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# Manuscript [5000 words]

## Section one: Introduction [882 / 1000 words]

In the run up to the EU referendum, amidst discussions of migration, identity, expertise and economic impacts, the issues of Northern Ireland and its border with the Republic of Ireland received scant attention. This lack of focus on pan-Irish issues seems a conspicuous oversight given: that the Republic of Ireland will remain an EU member state, to which other EU citizens have rights of migratory access; the long and porous border between Northern Ireland and the Republic of Ireland; and more troublingly the long history of violent sectarian conflict in the region. At the time of writing (5 June 2017), just days prior to yet another political vote of seismic political importance, issues of terrorism have taken centre stage due to two barbarous attacks on English citizens over the campaign period; firstly the suicide bombing of concert-goers on 22 May 2017 in Manchester, resulting in 22 deaths and over one hundred injuries; (Www.bbc.co.uk, 2017) then later a combined vehicle and knife attack by three individuals around London Bridge on the night of 3 June 2017, resulting in the deaths of ten people and the malicious injuring of dozens more. (Www.bbc.co.uk, 2017) In the wake of these events, discussion of terrorist threats and the effective management of risks to UK citizens have only rarely drawn parallels with the UK’s experience of conflict in Northern Ireland. Once again, this absence of focus appears odd in light of the UK’s, and Western Europe’s, longer-term history of terrorism, where available statistics of deaths clearly indicate that the ‘Troubles’ in Northern Ireland consistently led to much higher levels of civilian deaths in Europe than have been associated with Islamic terrorism after 2001; indeed, for many decades Northern Ireland, along with the Basque region of Spain, have been the geographic fulmination points of terrorism-related deaths in Western Europe. (Www.economist.com, 2016)

This paper argues there is a pressing need for a deeper analysis and understanding of the causes and consequences of violent conflict in Northern Ireland, for learning from the history of the region about how a series of political and military mis-steps by the British Government over many years initiated a wave of lethal violence which propagated itself through the fabric of Northern Irish society for over two decades, and for considering whether the socioeconomic and cultural conditions still exist in the region such that further political mis-steps risk reinitiating violent instability in Northern Ireland and additional terrorist risk throughout the UK. I argue such issues seem particularly pertinent given a lack of clarity regarding plans for the Irish border in Brexit negotiations, and the importance of daily freedom of movement across the border in the island of Ireland for both cultural and economic reasons. Three specific empirical aims of this paper are: to use demographic data to visually illustrate the ‘excess deaths’ that appear attributable to the initiation of violent conflict in the early 1970s; to produce a number of estimates of total numbers of excess deaths attributable to the conflict, based on observed patterns and trends in overall mortality, and compare these with estimates based on deaths directly attributed to violence; and to characterise the particular pattern of excess mortality observed in Northern Irish demographic data, and describe why this is consistent with a tit-for-tat form of sectarian conflict. The main substantive aim of these empirical findings is, combined with a discussion of the political and military history of the island of Ireland, to highlight that the fundamentals which led to this earlier wave of death and instability both may still be present within Northern Irish society, and that poorly handled Brexit negotiations risk re-initiating a fresh wave of violence that, once started, may take decades to settle down again. Apropos to this argument about the self-sustaining nature of conflict in the region is a fundamental challenge to a dominant causal narrative about the peace process in Northern Ireland: a suggestion that key political events in this process, such as the IRA’s ceasefire announcement in 1994 and the Good Friday Agreement in 1998, followed rather than led trends towards reduced violence in the region.

The structure of this paper is as follows: section two, history, will provide a brief history of both the origins of Northern Ireland as a distinctly administered political territory, of the events which led to an initiation of violence in the early 1970s, and of key events and trends in violence and peace which occurred in the decades since. Section three will introduce the data and methods used to both visually identify the impact of sectarian conflict on deaths in Northern Ireland, and produce estimates of the total number of additional deaths which might be attributable to the conflict. Section four will present firstly visual representations of mortality patterns seen in Northern Ireland, in comparison to neighbouring countries and regions; and secondly estimates total excess mortality associated with the conflict. Finally, section five, the discussion, will begin by comparing my estimates of conflict-attributable mortality with extant estimates of conflict-attributable deaths; then conclude with a discussion of political, sociological and social psychological literature which may shed light on the patterns uncovered, before highlighting a number of critical pitfalls that Westminster should be mindful of in Brexit negotiations to reduce the risk of a new initiation of conflict in the region.

## Section two: History: Ireland, Northern Ireland, and the Troubles [1745 / 1000 words]

Understanding the causes of the eruption of violence in Northern Ireland in the early 1970s requires a broader understanding of the longer-term history and dynamics of the island of Ireland and its complex relationship with British rule. An understanding of historical dynamics requires going somewhat beyond the listing of historical and political facts, and briefly considering some broader theories, even grand theories, of empire formation and the functional role of religion therein.

The mathematical ecologist turned historian Peter Turchin has argued that one of the central challenges in the establishment and maintenance of complex, large, hierarchical societies – empires – has been the promotion of social cohesiveness across ethnic groups. Turchin thus suggests that complex societies can emerge only once ­*meta­ethnic ­*communities, in which group membership can be readily identified through ‘symbolic markers’, have been established and agreed upon. Turchin states that the “most commonly used kind of symbolic marker to delineate metaethnic communities is religion – particularly, the exclusive, proselytizing kinds such as Christianity or Islam.” [p. 181] Common metaethnic identity allows for greater within-group cohesiveness and for the assimilation of otherwise ethnically heterogeneous populations, but where distinct and mutually exclusive metaethnic groups are territorially contiguous, *metaethnic* frontiers form, and at these frontiers competition and conflict between societies is often intense.

This sweeping characterisation of societies as metaethnic communities, and metaethnic frontiers as endemic sources of conflict, is useful to consider in reference to the following sweeping generalisation about the spread of Catholicism and Protestantism throughout Europe: Catholic religion pre-existed Protestantism, began in Southern Europe, and spread north and west, including to Ireland at Europe’s western periphery. Protestantism then emerged later, from Northern Europe, and spread south and west. The conditions for a metaethnic frontier in the island of Ireland, demarcated along Catholic-Protestant religious distinction, were thus centuries in the making.

Within the political organs of an imperious, expansionist state united by Protestant identity, positions for Catholics were limited, and there were concerns amongst British imperialists that Ireland could be used as a cultural and potentially military ‘back door’ through which the Catholic Spanish and French Empires could undermine British imperial power and influence. Ireland thus held an ambivalent position within the British Empire, geographically proximate yet culturally distant, a ‘colony within the core’. Many of the patterns of political control and population management developed in the case of Ireland later formed a blueprint for British colonialism for later, larger overseas territories such as India. (Anderson & O’Dowd, 2007)

The longstanding harsh British indifference to the conditions of the Irish was the target of Jonathan Swift’s 1729 satirical essay ‘A Modest Proposal’. Such indifference and colonial mismanagement had contributed to the Great Famine of the 1840s, leading to mass emigration and population decline. Together with a steady influx of Protestants over many generations, by the end of the 19th century the demography and economy of Ireland had shifted to the North East of the island, in particular to the city of Belfast, and the populist Protestant Orange Order had emerged in response to increasing political agitation from Catholic populations for improved voting rights and the return of Irish Home Rule which had been abolished with the Act of Union in 1801. Whereas in Westminster the Tory party supported Irish Unionists in opposing Home Rule, the Whigs supported this measure, and in the 1910 General Election the Whigs were able to establish a minority government with the support of Irish Nationalists, leading to the passing of the Third Home Rule Bill in 1912. The backlash to Home Rule from Ulster Unionists led to the establishment of paramilitary organisations by both sides, and a period of civil war which continued with the Great War of 1914, and culminated in the Easter Rising of 1916, in which fifteen Irish nationalists launched a failed coup attempt and were executed by firing squad. These executions then enflamed rather than quelled nationalist opposition to British rule, and in 1918 the newly formed Sinn Féin party were elected with more than three quarters of Irish seats in Westminster; when political demands for independence over the whole of Ireland were unsuccessful, civil war intensified, and the paramilitary Irish Republican Army (IRA) fought a guerrilla war into the 1920s. Ireland was partitioned through the Fourth Government of Ireland Act in 1920, into territories defined as ‘Northern Ireland’ and ‘Southern Ireland’, and a truce was established in 1921. The majority Protestant ‘Southern Ireland’ renamed itself the ‘Irish Free State’ and became an independent state in 1922, leading also to the formation of Northern Ireland in that year as a distinct administrative geography, which voted against Home Rule and to remain a British territory.

(Anderson & O’Dowd, 2007) summarise the legacy of the establishment of the Northern Irish border as follows:

Under one-party unionist rule for 50 years, Northern Ireland provide to be the most problematic legacy of partition. It provided a ‘cage’ for two communal blocs locked into a mutually antagonistic and self-reproducing relationship with each other. The sizeable nationalist minority – initially a third of its population but threatening to erode unionism’s ‘safe’ majority – was the main loser, disaffected and permanently excluded from state power. The majority unionist bloc maximised its micro-territorial control within Northern Ireland, but it retained endemic fears of being undermined by nationalist population growth, and/or physical attacks on partition, and/or being ‘sold out’ by British governments. The relegation of Ireland, including Northern Ireland, once again to the status (of a now reconfigured) imperial frontier, had clearly reduced the capacity or willingness of British governments to combat the dynamics of separation and division set in train by the partition settlement. The eruption of ethno-national violence a half-century after partition was part of the imperial legacy. [p. 947]

The dormant but unresolved tensions described above led to the conditions for a reignition of conflict beginning in the late 1960s. A series of errors in the British Army’s deployment to Northern Ireland between 1969 and 1972 have been identified as important in making the situation much worse, and turning the initially envisaged task of ‘peace support’ into one of fighting an insurgency.(Thornton, 2007)

The post-War background to the Northern Ireland conflict has been summarised as follows: in the late 1960s a Catholic protest movement emerged, inspired by the civil rights’ movement in the United States, prompting an often violent Protestant counter-movement opposed to Catholic marches, leading to widespread clashes between sides. By 1969 such clashes could not be controlled by the police forces in Belfast and Londonderry (numbering around three thousand full time officers and ten thousand reservists), and around 2,500 troops from the British Army were mobilised. In 1969 and 1970, the Army was considered relatively effective in protecting Catholics from Protestant attacks, and restrained in its response to violence, and so resistance to the Army from the IRA remained limited, as were IRA reprisal attacks on Protestants. The IRA was conflicted in its response to both the Army presence and Protestant reprisals, however, and in 1969 split into the less-militant Official IRA (OIRA), and the more militant Provisional IRA (PIRA). The Army, the OIRA and the PIRA then each competed to win favour and appear legitimate from the perspective of Catholic communities, with the PIRA to some extent hoping and goading the Army into behaviours which would de-legitimise the Army’s presence in these communities, in particular through their handling of sectarian tensions during marches. Lack of troop numbers possibly led to excessive use of CS gas in riots which lasted for many days in Ballymurphy, the creation of Army ‘no go’ areas and so a power vacuum which the PIRA was able to fill when the army was unable to defend the Catholic Short Strand enclave against Protestants in June 1970. Army attempts to disarm Catholic communities, combined with a lack of success defending them on all occasions, further acted to delegitimise the Army amongst affected Catholic communities. With reduced support for the Army in Catholic communities, the PIRA then began attacking the Army in 1971; worsening Army-PIRA relations led the Army to publicly name IRA leaders on 5 February 1971, swiftly followed by the first killing of a British soldier by the IRA the following day. Internment, i.e. indefinite detention without trial of suspected Republican paramilitaries, then swiftly followed, and on a large scale; on 9 August 1971, 342 people were arrested (of which only 55 were PIRA members), leading to protests over the following days in which 23 people died, including a Catholic priest. Army troop numbers increased by around a quarter within the year, reaching nearly 16,000 by October, and PIRA bombings and killings intensified. The effect of internment was to bring an end to Army-IRA relations in 1971; amity was then further increased through the deployment and actions of the Parachute Regiment (‘the Paras’), who were more inclined to use deadly force than existing forces. It was the Paras who faced a 7,000-strong Catholic civil rights march on 13 January 1972, ‘Bloody Sunday’, and shot dead 14 people later found to be unarmed, further delegitimising the Army and legitimising PIRA within many Catholic communities. This event, more than any other, can be seen to have ignited the decades of sectarian conflict that followed.(Gerike et al., 2016)

## Section three: Data and Methods [732/500 words]

Data on all-cause mortality and population size, disaggregated by gender, age in single years and year, were extracted from the Human Mortality Database (HMD). Mortality rates were calculated by dividing death counts by population exposure (adjusted population counts). All data management and analyses were performed using the R statistical programming environment.

In the first stage of the analysis, mortality rates by age and year were explored visually using level plots in which each column is a different year, each row a different age, and each cell is a mortality rate or log mortality rate for a specific combination of year and age in single years. This arrangement is known as a Lexis surface. A qualitative colour scheme, ‘Paired’ from the RColorBrewer package, was used to colour cells in the level plots such that different ‘bands’ of mortality rates or log mortality rates can be identified by cross-referencing the colour of cells with colour key legends to the right of each plot. The R packages Lattice and latticeExtra were used to produce the visualisations.

In the second stage of the analysis, level plots for males aged between 15 and 45 years inclusive were produced, again using the same ‘Paired’ colour scheme but with a narrower scale of values, meaning cells are coloured differently. This gender and age range was focused on as a mortality pattern that appears attributable to the conflict post 1972 appears very clearly for this group, whereas in females and males at other ages no similar pattern is apparent.

In the third stage of the analysis, a model was developed which aims to reproduce the main features of the level plot of mortality values over this Lexis surface for this gender and age group, and in which the conflict-attributable pattern of excess deaths is modelled as a separate variable. The final model specification was developed by comparing the penalised model fit of different model specifications using AIC and BIC, as well as the root mean square (RMS) error, and by visually exploring both the Lexis surfaces of predicted values, and of residuals (differences between predicted and actual values) in order to assess whether the model appears to capture the most salient features of the Lexis surface of the data itself. The model specification is as follows:

Where indicates the mortality rate for males of age in year , the superscript indicates which of three distinct phases in mortality improvement to which year belongs, and indicates the number of years since the start of the mortality improvement phase to which year belongs. The three mortality improvement phases, identified through visual exploration of the Lexis surfaces, are: Phase One: 1922 to 1938 inclusive; Phase Two: 1939 to 1955 inclusive; and Phase Three: 1956 and later. Within these three phases, the rate of age specific mortality improvement tended to be greatest in Phase Two (1939 to 1955), despite this period including World War Two.

is the function which models the mortality effect of the conflict. It assumes that the additional mortality effect is greatest in the first year of the conflict, then decays exponentially with each subsequent year. The rate of decay in additional mortality is modelled using the parameter , and can have any value from 0 to 1 inclusive. In the fourth phase of the analysis, numerical optimisation is used to select k such that AIC (penalised model fit) is minimised. Given , the ‘half life’ of the conflict, i.e. number of years it takes for the additional log mortality risk to fall by half, can also be calculated using the formula .

Finally, in the fifth phase of the analysis, the numbers of deaths at each age and in each year are estimated by applying the model’s predicted mortality risks to the populations exposed to these risks, i.e. , where is the number of deaths at age and in year under the active conflict scenario A, and indicates the size of the population at this age and in this year exposed to the mortality risk. A counterfactual surface of risks is modelled by setting to 0 in all years. The total number of conflict-attributable deaths estimated by the model in this age range is then the sum of differences in deaths estimated under both scenarios, i.e. .

## Section four: Results [1500 words]

## Visual exploration of patterns

Figure 1 shows the Lexis surfaces of log­10 mortality rates for both genders and for each age between newborns and 90 years. White cells indicate missing values due to no deaths occurring at those particular ages, but other cells are coloured according to mortality rate. The legend on the right show which colours correspond with which mortality values. Because a base-10 logarithmic transformation is used, the values on this legend indicate the ‘number of zeros’ associated with the mortality risk. Ranging from 100or 1.0 risk for light blue at the top, then to 10-1 (one in ten) for some lighter green shades, 10-2 (one-in-100) for lighter reds, 10-2 (one-in-1000) for some reds, 10-3 (one in 10 000) for the middling orange shade, 10-4 (one in 100 000) for the middle purple shade, and finally 10-5 (one in a million) for the brown shade at the bottom of the scale. Because the population of Northern Ireland is relatively small, at ages and in years in which mortality risk is very low, missing values for log mortality risk, indicated by white cells, are more likely than these very low values, because no deaths occurred. These ‘missing data’ cells are observed more in females than males, and in particular in childhood since the early 1980s. This is consistent with mortality trends in the affluent world elsewhere, where mortality risks in childhood tend to be very low.

Figure 2 provides a stylised ‘pen portrait’ of some of the main features seen in figure 1. As with in many other countries, there is a much sharper increase in mortality risk once males reach adulthood, not observed to the same extent in female. In more recent years this can be seen by noting that for males almost all purple cells are seen in childhood, with cells at older ages coloured light or dark orange. This broadly corresponds to somewhere between half an order of magnitude, to a full order of magnitude, increase in mortality risk after males reach adulthood compared with their risks in childhood. By contrast for females the difference in colour and shade in early adulthood is much less different to in childhood.

Within Figure 2 P1, P2 and P3 indicate ‘Phase 1’, ‘Phase 2’ and ‘Phase 3’, each demarcating periods of years in which there appeared to be systemic differences in the rate of change in mortality risk at different ages. As described previously Phase One covers the years 1922 to 1938 inclusive, Phase Two the years 1939 to 1955 inclusive; and Phase Three the years 1956 and later. The much more rapid falls in both female and male young adult mortality over Phase Two is evident in the Figure 1 levelplot by noting that most of the cells in the age range 20 to 40 years are red before the late 1930s, whereas during this Phase they turn dark and light orange. This represents close to an order of magnitude fall in mortality risk at these ages over these years. This is despite the period including the World War Two, indicated with a shaded polygon in Figure 2. There is evidence of World War Two having some effect on mortality patterns, with some cells after around 1941-2, for males in their early twenties, switching back to red after having turned orange a few years previously, before reverting back to orange in later years.

The effect of the Troubles on mortality is evident by noting the faint vertical band of red cells which appears in the male level plot from around age 18 to 40 after the early 1970s. Before this red band appeared cells tended to be a darker orange shade (slightly under 10-3 or 1-in-100 risk of dying), and a slightly lighter orange/yellow shade after. No similar discontinuity at this age range after the early 1970s is evident for females. Figure 3 explores this pattern further, by plotting the number of deaths for males and females aged between 18 and 40 years. A grey band is added indicating the years 1971-1973. Male deaths risk in 1971 and 1972, peak in 1973, and then remain above those seen in earlier years for many years afterwards; by contrast no similar increase is seen for females. It appears that the Troubles had a longer term effect than WW2 on male mortality, and within Figure 2 this is represented by a polygon that extends to a slightly further to the right than the WW2 polygon.

Within Figure 2, the large horizontal grey band indicates the age range 15 to 45 years, within which further analyses will focus. Figure 4 shows level plots for males and females for this age range only, using a slightly different colour scheme and range of log10 mortality values to before. Within this plot the effect of the Troubles on male mortality is even clearer, and appears as a band of light red, then dark red, cells after the early 1970s after orange and dark red cells in earlier years. Again, no similar pattern is seen for females. The disruption to earlier trends for males appears mainly to affect males once they have reached adulthood, and to be sharpest at younger adult ages, from around the ages of 18 to 21 years of age.

## Modelling

The model specification is as described in the methods section, and was arrived at through attempting to develop a specification for male mortality rates that produces a predicted Lexis surface qualitatively similar to that observed in the data itself. This process involved both comparing standard metrics such as AIC and RMS error for a range of model specifications, as well as qualitative comparison of both the predicted surface against the data itself, and exploration of the surface of residuals to identify any forms of systemic bias.

Figure 5 comprises three rows, each presenting a log10 mortality surface for males over the age range 15 to 40 years and for all years. On the top row, labelled ‘predicted’, the model predicted surface, including the parameter for the Troubles, is presented; on the middle row, labelled ‘counterfactual’, the model prediction for a counterfactual scenario, in which the Troubles term is not applied, is presented; and in the bottom row, labelled ‘actual’, the actual log10 mortality values from the data are presented. This comparison shows a number of important features. Firstly, be comparing the predicted against actual surface, we can see that the model is relatively effective at capturing the broad pattern and features of the actual surface, though is clearly and necessarily a somewhat stylised representation of the actual values; as the number of deaths within this age range has tended to fall over time, so the variation in mortality values between neighbouring ages and years has tended to increase, producing a more ‘speckled’ or ‘noisy’ appearance overall. The relatively small population size of Northern Ireland also contributes to this noisy appearance; we would hypothesise that if Northern Ireland’s population were much larger then this ‘speckled’ appearance would reduce, as specific mortality estimates for specific combinations of age and year would be derived from more observations.

There were two ways in which the ‘predicted’ surface does not quite represent the pattern of the actual surface following the onset of the Troubles: firstly, as we saw in Figure 3, deaths in this age group for males actually increased sharply over two consecutive years, in 1972 then 1973, whereas the model specification represents the assumption that a sharp jump occurred in the space of the single year of 1972. This means that the modelled Troubles parameter will tend to over-estimate additional mortality in 1972, and under-estimate it in 1973. However, we chose against including an additional parameter just for either 1972 or 1973 to avoid over-fitting the model in a naively empiricist manner. Our use of the exponential decay model is in judging whether a simple and stylised representation of the Troubles, with a clear and meaningful interpretation in the context of sectarian tit-for-tat violence, is able to capture enough of the essence of the process observed. Secondly, the predicted surface perhaps models for more of a discontinuity above the age of 40 years due to the Troubles than might be reasonable. Above the age of around 35 increased mortality risk associated with natural processes of ageing start to become apparent, and so at these upper ages perhaps the Troubles coefficients are capturing changes in the rate of this ageing-related mortality risk rather than additional risk due to violent conflict per se; however again we decided against overfitting the model by including additional parameters, and instead simply applied the same Troubles term to all ages.

Secondly, the ‘counterfactual’ surface is broadly able to represent what we might expect the trends in the actual surface might have looked like, had the Troubles-associated pattern which appears in the early 1970s not occurred. If we look at the darker red cells after around 1958, in the counterfactual this ‘band’ of dark red colours appears to ‘drift’ upwards in subsequent decades, from around the ages of 33 in the late 1958s, to around the age of 40 by 2013. This represents continual falls in age-specific mortality risks from around the age of 35, characteristic of general improvements in population health seen elsewhere in the affluent world.

Overall, and subject to the two caveats above, we can see that the stylised assumptions incorporated in the model, as described in the methods section, are able to produce a surface qualitatively very similar to the data surface itself, including the sharp rates of improvement observed during phase 2. Systemic bias in over-estimation or under-estimation of age-year specific mortality risks can be explored by looking at the surface of residuals between the predicted and actual surfaces, as shown in Figure 6:within this figure red cells indicate that the model over-estimated age-year specific log mortality rates, and blue cells indicate under-estimation, and the shade of cells indicates the degree of difference between actual and predicted values, with light cells indicating small differences and dark cells indicating larger differences. We are not so much concerned about the overall accuracy of the model as whether there are systemic biases in these estimates, which would be apparent in the residuals surface as large ‘patches’ of cells with positive or negative residuals, as well as discontinuities in the data. We can see in this figure a vertical band of red cells at younger ages in 1939; this suggests that the model underestimates deaths in younger males during World War Two, which should not be surprising given the model does not include any terms to represent this event, and instead assumes a continuous and rapid rate of age-specific mortality improvement over this period (Phase Two).

However, more importantly for the purpose of the model, there is no obvious patch or cluster of residuals in the early 1970s, which we would see if the model were not adequately capturing the underlying pattern and form of mortality associated with the Troubles. Instead, the surface of residuals largely appears random after around 1955, with red and blue cells about as likely to be visible.

Given the characterisation of the Troubles effect as having this characteristic pattern of exponential decay, as discussed in the methods section the effect of changing the decay rate parameter k on model fit was explored both by using the optimise function in R to minimise AIC, and also by plotting the relationship between AIC and k; this is shown on figure 7, and indicates that the model has a best fit when k is 9.748%. This value suggests the ‘half life’ of the Troubles was around 6.76 years.

## Counterfactual estimation

Using the approach described in the methods section, the number of additional deaths attributed to the Troubles by the model can be estimated by applying mortality risks to population sizes under both the ‘with-Troubles’ and ‘without-Troubles’ scenarios. Figure 8 shows the estimated number of additional deaths at each age and year after 1972. These tend to be concentrated at the youngest adult ages, then reduce with age. This is further confirmed by extracting the coefficient associated with the Troubles for each age, as shown in Figure 9, which include the equivalent coefficients for females if using the same model specification. For males the effect is positive at almost all ages, and is largest at age 18, then falls at most older ages; for females it tends to be negative, suggesting the model may be misspecified for females, and instead capturing broader continual improvements in mortality risks over this time period. Table 1 shows the number of estimated additional male deaths by year and age group in five year intervals to the nearest whole number for each year from 1972 to 2013, with margins indicating the total number by year and age. This estimates nearly 2800 additional deaths by 2013, with over 1000 occurring in the first three years of the conflict from 1972 to 1975. Looking by age, over half of the estimated deaths (1470 out of 2776) are estimated to have occurred in boys and men aged between 15 and 25 years inclusive.

## Section five: Discussion [1500 words]

### Comparison of mortality estimates

There have been a number of studious attempts to estimate the total number of deaths attributable to the Troubles, each utilising different sources of data and methods, and focusing on different population groups. (Smyth, 1998) estimated that a total of 3598 deaths were attributed killings in the conflict between 1969 and 1998; this compares with 2661 estimated in our model between 1969 and 1998, except our focus was just in younger adult males in Northern Ireland, rather than additional deaths in other countries, and other demographic groups. Analysis of a database of more than a thousand individuals involved in PIRA found the members when committing their first identifiable PIRA-related activity was 25 years, the same age as Jihadi recruits in more recent conflicts.(Gill & Horgan, 2013) The average age of recruitment was around three years younger, and increased as the conflict progressed.(Gill & Horgan, 2013) As the average age of recruits increased, violence decreased.(Gill & Horgan, 2013)

Like our estimates, (Smyth, 1998) found that a disproportionate share of deaths occurred in young adults, with a quarter occurring in people aged 18-23 years, and attributable deaths then falling at older ages. Within our model a qualitatively similar pattern of mortality burden by age was also found, though we estimated an even greater share in 18-23 age group, with 1053 deaths out of 2776, or 38% of all deaths, estimated to have occurred in this age group. (Smyth, 1998) also found deaths attributable the Troubles occurring in children as young as 12 years old, which was below the minimum age we modelled of 15 years old. Other total mortality estimates for the Troubles tend to be similar, with (McDowell, 2008) estimating slightly under 3700 deaths, and (Curran, 2001) estimating 3740 additional deaths between 1969 and 1999 (compared with our estimate of 2675 between 1972 and 1999).

Our model was based only on all-cause mortality data, and is an attempt only to characterise an unusual pattern in such data using a highly simplistic and stylised representation of this pattern in a linear modelling framework. It also focused only on one age group and gender, and did not attempt to model any additional deaths due to the Troubles through terrorist campaigns elsewhere in the UK. Despite this, it estimates up to around three quarters of the deaths that actually occurred, suggesting once again that the fundamental character of the modelling assumption - an initiation event leading to the sudden onset of a conflict whose intensity only slowly decays over many years – captures something of the essence of what occurred in Northern Ireland.

There may be two reasons why our estimates are below death counts directly attributed to political violence, in addition to our use of a more restrictive demographic group. Firstly, as noted in the results section, we did not explicitly model to include the particularly high spike of deaths in 1973; whereas the data show the mortality effect of the conflict growing over two consecutive years, our stylised model assumed it began in a single year. Secondly, adult males tend to experience a notable increase in mortality risk once they reach adulthood in most affluent nations, for a variety of reasons, and it is possible that a young adult male mortality displacement effect occurred in Northern Ireland after the onset of the Troubles. For example, it has been noted in both Northern Ireland and elsewhere that rates of homicide risk and suicide risk tend to be inversely correlated, and that both disproportionately affect younger adult males. (Curran, 2001; Durkheim, 1951; Lester, 2002) The distinction between (intergroup) ‘bridging’ and (intragroup) ‘bonding’ forms of social capital proposed by Robert Putnam has been considered in the context of Northern Ireland, and the argument made that sectarian conflict may have increased ‘bonding’ capital within either group at the expense of ‘bridging’ capital between the groups. (Leonard, 2004) If so, it may be that the high rates of ‘bonding capital’ within Northern Irish communities, though responsible for the maintenance of sectarian conflict, were also protective against some other forms of mortality risk, such as alcohol and drug-related deaths, that otherwise would have claimed more young adult males. Strong sectarian identity may also have a protective effect on the emotional impact of experiencing sectarian antisocial behaviours within adolescents, in particular for Protestants.(Merrilees et al., 2014) In the counterfactual scenario, therefore, it may well have been that some of those who did not die of sectarian violence instead died of some of these other causes, and so the net deaths ‘caused’ by the conflict may be less than the number of people who died of conflict-related violence.

### Methodological considerations and implications

There are two important methodological points to consider: firstly a more general point about the value of complex data visualisation for inductive social hypothesis generation, and secondly a more specific point about the potential use of the model specification developed here to estimate the mortality impact of conflict in populations about which high quality data are not routinely recorded.

Regarding the first point: this research originated through the use of Lexis surface visualisation to compare mortality trends in Scotland against neighbouring populations. As part of a series of comparisons Scotland was compared firstly against the rest of the UK, then against England and Wales, and Northern Ireland, separately. It was in this latter comparison, of age-year specific mortality rates by sex in Scotland compared with Northern Ireland, that a distinct visual ‘signal’ in Northern Irish male mortality was identified: whereas in Scotland mortality risks tend to be higher than for equivalent populations in the rest of the UK overall, and have been so for many generations, suddenly after 1972 mortality risks in Scottish young adult males ‘became better’ than those for equivalent populations in Northern Ireland, a relative improvement that could not be attributed to sudden improvements in Scottish mortality risks, but sudden deterioration in Northern Irish mortality risks at these age groups. Comparisons with other populations found that in the years immediately following 1972 mortality risks amongst young adult males in Northern Ireland were so bad as to be worse than in Eastern Europe, despite mortality rate trends in such countries having fallen sharply behind those in Western Europe since the establishment of the USSR. The incidental and accidental origins of this paper therefore highlight the value to us of the data visualisation approaches employed, and of the value of what Robert K Merton called ‘theories of the middle range’, and of research processes in which social hypotheses ‘emerge upwards’, inductively or abductively from data exploration, rather than are simply ‘applied downwards’, beginning in canonical social texts, then operationalised and empirically tested in a hypothetico-deductive fashion.

Regarding the second point, the specific model specification, including first an impulse component then an exponential decay, can be used to model particular types of mortality pattern disruption, likely attributable to violence or more general social disorder, even when only relatively limited all-cause mortality data are available, and specific death codes, such as ICD-10 codes, are likely to be recorded only inadequately or not at all. Such a situation is likely to be the case both for less affluent nations in more recent years, as well as for historic demographic data from more affluent data. Though the approach used relies on some subjective assumptions along with formal statistical testing, the relatively low level of detail required of the data used, requiring only population counts and counts of total deaths, means the modelling approach can produce estimates of particular types of conflict-attributable mortality even in the absence of high quality data. This has clear benefits both for the estimation of the mortality effects of historical conflicts, as well as for more contemporary conflicts in less affluent nations. One specific benefit of the modelling approach used here is in allowing conflict-attributable mortality to be compared in terms of both initial intensity (the height of the initiation in the first year) and also duration in terms of decay rates and so conflict half-life.

### Implications of the initiation-decay model to conflict in Northern Ireland

From the perspective of Turchin’s metaethnic frontier theory, conflict in the island of Ireland may long have been likely due to it being the presence of a metaethnic frontier between incompatible Axial religions. Even if this theory appears too broad or abstract to be valuable in this specific discussion, it appears clear from the historical accounts in the years immediately prior to the Troubles, in the decades that followed its initiation, and in the origins of Northern Ireland as a distinct country, that sectarian conflict has long existed throughout Ireland. The particular pattern of apparently conflict-attributable excess mortality modelled, though selected because it captures much of the empirical pattern of mortality change, also has a clear substantive meaning and interpretation fully compatible with sectarian processes as a primary cause of the pattern.

The model appears characteristic of a population that was in some senses ‘febrile’ or ‘fissile’ in its response to exogenous social, political and economic events and processes. Though it took a number of years, possibly three years, for the series of events which began in the late 1960s to lead to the initiation of conflict, this effect of this conflict was then sustained endogenously over many decades. This appears to represent the essence of cycles of violence driven by tit-for-tat processes of recrimination and revenge. For both sides, justice meant responding to violence with violence, a process of call and response in deadly conflict that, like an echo in a cave, only diminished slowly in intensity over time. Once this wave of conflict was initiated, it may have been that there was little that external agents could have done to either exacerbate or hasten the process of decline in violence.

The Northern Ireland conflicts involved multiple interacting elements, and it has been argued these elements should be modelled as a complex social ecology or system, incorporating positive and negative feedback between elements, rather than as a simple regression, in order to appropriately model the kind of ‘lock-in’ in rates of violence which emerge after initiating events.(Wright, 2006) Events and actions which have been included in a complex ‘systemogram’ modelling deaths through violence in Northern Ireland include the searching of vehicles and houses, deaths of civilians, the use of CS gas, the internment of republicans, the deaths of military personnel, and the number of bombs exploded in a given month, each of which is measureable and can be seen to have an influence on the likelihood of over events in later time periods.(Wright, 2006) A paper describing an agent-based model of processes and dynamics of civil war emphasises the punctuated equilibria – sudden increases in violence punctuating longer periods of relative calm – can be expected in such complex systems, and that it is important to consider the ways that agents involved in war adapt over time in their attitudes and behaviour.(Findley, 2008)

If, once initiated, the conflict was largely endogenously driven, this has important implications for how the various peace initiatives and processes which were attempted after 1972 should be interpreted in terms of their effectiveness. Paramilitary operations by the Irish Republican Army (IRA) officially ended on 31 August 1994; six weeks later, on 13 October 1994, a cessation of violence was announced by Loyalist forces, leading to a situation described in 1995 as a ‘cold peace’.(Boyle & Hadden, 1995; O’Leary, 1995) Though there was then a resumption of IRA violence on 9 February 1996, marked by the bombing of Canary Wharf in London, (Kyle, 1996) if the fundamental logic of the process implied by the model is accurate, it may be more effective to think of such official ceasefire announcements as *following,* rather than *leading,* a more general and long-term decline in the intensity of this process of conflict. Up to seven prior attempts at bringing peace to Northern Ireland were made between 1969 and the Belfast Agreement of 1998, including the Sunningdale Agreement of 1973. It has been argued that what made the Belfast successful was the presence of key individuals acting effectively as ‘brokers’ in the complex social networks which had to be negotiated at the time.(Goddard, 2012) However, if the underlying dynamics of the model are accurate, then both factors attributable to the failure of earlier initiatives and the success of the GFA may be greatly overstated. If the half-life of the conflict was 6.76 years and began in 1972, it follows that by 1994 the intensity of the conflict had diminished to around one-tenth of its initial level. (i.e. ). Similarly, by the time of the Good Friday Agreement in 1996 the underlying conflict intensity had diminished to around 7% of its initial value (i.e. ). Note that these intensity values apply to log10 mortality risks, so the actual level of decline of conflict intensity on deaths by the mid to late 1990s will have been even greater.

Regardless of the precise rate of decay in conflict intensity, the model’s implication is that once conflict was exogenously initiated, it was then endogenously sustained. The lack of any obvious signals that events in any single year after 1972 had a strong effect on mortality in the same way underlines the importance of acting to avoid the reinitiation of a new wave of conflict, because once such conflict is started, it can be very difficult to stop.

The next section of the discussion section raises some concerns about how both the nature of the Good Friday Agreement in 1998, and more recent political events, imply both that the same underlying conditions for ‘febrility’ in Northern Irish society remain, and that political processes relating to Brexit risk such a reignition of a new decades-long wave of violence.

# The Good Friday Agreement [386]

The power sharing arrangement following the Good Friday Agreement (GFA) has been described as an example of ‘consociationalism’, a system of government in which coalition by both Republicans and Loyalists is mandated; this arrangement was for many years abided to by both sides to avoid either ‘direct rule’ from London (unacceptable to Republicans) or ‘joint sovereignty’ with the Republic of Ireland (unacceptable to Loyalists).(ANDERSON, 2008) Questions have therefore been raised about whether the GFA represents or helps to bring about conflict *resolution*, or is simply conflict *management* (or more pessimistically conflict deferment).(ANDERSON, 2008) Consociational governments have their origins in the Dutch experience of managing ‘plural societies’, and based around four prescriptions for political process: grand coalition; proportional representation; mutal veto; and autonomy. It is argued that such arrangements are somewhat segregationalist rather than integrationalist by design.(Dixon, 2011) The consociational arrangement following the GFA has led to little change in the ethno-sectarian identity focus of any of the main parties within Northern Ireland. Indeed, the political success of Sinn Fein at the expense of the more moderate Social Democratic and Labour Party (SDLP) in capturing the Irish Nationalist voting block after the GFA suggests sectarian identity may have come to matter more, not less, to voting intentions following the GFA.(McGlynn, Tonge, & McAuley, 2014) Cross-ethnic political parties have seen only limited success after the GFA compared with sectarian political parties, and this lack of success has been attributed to the consocational institutions established in the wake of the GFA to accommodate (rather than attempt to blend) rival identities.(Murtagh, 2015)

Cultural and often physical segregation between communities in Northern Ireland begins early in the life course, with Catholics and Protestants often taught in separate schools, limiting opportunities for social contact which have the potential for greater community integration. Integrated schools were established in Northern Ireland in the early 1980s. Their perceived legitimacy amongst parents may depend more so on the level of trust parents have in head teachers than amongst other school types.(Donnelly, Furey, & Hughes, 2016) Amongst children in integrated and segregated schools in Northern Ireland, cross-group friendships and extended out-group contact had somewhat different positive effects on intergroup relations, with the former leading to better intergroup relations through increased self-disclosure and outgroup empathy, and the latter leading to improved perceived peer norms towards the out-group.(Turner, Tam, Hewstone, Kenworthy, & Cairns, 2013) According to the contact hypothesis, if people from opposing groups are brought into contact with each other under certain optimal conditions then conflict between groups can be reduced.(Allport, 1954) The benefits of intergroup contact for reducing out-group prejudice amongst school children has been found in all school types (segregated, mixed and integrated).(J. Hughes, Campbell, Lolliot, Hewstone, & Gallagher, 2013) Segregated schools appear to contribute to in-group bias and out-group prejudice amongst school children, with broader political ramifications.(J. Hughes, 2011) Given the consociational emphasis of the GFA, an outcome of the Northern Ireland peace process may have been to reduce earlier trends towards integrated education, in order for the agreement to be mutually acceptable by both nationalists and unionists.(Nolan, 2007) Lack of contact between groups can be self-sustaining, as a precondition for increased intergroup contact may be reduced intergroup anxiety; anxiety and lack of contact can therefore be mutually reinforcing, and poor quality contact may further increase anxiety, as well as relative intergroup status – meeting on equal terms – which can further increase intergroup anxiety and reduce positive contact.(Nicole Tausch, Hewstone, Kenworthy, Cairns, & Christ, 2007) A meta-analysis of over 500 studies on intergroup contact theory suggests that benefits of intergroup contact are found even when the four originally proposed conditions for optimal contact – equal status, common goals, no intergroup competition, and authority sanction – are not met; and that there tends to be generalisation of positive attitudes beyond the immediate outgroup in the members of the situation.(Thomas F Pettigrew, Tropp, Wagner, & Christ, 2011) This capacity for positive contact with a primary outgroup to lead to generalised positivity towards other outgroups is known as the secondary transfer effect (STE). (Nicole Tausch et al., 2010) The conflict and its revolution may have affected broader social attitudes held by prominent individuals in the region, such as attitudes towards homosexuality.(Ashe, 2009) Analysis of data from 1989 and 1991 found that contact between groups in Northern Ireland was associated with more positive attitudes to denominational mixing, intergroup forgiveness, perspective taking and trust.(Hewstone, Cairns, Voci, Hamberger, & Niens, 2006) Northern Ireland remains by many measures the most socially conservative part of the UK, including being the only part of the UK where abortions are illegal. Gay marriage is legal within the Republic of Ireland, while remaining illegal in Northern Ireland. It may well be that some of this social conservatism stems from high levels of antipathy towards primary outgroups, leading to lower empathy towards secondary outgroups – such as immigrants, homosexuals and teenage parents – about which some of these socially conservative policies are targeted; conversely, increased integration between Protestants and Catholics in Northern Ireland may lead to increased social liberalism more generally. Perhaps because there is further to travel along this social liberalism axis, research assessing the extent of STEs suggests that the effects of positive contact on attitudes to secondary groups may be stronger in Northern Ireland than in Germany.(Schmid, Hewstone, & Tausch, 2014)

An economic resurgence followed the GFA, with important implications for migration, with the region changing from experiencing net out-migration to net in-migration, drawing migrants – as with much of the UK – from predominantly former Eastern bloc countries.(Geoghegan, 2008; Jarman, 2006) Increased exposure to a greater diversity of ethnicities and cultural backgrounds led to an increased focus on acts of racism and anti-racism in the region. It has been argued that even statements of anti-racism, such as those presented on public murals, still employ sectarian narratives.(Geoghegan, 2008) The apparent stability of peace in Northern Ireland since the Good Friday Agreement has allowed for a greater focus on economic regeneration in Belfast.(Ellis & McKay, 2000) Infrastructure which emerged during the conflict – such as military installations and sectarian street murals - are now being promoted as tourist attractions.(McDowell, 2008)

# European Union

The EU has been seen as important to conflict resolution and facilitating British-Irish cooperation in Northern Ireland.(Tannam, 2012) It has been suggested that the European Commission’s approach to conflict resolution in Northern Ireland altered from the late 1980s due both to greater analytical understanding, and changes to the situation in Northern Ireland resulting from successful British and Irish negotiations.(Tannam, 2007) The EU may also have been encouraged to take a more pro-active role in the region due to a perceived failure at ethnic conflict mitigation in the Balkans in the early 1990s.(Tannam, 2007) It has been suggested that the EU can affect border conflict through four mechanisms: compulsory impact, in which borders have to be removed or reduced to meet EU treaty obligations; enabling impact, in which actors in specific parties to the dispute link their political agendas to the EU; connective impact, in which the opportunities and challenges posed by greater EU membership are recognised as requiring cross-party collaboration; and constructive impact, in which the group identities of antagonistic parties become re-written under a broader European identity.(Diez, Stetter, & Albert, 2006) It has been argued that, whereas ethno-national conflict since the establishment of Northern Ireland in 1921 sharpened the border with the Republic of Ireland, the European Single Market made it more permeable, highlighting the influence that global factors can have on the region.(Anderson & O’Dowd, 1999) The advancing role of the European Union within Northern Ireland, as well as within Eastern Europe, has been presented in the context of an ongoing debate about the nature and role of territorial borders and individual states in the context of globalisation; within this debate some theorists may be characterised as global trans-nationalists, who emphasise the new permeability of ethno-nationalist borders in a global economic system in which goods and services flow frictionlessly between traditionally defined territories, and more nationalistically focused theorists who emphasise the continued importance of state actors and territorial divisions in demarcating and administering political power and defining place. As always the reality is likely to exist somewhere along this nationalist-transnationalist continuum, but recent political developments in both the UK and USA mean the position in this continuum may have shifted further towards the former pole.(Anderson & O’Dowd, 1999)

The European Commission invested over £80 million into district partnerships in Northern Ireland, through its Peace and Reconciliation Special Support Programme by the end of 1999.(Williamson, Scott, & Halfpenny, 2000) EU Peace Programmes for Northern Ireland and the Border Counties began in 1995 with the Special Support Programme for Peace and Reconciliation (Peace I) which provided €500 million in structural funds to the region, supplemented with an additional €167 from government; followed by the Programme for Peace and Reconciliation (Peace II), which provided €531million via the EU and an additional €304 from national governments between 2000 and 2004.(Buchanan, 2008) Most of this money was spent on projects focused on economic renewal and local regeneration rather than those explicitly addressing social integration, though it is argued the former aims facilitate the latter, with the Community Relations Council arguing that on the Irish border violence promotes poverty and poverty promotes violence.(Buchanan, 2008) Such programmes were considered distinct from national government-led peace promotion efforts in their involvement of grass-roots community organisations in bidding for grants and implementation of initiatives.(Buchanan, 2008) The third phase of the EU programme for Peace and Reconciliation in Northern Ireland took place over the years 2007 to 2013. Community group leaders considered it largely successful at promoting cross-community contact and reconciliation, but bureaucratic.(Karari, Byrne, Skarlato, Ahmed, & Hyde, 2013)

# Demography

Catholics in Northern Ireland had disadvantaged class positions relative to Protestants for much of the period 1922 to 1972, but these inequalities had sharply reduced by 1996. (Breen, 2000) Structural inequalities – perceived or real – that exist between groups can affect both rates and quality of inter-group contact, as well as negative outgroup attitudes.(Kauff, Schmid, Lolliot, Al Ramiah, & Hewstone, 2016) The Catholic share of Northern Ireland’s population has been steadily rising throughout the 1970s and 1980s.(O’Leary, 1995) Catholics have higher mortality rates than non-Catholics in Northern Ireland, but such differences appear to be explained by differences in socioeconomic status.(O’Reilly & Rosato, 2008) Differences in behaviour and lifestyle associated with different religious denominations in Northern Ireland mean religious identity is predictive of differences in population health.(O’Reilly & Rosato, 2008) The role of the Irish diaspora, and in particular on Americans of Irish descent, on bringing international attention and support to peace-building in the region is important to consider.(Cochrane, Baser, & Swain, 2009)

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