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Hard to forget: The long-lasting impact of war on mental health[☆]

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Abstract

In this paper we examine the impact of war trauma experienced during the 1992-1995 Bosnia and Herzegovina conflict on individual mental health and labor market outcomes. By using a medically-validated depression scale and an instrumental-variable approach we show that, six years after the conflict, traumatized individuals are more likely to be at risk of depression (by 60 percentage points) and have worse labor-market outcomes. Our results are robust to a number of sensitivity checks accounting for individual geographical mobility and different treatment intensities, and suggest that the negative effects of war trauma are not mainly mediated by physical health problems. [I1,O1]

Keywords: war trauma, mental health, depression, Bosnia and Herzegovina

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"*We will never forget that Bosnia was as much a moral cause as a military conflict. The tragedy of Srebrenica will haunt our history forever.*" Kofi Annan, 1999.

"*Serbia's PM Aleksandar Vucic has been chased away by stone-throwing protesters from a ceremony marking the 20th anniversary of the Srebrenica massacre in Bosnia-Herzegovina.*" BBC Europe, 11th July 2015.

1. Introduction

The civil wars that broke out during the 1990s in the territory of former Yugoslavia are often described as Europe's deadliest conflict since World War II (WWII, hereafter). Along with civilian casualties and disruption, the armed conflict has become infamous for the war crimes involved, including ethnic cleansing, rape and crimes against humanity. A growing body of literature has been providing evidence on the disruptive effects of military conflicts in different contexts in terms of the human capital costs of survivors and lower economic growth and development (Blattman and Miguel 2010; Justino, 2009; Akresh et al.2011). Beyond the latter losses though, the cumulative exposure to traumatic episodes of violence may have other 'intangible' consequences on affected individuals such as long-term changes in mental health and psychological well-being.

Mental health is an important dimension of human capital with a significant impact on many aspects of human life, e.g. well-being, employment, earnings, wealth, stigma, etc. Yet, while the 'tangible' costs of wars through the impact on survivors' physical health, education and economic wealth are routinely assessed, evaluations of the psychological costs of wars, including those on mental health, are far more scarce. This paper aims at filling this gap by assessing the long-lasting impact of war on mental health in post-conflict Bosnia and Herzegovina (BiH hereafter). The Bosnian war (1992-1995) came about following the breakup of Yugoslavia and resulted in a brutal conflict between the three main ethnic groups, Serbs, Croats and Bosniaks (i.e. Bosnian Muslims), which devastated much of the country's infrastructure and took a severe toll on the whole economy (DFID, 1999).

To assess the mental health effects of violence, we depart from the assumption that the effects are homogenous across groups or individuals and we account for the degree of individual exposure to violence, i.e. *war trauma*. This is done because war may have particularly traumatizing effects on those directly exposed to terror (Miller and Rasmussen 2010, Kesternich et

al. 2014). This is even more true when violence and crimes are systematically targeted against some specific groups in the population, as it is the case for ethnic conflicts in general and for the process of 'ethnic cleansing' perpetrated during the Bosnian war in particular.

Our empirical analysis is based on the BiH Living Standards Measurement Survey (LSMS), which provides a highly reliable individual mental health measure, the Center for Epidemiologic Studies Depression (CES-D) scale (Radloff, 1977). A higher CES-D score indicates more symptoms of depression (i.e., worse mental health). By matching each individual to detailed local-area (municipality) war statistics gathered by the Bosnian Book of the Dead database on war-related casualties, and using survey information on a proxy for war trauma, we are able to assess the lasting impact of war on mental well-being. Our identification strategy is based on instrumental variables (IVs) estimation. We use a proxy for an individual's war trauma (i.e., recalling painful war events) which is instrumented by using arguably exogenous variation in the intensity of war violence measured by the casualty rates at the municipality level. Past research findings and the nature of the Bosnian conflict, which was driven by the desire to create ethnically homogenous geographic areas, support the validity of our identification strategy, i.e. the exogeneity of war intensity with respect to individual mental health.

We add to the existing literature by focusing on the direct link between war trauma and the mental distress of survivors, and by providing a precise assessment of the magnitude of these effects. Our paper also adds to the policy debate on the legacies of war and the optimal design of post-conflict policies for recovery.

Our IV estimates indicate that individuals who frequently recall the war are significantly more likely to suffer from worse mental health. In particular, they score approximately 1.6 standard deviations higher in the CES-D score, with higher scores meaning that an individual shows more depression symptoms. Recalling the war causes an increase in the likelihood of suffering from depression (CES-D score higher than 15) of 60 percentage points (p.p., hereafter). These effects must be interpreted as local average treatment effects (LATE), i.e., as the effects on the individuals whose recall war status is triggered by the instrument (war intensity). Using nonlinear models, which allow for recovering average treatment effects on the treated (ATET), we obtain lower effects of recalling the war both on the CES-D score and on the probability of depression, which are one standard deviation of the CES-D score, and 50 p.p., respectively. Our results are robust to a number of sensitivity checks, which take into account

individual geographical mobility and allow for different treatment intensities, and show that the negative effects on mental health are not mainly mediated by physical health problems.

We further provide some evidence on the economic costs of war trauma, by estimating its effect on individual labour force participation, working hours and monthly labour incomes. Using both linear and nonlinear models, large negative effects are found on all of these outcomes. When aggregating the forgone labour income at the national level using simple back-of-the-envelope calculations, we find that war trauma could have been responsible for a fall of 4.2% in BiH's 2001 GDP.

The remainder of the paper is organized as follows. Section 2 summarizes earlier findings in the literature relevant for our study. Some background information on the BiH conflict is provided in Section 3. Section 4 describes the data used in our empirical analysis, and Section 5 discusses our conceptual framework and the identification strategy. The the main results of the empirical analysis are reported in Section 6, while Section 7 reports some robustness checks. In Section 8, we estimate the labour market effects of war trauma, and make some back-of-the-envelope calculations of the total costs for the country. Section 9 summarizes the main findings and concludes.

2. Exposure to violence and mental health: A brief literature review

The consequences of wars have received considerable attention in the recent literature. Studies on the countrywide impact of conflict show that affected countries and populations adjust relatively quickly and often return to their pre-conflict growth trajectories (Davis and Weinstein, 2002; Brakman et al., 2004; Miguel and Roland, 2011). On the other hand, a growing body of research at the micro-level finds that conflict situations cause more mortality and disability than any major disease, destroy communities and families, and disrupt the development of the social and economic fabric of nations (Justino 2009, 2012a). The effects of war include short- and long-term physical harm, as well as reduction in material and human capital (Murthy and Lakshminarayana 2006). Akresh et al. (2012), for instance, examined the consequences of the Ethiopian-Eritrean war on the height of young children in Eritrea and found that children exposed to the war were shorter than the reference population by 0.42 standard deviations. Similarly, Akresh et al. (2012) showed that individuals exposed to the Nigerian civil war (1967-70) at all ages between birth and adolescence exhibited reduced adult stature

and that these impacts were largest in those exposed during adolescence (see also Bundervoet et al. 2009; Akresh et al. 2012). The educational effects of violent conflict are also substantial. The existing literature shows that violent conflict almost always results in reductions in educational access and attainment (Alderman, Hoddinott, and Kinsey 2006; Akresh and de Walque 2008; Swee, 2013; Justino, Leone and Salardi 2014). Relatively minor shocks to educational access during childhood can lead to significant and long-lasting detrimental effects on individual human capital accumulation (Ichino and Winter-Ebner 2004; Leon 2012; Akbulut-Yuksel 2014).

Comparatively much less evidence exists on the mental health effects of conflict. However, mental health is an important component of human capital supporting individual well-being and productivity. Poor mental health may entail poor labour market conditions, income losses, and higher health expenses (Miranda and Patel, 2005). Studies of individual behaviour have documented the impact of mental health on employment, productivity and earnings (Ettner et al. 1997; Bartel and Taubam, 1986), criminal activity (Steadman et al. 1998), child abuse and neglect (Kelleher et al, 1994), homelessness (Jenks, 1994), fertility and divorce (Bartel and Taubman, 1986), and offspring's education (Bratti and Mendola, 2014). Emerging data from low- and middle-income countries further indicate a strong association between mental illness and low education, food insecurity, inadequate housing, poverty and financial stress (Das et al. 2008; Patel and Kleinman 2003). In addition to these large personal costs, collective economic costs are also significant, due to higher direct health costs and indirect costs related to higher levels of unemployment together with increase in alcohol abuse, drug addiction and social exclusion. According to World Health Organization's (WHO), the cost of mental health problems is estimated to be between 3% and 4% of GNP in developed countries (WHO, 2003). Unipolar depressive disorders alone rank as the third leading contributor to the global burden of diseases, accounting for approximately 12% of years lived with disability (WHO's Global Burden of Disease 2001).[1]

Scholars have estimated the causal effects of war exposure on soldiers' mental health. Their findings suggest that deployment to combat zones, exposure to enemy fire and to dead, dying, or wounded people, generally cause a decrease in mental health status and raise the risk of

[1] http://www.who.int/healthinfo/global_burden_disease/estimates_regional_2001/en/.

suffering from post-traumatic stress disorder (PSTD) or depression (Gade and Wenger 2011; Cesur et al. 2013). Less evidence is available on the effects of wars on the mental health of the general population. In particular, although a number of papers report correlations between individual war exposure and mental health problems (see the review in Murthy and Akshminarayana 2006), studies addressing causality are remarkably rare.

Two main obstacles must be overcome when investigating the mental health effects of war (see Do and Iyer, 2012). First, there are very few surveys collecting reliable measures of mental health. Second, researchers must address endogeneity, i.e., take into account potential individual unobservable factors simultaneously affecting war victimization and mental health, and reverse causality issues when self-reported measures of war-trauma (recalling the war) like those provided in the BiH LSMS are employed. Indeed, mentally depressed individuals may be more likely to remember stressful events, including those related to war, making the effect of war on mental health appear larger than it is in reality. On the other hand, random errors in the self-reported measure (i.e. misclassification error) or the tendency to under-report war trauma to avoid the social stigma associated with mental health problems or specific war episodes (e.g., rape) could bias the OLS effect towards zero.

To address endogeneity and measurement error issues, a source of plausibly exogenous and more objective variation in an individual's degree of exposure to violence is necessary. The latter is provided in the context of veterans' mental health by random variation in deployment zones (e.g, combat vs. non-combat). When the goal is to investigate mental health in the general population, a similar approach consists of using exogenous variation in war intensity existing across geographical areas, such as the countries (Kesternich et al. 2014) or the municipalities (Do and Iyer 2012) where individuals resided during the war. Kesternich et al. (2014) found, for instance, that exposure to WWII combats increased the risk of depression for individuals aged 50 or more. Do and Iyer (2012), instead, use the same BiH LSMS data and do not report any significant negative effect of objective measures of war intensity (casualty rates by municipality) on individual mental health (CES-D score). Two main aspects differentiate our paper from Do and Iyer's (2012) analysis. First, we only employ the 2001 wave of the LSMS, which allows us to use a more complete measure of mental health (the 14-item CES-D

score instead of the 7-item version, which is available in the 2003 and 2004 waves).[2] Second, while Do and Iyer (2012) estimate the average effect of war both on victims and non-victims of war trauma, we only focus on the former.[3] This is motivated by the fact that among the many mechanisms through which wars could affect mental health, such as backward-looking (memories of past traumatic events), current (e.g., a slower economic recovery associated with current lower income), or forward-looking mechanisms (less trust and willingness to cooperate after the war), the literature on natural disasters and economic crises suggests that the first type of mechanism is the most likely to be at work (Friedman and Thomas 2008; De Mel et al. 2008). Unlike others, backward-looking mechanisms, though, are likely to operate differently on the victims of violence and on the non-victims.[4]

3. The BiH conflict

BiH is historically an ethnically diverse state. In 1991, the population of BiH was approximately 4.4 million, including various ethnic groups, with the three largest ones being the Bosniaks with 43.5 percent of the population, Serbs with 31.2 percent, and Croats with 17.4 per cent. There are differences among these ethnic groups with respect to their religious belonging, Bosniaks being mainly Muslims, the Serbs of Orthodox religion, and the Croats of Roman Catholic religion. Before its independence, Bosnia was a constituent republic of the former Yugoslavia. In 1991 and 1992, Yugoslavia disintegrated under the pressures of ethnic conflict, economic issues, and political interests. The secessions of Slovenia and Croatia triggered warfare in both new nations, with the United Nations inserting a peacekeeping force in mid-1992 to stabilize the situation. Bosnia's declaration of independence from Yugoslavia in 1992 raised the violence to a new level, triggering a war that lasted over three years and exemplified the complexities of the "post-Cold War" strategic environment. Initially, Croats and Serbs expanded their territorial control at the expense of the Bosnian state, with the Serbs, supported

[2]Moreover, extending the analysis to the period 2001, 2003 and 2004 would increase the number of observations but decrease the number of individuals, because only about half of respondents to the first (2001) wave were followed in later waves.

[3]This point will be further discussed in Section 5.1.

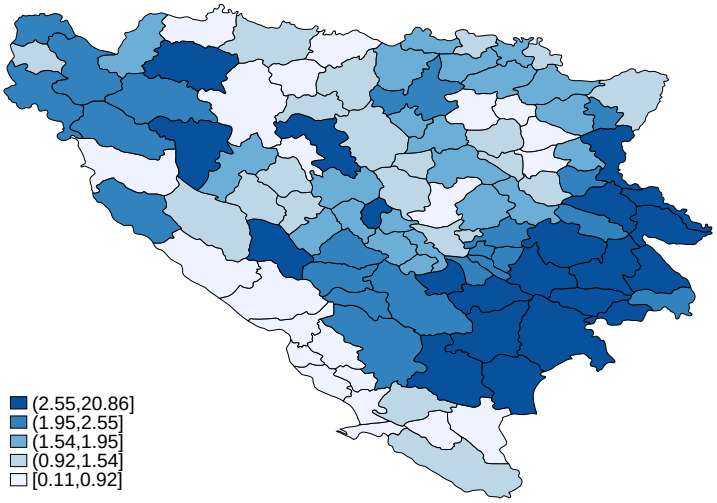
[4]This does not, however, exclude that for exposure to other traumatic events, such those related to non-war crime, the indirect costs for the non-victims may also be substantial (Cornaglia et al. 2014). The main difference between these different traumatic events is indeed that large economic crises, natural disasters and wars are much rares events than ordinary crime episodes for the populations living in certain geographical areas, and the fear of future victimization (i.e., forward-looking mechanisms) for the non-victims may be accordingly quite low.

by Serbia and the Yugoslav National Army (JNA), eventually controlling approximately 70% of BiH. Shifts in territorial control were accompanied by the execution of widespread "ethnic cleansing" in occupied areas, creating horrific scenes of refugees and concentration camps that seemed unthinkable in modern Europe. After Serb attacks on the Srebrenica "safe area" in 1995, a dual arrangement between the U.N. and NATO was established to control tactical air power in response to Serbian attacks. The conflict and partitioning displaced 1.3 million people (see Kondylis, 2010). In December 1995 the Dayton Peace Agreement ended four years of ethnic conflict in BiH.

The Bosnian war was characterized by the use of extreme violence, carrying out purposeful policies of ethnic cleansing, mainly against civilians (Mrvić-Petrovic 2001). In particular, the use of violence was targeted against ethnic communities with the aim of leading to their departure from areas over which the warring parties fought for control. Thus, war intensity was mainly driven by the intentions of hostile ethnic groups to create homogenous group territories such that Bosnia has become a pivotal case study for empirical research on ethnic violence in civil wars (e.g. Weidmann, 2011; Beger, 2012). For our purpose this means that the violence of the conflict by municipality was largely uncorrelated to individual-level characteristics such as mental health or well-being.

Detailed information on war casualties is provided at the municipality level by the Bosnian Book of the Dead published by the Research and Documentation Center (RDC) in Sarajevo. This database includes 97,207 names of Bosnia and Herzegovina's citizens, who were killed or were missing during the 1992-1995 war. The research findings were evaluated by an international team of experts before the results were released. According to the database, of the 97,207 documented casualties, 40% had civilian status, 90% were male, 65% were Bosniaks, 25% were Bosnian Serbs and approximately 8% were Bosnian Croats. Figure 1 reports casualty rates by municipality computed on the (1991 Census) population. Although there are some data shortcomings (e.g. information was collected by a number of sources, including individual informants, eye witnesses, close relatives, friends, neighbours, as weel as from press reports, books, NGOs, government sources, and no standardized documents were required to prove statements of the respondents), the overall quality of the database is considered as high

Figure 1: Casualty rates (%) by BiH municipality



Note: Casualty rates are computed on the (1991 Census) population. Municipalities in darker color are in higher quintiles of the distribution. Data on casualties are provided by the Bosnian Book of the Dead collected by the Research and Documentation Center in Sarajevo (RDC).

(Ball et al. 2007).[5]

4. Data and descriptive evidence

Our empirical analysis is based on the BiH LSMS, a survey conducted in 2001 by the World Bank in co-operation with the Republika Srpska Institute of Statistics (RSIS), the Federal Institute of Statistics (FOS) and the Agency for Statistics of BiH (BHAS). The survey is nationally representative and contains over 5,400 households sampled from 25 municipalities (11 in Republika Srpska and 14 in the Federation of Bosnia Herzegovina) and more than 9,000 individuals.[6] Questions were asked of each household member of age 15 or older, while for younger members, information was provided by parents or guardians. The survey contains detailed information on individual health status (both self-reported general health status and physical disabilities) and educational levels, along with detailed demographic characteristics of

[5]It should be noted that, as far as our identification strategy is concerned, measurement error that is uncorrelated with individual mental health status would only affect the instruments' strength.

[6]Approximately half of the LSMS respondents were re-interviewed in the other three waves, collected in 2002-2004 (the Living in Bosnia and Herzegovina survey). The attrition rate across the panel waves is approximately 5%, which is relatively low compared to other national panels. As our excluded instrument is time invariant, using panel data would not improve our identification strategy because individual fixed effects cannot be included in the estimation. Moreover, the panel would include a much lower number of individuals, and we would have to focus on the 7-item version of the CES-D questionnaire.

household members, household asset endowments and wealth, ethnicity, migration, and current area of residence. Crucial for our identifying strategy is the availability of retrospective information on individuals' municipality of residence before the war (see the following section).

As for mental health, the first wave (2001) includes a battery of questions that can be used to compute the CES-D scale. Despite being subjective, as the questionnaire asks individuals about their internal states and associated behaviour, this scale has been validated in the psychological literature. In particular, the CES-D scale has been subjected to a specific validation for Bosnia and Herzegovina (Kapetanovic, 2009). In the current study, we use the full battery of 14 items that were administered in the 2001 wave, which are reported in Appendix A.[7]

The possible answers to these questions are 'Not at all', 'A little', 'Quite a bit', and 'Extremely often', which are assigned scores of 0, 1, 2, and 3, respectively. Scores on single questions are then summed to obtain an aggregate score ranging between a minimum of 0 (no depression symptoms) and a maximum of 42 (very severe depression symptoms). Higher CES-D scores indicate worse mental health. On a 20-item (60-point) scale, the cut-off score of 16 is generally considered as indicative of 'significant' depressive symptomatology. In the analysis that follows, the score of the 14-item scale was converted into the 60-point scale.[8]

The 2001 of BiH LSMS also includes the following question: 'During the previous week, including today, how many times did you constantly recall the most painful events you experienced during the war?' The possible answers are defined on the Likert scale described above. In 2001, 49% of the individuals age 16 or older answered 'Not at all'; 28.7% 'A little'; 14.75% 'Quite a bit'; and 7.6% 'Extremely often'. In the current paper, we consider as victims of war trauma individuals who answered 'Quite a bit' or 'Extremely often', and for brevity, we will refer to these individuals at to those 'recalling the war'.

Table 1 reports the means of the CES-D score and depression by war trauma status and their differences, split by gender and ethnicity. All differences by recall war status are statistically significant at the 1% level, and in particular, individuals recalling the war have worse mental health. In the sample, individuals exposed to war trauma are 40 p.p. more likely to suffer from

[7] This represents a major difference with respect to Do and Iyer (2012), who instead use the 7-item version of the questionnaire that is also available in the 2003 and 2004 waves.

[8] By multiplying the observed scores by 60 and dividing them by 42, i.e., the maximum scores in the 20-item and the 14-item scales, respectively.

depression. The differences in means are very similar by gender (with a slightly larger effect on depression for women), and by ethnic group, with slightly larger differences for 'other' ethnicity, which represents a small minority of the population. For this reason, in what follows, we will report regressions pooling men and women, and we impose a common effect of the treatment (war trauma) across the different ethnic groups.

Table 1: Differences in CES-D score and depression by recall war status

	Recall the war[(a)] (A)	Does not recall the war[(b)] (B)	Diff. (A)-(B)	t-test s.e.
CES-D score				
All sample	18.9	7.1	11.8***	0.26
Gender				
man	15.6	5.5	10.1***	0.35
woman	21.3	8.6	12.7***	0.38
Ethnicity				
Bosniak	18.5	6.6	11.9***	0.37
Serb	19.4	8.1	11.3***	0.43
Croat	17.3	4.1	13.3***	1.08
other	23.5	8.0	15.5***	2.17
unreported	18.5	8.1	10.5***	1.01
Depression				
All sample	0.53	0.13	0.40***	0.01
Gender				
man	0.40	0.08	0.32***	0.01
woman	0.62	0.18	0.44***	0.02
Ethnicity				
Bosniak	0.52	0.11	0.42***	0.02
Serb	0.53	0.16	0.37***	0.02
Croat	0.53	0.07	0.46***	0.04
other	0.67	0.13	0.54***	0.08
unreported	0.48	0.15	0.33***	0.04

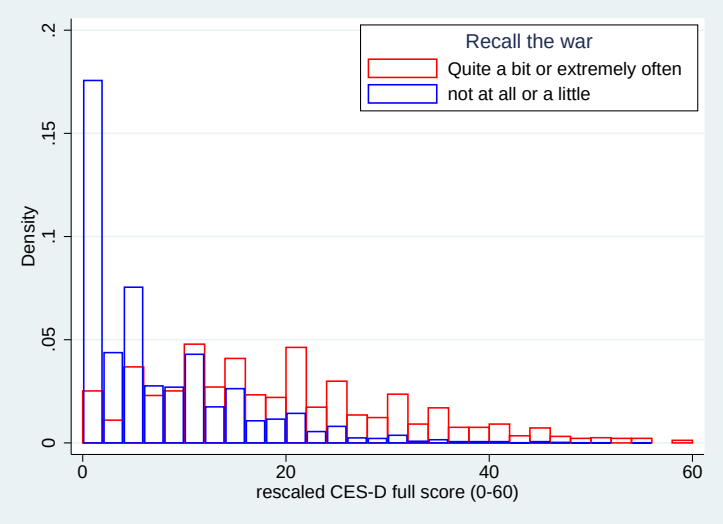
*, **, *** statistically significant at the 10%, 5% and 1% level, respectively.

[(a)] Recall the war 'quite a bit' or 'extremely often' in the past week.

[(b)] Recall the war 'a little' or 'not at all' in the past week.

The same positive association between worse mental health and war trauma is also clear in Figure 2, which plots the whole distributions of the CES-D score for individuals recalling the war and for those who do not.

Figure 2: Distribution of CES-D score by recall war status



Note: A higher CES-D score means worse mental health.

5. Conceptual framework and empirical strategy

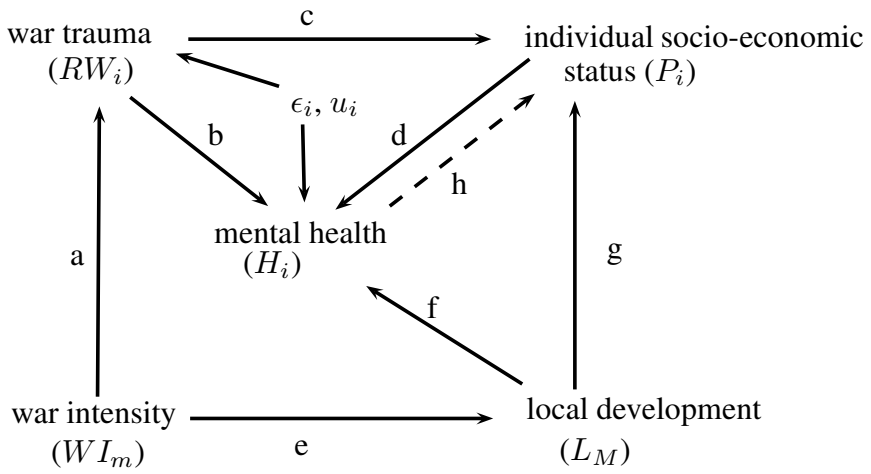
We are interested in the effect of war trauma on individual mental health in the aftermath of the BiH conflict. War trauma is defined as a situation in which an individual recalls painful events related to the war. As we mentioned above, the BiH LSMS does not ask direct questions about war victimization, but includes one about recalling the war.[9] The possible answers are: not at all; a little; quite a bit; extremely often. For the purpose of our analysis, the last two answers are grouped into a dichotomous indicator, which will be referred to as 'recalling the war' (*RW* for brevity), and is our proxy of war trauma.[10]

The main elements of our conceptual framework are shown in Figure 3. ε_i and u_i are the individual unobservables affecting mental health (H_i) and war trauma (RW_i), which might be mutually correlated and cause an endogeneity problem. War intensity in individual i's municipality m of residence before the war (WI_m) increases his/her likelihood of suffering from a

[9] Our proxy of war trauma differs from that used by Bellows and Miguel (2009) which refers to killings, injuries or refugee experiences of household members.

[10] Thus *RW* takes the value of one if individuals recalled the war 'Quite a bit' or 'Extremely often' and zero otherwise. The results obtained when all categories are considered separately are reported in Section 7.

Figure 3: Conceptual framework (causal diagram)



Note. *i*, *m* and *M* are the individual, the pre-war municipality (of residence) and the current municipality (of residence) subscripts, respectively.

war trauma. This is the exogenous source of variation (instrument) that we use to identify the causal effect of war trauma on mental health. War trauma negatively affects an individual's mental health, i.e. the *direct effect of war trauma* on mental health (pathway b). War trauma also has an indirect effect (pathway d) on mental health which is mediated by the individual's socio-economic status (SES, $\mathbf{P}_i$). Indeed, war trauma may reduce the individual's productivity in the labour market, and, in this way, also affect her employment opportunities and wage (*indirect effect of war trauma*, pathway d). War intensity also has an 'aggregated' effect on mental health, which is not mediated by war trauma (pathway f). Indeed, physical capital losses affect the level of development of the area in which the individual currently resides ($\mathbf{L}_M$), and also her SES, e.g. via the likelihood that she finds a job or her income level. Notice that mental health may have a feedback effect on individual SES for reasons that are unrelated to the war (reverse causality, the dashed pathway h).

Figure 3 also makes explicit some of the assumptions and the difficulties underlying our IVs identification strategy, and helps derive our empirical specification. On the one hand, to use war intensity as an instrument for war trauma and to comply with the exclusion restriction assumption (i.e. war intensity only affects mental health through war trauma), in the mental

healht equation, we need to control for all potential non-trauma effects of the war. In particular, it would be important to control for the individual's SES. However, controlling for the SES poses two problems. First, SES would capture part of the trauma effect of the war (pathway c).[11] Second, SES is potentially affected by mental health (pathway h) and is therefore an endogenous regressor. Mentally vulnerable individuals, for instance, are less likely to work. The inclusion of endogenous regressors would undermine our identification strategy. Thus we adopt the following identifying strategy. To block all direct pathways going from war intensity towards mental health, we control for (aggregated) average post-war municipalities' economic characteristics instead of an individual's post-war SES. We argue the individual unobservables' contributions to the aggregate variables is averaged out taking the mean, so as these variables are likely to capture well the non-trauma effects of war intensity (e.g., physical capital loss) and to be exogenous, i.e., uncorrelated with an individual's mental vulnerability.[12] This strategy will allow us only to estimate the partial causal effect of war on mental health (that running through war trauma) and not the total effect of the war.

Our conceptual framework can also be formally described by introducing the individual's mental health equation. Let us define as H_i the stock of mental health of individual i who lived before the war in municipality m and is currently living in municipality M. Accordingly, we specify the following production function $f(.)$ for the *current stock of mental health*

$$H_i = f(RW_i, \mathbf{P_i}(RW_i, \mathbf{L}_M), \mathbf{X_i}, \varepsilon_i) \tag{1}$$

where RW_i (recalling the war, i.e. our proxy of war trauma) and $\mathbf{L}_M$ are both a function of war intensity WI_m. $\mathbf{X_i}$ is a vector of personal characteristics not affected by war intensity,[13] such as gender and age, and ε_i an idiosyncratic unobservable factor (e.g., mental vulnerability).

The total effect of war on mental health is therefore

[11] Indeed, in Section 8 we will investigate the economic costs of war trauma in terms of lower individual labour force participation, less working hours and lower incomes.

[12] See Deuchert and Huber (2014) for a good discussion of the importance of control variables in IV estimation.

[13] These variables were omitted from the figure because they are not relevant to assess the mental health effects of the war.

$$\frac{\partial H_i}{\partial WI_m} = \underbrace{\frac{\partial f}{\partial RW_i}\frac{\partial RW_i}{\partial WI_m}}_{\text{direct effect of war trauma (A)}} + \underbrace{\frac{\partial f}{\partial \mathbf{P}_i}\frac{\partial \mathbf{P}_i}{\partial RW_i}\frac{\partial RW_i}{\partial WI_m}}_{\text{indirect effect of war trauma (B)}} + \underbrace{\frac{\partial f}{\partial \mathbf{P_i}}\frac{\partial \mathbf{P_i}}{\partial \mathbf{L}_M}\frac{\partial \mathbf{L_M}}{\partial WI_m}}_{\text{non-trauma effects of war (C)}} . \quad (2)$$

In equation (2) we can distinguish between three effects of the war on mental health. The first effect is the *direct effect of war trauma* (A), i.e., the consequences of direct exposure to war-related violence. This is the effect that is not mediated by individual SES. A second effect is the *indirect effect of war trauma*, mediated by individual SES, e.g., by lower labour market productivity (B). The last effect (C) is that related to other "stressors", which although being affected by the war, do not originate from war-trauma, e.g., the stressful social and material conditions that are often caused or exacerbated by destruction caused by armed conflict (e.g., lower income owing to lower economic development). This distinction roughly corresponds to the distinction between *trauma-focused research* and the *psychosocial model* made by Miller and Rasmussen (2010). Controlling for the input $\mathbf{L}_M$ in the mental health production function (i.e., including these variables in a regression framework), one aims at isolating the effect of war trauma on mental health. In the current paper, by focusing on the effect of recalling the war on mental health and omitting individual SES characteristics,[14] we estimate the effect $\frac{\partial f}{\partial RW_i} + \frac{\partial f}{\partial P_i}\frac{\partial P_i}{\partial RW_i}$. This is a major difference with respect to Do and Iyer (2012), which do not focus on recalling the war in equation (1) but directly on the effect of war intensity (WI_m) on mental health, controlling for individual SES and excluding therefore all effects mediated by the latter. Thus, they estimate the parameter $\frac{\partial f}{\partial RW_i}\frac{\partial RW_i}{\partial WI_m}$, which is the combined effect of the direct effect of war trauma on mental health and of the rise in the probability of being traumatized owing to higher war intensity. To put it in other words, we focus on the average mental health effects of war on the victims of war trauma while Do and Iyer (2012) on the average effect in the whole population, including the non-victims.

5.1. Identification strategy

We consider war trauma as the "treatment" to which individuals are exposed, and we are interested in assessing its effect on individual mental health. Because unobservable factors may make some individuals more likely to recall the war and suffer from mental health problems

[14] We already said that if they are affected by war trauma, they are likely to be endogenous.

(e.g., mental vulnerability), or because the latter may influence the former (reverse causality), we need a source of potentially exogenous variation in treatment intensity. To this aim, we use data on war intensity at the geographical level (municipality) gathered by the Bosnian Book of the Dead (see Section 3). More formally, our IVs identification strategy can be illustrated using two equations. The first equation is the mental health equation

$$H_i = \alpha_0 + \alpha_1 RW_i + \alpha_2{}' \mathbf{C_{imM}} + \varepsilon_i, \tag{3}$$

where $\mathbf{C_{imM}} = (\mathbf{L}_m, \mathbf{L}_M, \mathbf{X_i})$ a vector of personal and municipality-level controls (some of which may be affected by the war), ε_i is an idiosyncratic error term, and the α's are the parameters to be estimated. With respect to the conceptual framework in Figure 3, we further include a vector of pre-war municipality controls ($\mathbf{L}_m$) to control for factors that might influence both the degree of violence of the war and individual mental health (see the following section). The other variables are as defined above. In particular, we take RW_i as a proxy of individual war trauma, i.e., of how closely and intensively an individual was involved in war-related violence. One thing is worth noting in equation (3), because the CES-D score is *higher* for those having *worse* mental health, we expect a *positive* coefficient on RW_i, i.e. $\alpha_1 > 0$ implies a *negative* effect of war trauma on mental health.

A problem with estimating equation (3) is that individuals with worse (latent) mental health (i.e. more mentally vulnerable) may also be more likely to recall all painful events, including those related to war (see, for instance, Neuner, 2010), generating a reverse causality problem. To address this issue, and other issues related to the potential endogeneity of recalling the war (i.e., the correlation between the unobservables entering the error term of the mental health equation and RW_i), we need a source of exogenous variation in RW to identify α_1. We argue that this source of variation can be provided by the interaction between objective measures of war intensity at the geographical level and individual ethnicity. Thus, the second equation, for recalling the war, is defined as

$$RW_i = \beta_0 + \beta_1 WI_m + \sum_{j=2}^{J} \beta_j (WI_m \times ethnic_i^j) + \gamma' \mathbf{C_{imM}} + u_i. \tag{4}$$

where $ethnic_i^j$ is a dichotomous indicator for individual i being of ethnicity j, and u_i an error term. Information on war intensity (i.e., the total number of casualties for the period of the war)

from the Bosnian Book of the Dead is matched to the LSMS on the basis of the reported individual's residence just before the war, i.e., in April 1992.[15] It is worth noting that the number of casualties for the whole duration of the war is imputed to individuals according to their pre-war municipality of residence. First, casualties by year of death are not available. Second, although when imputed according to pre-war residence war intensity has the disadvantage of being less precise for movers (potentially affecting the strength of the instrument), it has nonetheless the advantage of being 'more exogenous', that is, less related to the decision to migrate, which is likely to depend on the intensity of the conflict (see Kondylis, 2010). The interaction terms with ethnicity are used because war victimization was not evenly distributed across ethnic groups, with most victims being Bosniaks.

Our instrumental variables, namely, war intensity (which captures the effect of war intensity on the excluded ethnicity group) and the war intensity-ethnicity interactions, must satisfy the usual three conditions. The first one is *exogeneity* of the instruments with respect to mental health (i.e., they must be uncorrelated with ε_i). Concerning war intensity (WI_m), the Bosnian war was mainly a racial war (see the discussion in Kondylis 2010 and Section 3), and we have no reason to expect that violence was especially targeted at individuals with poor mental health. In particular, violence was perpetrated against other ethnic communities with the aim of leading to their departure and creating ethnically homogenous territories. Weidmann (2011) reports war intensity to be mainly predicted by the ethnic composition of the local population and the distance to the Croat and Serbian borders, and is unrelated with potential correlates of mental health such as the level of percapita GDP before the war. This is also evident in Figure 1 where casualty rates are higher closer to the Serbian border. A potential threat to our identification is that war intensity might, in reality, capture latent higher conflict already present in a municipality, which may also affect mental health. For this reason, in the recall war equation we include the Ethno-Linguistic Fractionalization (ELF) index computed from the 1991 population census, which is aimed to control for the latent lack of trust and greater conflict that might prevail in more culturally diverse environments (Alesina and La Ferrara, 2002). As for the second component of the instruments, i.e. ethnicity, a potential threat to identification could be generated by some ethic groups being more targeted by violence and

[15]The exact wording of the question is: 'In which municipality and settlement did you live just before the war (April 1992)?' Unfortunately, we do not have data on casualties at the settlement level.

more prone to worse mental health at the same time. For this reason, ethnicity is controlled for in the mental health equation.[16]

The second requirement for the instruments is the *exclusion restriction assumption*. In our case, this means that war intensity should not have a direct effect on mental health after the conflict over and above war trauma. Provided that an individual's income and labour force status are important correlates of mental health, war intensity might have had a long-lasting effect through these mediating variables (see Miller and Rasmussen, 2010).[17] In this case, it could be not war trauma per se but the underdevelopment of municipalities that suffered more intense destruction causing worse mental health.[18] As we anticipated, to corroborate the exclusion restriction assumption, we include in the regressions average municipality-level economic characteristics in the current municipality of residence (the term (C) in equation eq:effect).

The third instrument requirement is its *relevance*: the instruments must be economically and statistically significant predictors of our proxy of war trauma (RW_i). Evidence supporting the instruments' relevance is provided in the following section.

Table B.1 in Appendix B reports the list of variables and the sample descriptive statistics.

[16]Like other papers on the effect of the war (Do et al. 2008, Bellows and Miguel, 2009, Do and Iyer 2012, etc.), our analysis is also subject to a triple form of sample selection. Indeed, individuals have to satisfy three selection criteria to be observed in the survey sample: they must have survived during the war; they must have survived during the post-war period, until 2001; and they have to have lived in BiH in 2001. We already argued that the first type of selection is unlikely to have produced a selected sample in terms of mental health. As to the second, one could put forward that if the war had a negative effect on mental health, we should expect relatively healthier individuals to have survived until 2001 (e.g., severely depressed individuals may have made suicide), and our estimates could be interpreted as *lower bounds*. (Remember that a positive coefficient on recalling the war in equation (3 means worse mental health.) Concerning the third type of selection, on migration, Begin and Mcdonald (2006) found that Bosnian refugees in the US reported significantly greater levels of PTSD than members of their Bosnian resident cohort, but not greater levels of anxiety or depression. Hunt and Gakenyi (2005), comparing Bosnian refugees in the UK with Bosnian residents, also found a higher incidence of traumatic symptoms in the former and concluded that there may be more serious long-term psychological problems in people who are forced to leave their country during wartime. Thus, from the existing evidence, we argue that the last form of selection is likely to introduce a negative bias in our estimates, making the estimated positive effect of the war on depression smaller than the true effect.

[17]Physical capital recovery, however, could be fast. See, for instance, Miguel and Roland (2011) and Waldinger (2012).

[18]This nonetheless represents the causal effect of war, regarding the part that is mediated by material destruction (effect C in equation 2).

6. Main results

We consider two main indicators of mental health, the CES-D score and a dichotomous version of it, which takes the value of one in case the CES-D score is at least 16 and zero otherwise (for brevity we label this variable as 'depression'). [19] In spite of the discrete bounded (between zero and 60) nature of the first indicator and the dichotomous nature of the second, in this section we use linear models for both. The same is done for the endogenous treatment (recall war) equation. Linear models have become quite popular among applied economists (see Angrist and Pishke, 2009) and have a number of convenient features. First, they do not require using a specific distribution for the error term in the mental health and recall war equations. The advantages are even larger when one is interested in the effect of an endogenous treatment, because instrumental variables can be used. Unlike non-linear models, to deliver consistent estimates of the regression's coefficients, linear models do not require, in our specific case, both the mental health and the endogenous (treatment) dummy equations to be correctly specified. Hence, they are 'true' instrumental variable estimators (Lewbel et al., 2012). Yet linear models also have a number of less convenient features when they are applied to dichotomous variables. Horrace and Oaxaca (2006) showed, for instance, that the Linear Probability Model (LPM) is inconsistent when the linear predictions fall outside the unit interval (i.e., predicted probabilities are less than zero or greater than one). These and other issues will be addressed in the following section.

As we mentioned above, both the recall war and the mental health equations include individual variables and municipality-level controls that might be simultaneously correlated with the violence of the conflict and the socio-economic conditions associated with mental health of the local population. Namely, we included gender, a quadratic in age, ethnicity, highest educational qualification attained, and the characteristics of the municipality of residence (urban or rural). At the pre-war municipality level, we controlled for the Ethno-Linguistic Fractionalization (ELF) index computed from the 1991 population census. The former is aimed to control for the latent lack of trust and greater conflict that might prevail in more culturally diverse environments (Alesina and La Ferrara, 2002), potentially affecting both the onset and intensity of conflict and latent individual mental health. To control for local economy characteristics (i.e.

[19] As we mentioned, 16 is the cut-off point generally considered as indicative of being at risk of depression.

to account for the non-trauma effects of the war and preserve the exclusion restriction assumption) we further include the average monthly wage and the unemployment rate of the current municipality of residence in all regressions.[20]

Table 2 reports main results, both OLS estimates as a benchmark and IV-GMM results. OLS estimates of the CES-D score equation are reported in column 1, and those of the depression equation in column 2 of Table 2. Recalling the war is associated with a 9.7 points ($t = 14.1$) increase in the CES-D score (i.e. one standard deviation) and a 33.2 ($t = 13.1$) p.p. rise in the probability of depression. Other factors turn out to be significantly associated with mental health such as gender (women have worse mental health) and education (highly educated individuals have better mental health status, but the effect is non-monotonic).

Columns 3 and 4 of Table 2 report the IV-GMM estimates of the mental health and the depression equations, respectively. The $F-$statistic of the excluded instruments in the first-stage is 24.9, showing no sign of a weak instruments problem. Individuals who resided just before the war in municipalities characterized by higher war casualty rates are significantly more likely to recall the war. In particular, from the first stage (in Table B.2 in the Appendix B), a 1 p.p. increase in the war casualty rate causes a 1.8 p.p. ($t = 3.7$) rise in the likelihood of recalling the war, and the effect is not different for Bosniaks, Serbs and Croats (the only statistically significant interaction term is that related with 'other ethnicity', which is positive). The Hansen-J statistic of over-identification always supports the instruments' validity (exogeneity and exclusion restriction). In particular, the over-identification test suggests that war intensity can be excluded from the mental health equation, conditional on the controls included and recalling the war. In the second stage, recalling the war is estimated to increase the CES-D score by 16.2 points ($z = 5.13$) and the probability of depression by 59.8 p.p. ($z = 3.8$). The estimated effects are relatively large, e.g., recalling the war has a CES-D score effect that is approximately 8 times that of lowering the educational achievement of an individual from the non-university post-secondary[21] to the primary level, and recalling the war has an effect on the probability of

[20] We do not include current municipality of residence fixed effects when working with cross-section data because the effect of recalling the war on mental health would only be identified by non-returning migrants. On this specific point, see the following section.

[21] In BiH, education at the tertiary level is two to three years in duration at *visa skola* and *visoka skola* (post-secondary, non-university institutions) and four to six years at universities.

Table 2: Effect of recalling the war on mental health (linear models)

	(1) OLS *CES-D score*	(2) OLS *Depression*	(3) IV-GMM *CES-D score*	(4) IV-GMM *Depression*
Main equation: Mental health				
recall the war[(a)]	9.656***	0.332***	16.159***	0.598***
	(0.686)	(0.025)	(3.152)	(0.108)
age	0.085*	-0.000	0.038	-0.003
	(0.043)	(0.002)	(0.056)	(0.002)
age squared	0.001	0.000**	0.001*	0.000***
	(0.001)	(0.000)	(0.001)	(0.000)
female	2.820***	0.093***	2.503***	0.079***
	(0.219)	(0.009)	(0.245)	(0.010)
Education (elementary)				
general secondary	-0.917	-0.046	-0.531	-0.022
	(0.669)	(0.029)	(0.569)	(0.027)
other secondary	-4.129***	-0.150***	-3.392***	-0.127**
	(0.796)	(0.049)	(0.959)	(0.054)
vocational secondary	-1.392***	-0.062***	-1.340***	-0.055***
	(0.440)	(0.019)	(0.317)	(0.018)
technical secondary	-0.949***	-0.039***	-0.861***	-0.031**
	(0.296)	(0.013)	(0.209)	(0.013)
post-secondary non-university (2-3 yrs)	-2.270***	-0.073***	-2.052***	-0.054**
	(0.601)	(0.024)	(0.495)	(0.023)
university or higher	-1.873***	-0.043**	-1.296**	-0.018
	(0.509)	(0.019)	(0.581)	(0.025)
not reported	3.336***	0.101***	3.411***	0.110***
	(0.613)	(0.025)	(0.545)	(0.021)
Ethnic group (Bosniak)				
Serb	0.195	0.012	0.521	0.024*
	(0.466)	(0.017)	(0.350)	(0.012)
Croat	-3.357***	-0.086**	-1.760	-0.034
	(1.164)	(0.033)	(1.166)	(0.033)
other	2.202***	0.048	1.926***	0.043*
	(0.796)	(0.029)	(0.711)	(0.025)
not reported	0.777	0.008	1.206**	0.005
	(0.652)	(0.023)	(0.587)	(0.021)
Residence (capital)				
other urban	0.725	0.031	0.852	0.025
	(0.971)	(0.028)	(0.799)	(0.021)
rural	0.569	0.011	0.332	-0.003
	(1.035)	(0.030)	(0.931)	(0.027)
First stage: Recall the war				
$F-$statistic excluded instruments [$p-$value]			24.85 [0.00]	24.85 [0.00]
Anderson-Rubin Wald statistic [(b)] [$p-$value]			30.76 [0.00]	46.73 [0.00]
Hansen J-statistic[(c)]			5.968 [0.20]	5.85 [0.21]
Pre-war municipality controls	Yes	Yes	Yes	Yes
Current municipality controls	Yes	Yes	Yes	Yes
N. observations	6796	6796	6796	6796

*, **, *** statistically significant at the 10%, 5% and 1% level, respectively.

[(a)] Answer to the question: "During previous week, including today, how many times did constantly recall most painful events you experienced during the war?". Recall war takes on value one if individuals answered 'quite a bit' or 'extremely often' and zero otherwise.

[(b)] Weak instruments' robust inference test (null hypothesis: coefficients on the instruments in the reduced form are jointly zero).

[(c)] Overidentification test (null hypothesis: instruments are valid).

Note. The excluded instruments are the casualty rate in the pre-war municipality of residence of the individual and its interactions with ethnicity dummies. Full first stage results are reported in Table B.1. Heteroskedasticity-robust standard errors are clustered at the pre-war municipality of residence level (94 clusters).

depression that is approximately 7.5 times as large as the gender gap.[22] and 63 p.p. ($z = 6.23$) in the CES-D score and the depression equations, respectively.

Overall, IV-GMM estimated effects are larger in magnitude than OLS estimates. OLS results may be upward biased because of endogeneity[23] (i.e. mentally vulnerable people tend to recall war more frequently), but on the other hand, misreporting in recalling the war (misclassification error) is likely to produce a downward bias in the estimated effects (Lewbel, 2007), i.e., a bias towards zero. IVs, which address both the above-mentioned sources of bias, seem to suggest that the latter is the most relevant bias. Moreover, the usual Local Average Treatment Effect (LATE) interpretation may also explain the larger magnitude of the IVs estimates, i.e. compliers with the war-intensity instrument (individuals whose recall war status is triggered by war intensity) may be a peculiar sub-population that is especially sensitive to mental health issues, for instance. Last but not least, it may be the case that using a linear model for dichotomous dependent variables affects the magnitude of the estimated effects. We this and related issues in the next section.

7. Robustness checks

In this section, we check the robustness of our main results by adding more controls in the regressions, and by using nonlinear models.

Geographical mobility. A first potential issue with our analysis is the role played by movers. In the estimated specifications reported above, we do not include current-municipality fixed effects (FEs) because upon their inclusion, the causal effect of recalling the war would be identified by permanent movers only, i.e., by individuals whose current and pre-war municipality of residence are different.[24] Thus, in the previous section, we identify the mental health effect by using both movers and non-movers. Here, though, we check the robustness of our IV-GMM estimates to the inclusion of current-municipality FEs. Movers and non-movers may be very different sub-populations, and it is difficult to predict whether the effects of recalling the war

[22] We also estimated IV-GMM models not controlling for education. The latter may be indeed potentially affected by war trauma (Swee, 2013), and including it could make our estimated causal effects on mental health more 'partial' (i.e. excluding the effect mediated by education). The estimated coefficients on war trauma in these models are 16.9 ($z = 5.89$

[23] If the true effect of war on depression is positive, OLS would produce larger positive estimates.

[24] Indeed, in the absence of movers, in the first-stage regression, the war-intensity variable would be completely absorbed by current-municipality fixed effects. There is still some variation induced by war intensity-ethnicity interactions, but it is insufficient to identify the model.

are larger for the former or the latter. In our estimation sample, 53% of individuals are movers. If movers are those who suffer the most from war-related violence, for instance, we might expect larger effects of recalling the war on them. Interestingly, this is not the case. Columns 1 and 2 of Table 3 report the estimates of recalling the war on the CES-D score and depression obtained with IV-GMM controlling for current municipality FEs. The estimated effects are in line with those reported in Table 2, namely, 15.7 points ($t = 5.7$) and 54 p.p. ($t = 5.5$) on the CES-D score and depression, respectively. Our analysis may provide an additional explanation for the strong negative effects of war-induced displacement on individual labour market outcomes found by Kondylis (2010): individuals who migrated because of high war intensity are also more likely to have worse mental health.[25]

Physical health. Up to now, we have focused our analysis on mental health. A possible reason why individuals constantly recall the war, though, is that they suffered physical harm, which still persists and has a feedback effect on their current mental condition. This channel of influence would imply very different policies to address individuals' mental health problems, centred on physical rather than on mental therapy. We investigate this potential channel by including among the controls the number of days with limitations in Activities of Daily Living (ADL) during the last 4 weeks, as a proxy of physical health status.[26] Physical health, in this way, is just another psychosocial stressor and a potential mediating factor that might affect mental health. After controlling for it, we only focus on the effect of war mental traumas on mental health. The results are reported in columns 3 and 4 of Table 3. The estimated effects of recalling the war increase, with 17.7 points ($t = 6$) on the CES-D score and 62.5 p.p. ($t = 6.2$) regarding the probability of depression. Interestingly, each day an individual spends with ADL limitations is associated with a 0.35 points ($t = 5.9$) increase in the CES-D score and a 1.2 p.p. ($t = 6.2$) rise in the likelihood of being depressed. When using an indicator for having a chronic disease instead of the number of days with ADL limitations, the estimated effects are 12.7 points ($t = 3.2$) on the CES-D score and 53.7 p.p. ($t = 4.8$) on depression. In both cases the instruments are not weak, and the Hansen-J statistic confirms their validity.[27] Overall,

[25] In her analysis, Kondylis (2010) uses municipality-level war intensity as an instrument for geographical displacement, and includes controls for individuals' physical health but not for mental health problems.

[26] The exact wording of the question is 'How many days in the previous 4 weeks you did not perform the usual activities due to illness ?'

[27] The complete results of these estimates are not shown in the table and are available upon request.

Table 3: Robustness checks (geographical mobility and physical health)

	(1) IV-GMM *CES-D score*	(2) IV-GMM *Depression*	(3) IV-GMM *CES-D score*	(4) IV-GMM *Depression*
Main equation: Mental health				
recall the war[(a)]	15.661***	0.540***	17.673***	0.625***
	(2.767)	(0.098)	(2.925)	(0.101)
age	0.010	-0.003*	0.066	-0.002
	(0.054)	(0.002)	(0.057)	(0.002)
age squared	0.001**	0.000***	0.000	0.000**
	(0.001)	(0.000)	(0.001)	(0.000)
female	2.523***	0.084***	2.527***	0.081***
	(0.223)	(0.010)	(0.248)	(0.010)
Education (elementary)				
general secondary	-0.954	-0.045	-0.227	-0.012
	(0.654)	(0.029)	(0.519)	(0.025)
other secondary	-3.318***	-0.139***	-2.585***	-0.103*
	(0.946)	(0.053)	(0.922)	(0.055)
vocational secondary	-1.285***	-0.057***	-1.063***	-0.048***
	(0.377)	(0.018)	(0.321)	(0.017)
technical secondary	-0.924***	-0.038***	-0.607***	-0.024**
	(0.229)	(0.014)	(0.194)	(0.012)
post-secondary non-university (2-3 yrs)	-2.167***	-0.063***	-1.655***	-0.044*
	(0.523)	(0.025)	(0.501)	(0.023)
university or higher	-1.799***	-0.034	-0.640	0.002
	(0.487)	(0.023)	(0.556)	(0.024)
not reported	2.946***	0.084***	2.940***	0.094***
	(0.528)	(0.023)	(0.442)	(0.019)
Ethnic group (Bosniak)				
Serb	-0.184	-0.023	0.357	0.017
	(0.539)	(0.025)	(0.336)	(0.012)
Croat	-0.234	-0.000	-1.675	-0.034
	(0.697)	(0.017)	(1.178)	(0.034)
other	2.314***	0.046*	1.613**	0.033
	(0.632)	(0.024)	(0.738)	(0.025)
not reported	0.202	-0.007	0.798	-0.005
	(0.550)	(0.019)	(0.512)	(0.019)
Residence (capital)				
other urban	2.246***	0.026	0.592	0.018
	(0.488)	(0.025)	(0.754)	(0.021)
rural	0.971	0.037	0.000	-0.013
	(0.656)	(0.029)	(0.875)	(0.025)
days with limitations in ADL			0.347***	0.012***
			(0.059)	(0.002)
First stage: Recall the war				
$F-$statistic excluded instruments [$p-$value]	23.79 [0.00]	23.79 [0.00]	37.01 [0.00]	37.01 [0.00]
Anderson-Rubin Wald test[(b)] [$p-$value]	42.59 [0.00]	52.00 [0.00]	42.58 [0.00]	65.77 [0.00]
Hansen J-statistic[(c)]	1.93 [0.74]	1.61 [0.81]	5.97 [0.20]	5.90 [0.21]
Pre-war municipality controls	Yes	Yes	Yes	Yes
Current municipality controls	No	No	Yes	Yes
Current municipality FEs	Yes	Yes	No	No
N. observations	6796	6796	6794[(c)]	6794[(c)]

*, **, *** statistically significant at the 10%, 5% and 1% level, respectively.

[(a)] Answer to the question: "During previous week, including today, how many times did constantly recall most painful events you experienced during the war?". Recall war takes on value one if individuals answered 'quite a bit' or 'extremely often' and zero otherwise.

[(b)] Weak instruments' robust inference test (null hypothesis: coefficients on the instruments in the reduced form are jointly zero).

[(c)] Two observations are dropped from the sample because days with ADL limitations are missing.

Note. The excluded instruments are the casualty rate in the pre-war municipality of residence of the individual and its interactions with ethnicity dummies. Heteroskedasticity-robust standard errors are clustered at the pre-war municipality of residence level (94 clusters).

this evidence suggests that although physical conditions strongly affect an individual's mental health status, they are not the main channel through which recalling the war reduces individual mental well-being.

War and physical capital destruction. As discussed in Section 5.1, we have included current-municipality controls in the mental health and depression equations to capture the direct effect of war intensity on local economic development, and through this, on an individual's mental health. Here we also check the robustness of our results to including more direct measures of the direct effects of war intensity running through physical capital destruction. In particular, we re-estimate the specifications in columns (1) and (2) of Table 3 omitting current-municipality controls but including the rate of housing units (over the 1991 population) destroyed during the war (collected by the UNHCR), measured at the current-municipality level. The estimated effects on the CES-D score and the likelihood of depression are 15.5 ($z = 4.7$) and 59 p.p. ($z = 5.19$), respectively.[28] Thus, our results are robust to alternative ways of controlling for the direct effect of the war on physical capital disruption.

Nonlinear models. Using linear models to model non-linear outcomes may affect the consistency of the estimates. In particular, linearity is likely to have a bearing on the magnitude of the estimated effects.[29] For this reason, we further check the sensitivity of our estimates to using non-linear models. We use an endogenous treatment regression model, in which the CES-D score is modelled as linear and the recall war equation as a probit model (*endogenous treatment regression*). We also use a bivariate probit (more precisely, an *endogenous treatment probit*, ET-Probit hereafter) model for depression, in which both the recall war and the depression equations are modelled as probit. On the one hand, both these models rely on joint normality and on much stronger identifying assumption than those reported in the previous section. On the other hand, the additional distributional assumptions, if correct, are likely to greatly increase the estimates' precision (i.e., to increase efficiency), and, unlike linear IVs, allows us to obtain other parameters of interest such as Average Treatment Effects (ATE) and Average Treatment Effects on the Treated (ATET).

[28] The full set of estimates is not reported in the paper for the sake of brevity, and is available upon request from the corresponding author.

[29] Lewbel et al. (2012) give examples in which even the sign of the estimated effects may be wrong, and researchers can get significant negative effects when the true treatment effects of interest are instead positive.

Table 4: Effect of recalling the war on mental health (nonlinear models)

	(1) ET-regression[(b)] *CES-D score*	(2) ET-probit[(b)] *Depression*
Main equation: Mental health		
recall the war[(a)]: ATE	10.669***	0.308***
	(0.834)	(0.056)
recall the war: ATET		0.504***
		(0.098)
$\rho^{(c)}$	-0.076**	-0.284
	(0.037)	(0.275)
Treatment equation: Recall the war		
χ^2 excluded instruments [$p-$value]	47.67 [0.00]	52.61 [0.00]
Pre-war municipality controls	Yes	Yes
Current municipality controls	Yes	Yes
N. observations	6796	6796

*, **, *** statistically significant at the 10%, 5% and 1% level, respectively.

[(a)] Answer to the question: "During previous week, including today, how many times did constantly recall most painful events you experienced during the war?". Recall war takes on value one if individuals answered 'quite a bit' or 'extremely often' and zero otherwise.

[(b)] ET stands for 'Endogenous Treatment'. In the Table the coefficient on recall war status, which corresponds both to the ATE and the ATET, is reported in column (1). In column (2), the ATE is computed as the the average partial effect (APE) on the estimation sample, and the ATT as the APE on the sample of individuals for whom war recall status equals one.

[(c)] Correlation coefficient between the errors in the mental health and the recall war equations.

Note. The 'excluded instruments' are the casualty rate in the pre-war municipality of residence of the individual and its interactions with ethnicity dummies. All models include the same controls as in the linear models of Table 2. Standard errors are heteroskedasticity-robust and clustered at the pre-war municipality of residence level (94 clusters) in column (2), and clustered by pre-war municipality in column (1).

Column 1 of Table 4 reports the estimates of the endogenous treatment regression model for the CES-D score. The excluded 'instruments' are highly statistically significant in the recall war equation ($\chi^2(5) = 47.7$).[30] The estimated ATE of recalling the war on the CES-D score is 10.7 ($z = 12.8$), lower than that obtained with IV-GMM estimation in Table 2. Interestingly, the estimated correlation between the error terms in the CES-D score and the recall war equations is negative (-0.08) and statistically significant, suggesting that latent unobserved traits that make individuals more likely to recall the war are *negatively* correlated with those worsening their mental health status (as a higher CES-D score means less mental well-being). This negative correlation is consistent with the downward bias found in the OLS estimates when compared to the IV-GMM estimates. A possible explanation is that individuals who are more mentally vulnerable may tend not to report remembering the war as a self-protection mechanism, generating false negatives in the treatment status. Column 2 shows the estimates of the ET-probit model. In this case as well, the excluded variables used to identify the model are highly statistically significant in the first stage ($\chi^2(5) = 52.6$), and the estimated correlation between the error terms is negative but insignificant (-0.28). The estimated ATE of recalling the war on the probability of depression is 30.8 p.p. ($z = 5.5$),[31] smaller than the one obtained with IV-GMM in the LPM (62.5 p.p.). However, when marginal effects are computed only on the treated individuals (ATET), the estimates are much closer to those obtained with IV-GMM. The estimated ATET is indeed 50.4 p.p. ($z = 5.5$). Overall, these results suggest that the effects on the treated are larger than those on the overall population and that this is partly responsible for the large magnitude of the IV-GMM estimates.

It should be noted though, though, that the ET-probit model (i.e., essentially a bivariate probit model, BP hereafter) may be inconsistent in case the true data-generating process is not jointly normal, and for this reason Chiburis et al. (2012) recommend running the Rao score test (Murphy, 2007) to detect when the BP model is misspecified, and hence BP estimation is inconsistent. The value of the score test for the model in column 2 of Table 4 is 12.21 (distributed as $\chi^2(9)$) with a p-value of 0.2. Thus the null hypothesis of joint normality cannot

[30] The complete estimates of the recall war equation in the models reported in this Section are available on request.

[31] This is computed as the average change in the probability of depression produced by switching the recall war status from zero to one in the estimation sample.

be rejected in our data, and the ATE and ATET estimates obtained with the ET-probit model can be considered reliable.

Different treatment intensity. In all previous models, we have used a dichotomous indicator for the frequency of recalling the war by grouping the two highest categories of the possible answers. However, one might be interested in assessing the robustness of our results when considering treatments of different intensity corresponding to the four answers in the Likert scale. At what frequency does recalling the war become a problem? To give an answer to this question, we estimated a linear regression joint with an ordered probit for the CES-D score and a probit model joint with an ordered probit for the likelihood of depression.[32] In this case, we used the same set of controls as in Table 2, and the results are shown in Table 5. Column 1 shows that all individuals remembering the war have worse mental health, the estimated effects, which are all statistically significant at the 1% level, are 4.8 points for remembering 'A little', 9.8 points for remembering 'Quite a bit' and 17.8 points for remembering 'Extremely often'. Consistent with these results, the effect we obtained with the IV-GMM estimator after dichotomizing the treatment in Section 6 is very close to that found for the top category (i.e. remembering 'extremely often'). The estimates in column 2 are also consistent with those in Section 6. The last two categories are indeed the most important in terms of increasing the probability of depression, with estimated ATEs of 12 p.p. ($z = 2.8$), 29 p.p. ($z = 3.1$) and 52.5 p.p. ($z = 3.4$) for remembering the war 'A little', 'Quite a bit' and 'Extremely often, respectively. The ATETs for the same treatments are 12.5 p.p., 32.5 p.p. and 57 p.p., respectively, and are always statistically significant at the 1% level.

8. The economic burden of war trauma

As shown in the previous section, war victimization has long-lasting negative effects on individual mental health. In this section, we provide some evidence on the economic burdens of war trauma. There are different types of costs for individuals or firms at a micro-economic level and for the society as a whole at a macro-level (WHO 2009). Providing hard figures for such costs is difficult and requires many assumptions. Just focusing on individuals, for instance, reaching a comprehensive estimate of all of the costs is difficult because of the many aspects of

[32] These models were estimated using the `cmp` command in STATA.

Table 5: Different intensities of war-trauma (i.e. recalling the war)

	(1) Simultaneous equation model *CES-D score*	(2) Simultaneous equation model *Depression*$^{(b)}$
Main equation: Mental health		
Remember the war$^{(a)}$ *(not at all)*		
ATE:		
a little	4.772***	0.120***
	(0.665)	(0.043)
quite a bit	9.823***	0.290***
	(0.971)	(0.095)
extremely often	17.789***	0.525***
	(1.508)	(0.156)
ATET:		
a little		0.125***
		(0.045)
quite a bit		0.325***
		(0.099)
extremely often		0.570***
		(0.148)
Treatment equation: Recall the war		
χ^2 excluded instruments [$p-$value]	49.85 [0.00]	52.10 [0.00]
N. observations	6796	6796

*, **, *** statistically significant at the 10%, 5% and 1% level, respectively.

$^{(a)}$ Answer to the question: "During previous week, including today, how many times did constantly recall most painful events you experienced during the war?". Recall war takes on value one if individuals answered 'quite a bit' or 'extremely often' and zero otherwise.

$^{(b)}$ ATE is computed as the average partial effect (APE) in the estimation sample. ATET is computed as the APE computed only on the sample of individuals for which each specific treatment is equal to one.

Note. The excluded instruments are the casualty rate in the pre-war municipality of residence of the individual and its interactions with ethnicity dummies. All models include the same controls as in the linear models of Table 2. The model in column 1 is an ordered probit (recall the war) jointly estimated with a linear equation (CES-D score). The model in column 2 is an ordered probit (recall the war) jointly estimated with a probit (depression). Heteroskedasticity-robust standard errors are clustered at the pre-war municipality of residence level.

an individual's life involved, such as the direct costs of health expenditures (including health insurance), the loss of productivity and output, the consequences for other household members (who may react to an individual's reduced health with various coping mechanisms), the effects on human, physical and financial capital accumulation, non-market impacts (e.g., leisure) and other economic welfare losses. Many of these components are very difficult to quantify. The part of these costs that is probably easier to estimate using microdata is the labour market effect of a particular health condition. WHO (2009) recommends the use of the *output-related approach* (Goldschmidt-Clermont, 1987), which aims at isolating only the fraction of market production lost by an individual due to a specific health condition, by making comparisons between individuals with and without such a condition.

In this paper, we focus on the economic burden of mental illness and depression *caused* by war trauma. Hence, in what follows we measure the effects that recalling the war has on an individual's labour force participation status, weekly working hours and net monthly income. When evaluating these effects, it should be noted that they may be an upper bound of the corresponding costs for households, which may use several coping mechanisms to alleviate the negative consequences produced by the onset of a negative health shock to one of its members (e.g., other household members may increase their labour supply in response to the reduced working capacity of the ill member). However, it is also the case that some of these coping mechanisms are only temporary (WHO, 2009), may not prevent more negative consequences in the long run (e.g., reduced investment in children's human capital) and that, in principle, negative spillovers on other healthy family members are also possible (e.g., healthy members might need to take care of the ill member and withdraw from the labour market).

In this section, we estimate the labour market effects of war victimization by both using linear IV-GMM and nonlinear models, focusing on the ATET in the latter case. We start from the latter, which are reported in panel A of Table 6. All models include the controls used in Table 2 and the number of days with ADL limitations as a proxy of an individual's physical health, which is likely to negatively affect labour market outcomes. Column 1 uses an ET-probit model and shows that recalling the war reduces the probability of labour force participation by approximately 23 p.p. ($z = -8.9$). This is a very large effect, given that the average probability of participating in the labour market is 55% in the estimation sample for individuals not recalling the war. A significant effect also emerges for the number of weekly working hours

Table 6: Labor market effects of war trauma

Panel A. Nonlinear models

	(1) ET-probit[(b)] *labor force participation*	(2) ET-regression *weekly working hours*	(3) ET-regression *net monthly income*
Main equation: Labor market outcomes			
Recall the war[(a)]	-0.270***	-12.172***	-64.709***
	(0.038)	(2.496)	(19.825)
ρ[(c)]	0.534***	0.352***	0.147***
	(0.110)	(0.060)	(0.050)
First stage: Recall the war			
χ^2 excluded instruments [$p-$value]	79.24 [0.00]	63.77 [0.00]	68.6 [0.00]
N. observations	6794[(d)]	6745[(d)]	6794[(d)]

Panel B. Linear IV-GMM models

	IV-GMM *labor force participation*	IV-GMM *weekly working hours*	IV-GMM *net monthly income*
Main equation: Labor market outcomes			
Recall the war[(a)]	-0.489***	-23.128***	-141.888***
	(0.142)	(3.957)	(40.336)
First stage: Recall the war			
F-statistic excluded instruments [$p-$value]	37.01 [0.00]	37.42 [0.00]	37.01 [0.00]
Anderson-Rubin Wald statistic [$p-$value]	91.67 [0.00]	40.4 [0.00]	64.34 [0.00]
Hansen-J statistic [$p-$value]	5.41 [0.25]	8.46 [0.13]	8.86 [0.06]
N. observations	6794	6745[(d)]	6794

*, **, *** statistically significant at the 10%, 5% and 1% level, respectively.

[(a)] Answer to the question: "During previous week, including today, how many times did constantly recall most painful events you experienced during the war?". Recall war takes on value one if individuals answered 'quite a bit' or 'extremely often' and zero otherwise.

[(b)] APEs for the individuals recalling the war are reported in this column, which corresponds to ATET.

[(c)] Correlation coefficient between the errors in the recall war and the labour outcome equations.

[(d)] 44 individuals who reported more than 72 weekly working hours (99th percentile) are omitted from the estimation sample.

Note. The excluded instruments are the casualty rate in the pre-war municipality of residence of the individual and its interactions with ethnicity dummies. All models include the same controls as in the linear models of Table 2 and a measure of ADL limitations. Heteroskedasticity-robust standard errors are clustered at the pre-war municipality of residence level. Income is expressed in Convertible Marks.

in column 2 (where for both unemployment and non-participation hours are set to zero)[33]: individuals recalling the war work -12.1 ($z = -4.9$) hours less per week. When translated into monetary terms these negative effects amount to an approximately 65 ($z = -3.3$) Convertible Marks (KM) lower income (column 3), which corresponds to about 0.6 of a standard deviation in income (109 KM in our sample).

To have a rough idea of the aggregate cost of war trauma in terms of labour income losses, we make some back-of-the-envelope calculations. By multiplying the average income loss per individual (-64.7 KM) by the fraction of the population age 15 or older in 2001 (estimated at 3,105,544 in the World Bank's Development Indicators) who recall the war (3,105,544$\times$ 22%=683,220) and by 12 months, we obtain an increase of approximately 530 million KM in total annual labour incomes six years after the end of the war,[34] corresponding to 4.2% of GDP in 2001 (12.6 billion KM according to the World Bank World Development Indicators).

Panel B of Table 6 reports the effects estimated with linear IV-GMM. The effects on individual labour market outcomes are generally larger, and amount to -49 p.p. on labour force participation, -23 weekly working hours and -142 KM in monthly wages, and are all statistically significant at the 1% level.

9. Concluding remarks

War-related violence may have long-lasting effects on an individual's mental health. However, assessing the causal effect of war on mental health is not an easy task given the paucity of high-quality data on individual war victimization and mental health. In this paper, we address this issue by matching the BiH LSMS, which contains a medically validated depression scale (CES-D), with high-quality data on war intensity at the municipality level provided by the Bosnian Book of the Dead. We add to the existing literature on the consequences of the BiH war by focusing on the effect of war trauma, proxied by constantly recalling painful war episodes, on individual mental health. This is an important distinction to make when assessing the effect of war violence unevenly inflicted across the civilian population.

The IV-GMM estimates suggest that war trauma causes an increase of 16 points (more than one standard deviation) in the CES-D score (i.e., worse mental health) and a 60 p.p. increase

[33] This is done to account for the fact that war trauma may cause a complete withdrawal from the labour market.
[34] Precisely, 7,956,776 KM.

in the likelihood of showing depression symptoms (CES-D score greater than 16). Sensitivity checks indicate that the estimates are robust to a number of issues, such as considering geographical mobility and allowing for different treatment intensities, and that the negative effects on mental health are not mainly mediated by physical health problems. Given that linear IV-GMM provides local estimates (LATE), we also estimate nonlinear models, which provide very similar effects of war trauma on mental health. Using simple back-of-the-envelope calculations, we compute that the war-trauma effect may be as large as to account for 4.2% of BiH's GDP in 2001.

Our findings point to large negative effects of war violence on individual mental health, which last several years after the end of the conflict and which are not mediated by other socio-economic stressors (unrelated to war trauma). Policies of reconstruction, investment, and economic recovery, may not be sufficient alone to completely remove the mental health legacy of war, while specifically targeted health programs may be needed for victimized individuals to overcome the psychological distress caused by the conflict.

References

Akbulut-Yuksel, M. (2014). Children of war: The long-run effects of large-scale physical destruction and warfare on children. Journal of Human Resources, 49(3): 634–662.

Akresh, R., Lucchetti, L. and Thirumurthy, H. (2012), Wars and child health: Evidence from the Eritrean-Ethiopian conflict. Journal of Development Economics, 99(2): 330–340.

Akresh, R., Verwimp, P. and Bundervoet, T. (2011), Civil war, crop failure, and child stunting in Rwanda. Economic Development and Cultural Change, 59(4): 777–810.

Akresh, R., Bhalotra, S., Leone, M. and Osili, U. (2012), War and stature: Growing up during the Nigerian civil war. American Economic Review (Papers Proceedings), 102(3): 273–277.

Alderman, H., Hoddinott, J. and Kinsey, B. (2006). Long term consequences of early childhood malnutrition. Oxford Economic Papers, 58(3): 450–474.

Alesina, A. and La Ferrara, E. (2002). Who trusts others? Journal of Public Economics, 85(2): 207-234.

Angrist, J. D. and Pischke, J. (2009). Mostly harmless econometrics: An empiricist's companion. Princeton and Oxford: Princeton University Press.

Ball, P., Tabeau, E. and Verwimp, P. (2007), The Bosnian book of dead: Assessment of the database (full report), No 5, HiCN Research Design Notes, Households in Conflict Network, http://EconPapers.repec.org/RePEc:hic:resdes:5.

Bartel, A., and Taubman, P. (1986). Some economic and demographic consequences of mental illness. Journal of Labor Economics, 4(2), 243-256.

Begic, S. and McDonald, T. W. (2006) The psychological effects of exposure to wartime trauma in Bosnian residents and refugees: Implications for treatment and service provision, International Journal of Mental Health Addiction 4(4): 319–329.

Bellows, J. and Miguel, E., (2009). War and local collective action in Sierra Leone. Journal of Public Economics, vol. 93(11-12), pages 1144-1157, December.

Bhattacharya, J., Goldman, D., and McCaffrey, D. (2006). Estimating probit models with self-selected treatments. Statistics in Medicine, 25(3): 389–413.

Blattman, C. and Miguel, E. (2010). Civil war. Journal of Economic Literature, 48(1): 3–57.

Brakman, S., Garretsen, H. and Schramm, M. (2004). The strategic bombing of cities in Germany in World War II and it impact on city growth. Journal of Economic Geography 4(1): 1-18.

Bratti, M. and Mendola, M. (2014). Parental health and child schooling. Journal of Health Economics 35(C): 94–108.

Bundervoet,T., Verwimp, P. and Akresh, R. (2009). Health and civil war in rural Burundi. Journal of Human Resources, 44(2): 536–563.

Cesur, R., Sabia, J. J. and Tekin, E. (2013). The psychological costs of war: Military combat and mental health. Journal of Health Economics, 32(1): 51–65.

Chiburis, R. C., Das, J. and Lokshin, M. (2012). A practical comparison of the bivariate probit and linear IV estimators. Economics Letters 117(3): 762–766.

Cornaglia, F., Feldman, N. E. and Leigh, A. (2014). Crime and mental well-being. Journal of Human Resources, 49(1): 110–140.

Das, J., Do, Q.-T., Friedman, J. and McKenzie, D. (2008). Mental health patterns and consequences: Results from survey data in five developing countries. World Bank Economic Review, 23(1): 31-55.

Davis, D.R. and Weinstein, D.E. (2002) Bones, bombs, and break points: The geography of economic activity. American Economic Review 92(5): 1269–1289.

De Mel, S., Mackenzie D. and Woodruff C. (2008). Mental health recovery and economic Recovery after the tsunami: High-frequency longitudinal evidence from Sri Lankan small business owners. Social Science and Medicine, 66(3): 582-95.

Deuchert, E. and Huber, M. (2014). A cautionary tale about control variables in IV estimation. School of Economics and Political Science, Department of Economics, Universität St. Gallen, Discussion Paper no. 2014-39.

DFID (1999). Bosnia health briefing paper. Tech. rep., DFID Resource Centre.

Do, Q.-T. and Iyer, L. (2012). Mental health in the aftermath of conflict. In: Garfinkel, M., Skaperdas, S. (Eds.), Oxford Handbook of the Economics of Peace and Conflict. (Chapter 15). Oxford: Oxford University Press.

Ettner, S.L., Frank, R.G., and Kessler, R.C. (1997). The impact of psychiatric disorder on labor market outcomes. Industrial and Labor Relations Review, 51(1): 64–81.

Friedman, J. and Thomas, D. (2008). Psychological health before, during, and after an economic crisis: Results from Indonesia, 1993–2000. World Bank Economic Review, 23(1): 57–76.

Hunt, N. and Gakenyi, M. (2005) Comparing refugees and nonrefugees: the Bosnian experience. Anxiety Disorders 19(6): 717–723.

Ichino, A. and Winter-Ebmer, R. (2004). The Long-Run Educational Cost of World War II. Journal of Labor Economics 22(1): 57–87.

Gade, D. M. and Wenger, J. B. (2011). Combat exposure and mental health: The long-term effects among US Vietnam and Gulf war veterans. Health Economics 20(4): 401–416.

Goldschmidt-Clermont, L. (1987). Economic evaluation of unpaid household work: Africa, Asia, Latin America and Oceania. Women, Work and Development, no. 14. Geneva: International Labour Organization.

Jencks, C. (1994). The homeless. Cambridge: Harvard University Press.

Justino, P. (2012). War and poverty. In M. Garfinkel, and S. Skaperdas, eds., The Oxford Handbook of the Economics of Peace and Conflict. Oxford: Oxford University Press.

Justino, P. (2009). Poverty and violent conflict: A micro-Level perspective on the causes and duration of warfare. Journal of Peace Research 46(3): 315–33.

Justino, P., Brück, T. and Verwimp, P. (2013). A micro-Level perspective on the dynamics of conflict, violence and development. Oxford: Oxford University Press.

Justino, P., Leone, M. and Salardi, P. (2014). Short- and long-term impact of violence on education: The case of Timor Leste. The World Bank Economic Review, 28(2): 320-353.

Horrace, W. C. and Oaxaca, R. L. (2006). Results on the bias and inconsistency of ordinary least squares for the linear probability model. Economics Letters, 90(3): 321–327.

Kapetanovic, A. (2009). Validation of depression and PTSD scales used in the 2001 Living Standards Measurement Surveys (LSMS) in Bosnia and Herzegovina. World Bank unpublished paper.

Kelleher, K., Chaffin, M., Hollenberg, J., and Fischer, E. (1994). Alcohol and drug disorders among physically abusive and neglectful parents in a community-based sample. American Journal of Public Health, 84(10): 1586–1590.

Kesternich, I., Siflinger, B., Smith, J. P. and Winter, J. K. (2014). The effects of World War II on economic and health putcomes across Europe. The Review of Economics and Statistics, 96(1): 103–118.

Kondylis, F. (2010), Conflict displacement and labor market outcomes in post-war Bosnia and Herzegovina. Journal of Development Economics, 93(2): 235–248.

Leon, G. (2012). Civil conflict and human capital accumulation: The long-term effects of political violence in Peru. Journal of Human Resources 47(4): 991-1022.

Lewbel, A., (2007), Estimation of average treatment effects with misclassification. Econometrica, 75(2): 537–551.

Lewbel, A., Dong, Y. and Tao Yang, T. (2012). Viewpoint: Comparing features of convenient estimators for binary choice models with endogenous regressors. Canadian Journal of Economics, 45(3): 809–29.

Miguel, E. and Roland, G. (2011). The long-run impact of bombing Vietnam. Journal of Development Economics, 96(1): 1–15.

Miller, K.E. and Rasmussen, A. (2010). War exposure, daily stressors, and mental health in conflict and post-conflict settings: Bridging the divide between trauma-focused and psychosocial frameworks. Social Science & Medicine 70(1): 7–16.

Miranda, J. J., and Patel, V. (2005). Achieving the millennium development goals: Does mental health play a role? PLoS Medicine, 2(10): 962–965.

Mrvić-Petrovic, N. (2001). A brief history of the state of Bosnia-Herzegovina (from its origins to the 1995 Dayton peace accords) in V. Nikolic-Ristanovic (ed.), Women, Violence and War Wartime Victimization of Refugees in the Balkans, 7–19. Budapest: Central University Press.

Murphy, A. (2007). Score tests of normality in bivariate probit models. Economics Letters 95(3): 374-379

Murthy, R.S., and Lakshminarayana, R. (2006). Mental health consequences of war: A brief review of research findings. World Psychiatry, 5(1): 25–30.

Neuner, F. (2010). Assisting war-torn populations — Should we prioritize reducing daily stressors to improve mental health? Comment on Miller and Rasmussen. Social Science & Medicine 71(8): 1381–1384.

Patel, V. and Kleinman, A. (2003). Poverty and common mental disorders in developing countries. Bulletin of the World Health Organization, 81(8): 609–615.

Radloff, L., (1977). The CES-D scale: a self-report depression scale for research in general population. Applied Psychological Measurement 1(3): 385-401.

Steadman, H.J., Mulvey, E.P., Monohan, J., Robbins, P.C., Appelbaum, P.S., Grisso, T., Roth, L.H. and Silver, E. (1998). Violence by people discharged from acute psychiatric inpatient facilities and by others in the same neighborhoods. Archives of General Psychiatry, 55(5): 1–9.

Swee, E. (2013). On war intensity and schooling attainment: The case of Bosnia and Herzegovina. Households in Conflict Network (HiCN) Working Paper 57.

van der Kolk, B. (2007) The history of trauma in psychiatry. In Handbook of PTSD. Science and Practice (eds M. Friedman, T. Keane P. Resick), pp. 19-36. New York: The Gulford Press.

Waldinger, F. (2012). Bombs, brains, and science: The role of human and physical capital for the creation of scientific knowledge. CAGE Online Working Paper Series 78, Competitive

Advantage in the Global Economy (CAGE) forthcoming in The Review of Economics and Statistics.

Weidmann, N. B. (2011). Violence “from above” or “from below”? The role of ethnicity in Bosnia’s civil war. The Journal of Politics,73(4): 1178–1190.

WHO (2003). Investing in mental health. Geneva: World Health Organization.

WHO (2009), WHO guide to identifying the economic consequences of disease and injury. Geneva: World Health Organization.

Appendix A. Questions about mental health (CES-D depression scale)

Our translation of the questions in module 4.B of the Bosnian questionnaire:

(9) 'How often in the past week, including today, did you feel you had no energy or slowed down?'

(10) 'How often in the past week, including today, did you accuse yourself of different things?

(11) 'How often in the past week, including today, did you cry easily?'

(12) 'How often in the past week, including today, did you feel loss of appetite?'

(13) 'How often in the past week, including today, did you have problems falling asleep or sleeping?'

(14) 'How often in the past week, including today, did you feel hopeless in terms of the future?'

(15) 'How often in the past week, including today, did you feel sad (melancholic)?'

(16) 'How often in the past week, including today, did you feel lonely?'

(17) 'How often in the past week, including today, did you think of ending your life?'

(18) 'How often in the past week, including today, did you feel like you were captured or trapped?'

(19) 'How often in the past week, including today, did you feel that you worried too much about different things?'

(20) 'How often in the past week, including today, did you feel that you had no interest in things about yourself?'

(21) 'How often in the past week, including today, did you feel that everything was an effort?'

(22) 'How often in the past week, including today, did you feel worthless?'

Appendix B. Supplementary tables

Table B.1: Sample summary statistics

Variable	N. obs.	Mean	St. Dev.
CES-D score (mental health)	6796	9.703	10.239
depression (CES-D≥16)	6796	0.215	0.411
recall war (war trauma)	6796	0.220	0.414
age	6796	45.507	17.469
age squared	6796	2390.473	1674.141
female	6796	0.529	0.499
Education (elementary)			
general secondary	6796	0.028	0.164
other secondary	6796	0.006	0.078
technical secondary	6796	0.123	0.329
vocational secondary	6796	0.297	0.457
post-secondary non-university	6796	0.041	0.198
university or higher	6796	0.056	0.229
missing	6796	0.107	0.309
Ethnicity (Bosniak)			
Serb	6796	0.402	0.490
Croat	6796	0.084	0.278
Other	6796	0.021	0.142
Not reported	6796	0.078	0.268
Residence (capital)			
other urban	6796	0.406	0.491
rural	6796	0.343	0.475
Activities of Daily Living (ADL) limitations	6794	2.190	5.940
Pre-war municipality characteristics			
ELF (pre-war municipality)	6796	0.548	0.160
Post-war municipality characteristics			
unemployment rate	6796	0.383	0.129
current municipality average monthly wage	6796	338.924	123.288
Excluded instruments			
casualty rate	6796	2.166	2.459
casualty rate × Serb	6796	0.872	1.458
casualty rate × Croat	6796	0.079	0.353
casualty rate × other	6796	0.038	0.365
casualty rate × unreported	6796	0.201	1.122
Economic outcomes (cost of war trauma)			
labour force participation	6794	0.518	0.500
weekly working hours - including non workers[(a)]	6745	15.107	21.279
net monthly wages (KM) - including non workers	6794	109.906	231.411

[(a)] The sample excludes individuals who reported more than 72 weekly working hours (99th percentile).

Note. Summary statistics refer to the sample used in Table 2, and to the sample used in Table 6 only for the Economic outcomes used to compute the costs of war trauma.

Table B.2: First stage of IV-GMM estimates

	IV-GMM
age	0.010***
	(0.002)
age squared	-0.000**
	(0.000)
female	0.023**
	(0.012)
Education (elementary)	
general secondary	-0.055
	(0.035)
other secondary	-0.064
	(0.054)
technical secondary	-0.045**
	(0.022)
vocational secondary	-0.030*
	(0.016)
post-secondary non-university (2-3 yrs)	-0.092***
	(0.033)
university or higher	-0.121***
	(0.024)
not reported	0.050*
	(0.027)
Ethnic group (Bosniaks)	
Serb	0.003
	(0.050)
Croat	-0.095
	(0.084)
other	-0.098***
	(0.032)
not reported	0.044
	(0.035)
Residence (capital)	
other urban	0.014
	(0.046)
rural	0.065
	(0.044)
Excluded instruments	
casualty rate	0.018***
	(0.005)
casualty rate × Serb	-0.005
	(0.013)
casualty rate × Croat	0.004
	(0.047)
casualty rate × other	0.024*
	(0.012)
casualty rate × unreported	-0.006
	(0.007)
Pre-war municipality controls	Yes
Current municipality controls	Yes
N. observations	6796

*, **, *** statistically significant at the 10%, 5% and 1% level, respectively.

Note. The dependent variable is a dichotomous indicator for recalling the war 'quite a bit' or 'extremely often'. The excluded instruments are the casualty rate in the pre-war municipality of residence of the individual and its interactions with ethnicity dummies. Heteroskedasticity-robust standard errors are clustered at the pre-war municipality of residence level.