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Work disability and the Northern Irish Troubles*

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Abstract

In this paper, we examine the labour market implications of permanent illness or injury from conflict among civilians. From 1969 to 1998, Northern Ireland experienced a violent ethnopolitical conflict characterized by terrorist bombing campaigns, sectarian killings and armed forces patrolling the streets. The consequences of this period for current high work disability rates are disputed by the main political parties. We address this question using a new high-quality dataset. Potential endogeneity and reverse causation issues are addressed using the intensity of conflict-related deaths as instruments. We find clear evidence that conflict has increased work disability by 28% points. The main doctor-diagnosed medical condition mediating this effect is mental ill health.

I. Introduction

From 1969 to 1998, Northern Ireland (NI) experienced a violent ethnopolitical conflict known locally as ‘the Troubles’ which was characterized by terrorist bombing campaigns, sectarian killings and armed forces patrolling the streets. Currently, this region has the highest claimant rate for work disability benefits in the United Kingdom (UK) and much higher rates of limitation among middle-aged and older people than in the Republic of Ireland. The two major NI political parties – republican and unionist – disagree on the extent to which these high rates are attributable to the legacy of the conflict. In this paper, we explore this question using a new high-quality dataset which contains the most comprehensive information available to date.

Standard economic growth models predict the loss of human capital due to conflict will have longer lasting consequences than the destruction of physical capital and this...
is often confirmed in empirical studies (Blattman and Miguel, 2010). A relatively recent literature has examined the effect of war exposure on earnings highlighting lower productivity due to lost opportunities for studying and working (Blattman and Annnan, 2010; Akbulut-Yuksel, 2014; Kesternich et al., 2014). War can also impact on labour through work disablement with enduring psychological conditions, lower cognitive ability and higher rates of heart disease (Bedard and Deschênes, 2006; Angrist, Chen and Frandsen, 2010; David, Duggan and Lyle, 2011; Cesur and Sabia, 2016). A related literature has explored health outcomes from conflict but has largely neglected the labour market implications of permanent illness from war experiences due to data limitations (Akbulut-Yuksel, 2017; Havari and Peracchi, 2017).

Our paper makes the following contributions to this literature. First, we examine work disability in the general population not just in ex-combatants. Second, we use much richer data on the level and nature of experience of conflict. The Northern Ireland Cohort for the Longitudinal study of Ageing (NICOLA) follows the design and methodology of the English Longitudinal Study of Ageing (ELSA) and includes a module on exposure to injury, death, incarceration, bombing, riots, intimidation at work and house searches during the Troubles. A secondary source of data details fatalities during the Troubles according to location and whether they occurred through public disorder, bomb explosions or assassination. Using these data as instruments, we find clear evidence that conflict has increased work disability by 28% points. Our third contribution is we explore the medical conditions through which conflict impacts on work disability and find that despite growing evidence for the importance of psychosocial causes of ill health the main mediating pathway is through worse psychological morbidity.

A person is disabled if they have a health condition and have difficulties carrying out normal daily activities (WHO, 2001). Labour market analysis of work disability generally relies on self-assessed survey questions of the form ‘how much are you limited in the kind or amount of work that you can do due to a health condition?’ and we also use such measures in our study (Jones, 2008). But subjective assessments of this nature are prone to measurement error due to the lack of comparability across individuals and justification error due to the endogeneity of self-assessments to labour market status (Bound et al., 1999; Lindeboom, 2006). We address these biases in our dependent variable by using the vignette methodology where respondents evaluate the degree of work limitation of people described in hypothetical scenarios using the same response scales as in their self-assessments (Kapteyn, Smith and Van Soest, 2007). We also use a measure of functional limitations and work disability benefit receipt to test the robustness of our findings. Our main explanatory variable is a subjective report of how the Troubles have affected the respondent’s life. Potential endogeneity and reverse causation issues with this measure are addressed using the intensity of conflict-related deaths recorded at the local level.

The NI Troubles provide a particularly useful context in which to study the legacy effects of conflict as we can draw on comprehensive high-quality data unlike in developing countries where most civil wars occur but data are more limited. The political situation in NI has been and continues to be volatile as the implications of Brexit become apparent. It is therefore timely to consider the potential enduring economic consequences of a return to violence.
II. Background

A review of related literature

Standard growth models predict that the long-run impact of war on human capital is more important economically than the destruction of physical capital (Barro and Sala, 2003). A micro-literature has examined long-run human capital outcomes among those exposed to violence focussing especially on missed education, training and work experience opportunities. Studies provide evidence that ex-combatants earn less. Angrist (1990) finds White Vietnam veterans earned 15% less in the long-run due to lost labour market experience while Blattman and Annan (2010) reports lower wages for youth abducted as child soldiers by Ugandan rebels mainly because of lost education. Civilians have been likewise affected. Living through World War II retarded the accumulation of human capital leading to a permanent loss of labour productivity and earnings as educators were killed and schools were destroyed (Akbulut-Yuksel, 2014; Kesternich et al., 2014) with evidence that education effects are transmitted onwards intergenerationally (Havari and Peracchi, 2019). The Troubles would appear to have had less of an effect on education than these other conflicts with NI outperforming the rest of the UK in secondary school examination results during this time (Education, Science and Arts Committee, 1983). Studies also report many paramilitaries using their time in prison to gain formal education qualifications and engage in peer and collaborative learning (Irwin, 2003). In contrast, pupils often reported an affective impact on their education despite considering schools a ‘safe haven’ from the conflict (Kilpatrick and Leitch, 2004).

The persistent effects of war on labour through work disablement have been comparatively neglected with most studies analysing disability among war veterans. Considering that most causalities in most recent conflicts have been civilians this emphasis seems misplaced. The extent of war-induced mental illness has been recognized since World War I when 65,000 ex-servicemen were still drawing disability pensions due to neurasthenia 2 years after the Armistice Bogacz, 1989). Enduring psychological conditions have also been noted in more recent conflicts. Veterans of the Vietnam war experienced higher excess mortality due to motor vehicle accidents and suicides and made more disability claims for conditions such as post-traumatic stress disorder (PTSD) (Hearst, Newman and Hulley, 1986; Angrist et al., 2010). Many Gulf War veterans not fulfilling the diagnostic criteria for PTSD nevertheless reported disabling conditions such as tiredness, numbness, limb weakness and cognitive complaints such as loss of concentration, memory problems and low mood 10–15 years after combat (Iversen, Chalder and Wessely, 2007). Ex-combatants also have worse physical health than their peers in the long-run. Veterans had an increased risk of death from lung cancer and heart disease 20–50 years after discharge from military service in WWII and Korean War (Bedard and Deschênes, 2006).1

1On the other hand, Angrist et al. (2010) report that Vietnam service had little effect on self-reported health status by year 2000 but David et al. (2011) find a large increase in self-reported disability among this group in the following decade consistent with the adverse health consequences of combat exposure.
Studies of civilian impacts generally focus on health effects instead of work disability. Civilian death and disability caused by civil war is apparent well beyond the period of active warfare and disproportionately affects women and children (Ghobarah, Huth and Russett, 2003). Exposure to the Korean War during late childhood is associated with worse mental health five decades later (Kim, 2017). There is also evidence of long-run physical ill health due to experience of war in childhood. Children exposed to WWII destruction in very early years have higher BMIs and a higher incidence of cardiovascular diseases in adulthood (Akbulut-Yuksel, 2017) and war exposure during childhood or adolescence is associated with a significantly higher chance of having two or more chronic conditions sixty years later (Havari and Peracchi, 2017). This would not be surprising to medical practitioners. Meta-analyses of neurobiological studies show an association of PTSD with increased risk of coronary heart disease (Edmondson et al., 2013), obesity (Bartoli et al., 2015), respiratory disease (Pedersen, Zachariae and Bovbjerg, 2010) and metabolic syndrome (Heppner et al., 2009). More generally, Cohen, Murphy and Prather (2018) argues that psychological stress can impact most diseases since stressful events can potentially interfere with major organs such as brain, heart and liver and bodily systems such as the immune, endocrine and cardiovascular systems. Another possible non-medical causal channel from conflict to disablement is suggested by research showing how economic preferences are formed by early childhood experiences. Early life trauma can permanently reduce trust (Kesternich et al., 2016), reduce cognitive ability (Havari and Peracchi, 2017) and increase risk aversion (Jakiela and Ozier, 2019) which may impact on health behaviours resulting in a higher chance of being work disabled.

Overview of Northern Irish troubles

The Troubles was a 30-year conflict in which 3289 Northern Irish people were killed and 41925 injured. In 1969, civil rights marchers protesting at discrimination against the minority catholic community were met with a violent response by the politically dominant protestant community. As tensions escalated, confrontations drew in previously dormant paramilitary groups with roots in historical campaigns for independence from Britain on the republican (largely catholic) side and a desire to preserve the status of NI within the UK on the loyalist (largely protestant) side. The police assisted by British Army troops were unable to maintain order and street disturbances soon lead to fatalities. A series of misjudgements by the state authorities lead to an intensification of the violence and 1972 saw the greatest loss of life in the entire conflict (O’Duffy and O’Leary, 1990). Paramilitary campaigns sustained hostilities for three more decades before eventually being brought to an end by the signing of the Good Friday Agreement in 1998. During the Troubles there were 35669 shooting incidences, 15246 bombings and 2181 incendiary devices used leading to 957 members of security forces and 2332 civilians killed in a population of around 1.5 million people.

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2Deaths and injuries 1969-98 (CAIN, 2018) Despite a peace agreement in 1998, there have been 98 Troubles-related deaths 1999–2015 and 5237 Troubles-related injuries January 1999–June 2003.

3Security Related Incidents in Northern Ireland (only), Shootings, Bombings, and Incendiaries, 1969 to 1998 (CAIN, 2018). 1971 Census population estimate was 1,536,065 people (GRO, 1971).
Fay et al. (1999) describes how the patterns of violence varied spatially taking on a different nature in different contexts. Belfast saw the most intense violence and daily life in many areas was constantly fraught with risk. The city centre bore the brunt of the economic war against commercial targets, the segregated North experienced high levels of random sectarian assassinations while predominately Catholic West Belfast was highly dangerous for both security forces and the local civilian population. Sectarian killings were less common in Derry where an intense republican campaign of violence against security forces and economic targets led to high fatality rates among both paramilitaries and security personnel. The Mid-Ulster area saw a local war of sectarian killings as well as attacks on security force members with most victims being local residents. In contrast, the conflict in the border areas especially South Armagh was characterized by a republican campaign of ambushes and sniper attacks against the security forces. Fatalities in this area therefore tended to be non-residents. Other parts such as Antrim, Down and suburban Belfast were relatively unaffected (see Figure 1a).

Studies indicate that the Troubles have had a lasting effect on the physical and mental health of the Northern Irish population. Those who experienced conflict-related trauma are significantly more likely to suffer from mental disorders such as PTSD, anxiety and depression (Bunting et al., 2013) while physical injuries include blast and gunshot damage, loss of limbs, loss of hearing and vision and ongoing pain due to embedded shrapnel or wounds (Breen-Smyth, 2012). It is also clear that the age cohort of interest in our study have the highest risk of conflict related-trauma and the highest rates of activity limitation due to conflict-related violence as they were exposed to the most intense period of violence associated with the conflict as teenagers. There are three difficulties with these studies. First, all rely on self-reports of experience of conflict-related trauma. There is likely to be heterogeneity in reporting accuracy due to a perhaps politically motivated desire to play down the degree of conflict or to alternatively emphasize the degree to which they and their community suffered. Second, causation from experience of conflict to incapacity is not established as surveys often rely on respondents to make this association themselves. As we have seen this is difficult for many medical conditions and also respondents may not make this connection since the effects of conflict are often experienced indirectly through poverty, social marginalisation and family upheaval (Miller and Rasmussen, 2010). The third difficulty is the health outcome measure is often self-reported or only focuses on injury or mental health and does not allow for an analysis of work limitation.

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4Bunting et al. (2013) found the risk of conflict-related trauma peaked among the 45- to 54-year-old age group in interviews conducted from 2004 to 2008. Also, a supplementary analysis of the 2006/07 NI Survey of Activity Limitations and Disability (NISALD) shows that a higher proportion of those disabled in the 45–54 age group attributed their activity limitation to violence caused by the Troubles than those disabled in any other age group. (Authors’ calculations)

5(i) Police statistics on persons injured due to the Troubles do not imply permanent injury and do not include psychological conditions; do not include civilians injured 1969–70; do not rely on a specified definition of injury; are likely to be inconsistent over time; record only injuries known to the police and record local security forces injuries more comprehensively than civilian injuries (Breen-Smyth, 2012). (ii) NISALD relies on self-reported difficulties. (iii) 2010 NI Omnibus survey relies on self-reported physical injury. (iv) NI Study of Health and Stress used a screening tool for mental disorders only. (v) Cost of the Troubles relies on self-report of injury due to bomb explosion or shooting.
Figure 1. Experience of the Troubles in Northern Ireland

(a) Fatality rates per 1000 population 1969–1998

(b) Proportion of those aged 50–64 reporting that the Troubles had ‘quite a bit’ or ‘an extreme amount’ of impact on their lives
III. Theory

IV. Data and methods

Sample

Our data are taken from Wave 1 of the NICOLA study. This survey interviewed participants aged 50 and over living in their own home on their health, lifestyles and financial situation and was designed as a sister study to the English Longitudinal Study of Ageing. Fieldwork for this study began February 2014 and was completed March 2016. In addition to the main personal home interview, participants were invited to return a self-completion questionnaire covering the vignettes, experience of the Troubles and mental health. Of the 8504 respondents to the main interview, 59% returned a valid self-completion questionnaire. The sample in our analysis is further restricted to those between the ages of 50 and 65 who would have been between 4 and 19 years of age at the outbreak of the Troubles in 1969.

Our main work disability measure is the response of ‘None’, ‘Mild’, ‘Moderate’, ‘Severe’ or ‘Extreme’ to ‘How much are you limited in the kind or amount of activity or work that you can do due to an impairment or health problem?’ As such measures will be subject to reporting heterogeneity, we adjust these responses for the respondent’s perceptions of work limitation using the methodology described in the next section. We follow Kruse and Schur (2003) in using two alternative measures of work disability – functional limitation and disability benefit receipt – to test the robustness of our findings. Functional limitation in relation to mobility, arm function and fine motor function is determined from responses to ‘Because of a physical or mental health problem, do you have difficulty doing any of the activities: walking 100 m, running 1.5k, sitting 2 hours, getting up from a chair, climbing stairs, stooping/kneeling/crouching, reaching up, pulling or pushing chair, lifting weights over 5 kg or picking up a coin’. Disability benefit receipt is reported receipt of Incapacity Benefit, Employment and Support Allowance, Severe Disablement Allowance or War Disablement Pension.6,7

Our main explanatory variable is the response to ‘In general, what impact do you think the Troubles have had on your life?’. This is dichotomized with ‘none’, ‘a little bit’ or ‘a moderate amount’ coded zero and ‘quite a bit’ or ‘an extreme amount’ coded one (see Figure 1b). We expect this variable to be subject to measurement error and so we instrument using the intensity of conflict-related deaths recorded at the local level. Our instrumental variable for the impact of the Troubles is the number of Troubles-

6Until 2008, Incapacity Benefit was the main contributory earnings replacement benefit for those unable to work because of illness or disability replacing the previous Severe Disablement Allowance benefit. It was replaced in turn by Employment and Support Allowance (ESA) in 2008.
7These variables are not our preferred measures of work disability. Functional limitations are not the same as disablement. Functional limitations are restrictions in basic mental and physical actions due to illness or injury which can in turn cause disablement depending on the particular social context (Nagi, 1979). Variation in disability benefit receipt in the UK is often driven by labour market factors and health-related factors to a lesser degree (McVicar, 2008) and not all those with a disability, particularly mental ill health, take-up their benefit entitlement (Galloway, Boland and Williams, 2018; DSDNI, 2012).
related fatalities 1969-98 per 1000 population in each district electoral area (DEA).\textsuperscript{8} Malcolm Sutton’s ‘Index of Deaths from the Conflict in Ireland’ lists the location of 3489 fatalities during these years (Sutton, 2002). Each death was then geocoded using Google Maps giving 3319 postcoded fatalities within NI. Linking this list by name with Michael McKeown’s ‘Database of Deaths associated with Violence in Northern Ireland’ allowed the further classification of each fatality by the context in which it happened according to the taxonomy: Petty Crime, Riot Affray, Assassination, Gun Battle, Sniper, Explosion, Ambush, Beating, Hunger strike, Dumped, Arson, Stabbing, Rocket, Not Classified (McKeown, 2009a).\textsuperscript{9}

This instrument is demonstrated below to be relevant (section Experience of the troubles). Following the discussion in Deaton (2010), our instrument satisfies exclusion restrictions if (a) the average effect of being impacted by the Troubles on work disability is the same in areas with higher Troubles-related fatalities as throughout the region or (b) the Troubles impacted only those in areas with higher Troubles-related fatalities. Whereas (b) is obviously incorrect, our instrument may also violate (a) if areas with higher fatalities also have other characteristics associated with higher work disability. We therefore include a number of DEA-level observables in addition to standard demographic controls. It may be the case that residents of DEAs most affected by the Troubles are more inclined to regard themselves as disabled irrespective of their health state. Unemployment tends to be higher in these areas and high disability rates may reflect hidden unemployment (Koning and Van Vuuren, 2007). A dependency culture of overreliance on social security may arguably exist in areas most affected by conflict (Murray, 2008) encouraging residents to consider themselves as disabled. Residents living close to benefits offices may be prone to a form of supplier-induced demand for disability benefits (Evans, 1974). We therefore include the following variables at DEA-level in our model: percentage of residents aged 50–74 unemployed from 2011 Census; percentage of residents aged 16–74 long-term unemployed from 2011 Census and the population-weighted distance to benefits offices.\textsuperscript{10,11}

\textsuperscript{8}DEAs are groups of 5, 6 or 7 wards used in proportional representation elections to local government. There are 80 DEAs in NI. The population base is all persons from the 1991 Census of population.

\textsuperscript{9}There are four main authoritative sources for Troubles-related deaths - the two cited above as well as Lost Lives (McKittrick, 2001) and Northern Ireland’s Troubles: The human costs (Fay et al., 1999). All broadly agree on a total of around 3500 deaths in the period 1969-98 and McKeown argues the discrepancy between his list and those others is ‘within the one per cent margin…judged to be acceptable’ (McKeown, 2009b). They differ in the inclusion of suicides, trauma-related heart attacks, paramilitary accidents and paramilitary involvement in common criminality. All are based on publicly available information such as newspaper reports, coroners’ reports, death notices and published studies.

\textsuperscript{10}2013 mid year population estimates for 4,537 small areas (SA) were combined with distance from SA centroid to the nearest of 39 social security benefits offices and averaged at DEA level.

\textsuperscript{11}We also included the proportion of Catholics at DEA level (2011 Census) on the basis that Catholics may be more inclined to regard the state as illegitimate and desire to exploit benefits available to the disabled (Brewer and Higgins, 1998). This variable was not statistically significant in any of our models and was consequently dropped.
Statistical methodology

Vignettes

Our main work disability measure is the response to ‘How much are you limited in the kind or amount of activity or work that you can do due to an impairment or health problem?’ We adjust these responses for the respondent’s perceptions of work limitation using a series of nine vignettes across the three domains of pain, affect and heart problems. In these questions, respondents are asked to assess the degree of work limitation for hypothetical examples of people with health problems (see Table A1 in supplementary appendix). The vignette names were additionally randomized according to community background and gender.

We use an ordered probit model for the respondent’s self-assessment $y^*_i$

$$y^*_i = x'_i \beta + \epsilon_i$$

where $x'_i$ is a matrix of covariates, $\beta$ are parameters and $\epsilon_i$ a standard normally distributed error term.

The true level of work limitation $y^*_i$ is unobserved and respondents report a level of limitation $k$ generated by person-specific thresholds $\tau^k_i$

$$y_i = k \text{ if } \tau^k_{i-1} \leq y^*_i < \tau^k_i$$

Self-assessments therefore differ not only in their true underlying level of limitation but also in the thresholds they apply to describe this level.

The vignettes are used to eliminate threshold heterogeneity. It is assumed that all respondents observe the same underlying level of work limitation $\theta_j$ when they read vignette $j$.

$$z^*_ij = \theta_j + u_{ij} \text{ where } u_{ij} \sim N(0,\sigma^2)$$

It is also assumed that they apply the same thresholds to describe the vignettes as they use in their self-assessments, that is

$$z_{ij} = k \text{ if } \tau^k_{i-1} \leq z^*_ij < \tau^k_i$$

The only variation in the vignette descriptions are then due to variation in the person-specific thresholds allowing the parameters $\gamma^k$ below to be identified for each individual where $v_i$ are covariates.

$$\tau^1_i = \gamma^1 v_i$$

$$\tau^k_i = \tau^{k-1}_i + \exp(\gamma^k v_i), \ k = 2, \ldots, K$$

The parameters $\beta$ describing the relationship between the true level of work limitation and covariates can then be correctly identified. We estimate this hierarchical ordered probit model (HOPIT) using the Generalized Linear Latent and Mixed Models package (Rabe-Hesketh and Skrondal, 2002).

Vignette equivalence and response consistency

The vignette methodology depends on two important assumptions: vignette equivalence and response consistency. Vignette equivalence (VE) relies on all respondents having a
common understanding of the latent limiting condition in the vignette description so that all variation in ratings can be attributed to reporting heterogeneity. Response consistency (RC) relies on all respondents using the same standards to rate vignette work disability as they use to rate their own work disability.

VE tests come in two forms. Weak tests check that all vignettes (within the same domain) are ranked the same by all respondents whereas strong tests check whether the latent construct is affected by covariates. A simple assessment of RC can be constructed by comparing thresholds generated from anchoring vignette ratings and thresholds generated from self-ratings conditioned on objective measures of work disability (Grol-Prokopczyk et al., 2015).

Endogeneity
If \( y_2 \in x_i = (y_2, z_i) \) is endogenous in (1) then dropping the \( i \) subscript we have the following system:

\[
\begin{align*}
    y_1^* &= \delta_1 y_2 + z_i \beta_1 + \zeta + \epsilon \\
    \tau^1 &= \gamma^1 v \\
    \tau^k &= \tau^{k-1} + \exp(\gamma^k v), \quad k = 2, \ldots, K \\
    y_2^* &= z \beta_2 + \lambda \zeta
\end{align*}
\]

(3)

where \( \zeta \) is a latent variable constructed to capture shared unobserved heterogeneity and \( \lambda \) is the factor loading. This is similar to the endogenous treatment model in Rabe-Hesketh and Skrondal (2004) or the ordered probit model with endogenous explanatory variables outlined in Wooldridge (2010).

For our alternative work disability measures, we use a recursive bivariate probit model with Troubles impact \( y_2 \) and work disability measure \( y_1 \) where the error terms \( (\epsilon_1, \epsilon_2) \) are distributed bivariate normal with zero mean, unit variance and correlation coefficient \( \rho \). The system is then estimated by maximum likelihood.

\[
\begin{align*}
    y_1^* &= \delta_1 y_2 + z_i \beta_1 + \epsilon_1 \\
    y_2^* &= z \beta_2 + \epsilon_2
\end{align*}
\]

(4)

V. Results

Descriptive statistics

Summary statistics for selected variables are given in Table 1. The proportion reporting that they are severely or extremely limited in the kind or amount of activity or work that they can do due to an impairment or health problem (12%) is similar to rates of those claiming earnings replacement disability benefits in the general population at this time.\(^{12}\)

Overall, 22% of respondents report that the Troubles had ‘quite a bit’ or ‘an extreme

\(^{12}\)At July 2015, 11% of the working age population in NI were claiming disability benefits. There were 118300 claiming Employment & Support Allowance, 2900 claiming Incapacity Benefit and 1700 claiming Severe Disablement Allowance (Provisional Northern Ireland Benefit Claimants by Extract Date, NISRA). The 2011 population aged 18–64 was 1116380.
of impact on their lives. This is almost identical to the proportion reporting an impact of the Troubles on their lives or the lives of their families in a survey conducted almost twenty years earlier (O’Reilly and Stevenson, 2003) and bears out the longevity and salience of historic traumata (Dillenburger, Fargas and Akhonzada, 2008). The demographics of our sample are similar to the NI population - for example, the religion breakdown for this age group was 47% Protestant and 38% Catholic according to the 2011 Census. The proportion of Protestants whose lives were impacted by the Troubles (19%) is lower than Catholics (30%) and the proportion of Protestants severely or extremely work limited (12%) is also lower than Catholics (14%). Table 2 provides an analysis of the degree to which our work limitation variable reflects measures of ill health. A higher degree of work limitation is associated with a higher incidence of doctor diagnosed medical conditions with a clear graduation across levels of severity. Of those extremely work limited, 52% have a heart condition, 43% have a chronic condition such as lung disease or cancer and 44% have a mental health disorder. Almost 90% of those reporting the highest levels of work limitation are in pain while just over one quarter (26%) of those reporting no work limitation are often troubled with pain. Difficulties with instrumental activities of daily living (IADLs) – measures of disability in the domain of household management – follow a similar

| Work limitation         | Mean | s.d. |
|-------------------------|------|------|
| None                    | 0.59 | 0.49 |
| Mild                    | 0.17 | 0.38 |
| Moderate                | 0.13 | 0.33 |
| Severe                  | 0.09 | 0.28 |
| Extreme                 | 0.03 | 0.16 |
| Troubles impact         | 0.22 | 0.42 |
| Age                     | 57.2 | 4.14 |
| Female                  | 0.57 | 0.49 |
| Married                 | 0.76 | 0.43 |
| Years of education      | 13.3 | 3.03 |
| Protestant              | 0.50 | 0.50 |
| Troubles impact         | 0.19 | 0.39 |
| Severe/extreme limitation| 0.12 | 0.32 |
| Catholic                | 0.35 | 0.48 |
| Troubles impact         | 0.30 | 0.48 |
| Severe/Extreme limitation| 0.14 | 0.34 |
| Other religion          | 0.14 | 0.35 |

Notes: Respondents aged 50–64. Work limitation are responses to ‘How much are you limited in the kind or amount of activity or work that you can do due to an impairment or health problem?’ Troubles impact is a response of ‘quite a bit’ or ‘an extreme amount’ to ‘In general, what impact do you think the Troubles have had on your life?’

Also, the 2010 NI Omnibus Survey found that 24% of adults had been affected directly or indirectly by trauma related to the Troubles (CVS, 2010).
gradient with almost everyone with low levels of work limitation able to perform all IADLs while over half those with severe or extreme work limitation have difficulty with at least one IADL.\textsuperscript{14} Our two alternative measures of work disability are closely correlated with self-reported work limitation. Almost all those severely or extremely work limited have difficulty with two or more mobility, arm function or fine motor functions (94%) and almost half are claiming disability benefits. Only 14% of those with no work limitation have functional limitations while almost none is in receipt of disability benefits.

We also tested whether the vignette data adheres to the key VE and RC assumptions (results in Table A2). We first conducted weak VE tests to assess the percentage of respondents ranking the severity of work disability in the three vignettes within each domain in the expected order (panel A). Although it is not clear what constitutes an acceptable percentage, the rates in our data of 72% to 85% are higher than the WHO Study on Global AGing and Adult Health and comparable to the US Health and Retirement Study (Grol-Prokopczyk \textit{et al.}, 2015). The strong VE test assesses whether all respondents perceive the same underlying level of work limitation $\theta_j$ when they read vignette $j$ i.e. test the exclusion of covariates $X_j$ from equation (2). Results indicate that the assumption of strong VE is not rejected for the pain and heart domains but is rejected at the 5% level for the affect domain. A comparison of thresholds generated from anchoring vignette ratings and thresholds generated from

\textit{Notes}: Respondents aged 50–64. \textit{Heart condition} is a doctor diagnosis of high blood pressure, angina, heart attack, heart failure, diabetes, stroke, mini-stroke, high cholesterol, heart murmur, atrial fibrillation, abnormal heart rhythm or other heart disease. \textit{Chronic condition} is a doctor diagnosis of chronic lung disease, asthma, arthritis, osteoporosis, cancer, Parkinson’s disease, alcohol abuse, substance abuse, Alzheimer’s disease, dementia, serious memory impairment, stomach ulcers, varicose ulcers or cirrhosis. \textit{Psychiatric morbidity} is a doctor diagnosis of any emotional, nervous or psychiatric problems. \textit{Pain} is a response of ‘yes’ to ‘Are you often troubled with pain?’. \textit{Unable to perform IADLs} is difficulties with at least one instrumental activity of daily living: preparing a hot meal, doing household chores, shopping, making telephone calls, taking medications, managing money. \textit{Functional limitations} is difficulty with two or more of walking 100 m, running 1.5k, sitting 2 hours, getting up from a chair, climbing stairs, stooping/kneeling/crouching, reaching up, pulling or pushing chair, lifting weights over 5 kg, picking up coin. \textit{Disability benefit} Receiving any of Incapacity Benefit, Employment and Support Allowance, Severe Disablement Allowance or War Disablement Pension.

\begin{table}
\centering
\begin{tabular}{lcccccccc}
\hline
\textbf{Work limitation severity} & \textbf{Heart condition} & \textbf{Chronic condition} & \textbf{Psychiatric morbidity} & \textbf{Pain} & \textbf{Unable to perform IADLs} & \textbf{Functional limitations} & \textbf{Disability Benefit} \\
\hline
None & 0.16 & 0.03 & 0.12 & 0.26 & 0.01 & 0.14 & 0.02 \\
Mild & 0.31 & 0.14 & 0.20 & 0.56 & 0.05 & 0.47 & 0.05 \\
Moderate & 0.30 & 0.27 & 0.31 & 0.77 & 0.20 & 0.80 & 0.23 \\
Severe & 0.43 & 0.32 & 0.37 & 0.86 & 0.55 & 0.94 & 0.49 \\
Extreme & 0.52 & 0.43 & 0.44 & 0.89 & 0.63 & 0.94 & 0.46 \\
Total & 0.24 & 0.12 & 0.19 & 0.44 & 0.10 & 0.37 & 0.11 \\
\hline
\end{tabular}
\caption{Proportions of conditions by work limitation severity (N = 2397)}
\end{table}

\textsuperscript{14}Verbrugge and Jette (1994) define disability as difficulty doing activities in any domain of life due to a health or physical problem. They distinguish the domain of work from personal care (captured by measures of activities of daily living) and household management (captured by IADLs). We therefore do not consider IADLs as an appropriate alternative measure of work disability.

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self-ratings conditioned on objective measures of work disability is given in panel B and indicates the assumption of RC is not violated.

Experience of the troubles

In Table 3, we list summary results for a series of questions on experiences of particular events during the Troubles. It is clear that a significant proportion of the study cohort have had direct experience of the conflict. Just under one fifth had a friend killed (18%); over half witnessed a bomb explosion (54%); over half witnessed rioting (55%); almost one tenth had a close relative in prison (9%) and almost one-tenth had to move house due to attack, intimidation, threats or harassment (9%). We see also that 6% were physically injured although this may have not led to permanent physical incapacity.

We then regress our key ‘Troubles impact’ explanatory variable on these events to better understand the main experiences associated with a greater impact of the conflict on respondents’ lives. Coefficients and standard errors are also reported in Table 3 and generally show that the more immediate the experience the larger the impact on the respondent’s life. Being in prison has the most impact on the respondent’s life ($\beta = 0.995$) while having a relative or friend in prison does not have a significant impact. Similarly, being injured has a large impact ($\beta = 0.476$) while injuries to friends or relatives have less or no statistically significant impact. The other most influential events were having a relative killed and witnessing a riot. The respondent’s religious denomination does not affect the level of impact from the Troubles once exposure to these events is controlled for although Catholics were generally more likely to be exposed to political violence during this period (Poole, 1993; Fay et al., 1999). The effects of violence may also have had an impact on respondents in the absence of direct experience of the traumatic events listed here since the conflict exacerbated psychosocial stressors associated with ill health such as poverty, sectarian tension, intimidation and ostracization (O’Reilly and Stevenson, 2003; Miller and Rasmussen, 2010).

This analysis then informs our choice of instrumental variables. We calculate a DEA fatality rate for deaths due to all conflict-related violence. This fatality rate correlates well with the proportion of each DEA reporting ‘Troubles impact’ giving a correlation coefficient of $\rho = 0.622$. The location of the fatal incident in many areas of NI did not indicate where the impact was felt due to disturbances in urban centres with victims from suburbs. A further instrumental variable was constructed by calculating the fatality rates for deaths due to riot affray at a higher geographical level - local government district (LGD). This correlates well also with ‘Troubles impact’ ($\rho = 0.660$) and we therefore conclude that this instrument is relevant.

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15Fay et al. (1999) notes that Catholics had a 35% higher fatality rate from violence than Protestants during this period and Poole (1993) associates the probability of urban political violence with the presence of minority Catholic enclaves in towns.
In this section, we explore whether exposure to the Troubles increases work disability. We first estimate a simple ordered probit model of work limitation controlling for the age, gender, marital status, education and religion of the respondent as well as the unemployment rate in the DEA where they reside. Results are given in column (1) of Table 4. Our key explanatory variable is labelled ‘Troubles impact’. The coefficient on this variable is seen to be large and highly significant. As we have seen in Table 1, the lives of most people in this age cohort were affected to some degree by the Troubles and the coefficient on our dichotomous variable is largely capturing the difference in work limitations between those whose lives were impacted ‘quite a bit’ (the dominant high impact category) and those whose lives were impacted ‘a little bit’ (the dominant low category). These estimates therefore do not reflect the impact of the Troubles on

| Events experienced in the Troubles                        | Proportion in sample | Probit regression coeff. | (s.e.)  |
|----------------------------------------------------------|----------------------|--------------------------|---------|
| Friend killed                                            | 0.18                 | 0.224**                  | (0.093) |
| Relative killed                                          | 0.10                 | 0.360***                 | (0.111) |
| Knew someone killed                                      | 0.51                 | 0.081                    | (0.093) |
| Was injured                                              | 0.06                 | 0.476***                 | (0.154) |
| Friend injured                                           | 0.20                 | 0.180*                   | (0.104) |
| Relative injured                                         | 0.16                 | 0.153                    | (0.109) |
| Knew someone injured                                     | 0.42                 | 0.224**                  | (0.099) |
| Witness bomb                                             | 0.54                 | 0.150*                   | (0.082) |
| Witness murder                                           | 0.07                 | 0.249**                  | (0.124) |
| Witness gunfire                                          | 0.42                 | 0.073                    | (0.091) |
| Witness riot                                             | 0.55                 | 0.344***                 | (0.104) |
| Witness assault                                          | 0.36                 | 0.123                    | (0.092) |
| Witness other violence                                   | 0.26                 | 0.228**                  | (0.101) |
| Was in prison                                            | 0.01                 | 0.995**                  | (0.506) |
| Friend in prison                                         | 0.09                 | 0.120                    | (0.143) |
| Close relative in prison                                  | 0.09                 | 0.182                    | (0.134) |
| Other relative in prison                                  | 0.08                 | −0.230*                  | (0.138) |
| Knew someone in prison                                    | 0.22                 | 0.071                    | (0.088) |
| House searched                                           | 0.14                 | 0.187                    | (0.128) |
| Had to move house                                         | 0.09                 | 0.260**                  | (0.131) |
| Had to leave job                                          | 0.05                 | 0.303*                   | (0.170) |
| Protestant                                               | 0.50                 | −0.103                   | (0.089) |
| Other religion                                            | 0.14                 | −0.015                   | (0.113) |
| Pseudo $R^2$                                              |                      | 0.258                    |         |
| $N$                                                      |                      | 2143                     |         |

Notes: Dependent variable is a response of ‘quite a bit’ or ‘an extreme amount’ to ‘In general, what impact do you think the Troubles have had on your life?’ ‘Events experienced in the Troubles’ are responses of ‘yes’ to ‘Thinking of the Troubles, did you experience/witness any of the following events...’ Other explanatory variables are age dummies (2), female, married, education dummies (2) and DEA unemployment rate. Standard errors are clustered at DEA. *$P < 0.10$, **$P < 0.05$, ***$P < 0.01$
work limitations for those affected most compared to a counterfactual where conflict never occurred. Such an estimate would undoubtedly be higher. Interestingly, the religion of the respondent is of no relevance to the degree of work limitation. Omitting the Troubles impact variable results in the religion variables being negative and statistically significant which indicates that Catholics have a greater tendency to report work limitation because they have been more exposed to conflict (results available on request). Other control variables are as expected with being married reducing work limitations and more education also reducing limitations. The positive coefficient on DEA long-term unemployment rates provides some evidence of dependency culture effects on reporting of work limitations.

Clearly then, those respondents whose lives have been affected by conflict tend to report more limitations in the kind of work that they can do. In the second set of estimates, we account for heterogeneity in respondents’ view of what underlying degree of reduced functioning they consider as work limiting using the HOPIT model. If respondents whose lives have been affected by conflict have a systematic tendency to describe the vignettes as being work limited when other respondents describe them as being not work limited then we should lower their self-reported level of work limitation and the effect of conflict on work disability will be attenuated. The coefficient for Troubles impact is only slightly lower than before although the marginal effect on the highest two categories of work limitation is reduced from 9.1% to 8.5% indicating that reporting heterogeneity is an issue.

We then address the problem of endogeneity in the next set of estimates. In column (3), we estimate the endogenous treatment model in equation (3). The instrument set \( z \) includes Troubles-related fatality rates at DEA level and fatalities due to riots at LGD level as well as the subset of control variables which are plausibly exogenous to experience of conflict – age, gender and religion. The Troubles are seen to have a highly significant association with higher work limitation and the effect is much larger than in previous estimates. The coefficient estimate implies that respondents have a 27.7% higher probability of being severely or extremely work limited if the Troubles had ‘quite a bit’ or ‘an extreme impact’ on their lives. Instrumentation then corrects a downward bias in the estimate. The direction of the bias is as expected since unreliable self-reported measures of the impact of the Troubles on respondents’ lives results in measurement bias and attenuated estimates. Other coefficient estimates are largely the same as before and religion does not influence self-reported work limitation as before.

We first test the robustness of our results by exchanging our vignette dependent variable for the binary measure of two or more functional limitations described in section (Sample). Our model then becomes a recursive bivariate probit model which we estimate using maximum likelihood. The 2010 UK Equality Act and the UN Convention on disability rights ratified by the UK in 2009 require employers to make

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16See for example Kail (2016) who finds that marriage reduces the level of functional limitations and moderates the association between chronic conditions and functional limitations. Freedman, Martin and Schoeni (2002) state that it is a common finding that the least educated have the highest limitation and disability.

17The HOPIT model does not allow for tests of valid instruments. Applying 2SLS to model (3) and calculating the Sargan–Hansen test of overidentifying restrictions indicates the instruments are valid and the excluded instruments are correctly excluded from the estimated equation (see Table A3 in the appendix).
| Dependent variable: | (1) Work limitation | (2) Work limitation | (3) Work limitation | (4) Functional limitation | (5) Disability benefit | (6) Disability benefit* |
|---------------------|---------------------|---------------------|---------------------|--------------------------|-----------------------|------------------------|
| Troubles impact     | 0.434***            | 0.427***            | 1.533***            | 0.860**                  | 0.281                 | 1.135***               |
|                     | (0.057)             | (0.056)             | (0.351)             | (0.401)                  | (0.442)               | (0.333)                |
| Age 55–59           | 0.174***            | 0.170***            | 0.207***            | 0.170**                  | 0.086                 | 0.075                  |
|                     | (0.055)             | (0.058)             | (0.076)             | (0.072)                  | (0.089)               | (0.088)                |
| Age 60–64           | 0.304***            | 0.237***            | 0.319***            | 0.368***                 | 0.105                 | 0.108                  |
|                     | (0.061)             | (0.063)             | (0.085)             | (0.073)                  | (0.096)               | (0.090)                |
| Female              | 0.031               | 0.103**             | 0.227***            | 0.405***                 | −0.108                | 0.021                  |
|                     | (0.047)             | (0.048)             | (0.073)             | (0.055)                  | (0.073)               | (0.066)                |
| Married             | −0.413***           | −0.414***           | −0.529***           | −0.339***                | −0.620***             | −0.581***              |
|                     | (0.045)             | (0.044)             | (0.061)             | (0.061)                  | (0.077)               | (0.077)                |
| Secondary education | −0.159*             | −0.160*             | −0.218*             | −0.131                   | −0.058                | −0.019                 |
|                     | (0.092)             | (0.091)             | (0.120)             | (0.100)                  | (0.128)               | (0.121)                |
| Higher education    | −0.495***           | −0.494***           | −0.650***           | −0.420***                | −0.565***             | −0.515***              |
|                     | (0.096)             | (0.096)             | (0.129)             | (0.098)                  | (0.133)               | (0.123)                |
| Protestant          | −0.040              | 0.003               | 0.092               | −0.073                   | −0.209**              | −0.096                 |
|                     | (0.056)             | (0.058)             | (0.089)             | (0.074)                  | (0.090)               | (0.087)                |
| Other religion      | −0.106              | 0.015               | 0.049               | −0.157*                  | −0.176                | −0.140                 |
|                     | (0.068)             | (0.074)             | (0.104)             | (0.093)                  | (0.112)               | (0.100)                |
| Unemployment        | −0.004              | −0.004              | 0.003               | −0.007                   | −0.017                | −0.007                 |
|                     | (0.011)             | (0.011)             | (0.013)             | (0.010)                  | (0.013)               | (0.013)                |
| Long unemployment   | 0.024***            | 0.024**             | 0.031**             | 0.020                    | 0.028***              | 0.021**                |
|                     | (0.010)             | (0.010)             | (0.013)             | (0.012)                  | (0.010)               | (0.011)                |
| Access              | −0.007              | −0.007              | −0.006              | −0.001                   | −0.019**              | −0.020**               |
|                     | (0.009)             | (0.009)             | (0.012)             | (0.008)                  | (0.009)               | (0.008)                |
| Constant            |                     |                     | −1.082*             | −1.400**                 | −1.505**              | (0.633)                |
|                     |                     |                     | (0.646)             | (0.656)                  |                     | (Continued)            |
| Dependent variable: | (1) | (2) | (3) | (4) | (5) | (6) |
|---------------------|-----|-----|-----|-----|-----|-----|
|                      | Work limitation | Work limitation | Work limitation | Functional limitation | Disability benefit | Disability benefit* |
| Marginal effects     |     |     |     |     |     |     |
| P(y = 1)             | −0.163 | −0.161 | −0.517 | 0.314 | 0.053 | 0.291 |
| P(y = 2)             | 0.024 | 0.026 | 0.054 | −   | −   | −   |
| P(y = 3)             | 0.048 | 0.050 | 0.187 | −   | −   | −   |
| P(y = 4)             | 0.062 | 0.050 | 0.184 | −   | −   | −   |
| P(y = 5)             | 0.029 | 0.035 | 0.093 | −   | −   | −   |
| N                   | 2397 | 2401 | 2401 | 2401 | 2401 | 2401 |
| Log likelihood      | −2778.5 | −29508.0 | −30758.2 | −2755.0 | −2018.0 | −2081.3 |
| Log likelihood      | −2778.5 | −29508.0 | −30758.2 | −2755.0 | −2018.0 | −2081.3 |
| Model               | Ordered Probit | HOPIT | Latent HOPIT | Bivariate probit | Bivariate probit | Bivariate probit |

Notes: Respondents aged 50–64. Dependent variables: Work limitation responses to ‘How much are you limited in the kind or amount of activity or work that you can do due to an impairment or health problem?’; Functional limitations is difficulty with two or more of walking 100 m, running 1.5k, sitting 2 hours, getting up from a chair, climbing stairs, stooping/kneeling/crouching, reaching up, pulling or pushing chair, lifting weights over 5 kg, picking up coin; Disability benefit Receiving any of Incapacity Benefit, Employment and Support Allowance, Severe Disablement Allowance or War Disablement Pension. Disability benefit* Receiving disability benefit or diagnosed with emotional, nervous or psychiatric problems with severe or extreme work limitation as well as two or more functional limitations. Troubles impact is a response of ‘quite a bit’ or ‘an extreme amount’ to ‘In general, what impact do you think the Troubles have had on your life?’. Education is highest education level completed. Unemployment is DEA unemployment rate among those aged 50–74. Long unemployment is DEA long-term unemployment rate among those aged 16–74. Access is the population weighted distance to benefits offices. Cut point coefficients for ordered probit and HOPIT models have been omitted. Vignette dummy coefficients for HOPIT also omitted. Standard errors are clustered at DEA. *P < 0.10, **P < 0.05, ***P < 0.01
reasonable adjustments to accommodate disabled employees and therefore those reporting functional limitations will include respondents with milder conditions which do not limit their ability to work. Nevertheless our results are very similar. Interpreted as an average marginal effect, the Troubles impact coefficient estimate implies that respondents have a 31.4% higher probability of having difficulty with two or more mobility, arm function or fine motor functions if the Troubles had ‘quite a bit’ or ‘an extreme impact’ on their lives.18 All controls with statistically significant coefficients in the previous model have statistically significant coefficients again in this model.

In column (5), we use receipt of social welfare benefits for those unable to work due to their disability. The Troubles impact variable is no longer significant. However, not all those with a disability take up their benefit entitlement and those with poor mental health face particular challenges in navigating the application process (DSDNI, 2012; Galloway et al., 2018). To check if the effect of the Troubles has been attenuated in these estimates by unmet need we assume that those who have been diagnosed with emotional, nervous or psychiatric problems and report severe or extreme work limitation as well as two or more functional limitations should be claiming out-of-work disability benefits. We then create a new dichotomous disability benefit variable which takes the value one for the 284 respondents on disability benefits plus these 42 extra respondents. The model is re-estimated and results are given in the final column. The Troubles coefficient is now highly statistically significant corresponding to a marginal effect of 29.1% higher probability of claiming out-of-work disability benefits if the Troubles had ‘quite a bit’ or ‘an extreme impact’ on their lives. Worse access to benefits offices lowers disability benefit uptake but from the previous models we can see that access has no effect on other measures of disability.19

There were 310495 persons aged 50–64 in NI at the time of the last Census of Population in 2011. Assuming that the Troubles had ‘quite a bit’ or ‘an extreme impact’ on the lives of 68309 (22%) of this cohort then 18922 (27.7%) extra people were work disabled. At NI median earnings of £25050 this represents a loss to the economy of £5.8 billion as they pass through age 50 to age 64 using a 3% discount rate. If they were on disability benefits of £100 weekly during this time there would be an additional cost to the UK taxpayer of £1.2 billion. This figure of £7.0 billion in total is an underestimate of the economic cost of the Troubles in relation to work disability as firstly these persons may well have been incapable of work throughout adulthood and secondly most people were affected to some degree by the Troubles.19

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18Marginal effects were calculated by computing \( P[y_1 = 1,y_2 = 1, z_1, z] - P[y_1 = 1,y_2 = 0, z_1, z] \) using joint probabilities given in Greene (2012):

\[
\begin{align*}
P[y_1 = 1,y_2 = 1] &= \Phi(\mathbf{z}^\prime \beta_1 + \delta_1, \mathbf{z}^\prime \beta_2, \rho) \\
P[y_1 = 0,y_2 = 1] &= \Phi(\mathbf{z}^\prime \beta_1 - \delta_1, \mathbf{z}^\prime \beta_2, -\rho) \\
P[y_1 = 1,y_2 = 0] &= \Phi(\mathbf{z}^\prime \beta_1, -\mathbf{z}^\prime \beta_2, -\rho) \\
P[y_1 = 0,y_2 = 1] &= \Phi(\mathbf{z}^\prime \beta_1, -\mathbf{z}^\prime \beta_2, \rho)
\end{align*}
\]

19To check our results are robust to specification, we apply 2SLS to model (3) with a binary dependent variable and without adjusting for reporting heterogeneity. We also apply 2SLS to models (4) and (6). Results are given in Table A2 in the appendix and marginal effects are seen to be generally higher.
Sample selection and other potential biases

Our sample may not be representative due to sample selection issues. The discussion in section (Descriptive statistics) provides some reassurance that our sample is unbiased since descriptive statistics for our sample are largely in agreement with other sources on work disability and Troubles impact as well as NI demographics. We consider here potential biases due to exclusion of people in institutions from the population sampled, due to outmigration, due to failure of the exclusion restriction for our instruments and due to self-completion non-response.

The NICOLA Wave 1 cohort members were recruited from lists of people living in private households and therefore groups relevant to our study such as residents of institutions were excluded. However, the institutionalized population is negligibly small in NI among the age group relevant to this study. On Census day in 2011, there were 1641 persons aged 50–64 ordinarily resident in communal establishments including hospitals, care homes and prisons in NI out of 310495 persons aged 50–64 (0.53%).20 Adding this small institutional population to the sampling frame would not change estimates appreciably.

Our estimates could also have been biased by migration during the conflict.21 Movers may have higher current levels of disablement if they were exposed to more severe trauma than non-movers or they may have lower levels of disablement if they had greater access to resources. Although NI experienced large forced population movements especially during the early years of the Troubles (O’Connor and Sheehy, 1997) it would appear that most population movement was more local as areas became increasingly residentially segregated (Deloitte, 2007; Shuttleworth and Lloyd, 2009). As a robustness check for bias due to potential non-random internal migration, we drop those individuals that report ever moving house due to attack, intimidation, threats or harassment from our sample. Estimates are seen to be similar to Table 4 but slightly attenuated (Table A4 of supplementary appendix).

It is also possible that areas with greater conflict fatalities are simply areas of historical economic stagnation leading to higher levels of current work disablement through some indirect channel. Parts of NI were on a different economic trajectory before the Troubles broke out in 1968. Rowthorn (1981) highlights how investment and employment growth in the 1950s and 60s were concentrated in the Protestant areas around Belfast - Antrim, Down and North Armagh - and in the mainly Protestant part of County Londonderry while the rest of the province including Belfast received relatively little investment. We reduce our sample in Table A4 to residents of areas of historical underinvestment. The marginal effect of the Troubles on the highest two categories of work limitation, our main dependent variable of interest, is larger than

20This number is not particularly high considering the equivalent figure for England and Wales which were relatively unaffected by the Troubles is 47509 out of 10162771 persons (0.47%). Sources: (England) infuse2011.ukdataservice.ac.uk (Northern Ireland) http://www.ninis2.nisra.gov.uk.
21The sample will also have been truncated over time through excess deaths by suicide or natural causes. The Troubles will obviously have contributed to many of these events. However, as our study is concerned with explaining the current high levels of work disability in NI by experience of the Troubles, these cases are not considered a relevant further source of bias.
before at 0.359. The effect of the Troubles on functional limitation is also larger than before while the marginal effect on amended work disability is slightly reduced.

Results may be biased by nonresponse to the main interview. Weights have been calculated to match the 2011 NI Census according to age in three bands (50–59; 60–69, and 75 and over), sex and broad geographical distribution (in five bands). Reweighted results are given in Table A4 and effect sizes are largely unchanged. Our results could also be biased by nonresponse to the self-completion questionnaire. A detailed analysis of nonresponse is not yet available in NICOLA but ELSA (2009) provides details of exogenous factors affecting self-completion response (age, region, area deprivation, ethnicity and education). These variables inform our selection model. Wooldridge (2010) argues that adding the inverse Mills ratio (IMR) based on a selection model to 2SLS leads to consistent estimates. On the other hand, adjusting for sample selection where the outcome is binary and some regressors are endogenous is ‘difficult … and a useful area of further research’. We therefore include 2SLS estimates with the IMR in Table A5 to examine sample selection. While the sample is practically the same for all three dependent variables the IMR coefficients indicate evidence of potential sample selection bias only for the model of work limitation Table 5. The Troubles coefficient of 0.444 in this model is still only slightly lower than that reported in Table A3 (0.527) and still much higher than the marginal effect indicated by column (3) of Table 4 (0.277).

We undertake a number of additional falsification tests to justify our identification strategy based on cross-sectional variation in fatality rates. We first construct a DEA fatality rate where the victim was a member of the security forces - either British Army or police. In our dataset, 974 of 3319 postcoded fatalities can be classified in this way. The British Army deployed in NI comprised soldiers largely from the British mainland whereas Royal Ulster Constabulary (police) fatalities often occurred away from place of residence. This instrument although not quite a placebo should have a much weaker association with current work limitation than an instrument based on civilian deaths. Our results in panel B of Table 6 bear this out. An instrument based on security forces fatalities and also an instrument more broadly including paramilitary fatalities (1378 combatant deaths) has no association with work limitation whereas an instrument based exclusively on civilian deaths (1820 non-combatant deaths) has a strong association with work limitation.

Following Christian and Barrett (2017), we conduct a series of randomization inference tests where the endogenous variable is randomly re-assigned across individuals. The estimated causal relationship should then be eliminated or at least attenuated if the exogenous variables (Troubles-related fatalities) act through the endogenous variable (Troubles Impact) to cause the outcome (work disability). We conduct these tests for the original 2SLS estimates in Table A3 and density plots of our results are given in Figure A1. These randomized specifications very rarely produce t-statistics similar in magnitude to the original estimates. If areas with higher fatalities also have other unobserved characteristics associated with higher work disability we would expect this to happen more often. We conclude that these tests provide support for our identification strategy.
In this last section, we examine the medical conditions through which conflict has affected work disability in NI. The literature suggests a range of conditions which could provide a mediating pathway. As a first step, we examine whether the Troubles has affected any of the doctor diagnosed conditions in our survey. Many of these ailments are comorbid and we therefore aggregate into severe heart conditions, moderate heart conditions, respiratory diseases, musculoskeletal diseases, cancer, psychiatric morbidity and other conditions. We also include an additional measure of being often troubled with severe pain absent a doctor diagnosed medical condition to capture persistent pain due to ailments such as shingles, fibromyalgia, neuralgia and migraine which are associated with neurobiological processes but not captured in our survey (Lumley et al., 2011).

In Table 7, we first report the prevalence of these medical conditions in our sample. Over one half have moderate heart conditions such as high blood pressure and high cholesterol while more severe heart conditions such as heart attack are much less common. Just over one quarter have musculoskeletal problems such as arthritis; 13% have been diagnosed with asthma or chronic lung disease; 6% have cancer and 11% have other conditions such as stomach ulcers. One fifth have been told by their doctor that they have emotional, nervous or psychiatric problems. Only 4% of respondents are often troubled with severe pain absent a doctor diagnosed medical condition to capture persistent pain due to ailments such as shingles, fibromyalgia, neuralgia and migraine which are associated with neurobiological processes but not captured in our survey (Lumley et al., 2011).

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Troubles and health

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In Table 7, we first report the prevalence of these medical conditions in our sample. Over one half have moderate heart conditions such as high blood pressure and high cholesterol while more severe heart conditions such as heart attack are much less common. Just over one quarter have musculoskeletal problems such as arthritis; 13% have been diagnosed with asthma or chronic lung disease; 6% have cancer and 11% have other conditions such as stomach ulcers. One fifth have been told by their doctor that they have emotional, nervous or psychiatric problems. Only 4% of respondents are often troubled with severe pain absent a diagnosis of one of the medical conditions surveyed. The Troubles could also impact on work disability through other medical conditions not surveyed as exposure to stress may impact on any disease whose aetiology is associated with worse health behaviours, neurohormononal systems and the autonomic nervous system (Cohen et al., 2018).

We estimate a recursive bivariate probit model again for each group of conditions in turn and results are given in the next column of Table 7. Those whose lives have been impacted by the Troubles ‘quite a bit’ or ‘an extreme amount’ are much more
likely to report a doctor diagnosis of emotional, nervous or psychiatric problems than those impacted ‘none’, ‘a little bit’ or ‘a moderate amount’ with the coefficient of 1.035 equating to a marginal effect of 31.1% points. Conflict also appears to affect severe pain at least at the 10% level of significance and the estimated marginal effect is also substantial but lower (13.4% points). All other chronic conditions are unlikely to be mediating pathways as there is no association with the level of Troubles impact.\footnote{We also estimated all conditions together in a SUR system of equations but psychiatric morbidity is still the only condition significantly affected by the Troubles.}

In the last set of results, we determine if mental health mediates the entire effect of the conflict on work disability. The decomposition of the relationship from causal variable to outcome into direct effects through unmeasured pathways and indirect effects through a mediating variable is given in Heckman, Pinto and Savelyev (2013) and is standard in the mediation literature:

\[
E(y_1^T - y_1^0) = \underbrace{\tau}_{\text{effect due to unmeasured pathways}} + \underbrace{\alpha E(\theta^T - \theta^0)}_{\text{effect mediated by mental health}}, \tag{5}
\]

where \(y_1\) is our work disability measure with the \(T\) superscript denoting the individual has been impacted by the Troubles and \(\theta\) is the mediating mental health variable. The parameters \(\tau\) and \(\alpha\) and \(E(\theta^T - \theta^0)\equiv\beta\) are determined from the following estimating

\[
\begin{array}{llll}
\text{Dependent variable:} & \text{Work limitation} & \text{Functional limitation} & \text{Disability benefit}\footnote{We also estimated all conditions together in a SUR system of equations but psychiatric morbidity is still the only condition significantly affected by the Troubles.} \\
\hline
\text{Panel A: Baseline} & \text{Work limitation} & \text{Functional limitation} & \text{Disability benefit}\footnote{We also estimated all conditions together in a SUR system of equations but psychiatric morbidity is still the only condition significantly affected by the Troubles.} \\
\text{Rate} & 0.038** & 0.017 & 0.039*** \\
(0.019) & (0.013) & (0.014) \\
\text{Riot/affray} & 0.603* & 0.402 & 0.373 \\
(0.351) & (0.369) & (0.345) \\
N & 2401 & 4015 & 4015 \\
Model & HOPIT & Probit & Probit \\
\hline
\text{Panel B: Placebo instruments} & \text{Work limitation} & \text{Fatality rate instrument} & \text{Effect} & \text{Rate} & \text{Riot/affray} & \text{Nature of fatality instrument} & \text{Model} & \text{Fatality rate instrument} & \text{Effect} & \text{Rate} & \text{Riot/affray} & \text{Nature of fatality instrument} & \text{Model} \\
\hline
\text{Dependent variable:} & \text{Work limitation} & \text{Fatality rate instrument} & \text{All} & \text{Security forces} & \text{Combatant} & \text{Non-combatant} \\
\hline
\text{Rate} & 0.048*** & 0.051 & 0.065 & 0.096*** \\
(0.012) & (0.057) & (0.047) & (0.024) \\
N & 2401 & 2401 & 2401 & 2401 \\
Model & HOPIT & HOPIT & HOPIT & HOPIT \\
\hline
\text{Notes:} \text{Rate is DEA Troubles-related fatalities 1969–98 per 1000 Riot/affray is LGD fatalities 1969–98 per 1000 due to riot/affray. Fatality rate instruments are DEA Troubles-related fatalities 1969–98 per 1000 by victim status (McKeown, 2009a). Other explanatory variables are DEA unemployment, DEA long-term unemployment, population-weighted distance to benefit offices and dummies for age (2), female, martial status, education (2) and religion (2). HOPIT cut-point coefficients and Vignette dummy coefficients also omitted. }^* P < 0.10, ^** P < 0.05, ^*** P < 0.01
equations where the mediator $\theta$ has been added to (4):

$$y_1 = \tau y_2 + \alpha \theta + z_1 \beta_1 + \epsilon_1$$

$$\theta = \beta y_2 + z_1 \beta_0 + \epsilon$$

$$y_2 = z_2 \beta_2 + \epsilon_2$$

(3')

Our analysis can only be indicative due to a number of important technicalities. Heckman et al. (2013) make explicit the assumptions necessary to make this decomposition valid. Firstly, $\beta_1$ and $\alpha$ in (3') are assumed not to vary by Troubles impact. Secondly, any changes in unmeasured pathways induced by the Troubles must be independent of changes in mental health induced by the Troubles. This unlikely to be the case as psychiatric problems and physical conditions are often inter-linked (Ohrnberger, Fichera and Sutton, 2017). Non-linear models pose extra challenges for which solutions have been recently developed (e.g. Imai, Keele and Tingley, 2010) but these do not accommodate our HOPIT model or even our IV set-up.

We therefore present results for our alternative dichotomous work disability outcomes only and simplify the model structure by linear probability models for work disability ($y_1$) and mediator ($\theta$). As the estimates of the size of the mediated effect are usually positively skewed and kurtotic in linear mediation models we bootstrap the errors using 5,000 samples. We also provide bias-corrected confidence intervals since the mean of the bootstrapped distribution will not exactly equal the indirect effect.

### TABLE 7

| Condition          | prop. | coeff. | s.e.  |
|--------------------|-------|--------|-------|
| Moderate heart     | 0.52  | -0.075 | (0.399)|
| Severe heart       | 0.05  | 0.739  | (0.515)|
| Respiratory        | 0.13  | 0.328  | (0.411)|
| Musculoskeletal    | 0.27  | 0.485  | (0.399)|
| Cancer             | 0.06  | -0.090 | (0.812)|
| Other              | 0.11  | 0.123  | (0.549)|
| Psychiatric morbidity | 0.20  | 1.035**| (0.463)|
| Severe pain        | 0.04  | 0.932* | (0.530)|

Notes: Coefficient estimates are for separate recursive bivariate probit models with the medical condition and Troubles impact as dependent variables. Controls in condition model are age dummies (2), female, married, education dummies (2), religion dummies (2), DEA unemployment rate, DEA long-term unemployment rate, DEA distance to benefit offices. Controls in Troubles model are age dummies (2), female, religion dummies (2), DEA fatality rate and LGD riot/affray fatality rate. Moderate heart are diagnoses of high blood pressure or hypertension, angina, diabetes or high blood sugar, high cholesterol, heart murmur, atrial fibrillation, abnormal heart rhythm or any other heart trouble. Severe heart are diagnoses of heart attack, congestive heart failure, stroke or mini-stroke. Respiratory are diagnoses of chronic lung disease or asthma. Musculoskeletal are diagnoses of arthritis or osteoporosis. Cancer are diagnoses of cancer or a malignant tumour. Other are diagnoses of alcohol abuse, substance abuse, serious memory impairment, stomach ulcers, varicose ulcers, cirrhosis or serious liver damage. Psychiatric morbidity are diagnoses of emotional, nervous or psychiatric problems. Severe pain is a response of ‘yes’ to ‘Are you often troubled with pain?’ and a response of ‘Severe’ to ‘How bad is the pain most of the time?’ absent a doctor diagnosis of conditions above. Standard errors are clustered at DEA. *$P < 0.10$, **$P < 0.05$, ***$P < 0.01$
Results are given in Table 8. The total effect sizes ($\tau + \alpha\beta$) are slightly larger than before in Table 4 by 1 – 2% points. The percentage of the effect of the Troubles on work disability mediated by psychiatric morbidity ($\alpha\beta / (\tau + \alpha\beta)$) is consistent across all work disability measures at around a third.23

Almost two-fifths of Northern Irish adults experienced conflict-related trauma (Bunting et al., 2013) and were often unwilling or unable to access the mental health services they needed (Dillenburger et al., 2008; O’Reilly and Stevenson, 2003). NI continues to have higher levels of mental ill health than any other part of the UK with consequent lower levels of work capability. Currently, just less than half of all work disability benefit claims (47%) in NI are for psychiatric disorders (Department for Communities, 2018). There is also evidence to suggest that the negative effects of conflict on mental well-being are transmitted intragenerationally as the children of mothers whose lives were affected by historical political violence tend to have worse psychological health (Merrilees et al., 2011). The economic legacy of this period of violence could therefore endure into the next generation.

The mediating pathways for the remaining two-thirds are not clear but more precise measures of the severity of the medical conditions surveyed as well as information on other common disabling conditions such as ADHD, chronic fatigue syndrome or epilepsy and ailments specifically associated with the conflict such as gunshot damage and limb loss would provide clarity. To the extent that disability is socially constructed, areas that experienced the worst violence also have lower levels of trust and co-operation and lack the linking social capital to draw in public sector resources

| Work disability measure | Total effect (s.e.) (95% c.i.) | Mediated effect (s.e.) (95% c.i.) | Percent mediated (s.e.) (95% c.i.) |
|-------------------------|-------------------------------|-------------------------------|-------------------------------|
| Functional limitation   | 0.108*** (0.023) (0.061, 0.152) | 0.033*** (0.006) (0.022, 0.046) | 30.7*** (0.095) (18.3, 54.8) |
| Disability benefit      | 0.077*** (0.017) (0.044, 0.112) | 0.023*** (0.005) (0.015, 0.033) | 29.7*** (0.088) (18.3, 52.4) |
| Disability benefit*     | 0.110*** (0.018) (0.075, 0.147) | 0.034*** (0.006) (0.022, 0.047) | 30.6*** (0.063) (20.3, 45.3) |

Notes: From equation (5), the total effect is $\tau + \alpha\beta$, the mediated effect is $\alpha\beta$ and the percent mediated is $\alpha\beta / (\tau + \alpha\beta)$. P-values and standard errors (in parentheses) based on 5,000 bootstrap samples. 95% confidence intervals (in parentheses) are further corrected to account for bias in the mean of the bootstrapped distribution. Standard errors are clustered at DEA. * $P < 0.10$, ** $P < 0.05$, *** $P < 0.01$

23Replacing the doctor diagnosis of emotional, nervous or psychiatric problems with a screening tool measure of psychiatric morbidity (General Health Questionnaire score or four or more) to account for undiagnosed mental health issues does not increase the proportion indirectly mediated.

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(Murtagh, 1999; French, 2009) thus disabling those with health limitations who would be capable of work in other environments.

VI. Conclusion

The current literature on the effects of conflict on work disability has focused on war veterans. Considering that most causalities in most recent conflicts are civilians this emphasis seems misplaced. In our study, we have examined the effect of historic exposure to the Northern Irish Troubles on current levels of civilian work incapacity. Using fatalities as instruments, we find that clear evidence that conflict has increased work disability among the civilian population by 27.7% points and this result is robust to a number of alternative work disability measures. Based on this figure, the Troubles has cost the cohort currently aged 50–64 at least £7.0 billion in lost earnings and benefits. We also analyse a range of doctor-diagnosed medical conditions through which conflict has potentially impacted on work disability finding that the main mediating condition is worse psychological morbidity.

The 2012 UK Welfare Reform Act was introduced to curb welfare spending including benefits for people with disabilities. At that time, NI had the highest disability benefit rates in the UK but the passage of the Bill through the NI regional assembly was fraught with disagreement. Republican parties whose constituents were more likely to be adversely affected by the cuts argued that disability benefit rates were legitimately high due to legacy effects of the Troubles while unionist parties claimed legacy effects could not possibly be so persistent. We have shown that at least in relation to work incapacity the effects of conflict are indeed long-lasting.

The ongoing Brexit negotiations between the European Union and the UK have the potential to undermine the fragile peace in NI. Our study has shown that the economic consequences of a return to violence are not only the destruction of infrastructure, loss of life and reduced inward investment reported elsewhere but also a loss of work capability for decades after.

Appendix
Figure A1. Randomization inference tests

Notes: Results of randomization inference tests where Troubles Impact is randomly re-assigned across individuals. Density plots of second-stage t-statistics are based on 1000 replications. Vertical lines are estimates in Table A3. The $P$-values below plots are proportions of replications where t-statistic exceeds original t-statistic. *Receiving disability benefit or diagnosed with emotional, nervous or psychiatric problems with severe or extreme work limitation as well as two or more functional limitations.
In these next questions, we will give you some examples of people with health problems. We would like you to indicate the extent to which you think these people would be limited in the kind or amount of work they could do. Please assume that the people have the same age, education and work history that you have. Other than the conditions mentioned you should imagine the individual is in reasonably good health.

| Number | Vignette                                                                 |
|--------|--------------------------------------------------------------------------|
| 1      | [Dorothy] has almost constant pain in her back and this sometimes prevents her from doing her work. How much is [Dorothy] limited in the kind or amount of work she could do? |
| 2      | [Patrick] suffers from back pain that causes stiffness in his back especially at work but it is relieved with low doses of medication. He does not have any other pains other than this generalised discomfort. How much is [Patrick] limited in the kind or amount of work he could do? |
| 3      | [Bernadette] has pain in her back and legs, and the pain is present almost all the time. It gets worse while she is working. Although medication helps, she feels uncomfortable when moving around, holding and lifting things at work. How much is [Bernadette] limited in the kind or amount of work she could do? |
| 4      | [Samuel] feels worried all the time. He gets depressed once a week at work for a couple of days in a row, thinking about what could go wrong and that his boss will disapprove of his condition. But he is able to come out of this mood if he concentrates on something else. How much is [Samuel] limited in the kind or amount of work he could do? |
| 5      | [Irene] has mood swings whilst at work. When she gets depressed, everything she does at work is an effort for her and she no longer enjoys her usual activities at work. These mood swings are not predictable and occur two or three times a month. How much is [Irene] limited in the kind or amount of work she could do? |
| 6      | [Gerard] generally enjoys his work. He gets depressed every three weeks for a day or two and loses interest in what he usually enjoys but is able to carry on with his day-to-day activities at work. How much is [Gerard] limited in the kind or amount of work he could do? |
| 7      | [Bridget] has had heart problems in the past and she has been told to watch her cholesterol level. Sometimes if she feels stressed at work she feels pain in her chest and occasionally her arms. How much is [Bridget] limited in the kind or amount of work she could do? |
| 8      | [Kenneth] has been diagnosed with high blood pressure. His blood pressure goes up quickly if he feels under stress. [Kenneth] does not exercise much and is overweight. How much is [Kenneth] limited in the kind or amount of work he could do? |
| 9      | [Francis] has undergone triple bypass heart surgery. He is a heavy smoker and still experiences severe chest pain sometimes. How much is [Francis] limited in the kind or amount of work he could do? |

Notes: Responses were given on a five-point scale: ‘Not limited’, ‘Mildly’, ‘Moderately’, ‘Severely’, ‘Extremely’. Names were randomized according to community background and gender. The 2001 Census was used to identify the most three common male protestant forenames among those aged 40 and over which were not in the 40 most common male catholic forenames. Female protestant, male catholic and female catholic names were all identified likewise. Four lists were created alternating by community background and gender. These four lists were then randomly assigned to respondents.

In these next questions, we will give you some examples of people with health problems. We would like you to indicate the extent to which you think these people would be limited in the kind or amount of work they can do. Please assume that the people have the same age, education and work history that you have. Other than the conditions mentioned you should imagine the individual is in reasonably good health.
### TABLE A2

Tests of vignette equivalence (VE) and response consistency (RC)

| Domain     | Weak | Strong |
|------------|------|--------|
| **Panel A**|      |        |
| Pain       | 0.85 | 15.6   |
| Affect     | 0.78 | 21.9** |
| Heart      | 0.72 | 6.4    |

| Threshold  | Vignette | Self-rating |
|------------|----------|-------------|
| **Panel B**|          |             |
| $r^1$      | 1.57     | 1.92        |
| $r^2$      | 2.85     | 2.82        |
| $r^3$      | 4.17     | 3.95        |
| $r^4$      | 5.65     | 5.52        |

Notes: [Panel A] The weak VE test is the percentage of respondents ordering vignettes as expected. The strong VE test is a LR test ($\chi^2(10)$) of the statistical significance of covariates (sex, age, religion) in equation (2). * $P < 0.10$, ** $P < 0.05$, *** $P < 0.01$. [Panel B] To compare thresholds, $r^k$ were transformed by rescaling from vignette units to self-rating units and adding a constant following Grol-Prokopczyk et al. (2015). The objective measures of work disability used in the self-rating model to determine thresholds were self-reports of medical conditions, functioning in specific activities, GHQ12 score as well as measures of drinking, smoking and physical activity following d’Uva et al. (2011).

### TABLE A3

Explaining work disability - linear specifications with 2SLS

#### First-stage

| Dependent variable: Troubles Impact |
|-------------------------------------|
| Rate                               |
| 0.026***                           |
| (0.007)                             |
| Riot/affray                        |
| 0.318*                             |
| (0.163)                             |

#### Second-stage

| Work limitation | Functional limitation | Disability benefit* |
|-----------------|-----------------------|---------------------|
| Troubles Impact | 0.527***              | 0.308*              | 0.366***            |
| (0.165)         | (0.177)               | (0.127)             |
| Spatial s.e.    | 0.162                 | 0.139               | 0.130               |
| F-test of excluded instruments | 9.93*** | 10.01*** | 10.01*** |
| Hansen J overidentification test $\chi^2(1)$ | 0.076 | 0.764 | 0.189 |
| N               | 2397                  | 2401                | 2401                |
| Model           | 2SLS                  | 2SLS                | 2SLS                |

Notes: Rate is DEA Troubles-related fatalities 1969–98 per 1000, Riot/affray is LGD fatalities 1969–98 per 1000 due to riot/affray. Work limitation responses of ‘Severe’ or ‘Extreme’ to ‘How much are you limited in the kind or amount of activity or work that you can do due to an impairment or health problem?’; Functional limitations is difficulty with two or more of walking 100m, running 1.5km, sitting 2 hours, getting up from a chair, climbing stairs, stooping/kneeling/crouching, reaching up, pulling or pushing chair, lifting weights over 5 kg, picking up coins; Disability benefit* Receiving disability benefit or diagnosed with emotional, nervous or psychiatric problems with severe or extreme work limitation as well as two or more functional limitations. Other explanatory variables in both stages are DEA unemployment, DEA long-term unemployment, population-weighted distance to benefit offices and dummies for age (2), female, martial status, education (2) and religion (2). Clustered standard errors at DEA level is the default. Spatial s.e. Standard errors corrected for arbitrary cluster correlation in spatial environment with distance cut-off 50 km and uniform spatial decay (Colella et al., 2019). * $P < 0.10$, ** $P < 0.05$, *** $P < 0.01$
### TABLE A4

**Explaining work disability - non-movers & historic underinvestment**

| Dependent variable: | Non-movers | | Historic underinvestment | | Weighting |
|---------------------|------------|-------------------|-----------------|-----------------|-------------------|
|                     | Work limitation | Functional limitation | Disability benefit* | Work limitation | Functional limitation | Disability benefit* | Work limitation | Functional limitation | Disability benefit* |
| Troubles impact      | 1.377***     | 0.662              | 1.215***         | 1.889***        | 1.092**          | 0.905**           | 1.487***     | 0.871**            | 1.181***          |
|                     | (0.401)      | (0.718)            | (0.319)          | (0.354)         | (0.474)          | (0.438)           | (0.309)      | (0.420)            | (0.330)           |
| Marginal effects    |             |                   |                  |                 |                  |                  |             |                   |                  |
| P(y = 1)            | -0.477      | 0.242              | 0.316            | -0.581          | 0.388            | 0.235             | -0.507       | 0.354              | 0.306            |
|                     |             |                   |                  |                 |                  |                  |             |                   |                  |
|                     | 0.052       | -                 | -                | 0.023           | -                | -                | 0.047        | -                 | -                |
|                     |             |                   |                  |                 |                  |                  |             |                   |                  |
|                     | 0.171       | -                 | -                | 0.199           | -                | -                | 0.171        | -                 | -                |
|                     |             |                   |                  |                 |                  |                  |             |                   |                  |
|                     | 0.167       | -                 | -                | 0.234           | -                | -                | 0.181        | -                 | -                |
|                     |             |                   |                  |                 |                  |                  |             |                   |                  |
|                     | 0.086       | -                 | -                | 0.125           | -                | -                | 0.108        | -                 | -                |
|                     |             |                   |                  |                 |                  |                  |             |                   |                  |
| N                   | 2142        | 2142              | 2142             | 926             | 926             | 926              | 2442         | 2395              | 2395             |
| Log likelihood      | -27236.2    | -2357.1           | -1729.8          | -12007.9        | -1112.0          | -897.2           | -32255.2     | -2885.6           | -2190.5          |
|                     |             |                   |                  |                 |                  |                  |             |                   |                  |
| Model               | Latent HOPIT| Bivariate probit  | Latent HOPIT     | Bivariate probit| Bivariate probit| Bivariate probit| Latent HOPIT | Bivariate probit| Bivariate probit|

**Notes:** Non-movers Respondents aged 50–64 reporting they have not moved house due to attack, intimidation, threats or harassment. Historic underinvestment Residents of areas identified by Rowthorn (1981) as experiencing little investment and employment growth in the 1950s and 60s. Weighting Using sampling weights based on age in three bands (50–59; 60–69; and 75 and over), sex, and broad geographical distribution (in five bands). Work limitation is responses to ‘How much are you limited in the kind or amount of activity or work that you can do due to an impairment or health problem?’; Functional limitations is difficulty with two or more of walking 100 m, running 1.5k, sitting 2 hours, getting up from a chair, climbing stairs, stooping/kneeling/crouching, reaching up, pulling or pushing chair, lifting weights over 5 kg, picking up coin; Disability benefit* Receiving disability benefit or diagnosed with emotional, nervous or psychiatric problems with severe or extreme work limitation as well as two or more functional limitations. Explanatory variables are as in Table 4. Cut point coefficients for ordered probit and HOPIT models have been omitted. Vignette dummy coefficients for HOPIT also omitted. Standard errors are clustered at DEA. *P < 0.10, **P < 0.05, ***P < 0.01
### Table A5

| Dependent variable | Work limitation | Functional limitation | Disability benefit* |
|--------------------|-----------------|-----------------------|---------------------|
| Troubles Impact    | 0.444***        | 0.234                 | 0.322***            |
|                    | (0.160)         | (0.194)               | (0.128)             |
| Inverse Mills ratio| 0.151**         | 0.131                 | 0.080               |
|                    | (0.064)         | (0.085)               | (0.063)             |
| N                  | 2394            | 2398                  | 2398                |
| Model              | 2SLS            | 2SLS                  | 2SLS                |

*Notes: The Inverse Mills ratio is $\phi(x^\beta)/\Phi(x^\beta)$ from selection model $y_i = l(x^\beta + \varepsilon_i > 0)$ where $x$ includes all exogenous variables plus LGD, deprivation index and nationality. Work limitation responses of ‘Severe’ or ‘Extreme’ to ‘How much are you limited in the kind or amount of activity or work that you can do due to an impairment or health problem?’; Functional limitations is difficulty with two or more of walking 100 m, running 1.5k, sitting 2 hours, getting up from a chair, climbing stairs, stooping/kneeling/crouching, reaching up, pulling or pushing chair, lifting weights over 5 kg, picking up coin; Disability benefit* Receiving disability benefit or diagnosed with emotional, nervous or psychiatric problems with severe or extreme work limitation as well as two or more functional limitations. Rate is DEA Troubles-related fatalities 1969–98 per 1000 Riot/affray is LGD fatalities 1969–98 per 1000 due to riot/affray. Other explanatory variables in both stages are DEA unemployment, DEA long-term unemployment, population-weighted distance to benefit offices and dummies for age (2), female, martial status, education (2) and religion (2). Standard errors are clustered at DEA. *$P < 0.10$, **$P < 0.05$, ***$P < 0.01$.

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