main results remain broadly similar if we replace the country fixed effects with city latitudes and longitudes.

[32] With respect to the controls, being a traditional university host is the only control which displays a significant positive relationship with current city-level economic activity that is robust across all six specifications.

for median income, 110 for the economic activity rate, and 115 for the unemployment rate. Columns 1 and 2 indicate that there is always a positive and significant relationship between historical conflict exposure and current median income. A one standard deviation increase in the number of "nearer" historical conflicts is associated with a nearly 700 euro increase in current median income.

Columns 3 and 4 repeat the first three specifications for the activity rate, while Columns 5 and 6 repeat them for the unemployment rate. As predicted, there is a positive relationship between historical conflict exposure and the current activity rate, and a negative relationship between historical conflict exposure and the current unemployment rate. Both of these sets of relationships are highly significant for the benchmark and alternative conflict samples.

Overall, the Table 13 and 14 results suggest that the economic legacy of historical conflict exposure endures to the present day. There is a strong, positive, and robust relationship between historical conflict exposure and current economic activity.

6.3 Potential Bias from Unobservables

The previous regressions control for a wide range of city-level features. However, there could still be omitted variables that affect both historical conflict exposure and current city-level economic outcomes. To address this concern, we compute a measure based on Altonji et al. (2005), Bellows and Miguel (2009), and Nunn and Wantchekon (2011) that estimates how much greater the influence of unobservable features would have to be, relative to the observed controls, to fully explain away the OLS results. Specifically, this measure computes the ratio $\hat{\beta}^f/(\hat{\beta}^r - \hat{\beta}^f)$ according to the coefficients for our variable of interest, C_i^j, for two regressions, the first of which includes the covariates for a "restricted" set of controls (which we label $\hat{\beta}^r$), and the second of which includes the covariates for a "full" set of controls (which we label $\hat{\beta}^f$). The logic is that, the greater the ratio, then the larger that selection on unobservable features must be to fully explain away the OLS estimates.[33]

We test two sets of restricted covariates. The first includes no controls, and the second only includes log city populations in 1300. Similarly, we test two sets of full covariates: the first with the geographical controls from Equation 2, and the second with both the geographical and historical controls. There are thus four combinations of restricted and

[33] As Nunn and Wantchekon (2011) explain, the smaller the difference $(\hat{\beta}^r - \hat{\beta}^f)$ is in the denominator, then the less that selection on observable features affects the estimates, and the larger that $\hat{\beta}^f$ is in the numerator, then the greater is the effect that selection on unobservable features must explain away.

full covariates for which we can calculate ratios.

Table 15 presents the ratios for our benchmark measures of current economic-level activity for major conflicts (Panel A) and major battles only (Panel B). The results of this analysis suggest that, to fully explain away the positive relationship between historical conflict exposure and current city-level economic activity, the influence of unobservable features would have to be between 2.61 to 8.99 times greater than observable features, and on average 5.39 times greater (the median ratio is 4.29; no ratios are less than one). We thus conclude that it is not likely that unobservables fully drive our estimates.

7 Instrumental Variables Analysis

7.1 Break-up of Carolingian Empire

As an alternative strategy to address the possibility of omitted variable bias, we now perform an IV analysis based on Stasavage (2011, ch. 5) that exploits the ninth-century break-up of Charlemagne's empire. Following this lead, we argue that it is possible to view the way in which the Carolingian Empire was partitioned as the outcome of a set of "accidental" events that were unrelated to economic factors. If so, then we will able to use this partitioning to derive a potential source of exogenous variation in historical conflict exposure.

The break-up of the Carolingian Empire took place in multiple steps.[34] The traditional custom was partible inheritance by the ruler's sons, as the law of primogeniture was not yet established. This custom made dynastic successions more vulnerable to idiosyncratic disputes. Only one legitimate son, Louis the Pious, outlived Charlemagne, who died in 814. The death of Louis the Pious in 840 led to civil war between his three heirs. The Treaty of Verdun of 843 ended this conflict and divided the Empire into three kingdoms: West Francia, centered around present-day France; Middle Francia, the central territory running from the Low Countries to northern Italy; and East Francia, centered around present-day Germany. The necessity to split the territory equally between the three heirs was the apparent basis for this partitioning, which did not correspond with existing ethnic, linguistic, political, or religious borders (Ganshof, 1971). Facing serious illness, Lothar I, ruler of Middle Francia, divided his kingdom between his three heirs in 855: one received northern Italy; another the French region of Provence; and the third the northwestern territory called Lotharingia, running from the Low Countries through western Germany. The

[34] We base our historical account on Stasavage (2011, ch. 5); also see Ganshof (1971), Thompson (1935), and Airlie (1998).

Treaty of Meersen of 870 divided Lotharingia itself between West and East Francia. Like the earlier Treaty of Verdun, the desire for an equal territorial split, rather than contemporary ethnic, linguistic, political, or religious divisions, was the apparent reason for this partitioning (Thompson, 1935). Why was Lotharingia short-lived? Airlie (1998) highlights a royal marital dispute. Lothar II, King of Lotharingia from 855 to 869, wished to divorce his wife and marry his mistress. However, he died of fever before this marriage was declared legitimate, leading to the division of his kingdom.

Our description of the ninth-century break-up of the Carolingian Empire suggests a role reversal by 900. While the former border zones of West and East Francia became large and relatively stable kingdoms, the former Carolingian core of Lotharingia became politically fragmented. Stasavage (2011, ch. 5) uses the partition line established by the Treaty of Meersen, which closely corresponds with a longitudinal line running through the city of Meersen in the southeastern Netherlands (5° 45′ 0″ E), to proxy for the division of Lotharingia between West and East Francia in 870.[35] In the spirit of his work, our IV analysis exploits city distance from the Meersen partition line to instrument for historical conflict exposure. The logic is as follows: the nearer a city is to this partition, then the more likely that it was located within the politically fragmented territory of Middle Francia, and thus the more likely that it was exposed to historical conflicts. Given the geographical focus of our IV analysis, we always restrict the set of sample cities to those that lay within the Carolingian Empire.[36]

The exclusion restriction that our IV analysis must satisfy is that, conditional on the included controls, distance from the Meersen partition line has no effect on current economic activity other than through historical conflict exposure. We argue that, given the "accidental" ways in which the break-up of the Carolingian Empire took place, this assumption is tenable. However, the exclusion restriction would be violated if distance from the Meersen partition line was correlated with other historical variables that also affect current city-level economic outcomes. For example, Stasavage (2011, ch. 5) finds that distance from the Meersen partition line is a significant predictor of future city self-governance, and Stasavage (2013) links city self-governance with economic outcomes. Our IV analysis controls for historical city self-governance along with a wide range of other observable and unobservable factors. Regardless, since we cannot completely exclude the possibility that the exclusion restriction is violated, we must view the 2SLS results with caution.

[35]Thompson (1935) maps this partition line. No full text of the Treaty of Verdun of 843, which would enable us to map the Verdun partition line, survives.

[36]We identified Carolingian cities, of which there are 178, according to the map by Shepherd (1911, p. 56). Given the small overlap between the Urban Audit data and our restricted sample of Carolingian cities, we focus on luminosity levels as our measure of current city-level economic activity for the IV analysis.

7.2 Estimation Results

Table 16 presents the results of the 2SLS estimates of Equation 2. We treat the historical conflict exposure variable C_i^j as endogenous and model the first-stage equation as

$$C_i^j = \alpha + \eta M_i^j + \boldsymbol{\theta}'\mathbf{X_i} + \delta_c + \nu_i, \tag{3}$$

where our instrument M_i^j is the log distance j of city i from the Meersen partition line. Both the first-stage and 2SLS regressions include the full set of city-level geographical and historical (cultural, economic, educational, political, and religious) controls and country fixed effects from Table 13.[37]

Panel A displays the 2SLS estimates for β, our coefficient of interest from Equation 2, Panel B the corresponding first-stage estimates for η, and Panel C the corresponding OLS estimates for β. For consistency with the 2SLS regressions, here the OLS regressions only include Carolingian cities, which explains why the coefficient values differ from those in Table 13. Column 1 reports the results for the benchmark conflict sample. As predicted, there is a significant negative first-stage relationship between log city distance from the Meersen partition line and historical conflict exposure. The 2SLS estimate of the relationship between historical conflict exposure and current city-level economic activity as measured by log mean luminosity levels is positive and significant (the p-value is 0.055). The 2SLS estimate is smaller than the OLS estimate, which may suggest that omitted variables positively bias the OLS estimate.

Column 2 restricts the conflict data to major battles and excludes sieges. The results are very similar as before. Columns 3 and 4 use our alternative dependent variable, log median luminosity. The magnitudes and significance of these results resemble the first two specifications.[38]

Overall, the 2SLS results indicate that there is a significant positive relationship between historical conflict exposure and current city-level economic activity. This robustness check provides further evidence that the economic consequences of historical conflict exposure are persistent.

8 Conclusion

This paper presents new city-level evidence about the military origins of Europe's economic "backbone," the prosperous urban belt that runs from the Low Countries to north-

[37] Given that there were no cities under Muslim rule for the restricted sample of Carolingian cities, we exclude this control from the IV analysis.

[38] For robustness, we also tested the LIML estimator. The results were very similar to those reported.

ern Italy. We argue that military conflict was a defining feature of pre-industrial Europe. The destructive effects of conflict were worse in the countryside, leading rural inhabitants to relocate behind urban fortifications due to the threat of conflict. Conflict-related city population growth in turn had long-run development consequences through mechanisms including state building, social capital, technological change and human capital, and agglomeration effects.

To rigorously test our argument, we perform an econometric analysis on a novel city-level database that spans the medieval period to the present day. Our analysis accounts for potential biases from unobserved heterogeneity, omitted variables, and reverse causation. We show that the relationship between conflict exposure and historical city population growth was significant, positive, and robust. Furthermore, we show evidence for a strong and significant relationship between historical conflict exposure and current city-level economic activity. Our results thus suggest that the economic legacy of historical conflict exposure persists to the present day.

To the best of our knowledge, our paper is among the first to provide systematic evidence that military conflicts played a key role in the economic rise of urban Europe. The results, however, do not imply that the consequences of warfare are always positive. Besley and Reynal-Querol (2012) find that the legacy of historical conflict in Africa, while also significant, is negative. Pre-colonial African conflict is linked with greater current conflict, lower trust levels, and weaker national identity. Relative conflict exposure could be one reason for this divergence in long-run outcomes. Herbst (2000, pp. 112-33) argues that, if frequent warfare in Europe gave rise to efficient governments, then sporadic warfare and low population density in Africa had the opposite effect. Simple calculations lend credence to Herbst's claim: historical conflict exposure in Europe, at over 15 major conflicts per million square kilometers from 1400 to 1700, was much higher than in Africa, at just 3 conflicts per million square kilometers.[39] Systematic study of the factors that explain the divergent long-run consequences of military conflicts in different contexts is one valuable area for future research.

[39] We use the 1400-1700 period for consistency with Besley and Reynal-Querol (2012). Over this period, Africa saw 91 conflicts (Besley and Reynal-Querol, 2012), while Europe saw 66 (Table 2). Area in square kilometers for the African land mass and the European Union are from the CIA World Factbook (2013). Brecke (1999, figs. 2, 3) also finds large differences in the number of historical conflicts between Africa and Europe.

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Table 1: Major Conflicts Comprising the Thirty Years' War

	Conflict Name	Year	Nearest Settlement	Country
1	White Hill	1620	Prague	Czech Republic
2	Wimpfen	1622	Bad Wimpfen	Germany
3	Hochst	1622	Frankfurt am Main	Germany
4	Stadtlohn	1623	Stadtlohn	Germany
5	Breda	1624	Breda	Netherlands
6	Bridge of Dessau	1625	Dessau	Germany
7	Lutter	1626	Lutter am Barenberge	Germany
8	Breitenfeld	1631	Leipzig	Germany
9	Werben	1631	Werben (Elbe)	Germany
10	River Lech	1632	Rain	Germany
11	Nuremberg	1632	Nuremberg	Germany
12	Lützen	1632	Lützen	Germany
13	Nordlingen	1634	Nordlingen	Germany
14	Wittstock	1636	Wittstock	Germany
15	Casale	1640	Casale Monferrato	Italy
16	Second Breitenfeld	1642	Leipzig	Germany
17	Rocroi	1643	Rocroi	France
18	Freiburg	1644	Freiburg im Breisgau	Germany
19	Allerheim	1645	Allerheim	Germany
20	Lens	1648	Lens	France

Source: Clodfelter (2002).

Table 2: Major Conflicts, 1300-1799

Panel A: Continental Europe								
	1300s	1400s	1500s	1600s	1700s	Total	Avg	Share
Germany	0	0	1	15	22	38	7.60	0.19
Italy	0	1	7	2	28	38	7.60	0.19
France	6	7	8	3	12	36	7.20	0.18
Low Countries	2	0	4	7	21	34	6.80	0.17
Poland	0	1	0	0	13	14	2.80	0.07
Spain	2	0	0	0	7	9	1.80	0.04
Switzerland	2	2	0	0	3	7	1.40	0.03
Czech Rep	0	0	0	1	5	6	1.20	0.03
Turkey	0	0	0	0	0	0	0.00	0.00
Belarus	0	0	0	0	3	3	0.60	0.01
Estonia	0	0	0	0	3	3	0.60	0.01
Austria	0	0	0	2	0	2	0.40	0.01
Bulgaria	1	1	0	0	0	2	0.40	0.01
Gibraltar	0	0	0	0	2	2	0.40	0.01
Kosovo	1	1	0	0	0	2	0.40	0.01
Serbia	0	0	0	2	0	2	0.40	0.01
Sweden	0	0	0	1	1	2	0.40	0.01
Albania	0	0	0	0	0	0	0.00	0.00
Finland	0	0	0	0	1	1	0.20	0.00
Latvia	0	0	0	0	1	1	0.20	0.00
Norway	0	0	0	0	0	0	0.00	0.00
Portugal	1	0	0	0	0	1	0.20	0.00
Ukraine	0	0	0	0	1	1	0.20	0.00
Total	15	13	20	33	123	204	40.80	1.00
Panel B: England								
Total	5	11	0	11	0	27	5.40	1.00
Total, Panels A-B	20	24	20	44	123	231	46.20	1.00

Sources: Bradbury (2004) for 1300-1499 and Clodfelter (2002) for 1500-1799.

Note: Columns 1-8 show total conflicts per country per century. For example, "1300s" shows total conflicts for 1300-1399. Column 9 shows total conflicts per country for 1300-1800. Column 10 shows average conflicts per century per country. Column 11 shows the country's share of conflicts in total conflicts for 1300-1800. "Low Countries" sums Belgium and the Netherlands.

Table 3: City Populations in Continental Europe, 1300-1800

	No	1300	1400	1500	1600	1700	1800
Italy	80	1,514	1,284	1,486	1,979	2,012	2,563
France	62	1,120	953	1,123	1,433	1,780	2,204
Germany	46	529	520	556	692	711	1,165
Spain	39	833	744	642	889	792	1,149
Low Countries	24	265	282	383	502	795	783
Austria	3	26	28	29	64	143	290
Portugal	6	70	104	112	186	250	290
Bulgaria	9	107	120	148	171	204	237
Poland	5	30	55	71	154	111	191
Greece	6	121	128	82	138	110	141
Czech Rep	5	65	137	119	147	88	112
Denmark	1	3	9	10	40	65	101
Romania	5	51	62	83	59	86	79
Sweden	1	2	5	7	9	40	76
Hungary	2	7	12	16	18	24	57
Switzerland	3	13	16	20	30	34	46
Slovakia	2	8	9	12	16	17	45
Malta	1	5	10	16	21	24	37
Serbia	2	25	45	50	73	61	29
Norway	2	9	9	10	11	14	27
Kosovo	1	10	14	18	22	22	20
Macedonia	2	23	28	56	62	52	14
Albania	1	25	14	2	3	7	10
Total	308	4,861	4,586	5,050	6,718	7,442	9,666
England	20	193	135	134	326	734	1,579

Source: Bairoch et al. (1988).

Note: Balanced panel of sample cities. Column 1 shows number of sample cities per country. "Low Countries" sums Belgium and the Netherlands.

Table 4: Conflict Exposure, 1300-1799

	Cities × Conflicts	City Distance from Conflict (km)			Cutoff Distance (km)			
	Obs	Mean	Min	Max	p25	p50	p75	p90
1300s	4,620	1,094	12.34	3,102	606	1,026	1,581	1,887
1400s	4,004	1,005	1.87	3,127	558	910	1,382	1,774
1500s	6,160	906	0.33	2,532	524	846	1,237	1,651
1600s	10,164	938	0.18	2,587	517	847	1,339	1,690
1700s	37,884	1,020	0.16	3,632	577	906	1,434	1,813
Avg	12,566	993	2.98	2,996	556	907	1,395	1,763

Note: Benchmark sample of Continental European cities and conflicts. See text for construction details.

Table 5: Descriptive Statistics

Panel A: Panel Analysis, 1300-1800					
	Obs	Mean	Std Dev	Min	Max
Log city population growth	1540	0.142	0.515	-2.833	2.603
Major conflict exposure ($\leq$ p50)	1540	20.401	28.109	0	106
Major conflict exposure ($>$ p50, $\leq$ p90)	1540	16.319	22.203	0	111
Commune	1540	0.630	0.483	0	1
University	1540	0.196	0.397	0	1
Capital city	1540	0.077	0.267	0	1
Bishop seat	1540	0.616	0.487	0	1
Muslim rule	1540	0.068	0.252	0	1
City population in 1300	308	15.782	22.061	1	250
City population in 1400	308	14.890	18.421	1	200
City population in 1500	308	16.397	19.187	1	200
City population in 1600	308	21.811	30.319	1	300
City population in 1700	308	24.161	40.589	2	500
City population in 1800	308	31.383	50.033	1	550
Panel B: Cross-Sectional Analysis					
Mean luminosity, 2000-10	287	38.274	18.383	4.031	63
Median luminosity, 2000-10	287	37.465	20.980	2.909	63
Median income, 1999-2012 (euros)	85	16,022	6,272	2,123	42,002
Activity rate, 1999-2012	110	56.105	5.557	42	66.970
Unemployment rate, 1999-2012	115	11.010	5.414	2.370	31.800
Major conflict exposure, 1300-1799 ($\leq$ p50)	287	101	64.469	0.693	5.176
Sea port	287	0.202	0.402	2	177
River port	287	0.662	0.474	0	1
Roman road hub	287	0.373	0.484	0	1
Elevation above sea (meters)	287	170.460	209.774	-2	1,002
Ruggedness	287	70.828	78.452	0.466	559.450
Commune share, 1300-1800	287	0.625	0.434	0	1
University share, 1300-1800	287	0.182	0.341	0	1
Capital city share, 1300-1800	287	0.075	0.229	0	1
Bishop seat share, 1300-1800	287	0.639	0.461	0	1
Muslim rule share, 1300-1800	287	0.056	0.191	0	0.833
City population in 1300	287	16.233	22.731	1	250

Sources: See text.

Note: Benchmark sample of Continental European cities and conflicts.

Table 6: Conflict Exposure and City Population Growth, 1300-1800

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable is Log City Pop Growth					
	Major Conflicts			Major Battles Only		
Log conflict exposure,	0.108	0.098	0.108	0.107	0.096	0.101
($\leq$ p50)	(0.033)	(0.032)	(0.033)	(0.035)	(0.034)	(0.035)
	(0.001)	(0.002)	(0.001)	(0.003)	(0.005)	(0.004)
Log conflict exposure,	0.058	0.065	0.044	0.047	0.057	0.021
($>$ p50, $\leq$ p90)	(0.040)	(0.040)	(0.032)	(0.039)	(0.039)	(0.035)
	(0.144)	(0.103)	(0.176)	(0.228)	(0.147)	(0.539)
Commune		0.098	0.359		0.096	0.356
		(0.103)	(0.139)		(0.103)	(0.139)
		(0.343)	(0.010)		(0.352)	(0.011)
University		0.006	-0.077		0.005	-0.078
		(0.065)	(0.119)		(0.065)	(0.119)
		(0.928)	(0.516)		(0.933)	(0.510)
Capital city		0.527	-0.013		0.526	-0.006
		(0.136)	(0.187)		(0.135)	(0.188)
		(0.000)	(0.945)		(0.000)	(0.976)
Bishop seat		0.104	0.035		0.107	0.038
		(0.085)	(0.147)		(0.085)	(0.147)
		(0.223)	(0.813)		(0.212)	(0.796)
Muslim rule		-0.057	0.055		-0.053	0.064
		(0.178)	(0.173)		(0.178)	(0.172)
		(0.750)	(0.749)		(0.765)	(0.711)
Log city population	-0.522	-0.549	-1.032	-0.523	-0.549	-1.033
(lagged)	(0.035)	(0.033)	(0.041)	(0.035)	(0.033)	(0.041)
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Century fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City-specific time trends	No	No	Yes	No	No	Yes
R-squared	0.316	0.336	0.692	0.316	0.335	0.691
Observations	1,540	1,540	1,540	1,540	1,540	1,540

Note: Benchmark sample of Continental European cities and conflicts. Estimation method is OLS. Robust standard errors clustered by city in parentheses, followed by corresponding p-values.

Table 7: Conflict Exposure and City Population Growth: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable is Log City Pop Growth					
	Outside Urban Belt			"Nearer" Conflicts Only		
Log conflict exposure,	0.105	0.104	0.102	0.085	0.073	0.094
($\leq$ p50)	(0.037)	(0.037)	(0.034)	(0.027)	(0.026)	(0.031)
	(0.005)	(0.006)	(0.004)	(0.002)	(0.006)	(0.003)
Log conflict exposure,	0.044	0.060	0.001			
($>$ p50, $\leq$ p90)	(0.084)	(0.085)	(0.072)			
	(0.597)	(0.482)	(0.987)			
City-level controls	No	Yes	Yes	No	Yes	Yes
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Century fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City-specific time trends	No	No	Yes	No	No	Yes
R-squared	0.299	0.321	0.665	0.314	0.334	0.691
Observations	695	695	695	1,540	1,540	1,540

Note: Benchmark sample of Continental European cities and conflicts unless otherwise stated. Estimation method is OLS. Time-variant city-level controls for centuries for which cities were self-governing communes, university hosts, sovereign capitals, bishop or archbishop seats, under Muslim rule, and lagged log city populations. Robust standard errors clustered by city in parentheses, followed by corresponding p-values.

Table 8: Conflict Exposure and City Population Growth, 1300-1800: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable is Log City Pop Growth					
	Alternative Cutoff Distances			Dummy Variables		
Log conflict exposure,	0.053	0.042	0.063			
(≤ p25)	(0.028)	(0.027)	(0.030)			
	(0.062)	(0.124)	(0.037)			
Log conflict exposure,	0.044	0.039	0.097			
(> p25, ≤ p50)	(0.023)	(0.023)	(0.025)			
	(0.054)	(0.093)	(0.000)			
Log conflict exposure,	0.028	0.029	0.041			
(> p50, ≤ p75)	(0.031)	(0.031)	(0.033)			
	(0.359)	(0.356)	(0.209)			
Log conflict exposure,	0.009	0.009	0.039			
(> p75, ≤ p90)	(0.028)	(0.027)	(0.026)			
	(0.743)	(0.734)	(0.139)			
Conflict exposure dummy,				0.165	0.157	0.109
(≤ p50)				(0.048)	(0.049)	(0.053)
				(0.001)	(0.001)	(0.039)
Conflict exposure dummy,				0.164	0.161	0.077
(> p50, ≤ p90)				(0.078)	(0.076)	(0.068)
				(0.035)	(0.035)	(0.258)
City-level controls	No	Yes	Yes	No	Yes	Yes
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Century fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City-specific time trends	No	No	Yes	No	No	Yes
R-squared	0.313	0.333	0.694	0.314	0.335	0.689
Observations	1,540	1,540	1,540	1,540	1,540	1,540

Note: Benchmark sample of Continental European cities and conflicts. Estimation method is OLS. Time-variant city-level controls for centuries for which cities were self-governing communes, university hosts, sovereign capitals, bishop or archbishop seats, under Muslim rule, and lagged log city populations. Robust standard errors clustered by city in parentheses, followed by corresponding p-values.

Table 9: Conflict Exposure and City Population Growth, 1300-1800: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Log City Pop Growth			Log City Pop Level		
	Lagged and Future Conflicts			GMM		
Log conflict exposure,	0.140	0.131	0.076	0.135	0.132	0.132
($\leq$ p50)	(0.040)	(0.041)	(0.088)	(0.042)	(0.042)	(0.038)
	(0.001)	(0.002)	(0.387)	(0.001)	(0.002)	(0.000)
Log conflict exposure,	0.069	0.074	0.041	0.071	0.069	0.057
($>$ p50, $\leq$ p90)	(0.041)	(0.040)	(0.071)	(0.042)	(0.041)	(0.033)
	(0.090)	(0.069)	(0.561)	(0.088)	(0.094)	(0.088)
Log conflict exposure,	-0.035	-0.042	-0.056			
($\leq$ p50, $t-1$)	(0.071)	(0.067)	(0.087)			
	(0.621)	(0.538)	(0.525)			
Log conflict exposure,	0.042	0.047	-0.008			
($>$ p50, $\leq$ p90, $t-1$)	(0.059)	(0.058)	(0.082)			
	(0.479)	(0.415)	(0.919)			
Log conflict exposure,	0.013	0.016	-0.004			
($\leq$ p50, $t+1$)	(0.034)	(0.032)	(0.053)			
	(0.705)	(0.628)	(0.933)			
Log conflict exposure,	0.015	0.038	-0.044			
($>$ p50, $\leq$ p90, $t+1$)	(0.038)	(0.037)	(0.055)			
	(0.686)	(0.299)	(0.432)			
City-level controls	No	Yes	Yes	No	Yes	Yes
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Century fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City-specific time trends	No	No	Yes	No	No	Yes
R-squared	0.344	0.364	0.781			
Observations	1,232	1,232	1,232	1,232	1,232	1,232

Note: Benchmark sample of Continental European cities and conflicts. Estimation method is OLS unless otherwise stated. Time-variant city-level controls for centuries for which cities were self-governing communes, university hosts, sovereign capitals, bishop or archbishop seats, under Muslim rule, and lagged log city populations. Robust standard errors clustered by city in parentheses, followed by corresponding p-values.

Table 10: Conflict Exposure and City Population Growth: Robustness

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable is Log City Pop Growth					
	1300-1700 Sample			Plus English Cities, Conflicts		
Log conflict exposure,	0.123	0.111	0.098	0.130	0.119	0.109
($\leq$ p50)	(0.040)	(0.040)	(0.049)	(0.044)	(0.045)	(0.058)
	(0.002)	(0.006)	(0.046)	(0.004)	(0.008)	(0.060)
Log conflict exposure,	0.067	0.072	0.067	0.026	0.030	0.030
(> p50, $\leq$ p90)	(0.042)	(0.042)	(0.041)	(0.042)	(0.042)	(0.045)
	(0.108)	(0.085)	(0.104)	(0.536)	(0.471)	(0.501)
City-level controls	No	Yes	Yes	No	Yes	Yes
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Century fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City-specific time trends	No	No	Yes	No	No	Yes
R-squared	0.342	0.361	0.780	0.348	0.367	0.781
Observations	1,232	1,232	1,232	1,312	1,312	1,312

Note: Benchmark sample of Continental European cities and conflicts unless otherwise stated. Estimation method is OLS. Time-variant city-level controls for centuries for which cities were self-governing communes, university hosts, sovereign capitals, bishop or archbishop seats, under Muslim rule, and lagged log city populations. Robust standard errors clustered by city in parentheses, followed by corresponding p-values.

Table 11: City Populations and Future Conflict Exposure

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable is Log Conflict Exposure ($\leq$ p50)					
Log city population	0.038	0.013	-0.044			
(lagged)	(0.035)	(0.035)	(0.041)			
	(0.279)	(0.710)	(0.283)			
Log city population growth				-0.005	-0.008	-0.028
(lagged)				(0.028)	(0.029)	(0.050)
				(0.848)	(0.776)	(0.578)
Time-variant city-level controls	No	Yes	Yes	No	Yes	Yes
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Century fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City-specific time trends	No	No	Yes	No	No	Yes
R-squared	0.680	0.687	0.852	0.716	0.726	0.869
Observations	1,540	1,540	1,540	1,232	1,232	1,232

Note: Benchmark sample of Continental European cities and conflicts. Estimation method is OLS. Time-variant city-level controls for centuries for which cities were self-governing communes, university hosts, sovereign capitals, bishop or archbishop seats, or under Muslim rule. Robust standard errors clustered by city in parentheses, followed by corresponding p-values.

Table 12: City Exposure to Historical Conflicts

Panel A: Highest Exposure

Rank	City	Region	Country	Conflicts, ≤ p50
1	Heidelberg	Baden-Württemburg	Germany	177
1	Ulm	Baden-Württemburg	Germany	177
1	Augsburg	Bavaria	Germany	177
2	Stuttgart	Baden-Württemburg	Germany	176
2	Mainz	Rhineland-Palatinate	Germany	176
2	Speyer	Rhineland-Palatinate	Germany	176
3	Nördlingen	Bavaria	Germany	175
3	Frankfurt am Main	Hesse	Germany	175
3	Trier	Rhineland-Palatinate	Germany	175
3	Worms	Rhineland-Palatinate	Germany	175
3	Bern	Bern Canton	Switzerland	175
3	Zurich	Zurich Canton	Switzerland	175
4	Colmar	Alsace	France	174
4	Strasbourg	Alsace	France	174
4	Metz	Lorraine	France	174
4	Nancy	Lorraine	France	174
4	Freiburg im Breisgau	Baden-Württemburg	Germany	174
4	Munich	Bavaria	Germany	174
4	Nuremberg	Bavaria	Germany	174
4	Regensburg	Bavaria	Germany	174
4	L'Aquila	Abruzzo	Italy	174
5	Innsbruck	Tyrol	Austria	173
5	Bamberg	Bavaria	Germany	173
5	Würzburg	Bavaria	Germany	173
5	Aachen	North Rhine-Westphalia	Germany	173
5	Cologne	North Rhine-Westphalia	Germany	173
6	Bergamo	Lombardy	Italy	172
6	Como	Lombardy	Italy	172
7	Liège	Wallonia	Belgium	171
7	Düsseldorf	North Rhine-Westphalia	Germany	171
7	Soest	North Rhine-Westphalia	Germany	171
7	Erfurt	Thuringia	Germany	171
7	Maastricht	Limburg	Netherlands	171
8	Besançon	Franche-Comt	France	170
8	Passau	Bavaria	Germany	170
8	Goslar	Lower Saxony	Germany	170
8	Osnabrück	Lower Saxony	Germany	170
8	Leipzig	Saxony	Germany	170
8	Quedlinburg	Saxony-Anhalt	Germany	170
8	Crema	Lombardy	Italy	170
8	Milan	Lombardy	Italy	170
8	Monza	Lombardy	Italy	170

Note: Benchmark sample of Continental European cities and conflicts. "Conflicts, ≤ p50" shows number of major conflicts that took place within median cutoff distances each century from 1300 to 1799 for each city. See text for construction details.

Table 12, Continued: City Exposure to Historical Conflicts

Panel B: Lowest Exposure				
Rank	City	Region	Country	Conflicts, $\leq$ p50
298	Coimbra	Centro	Portugal	12
298	Almería	Andalusia	Spain	12
298	Écija	Andalusia	Spain	12
298	Málaga	Andalusia	Spain	12
298	Badajoz	Extremadura	Spain	12
299	Caltanissetta	Sicily	Italy	11
299	Ohrid	Southwestern	Macedonia	11
299	Jerez de la Frontera	Andalusia	Spain	11
299	Seville	Andalusia	Spain	11
300	Sofia	Sofia Capital	Bulgaria	10
300	Mascali	Sicily	Italy	10
300	Bergen	Western	Norway	10
300	Évora	Alentejo	Portugal	10
300	Santarém	Centro	Portugal	10
300	Lisbon	Lisboa	Portugal	10
300	Bucharest	Bucharest Municipality	Romania	10
300	Cadiz	Andalusia	Spain	10
301	Ruse	Ruse	Bulgaria	9
301	Silistra	Silistra	Bulgaria	9
302	Naro	Sicily	Italy	8
303	Varna	Varna	Bulgaria	7
303	Thessaloniki	Central Macedonia	Greece	7
303	Ioannina	Epirus	Greece	7
303	Larissa	Thessaly	Greece	7
303	Catania	Sicily	Italy	7
303	Piazza Armerina	Sicily	Italy	7
304	Plovdiv	Plovdiv	Bulgaria	6
304	Shumen	Shumen	Bulgaria	6
304	Preslav	Shumen	Bulgaria	6
304	Sliven	Sliven	Bulgaria	6
304	Caltagirone	Sicily	Italy	6
304	Licata	Sicily	Italy	6
305	Athens	Attica	Greece	5
305	Corinth	Peloponnese	Greece	5
305	Augusta	Sicily	Italy	5
306	Heraklion	Crete	Greece	4
307	Noto	Sicily	Italy	3
307	Ragusa	Sicily	Italy	3
307	Scicli	Sicily	Italy	3
307	Siracusa	Sicily	Italy	3
308	Valletta	Malta Xlokk	Malta	2

Note: Benchmark sample of Continental European cities and conflicts. "Conflicts, $\leq$ p50" shows number of major conflicts that took place within median cutoff distances each century from 1300 to 1799 for each city. See text for construction details.

Table 13: Economic Legacy of Historical Conflict Exposure

	(1)	(2)	(3)	(4)
Dependent Variable	Log Mean Luminosity, 2000-10		Log Median Luminosity, 2000-10	
	Major Conflicts	Battles Only	Major Conflicts	Battles Only
Log conflict exposure, 1300-1799 ($\leq$ p50)	0.205	0.207	0.271	0.270
	(0.040)	(0.038)	(0.045)	(0.042)
	(0.000)	(0.000)	(0.000)	(0.000)
Sea port	0.141	0.143	0.146	0.147
	(0.154)	(0.155)	(0.189)	(0.190)
	(0.371)	(0.366)	(0.450)	(0.446)
River port	0.078	0.079	0.051	0.053
	(0.087)	(0.090)	(0.091)	(0.094)
	(0.383)	(0.390)	(0.577)	(0.575)
Roman road hub	0.095	0.092	0.112	0.108
	(0.123)	(0.123)	(0.145)	(0.146)
	(0.450)	(0.466)	(0.450)	(0.465)
Elevation above sea	-0.000	-0.000	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
	(0.470)	(0.462)	(0.362)	(0.352)
Ruggedness	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
	(0.297)	(0.311)	(0.250)	(0.265)
Commune share, 1300-1800	0.119	0.111	0.106	0.097
	(0.119)	(0.119)	(0.124)	(0.123)
	(0.328)	(0.360)	(0.400)	(0.436)
University share, 1300-1800	0.202	0.203	0.269	0.271
	(0.083)	(0.082)	(0.106)	(0.105)
	(0.023)	(0.020)	(0.018)	(0.017)
Capital city share, 1300-1800	0.281	0.281	0.190	0.191
	(0.116)	(0.115)	(0.154)	(0.153)
	(0.024)	(0.023)	(0.229)	(0.224)
Bishop seat share, 1300-1800	0.105	0.099	0.092	0.085
	(0.107)	(0.104)	(0.126)	(0.123)
	(0.337)	(0.353)	(0.473)	(0.500)
Muslim rule share, 1300-1800	0.762	0.774	0.755	0.769
	(0.806)	(0.803)	(0.925)	(0.922)
	(0.354)	(0.345)	(0.423)	(0.413)
Log city population in 1300	-0.038	-0.040	-0.012	-0.015
	(0.019)	(0.019)	(0.029)	(0.027)
	(0.056)	(0.044)	(0.671)	(0.581)
Country fixed effects	Yes	Yes	Yes	Yes
R-squared	0.496	0.498	0.488	0.489
Observations	287	287	287	287

Note: Benchmark sample of Continental European cities and conflicts. Estimation method is OLS. Robust standard errors clustered by country in parentheses, followed by corresponding p-values.

Table 14: Economic Legacy of Historical Conflict Exposure: Alternative Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Median Income, 1999-2012		Activity Rate, 1999-2012		Unemployment Rate, 1999-2012	
	Major Conflicts	Battles Only	Major Conflicts	Battles Only	Major Conflicts	Battles Only
Log conflict exposure,	1406.820	1459.359	1.558	1.397	-4.735	-4.614
1300-1799 ($\leq$ p50)	(772.479)	(595.326)	(0.620)	(0.506)	(1.971)	(1.730)
	(0.094)	(0.031)	(0.023)	(0.014)	(0.028)	(0.016)
City-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.957	0.957	0.819	0.818	0.582	0.582
Observations	85	85	110	110	115	115

Note: Benchmark sample of Continental European cities and conflicts. Estimation method is OLS. City-level controls for sea and river ports, Roman road hubs, elevations above sea level, ruggedness, the share of centuries from 1300 to 1800 for which cities were self-governing communes, university hosts, sovereign capitals, bishop or archbishop seats, or under Muslim rule, and log city populations in 1300. Robust standard errors clustered by country in parentheses, followed by corresponding p-values.

Table 15: Assessment of Potential Bias from Unobservables

		(1)	(2)
Controls in Restricted Set	Controls in Full Set	Log Mean Luminosity, 2000-10	Log Median Luminosity, 2000-10
	Panel A: Major Conflicts		
None	Log city population in 1300, full set of geographical controls from Equation 2	4.230	4.027
None	Log city population in 1300, full set of geographical and historical controls from Equation 2	2.612	2.855
Log city population in 1300	Full set of geographical controls from Equation 2	8.342	8.987
Log city population in 1300	Full set of geographical and historical controls from Equation 2	3.961	4.950
	Panel B: Battles Only		
None	Log city population in 1300, full set of geographical controls from Equation 2	4.425	4.140
None	Log city population in 1300, full set of geographical and historical controls from Equation 2	2.777	2.998
Log city population in 1300	Full set of geographical controls from Equation 2	8.421	8.938
Log city population in 1300	Full set of geographical and historical controls from Equation 2	4.148	5.147

Note: Each cell reports the ratio based on coefficients for log conflict exposure, 1300-1799 ($\leq$ p50) for two regressions. The first includes the covariates for the "restricted" set of controls as listed; we label this coefficient $\hat{\beta}^r$. The second includes the covariates for the "full" set of controls as listed; we label this coefficient $\hat{\beta}^f$. We compute the ratio as $\hat{\beta}^f/(\hat{\beta}^r - \hat{\beta}^f)$. We use the benchmark sample of Continental European cities and conflicts and include country fixed effects for all regressions. City-level geographical controls are for sea and river ports, Roman road hubs, elevations above sea level, and ruggedness. City-level historical controls are for share of centuries from 1300 to 1800 for which cities were self-governing communes, university hosts, sovereign capitals, or bishop or archbishop seats.

Table 16: Economic Legacy of Historical Conflict Exposure: 2SLS

	(1)	(2)	(3)	(4)
Dependent Variable	Log Mean Luminosity, 2000-10		Log Median Luminosity, 2000-10	
	Major Conflicts	Battles Only	Major Conflicts	Battles Only
	Panel A: 2SLS Estimation			
Log conflict exposure, 1300-1799 ($\leq$ p50)	0.376	0.350	0.521	0.485
	(0.196)	(0.189)	(0.253)	(0.249)
	(0.055)	(0.065)	(0.040)	(0.052)
	Panel B: First Stage			
Log distance from Meersen partition line	-0.089	-0.096	-0.089	-0.096
	(0.033)	(0.031)	(0.033)	(0.031)
	(0.025)	(0.014)	(0.025)	(0.014)
F-test of excluded instruments	7.260	9.320	7.260	9.320
p-value, F-test	(0.025)	(0.014)	(0.025)	(0.014)
	Panel C: OLS Estimation			
Log conflict exposure, 1300-1799 ($\leq$ p50)	0.643	0.591	0.932	0.846
	(0.140)	(0.199)	(0.249)	(0.340)
	(0.001)	(0.016)	(0.005)	(0.034)
City-level controls	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Centered R-squared, first stage	0.556	0.548	0.556	0.548
Observations	178	178	178	178

Note: Sample of Continental European cities that lay within the Carolingian Empire. City-level controls for sea and river ports, Roman road hubs, elevations above sea level, ruggedness, the share of centuries from 1300 to 1800 for which cities were self-governing communes, university hosts, sovereign capitals, or bishop or archbishop seats, and log city populations in 1300. Robust standard errors clustered by country in parentheses, followed by corresponding p-values.

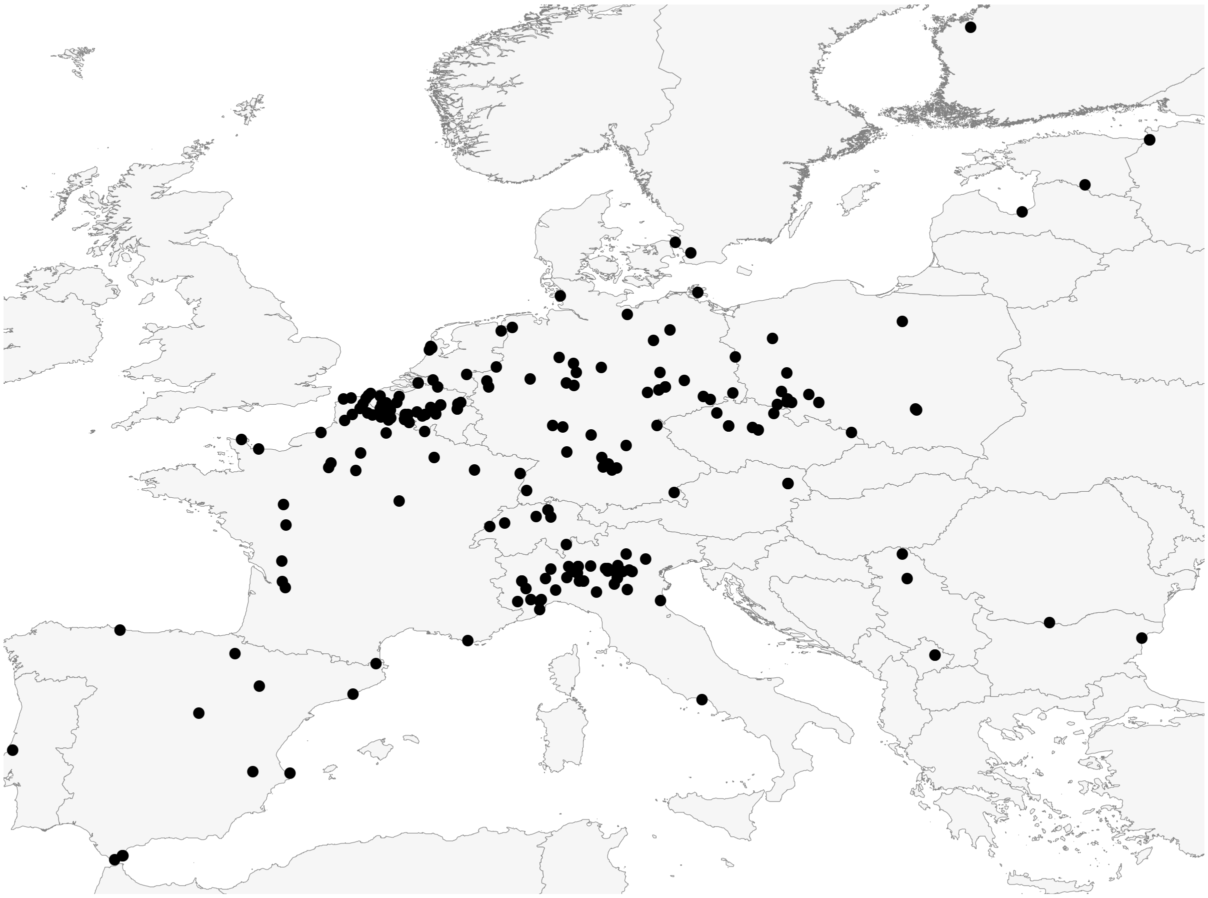

Figure 1: Major Conflict Locations, 1300-1799. 204 total conflicts in Continental Europe. See Panel A of Table 2 for data details. Sources are Bradbury (2004) for 1300-1499 and Clodfelter (2002) for 1500-1799.

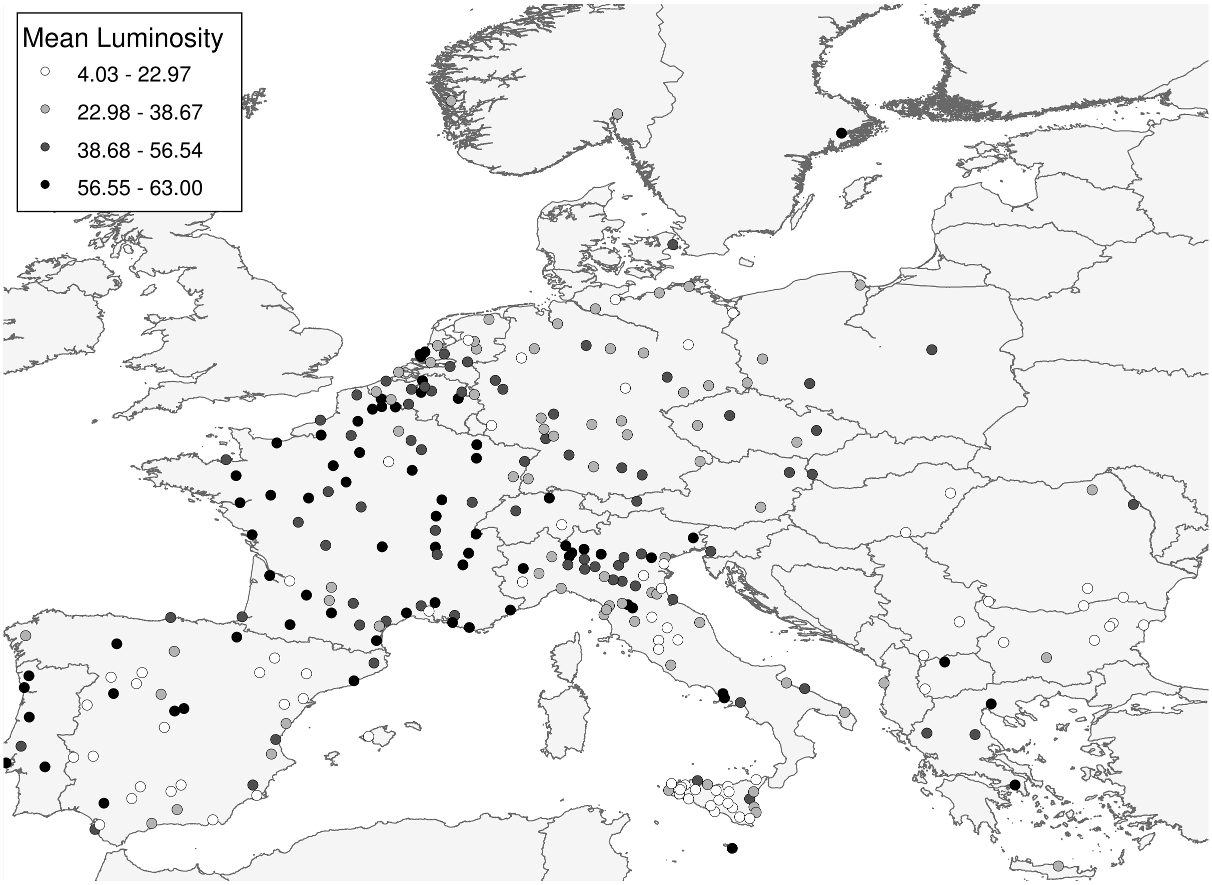

Figure 2: Urban Luminosity, 2000-2010. Log mean luminosity from 2000 to 2010 for benchmark sample of Continental European cities for which luminosity data are available. See text for construction details and source.

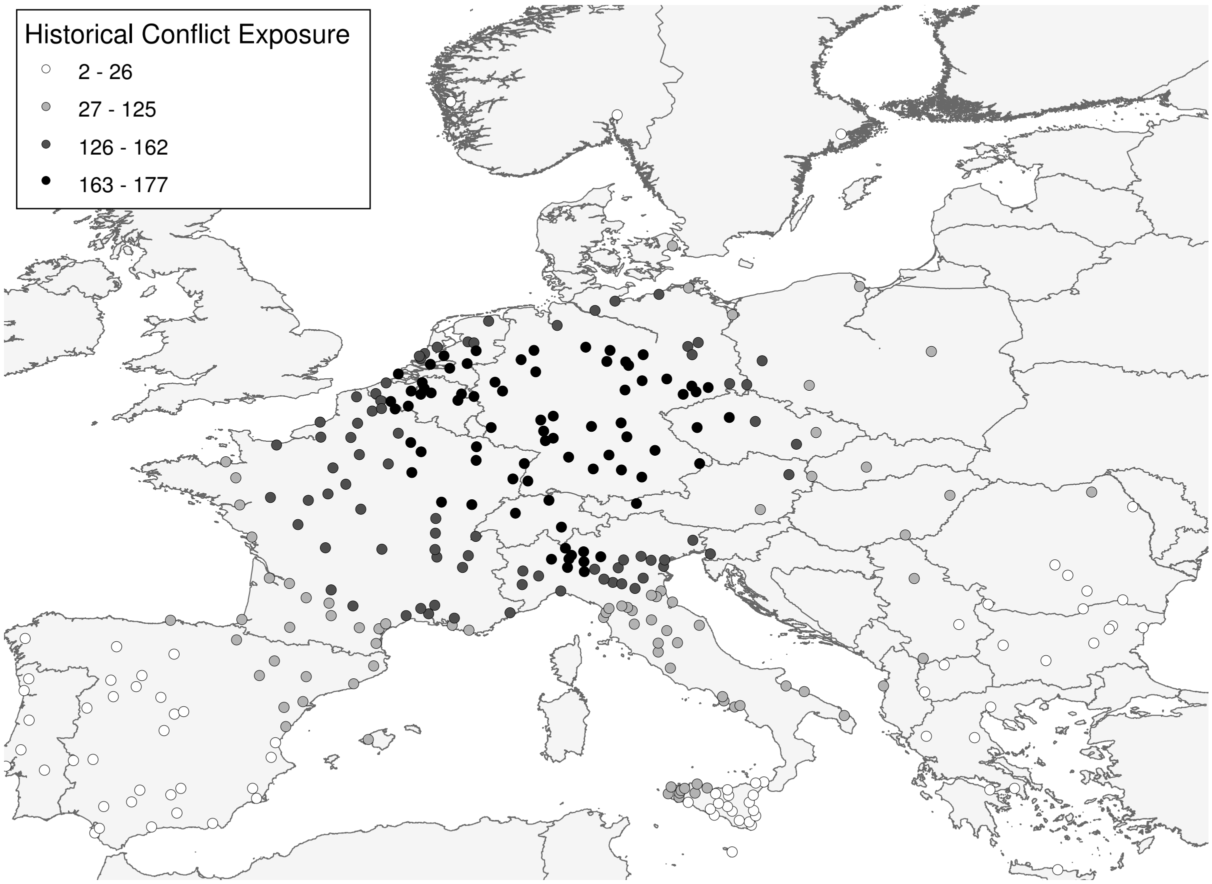

Figure 3: Historical Conflict Exposure. Number of major conflicts that took place within median cutoff distances each century from 1300 to 1799 for each city in benchmark sample for Continental Europe. See text for construction details and sources.