The Hidden Costs of Terrorism: The Effects on Human Capital at Birth*

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Abstract

We study the effects of in utero exposure to terrorism in Spain on birth outcomes, focusing on terrorism perpetrated by ETA during the period 1980-2003. We find that in utero exposure to terrorism early in pregnancy, as measured by the number of bomb casualties in the mother's province of residence in the first trimester of pregnancy, has detrimental effects on birth outcomes: in terms of average birth weight (lower), prevalence of low birth weight (higher) and fraction of "normal" babies (lower). While our findings are robust to a host of potential threats to validity, they seem to be driven by exposure to a relatively large number of bomb casualties. Focusing on the deadliest ETA terrorist attack, the Hipercor bombing of 1987 in Barcelona, we find substantial effects on birth outcomes. We then attempt to assess the mechanisms at stake by presenting evidence suggesting that exposure to bomb casualties increases stress and smoking among women, but not among men. While exposure to terrorism during conception does not affect total fertility, there seems to be a compositional change: during bombing periods, those women who conceive are more likely to be married, and married women tend to have better birth outcomes, on average. In addition, we find that exposure to bomb casualties increases fetal deaths. Thus, we interpret our estimated negative effects on health at birth as providing lower bounds to the true effects of in utero exposure to terrorism.

JEL Classification Codes: I12, J13.
Keywords: terrorism, birth outcomes, smoking, maternal stress, fetal deaths.

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1 Introduction

Terrorism and its subtle effects. Terrorism –one of today's most important challenges faced by governments and societies around the world– involves the destruction of human capital (by killing people), physical capital (by destroying infrastructure), or both at the same time, and economists have been studying its causes and consequences for several years (e.g., Krueger, 2007). Apart from its well-known direct consequences, terrorist attacks may generate a disproportionate amount of stress and fear (Becker and Rubinstein, 2011), which may have more "subtle" effects, including stress and anxiety responses (Nijdam et al., 2010). This is particulary problematic for pregnant women, if only because women experiencing stress during pregnancy are at increased risk of having a low birth weight child (e.g., Beydoun and Saftlas, 2008; Persson and Rossin-Slater, 2015; Black, Devereux and Salvanes, 2016).

Animal studies have provided credible causal evidence of a link between in utero exposure to stress and adverse offspring outcomes (Welberg et al., 2001) in both the short run (low birth weights) and the long run (hyper-responsive to stress and more anxious).[1] Low birth weight is not only a predictor of *child health* (e.g., McCormick, 1985), but of *long-term outcomes* such as educational attainment, labor market outcomes, and adult health (e.g., Behrman and Rosenzweig, 2004; Black, Devereux and Salvanes, 2007). Indeed, if we think of endowments at birth, such as birth weight, as proxies for the initial stock of human capital of an economy, we may well be worried that terrorism is damaging such stock by exerting a negative effect on its development during the critical stages of gestation (Almond and Currie, 2011; Heckman, 2007), potentially leaving an imprint that translates into worse long-term outcomes.[2]

ETA Terrorism and birth outcomes. In this paper we quantify the effects of a sustained terrorist conflict on *birth* outcomes, focusing our attention to Spain, and in particular to ETA terrorism.[3] By focusing on ETA terrorism, we depart from previous studies in at least three different ways. First, rather than investigating the effects of only *one-shock event* –September 11 (e.g., Brown, 2012)[4] or the Spain train bombings in Madrid in 2004 (e.g., Sherrieb and Norris, 2013)– our study speaks to the effects on birth outcomes of a *sustained* terrorist conflict. Second, the type of terrorism we investigate in this paper caused at most 21 fatalities in one attack (the 1987 attack to the *Hipercor* shopping center in Barcelona),

[1]Biological consequences of stress in the short run may emerge because of stress triggering the production of a placental corticotrophine-releasing hormone, which has been shown to lead to reduced gestational age and low birth weight (Hobel and Culhane, 2003). Biological consequences of stress in the long run may emerge because of "adverse programming" (Gluckman and Hanson, 2004).

[2]Aizer, Stroud and Buka (2012) show that exposure to elevated cortisol in utero adversely affects cognition at age 7 and educational attainment later in life.

[3]ETA (Euskadi ta Askatasuna or Basque Homeland and Freedom) was a terrorist organization who sought to gain independence for a Basque homeland in northern Spain and southern France. According to the *Barómetro del CIS* (2013) opinion polls, ETA terrorism was one of the *main worries* of Spaniards during the period 1980-2010. ETA announced "the definitive cessation of its armed activity" in October 2011, and no attack has been perpetrated by ETA since then.

[4]See also the studies of the terrorist attacks of September 11 by Berkowitz et al. (2003), Lederman et al. (2004), Lauderdale (2006) and Eskenazi et al. (2007).

a magnitude much smaller than that of September 11 (with more than 2,500 deaths in the World Trade Center) or the Spain train bombings (with almost 200 deaths). Last but not least, 9/11 was *not* only a source of acute maternal stress but also had negative *pollution* and *resource* shocks (Bram, Orr and Rapaport, 2002; Landrigan, 2001), which are known to have negative consequences on child health.[5] In Spain, ETA terrorist attacks have had negligible effects (if any) on resources and pollution.

We first investigate the impact of bomb casualties in each trimester of pregnancy on a battery of birth outcomes –birth weight (in grams), low birth weight (1 if birth weight less than 2,500 grams), prematurity ($<$ 37 weeks), "normality" (absence of complications during the pregnancy or labor) and gender of the child– using data on the universe of individual birth records from the national registry of live births in Spain, elaborated by the Spanish Statistical Institute (INE). We focus on the sequence of bomb casualties occurring between January 1980 and February 2003, a period characterized by *attrition* attacks (those taking place not only in the Basque Country but also in more distant locations from it; see de la Calle and Sánchez-Cuenca, 2006; LaFree et al., 2012).[6] Our identification strategy is based on a difference-in-difference approach across provinces (50 geographical regions) and time (more than 275 conception month-years). We regress birth outcomes on the number of bomb casualties in each trimester of pregnancy controlling for province and conception month-years, and our most complete econometric specification includes several socio-demographic and maternal controls and province-specific linear (month-by-year) time trends.

We find that in utero exposure to terrorism early in pregnancy (1st trimester), as measured by the number of bomb casualties in the mother's province of residence, has detrimental effects on birth outcomes: in terms of average birth weight (lower), prevalence of low birth weight (higher) and fraction of normal babies (lower). Our most conservative estimate implies that exposure to one bomb casualty in the first trimester of pregnancy translates into a reduction of 0.3 grams in birth weight. This estimate refers to the effect of "exposure to terrorism" for the population of pregnant women (and their babies) as a *whole*, or the "intent-to-exposure-to-terrorism" effect. Given that a lot of (pregnant) women in any province were unlikely to be at risk of being affected by bombings, scaling up this "intent-to-exposure-to-terrorism" effect is likely to yield a substantial "exposure-to-terrorism-on-the-exposed" effect, the effect of exposure to terrorism on birth outcomes among those mothers (and their babies) actually exposed to terrorism.

Our results are robust to a host of potential threats to validity: indirect treatment effects, confounding

[5]Indeed, Currie and Schwandt (2015) describe the events of 9/11 as an unparalleled environmental disaster, releasing a million tons of toxic dust into lower Manhattan. Hence, it is difficult to think of maternal stress as the unique (or main) driving force of birth outcomes behind terrorist attacks such as September 11. While Brown (2012) excludes residents of the attacked areas to remove the influences of pollution and resource shocks, part of the relevant effect of stress on birth outcomes is missed by using this approach.

[6]Prior to 1980 the registry of live births does not provide information on birth weight. The upper limit avoids Madrid train bombings (March 11 2004) interfering with our estimates. See Sherrieb and Norris (2013) for the analysis of the effects of the Madrid (Spain) train bombings of 2004 on birth outcomes.

economic factors, missing conception length, cumulated bomb casualties until pregnancy, region-specific effects, and statistical significance issues. In support of our identification strategy, we present two falsification tests. The first shows that the number of bomb casualties after birth does *not* predict birth outcomes. The second indicates that when bomb casualties at the month-year-province level are randomly allocated (we do that 1,000 times), we cannot reject (84% times) that exposure to terrorism in the 1st trimester of pregnancy has a null effect on birth outcomes. The relevance of bomb casualties in early rather than late pregnancy is consistent with experimental data and emerging theories pointing to the first rather than the second or third trimester as a crucial period for regulating the relevant fetal hormonal set points, in particular the hypothalamic pituitary axis (Schneider et al., 1999, den Bergh et al., 2005, Weinstock, 2001): Stress-dependent dysregulation of the hypothalamic pituitary axis affects birth weight and a child's subsequent growth and development (Wadhwa et al, 1996; Austin and Leader, 2000; Paarlberg et al., 1999; Gluckman and Hanson, 2004).

While our findings are robust to a host of potential threats to validity, they seem to be driven by exposure to a relatively large number of bomb casualties. In particular, we show that our main results are driven by province-month-year cells with relatively high number of bomb casualties (at least 5) – 3 or less bomb casualties in a province-month-year represent almost 90% of the cells with positive casualties. We then investigate the effects of the most devastating ETA terrorist attack: the Hipercor bombing of 1987, which killed 21 people and injured 45, representing the deadliest attack in ETA's history. We find that in utero exposure to this terrorist attack had a negative impact on birth outcomes.

The fact that stress *early* in pregnancy (rather than in other periods) is an insult for the fetus is consistent with recent research investigating the effects on birth outcomes of in utero exposure to maternal *stressors* at the *aggregate* level, such as hurricanes (Torche, 2011), landmine explosions (Camacho, 2008), number of casualties in the al-Aqsa Intifdada (Mansour and Rees, 2012), and homicide rates (Foureaux and Manacorda, 2016). However, our estimated effects could be (partially or totally) mediated, compensated or reinforced through selection effects due to behavioral responses, biological responses, or a combination of both.[7]

Mechanisms. Unfortunately the administrative data on live births do not contain measures on either maternal stress or health behaviors (such as smoking). However, we can use data from the Spanish National Health Survey cross-sections (1993, 1995, 1997, 2001) to provide some indirect evidence that exposure to terrorism is indeed positively related to stress. We find evidence that women of childbearing age (16-49) are

[7] Recently, Torche and Villarreal (2014) examine the effect of maternal exposure to local homicides on birth weight. They find that exposure to homicides in the first trimester of gestation increases infant birth weight and reduces the proportion of low birth weight. The authors show that the effect is not driven by fertility or migration responses to environmental violence, but it is due to an increase in mothers' health-enhancing behaviors (particularly the use of prenatal care) as a result of exposure to violence. The effect is coming from low-SES women living in urban areas.

more likely to report bad/very bad health in the last 12 months if they have been exposed to a bomb casualty in the last 12 months. However, no relationship is found for men of the same age. We also investigate the relationship between smoking behavior in the last 12 months among childbearing age women and bomb casualties in the last 12 months. We find a positive relationship between smoking and bomb casualties for women, but not for men. This finding is consistent with stress generating a negative behavioral response that has harmful effects on birth outcomes.

Other behavioral and biological responses to terrorism that must be assessed in interpreting our estimates on birth outcomes for live births are those involving effects on fertility, mortality, and migration. We find that exposure to terrorism during the conception period does not affect total fertility, but women who conceive during bombings appear to be positively selected (e.g., they are more likely to be married). In addition, since many of the bio-active mediators of maternal stress contribute to the pathophysiology of stillbirth (Silver and Ruiz, 2013), we also investigate whether terrorism increases fetal deaths, confirming the positive relationship. Thus, we interpret our estimated negative effects on health at birth as providing lower bounds to the true effects of in utero exposure to terrorism. Finally, we try to assess whether selective migration across provinces is contaminating our estimates. We do not find evidence of inter-provincial migration responses to terrorism, but we do find evidence of inter-provincial migration responses to provincial economic conditions as measured by the unemployment rate at the province level.

Related literature. Perhaps, the most recent and comparable study to ours, in that they try to estimate the impact of number of casualties per trimester of pregnancy on birth outcomes, is the one by Mansour and Rees (2012). These authors provide the first study on the effect of intrauterine exposure to armed conflict on pregnancy outcomes with evidence from the al-Aqsa Intifada.[8] Using data from the Palestinian Demographic Health Survey 2004, they find that an additional conflict-related fatality 9-6 months before birth is associated with a modest increase in the probability of having a child who weighed less than 2,500 grams.

While methodologically similar, the study by Mansour and Rees (2012) suffers from certain limitations that we can overcome. First, differently from us, they do not observe *gestational length*, so that they measure exposure by counting backwards from the date of birth, which means that exposure in the first trimester is likely to be assigned with measurement error for pre-term babies (Currie and Rossin-Slater, 2013). Second, while the al-Aqsa Intifada inflicted intense psychological damage on noncombatants living in the West Bank and Gaza, Mansour and Rees recognize that *other channels* apart from stress, namely, malnutrition and limited access to prenatal care, due to curfews, border closures and road blocks, could affect birth weight.[9]

[8]The name commonly used to describe a series of violent clashes between the Palestinians and Israel in the time frame between 2000 and 2004.

[9]For instance, they note that many women of reproductive age living in the Occupied Territories were not consuming

These channels are certainly negligible in our context. Third, their *sample size* is very small (hundreds or thousands), while here we use administrative records (millions), so we have enough statistical power to precisely estimate small effects. Finally, they only have 10 administrative districts, which makes difficult to use "standard" *clustering methods*, while we have instead 50 provinces.

In previous research, Camacho (2008) estimated the impact of prenatal exposure to terrorist attacks in the form of landmine explosions in Colombia. Using Colombian vital statistics records from the period 1998 through 2004, she found that first-trimester exposure to landmine explosions was associated with a reduction in birth weight of around 9 grams; second- and third- trimester exposure to landmine explosions was unrelated to birth weight. However, as emphasized by Mansour and Rees (2012), landmine explosions were not the primary threat to the civilian population in Colombia, nor were they closely related to conflict intensity. More recently, Brown (2012) finds that children exposed while in utero to the 9/11 terrorist attacks were born significantly smaller and earlier than previous cohorts, consistent with terrorism increasing maternal stress and the probability of low birth weight babies and of prematurity.

Contributions. Our paper offers several contributions to the existing literature. First, we are able to better isolate the effects of terrorism from other possible channels: environmental effects in Brown (2012), nutritional effects in Mansour and Rees (2012), other sources of violence in Camacho (2008), etc. Second, our study also breaks new ground by extending the analysis of the effects of terrorism in Spain to the realm of early life shocks, complementing the two main existing pieces of research on the economic and political consequences of terrorism in Spanish soil: The economic analysis of Abadie and Gardeazabal (2003) and the study of the electoral consequences of the Madrid train bombings of March 11 of 2004 by Montalvo (2011).[10] Third, while the estimated effects on birth outcomes appear to be small (consistent with previous studies on terrorism or other sources of maternal stress), the relevance of our study must be assessed from a global perspective. The effects of terrorism are not confined to developed countries. Indeed, the dramatic effects terrorism may have on large parts of the world are likely to be far more devastating than the one studied here. For one thing, the main driving force in our context seems to be maternal stress, but in developing countries many other channels are likely to be at work, including malnutrition and limited access to prenatal care (due to curfews, border closures and road blocks, amongst others).

Structure of the paper. The rest of the paper proceeds as follows. Section 2 describes the main data sources, and provides descriptive statistics and a graphical analysis. Section 3 contains the empirical

sufficient meat, poultry and dairy products at the height of the al-Aqsa Intifada. They try to assess the importance of these channels.

[10] Abadie and Gardeazabal find that, after the outbreak of ETA-terrorism, per capita GDP in the Basque Country declined about 10 percentage points relative to a region without terrorism, while Montalvo shows that the Madrid train bombings of March 11 of 2004, the worst terrorist attack in Spain (with 191 deaths and more than 2000 injured), affected the electoral outcomes of the Spanish General Election celebrated 3 days after.

strategy. Section 4 presents the results of our analysis and a battery of robustness checks. Section 5 provides an analysis of in utero exposure to the Hipercor bombing of 1987 on birth outcomes. Section 6 investigates mechanisms. Section 7 offers a discussion on the potential long-term outcomes of in utero exposure to terrorism, and Section 8 concludes.

2 Data

2.1 Main Sources

The national registry of live births in Spain (*Instituto Nacional de Estadística*, INE).[11] The unit of observation in this dataset is the live birth. For each live birth, we have information on its date of occurrence (month and year), gender, weight, gestational length, and normality (whether there were complications during the pregnancy or labor).[12] However, there is no information on other child health metrics such as Apgar score or head circumference. In addition, there is some demographic information on the mother of the child (province of residence, municipality size, place of delivery (home, hospital or clinic), age, parity history (number of births that she has had), marital status, and occupational status), but not on her risky behaviors (such as smoking), prenatal visits, educational attainment or (family) income. When appropriate, there is also information on her spouse: age and occupational status.

We use information on around 6.5 million births *conceived* between January 1980 and February 2003.[13] Following previous work on the determinants of birth weight, we focus on mothers aged 15-49, exclude multiple births and those newborns whose weight was under 500 grams.[14]

The Victims of ETA Dataset (de la Calle and Sánchez-Cuenca).[15] The unit of observation in this dataset is the ETA-victim casualty. It contains information on all casualties caused by ETA until 2006. For each casualty there is information on the date (day, month and year) and region of occurrence. During the period of analysis, January 1980 to February 2003, there were 612 victims of ETA: 200 of them were bomb casualties (including car bombs), while the remaining 412 included shootings (356) and booby traps (39), amongst others. Our analysis will be focused on bomb casualties, which we believe inflict more fear to the average citizen given its potential for collateral damage.[16]

[11] http://goo.gl/dMHm1E

[12] Juarez et al. (2012) investigate the quality of vital statistics on birth outcomes in Spain and find that low birth weight and prematurity are very similar when comparing hospital data (provided by medical personnel) with INE data (provided by parents when registering the birth).

[13] Since conception length is not available for all live births, as a robustness check we also measure exposure using date of birth. We have almost 10 million births *born* between January 1980 and December 2003.

[14] Bhalotra and Clarke (2014) report that exposure to bomb casualties in the 2nd and 3rd trimester of pregnancy decreases the probability of twins. Following Currie and Rossin-Slater (2013), newborns with gestational length below 26 weeks are also excluded.

[15] http://www.march.es/ceacs/proyectos/dtv/datasets.asp

[16] Shootings were targeted to specific individuals/groups of the populations such as police or politicians with limited scope

Spanish National Health Survey (*Ministerio de Sanidad, Servicios Sociales e Igualdad*).[17] We use the Spanish National Health Surveys cross-sections (1993, 1995, 1997, 2001), which include basic demographic information (e.g., age, gender, province of residence, date of the interview) and measures of health status and health behaviors, including self-reported health status and smoking behavior. Unfortunately, the 12-Item General Health Questionnaire (GHQ-12) was not introduced in the Spanish National Health Survey until the wave of 2006, so that we do not have information on mental health (and stress measures). In the online appendix we use the existing waves containing the GHQ-12 (2006, 2011) to assess the relationship between self-reported health status and measures of stress, and its stability over time.

2.2 Descriptive Statistics

Tabulations. We begin our empirical analysis presenting Table 1, a tabulation of the number of bomb casualties over the period January 1980 - February 2003 at the province-month-year level (13,900 cells). The table shows that bomb casualties are a rare event: 99.37% of cells contain 0 bomb casualties, 0.36% of cells contains 1 bomb casualty, 0.14% contain 2 bomb casualties, and 0.06% contain 3 bomb casualties. The largest number of bomb casualties per province-month-year is 21, which is the number of victims due to the Hipercor bombing attack of June 1987 in Barcelona. Given the severity of the attack, part of our study will be devoted to the analysis of such an event.

for collateral damage.

[17] `http://www.msssi.gob.es/estadEstudios/estadisticas/solicitud.htm`

Table 1: Number of Bomb Casualties per province-month-year, 1980-2003

Bomb casualties	Frequency	%
0	13,812	99.37
1	50	0.36
2	20	0.14
3	8	0.06
4	1	0.01
5	2	0.01
6	2	0.01
7	1	0.01
9	1	0.01
11	1	0.01
12	1	0.01
21	1	0.01
Sum	13,900	100.00

Some correlates. Table 2 displays descriptive statistics (averages) on birth outcomes (panel A) and mother-pregnancy characteristics (panel B) by exposure to bomb casualties (over the whole period of analysis 1980-2003) *during pregnancy*. This table has three columns. Column (1) contains the average of the corresponding variable in each row for children unexposed to bomb casualties during pregnancy, while column (2) focuses on children exposed to at least one bomb casualty during pregnancy, where exposure is defined using gestational length, date of birth and mother's province of residence. Column (3) contains the (mean) difference between the previous two columns (and its standard error).

Table 2: Descriptive Statistics

A. Birth Outcomes	No Bomb Casualty	Bomb Casualties $\geq$ 1	Difference
BW (500-6,590 g)[a]	3,291.64	3,255.78	−35.86***
			(8.28)
BW is available	0.95	0.95	0.00
			(0.011)
LBW (1 if BW $\leq$ 2,500 g)[a]	0.051	0.057	0.006***
			(0.001)
Premature	0.047	0.050	0.003
			(0.004)
Normal	0.899	0.883	−0.016*
			(0.009)
Male	0.517	0.516	−0.001*
			(0.0004)
B. Mother & Pregnancy Characteristics			
Mother's age (15-49)	28.8	29.4	0.6***
			(0.2)
Mother is married	0.883	0.879	−0.004
			(0.009)
First pregnancy	0.519	0.508	−0.011
			(0.009)
Second pregnancy	0.364	0.347	−0.017***
			(0.006)

Note: Live births *conceived* between January 1980 and February 2003.
Statistical difference based on a *t*-test.
[a] N=6,327,753. Otherwise N=6,641,478
Standard errors clustered at the province level (50 provinces).
$^{***}p-value < 0.01$, $^{**}p-value < 0.05$, $^{*}p-value < 0.1$

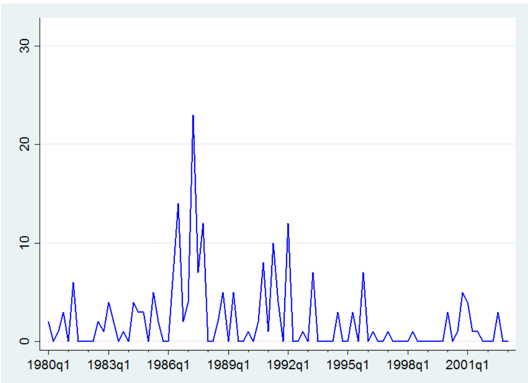
Panel A shows that children exposed to bomb casualties during pregnancy are on average 36 grams lighter; they are also 0.6 percentage points (or 6 per 1,000 live births) more likely to be low birth-weight babies and almost 2 percentage points (or 16 per 1,000 live births) less likely to be normal; they are 0.1 percentage points (1 per 1,000 live births) less likely to be males. Note that neither the fraction of available birth weights (non-missing values) nor the fraction of premature babies is related to exposure to bomb casualties during pregnancy.

Taken at face value, the estimates from panel A are consistent with exposure to terrorism while in utero affecting birth outcomes negatively. However, exposed and unexposed children may be different in many other dimensions apart from their exposure to bomb casualties. For instance, in Panel B, we can see that mothers of babies exposed to bomb casualties are more than half a year older than mothers of unexposed babies, and their order of births are also different. In addition, these descriptive statistics are *not* informative about the relative importance of the timing of exposure (trimester of pregnancy). A rigorous analysis must account for the (precise) *timing* of exposure and use a proper *identification strategy* in order to gauge the impact of terrorism on birth outcomes.

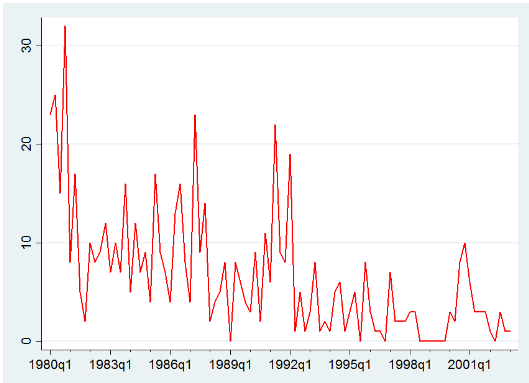
2.3 Graphical Analysis

Temporal variation. Figure 1 displays the quarterly evolution of bomb casualties (a) and total casualties (b) during the period January 1980 - February 2003, respectively. While the evolution of bomb casualties is quite erratic, with a peak in 1987 (the year of Hipercor bombing in Barcelona), the evolution of total casualties fluctuates around a downward trend.

Figure 1: Quarterly Evolution of Casualties – 1980-2003



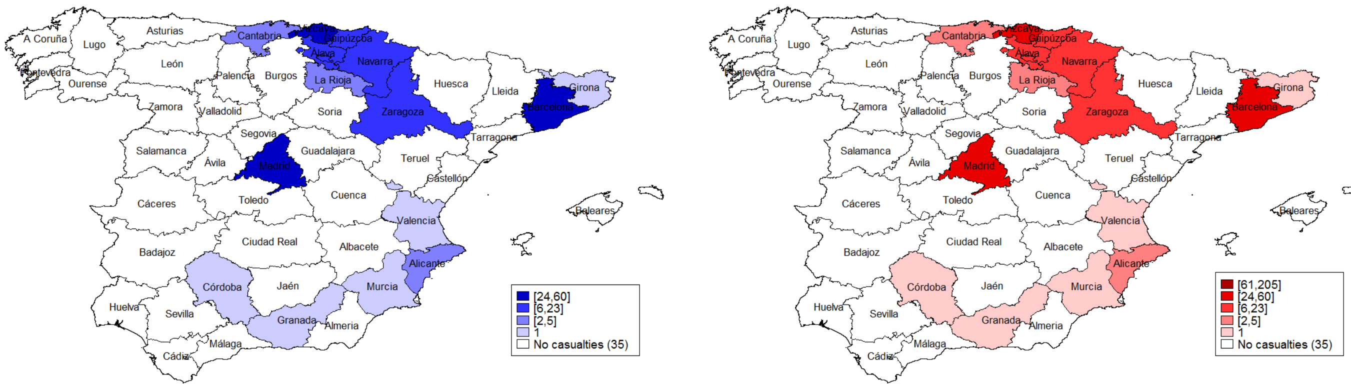
(a) Bomb Casualties



(b) Total Casualties

Spatial variation. Figure 2 describes the geographical dispersion of bomb casualties (a) and total casualties (b) during the period January 1980 - February 2003. While there are 3 focal points, the provinces of Barcelona, Madrid and Vizcaya, 12 other provinces were hit by bomb casualties, including Alicante, Cantabria and Zaragoza.

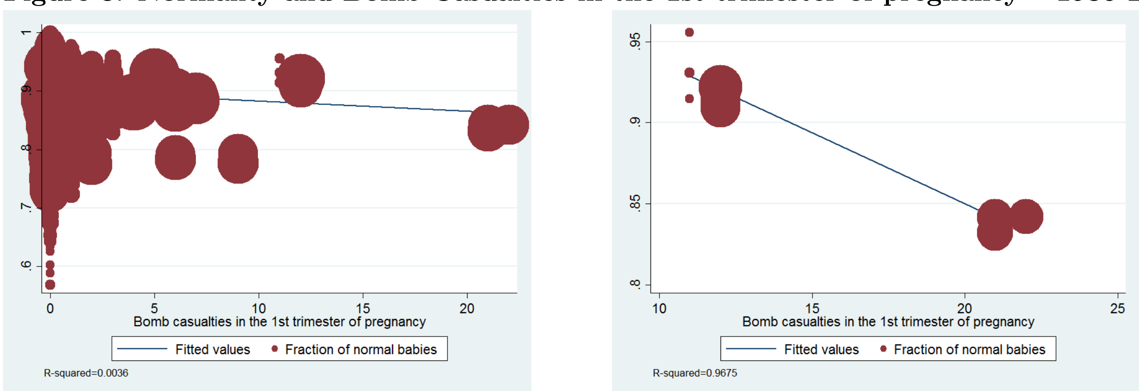
Figure 2: Bomb Casualties by Province – 1980-2003



(a) Bomb Casualties (b) Total Casualties

Terrorism in the 1st trimester and child normality. In Figure 3, we plot the fraction of normal newborns against the number of bomb casualties in the *first* trimester of pregnancy at the province-month-year level, and we find a negative relationship (the size of each cell is proportional to the number of live births). The gradient becomes steeper as we move from the full sample (a) to the sample including cells with *at least* 10 casualties (b).

Figure 3: Normality and Bomb Casualties in the 1st trimester of pregnancy – 1980-2003



(a) Full Sample (b) Bomb Casualties ≥ 10

3 Empirical Strategy: Difference-in-Difference

Our main analysis is based on a difference-in-difference approach using multiple years of data, and measuring exposure to terrorism during pregnancy by the number of bomb casualties at time t (month-and-year-of-conception) in the mother's province of residence p in each trimester of pregnancy.[18] One key assumption behind our identification strategy is that mothers are only "sensitive" to bomb casualties in their area of residence, perhaps because the increased perception that themselves (or her relatives) will be victimized only if a bomb occurs in her area of residence. While we will *relax* this assumption in the threats to our identification strategy subsection, for now, we estimate regressions of the form

$$\begin{aligned} Y_{i,p,t} = \alpha + \beta_1 Casualties^1_{p,t} + \beta_2 Casualties^2_{p,t} + \beta_3 Casualties^3_{p,t} \\ + \delta_p + \gamma_t + (\theta_p \times t) + \tau X_{i,p,t} + u_{i,p,t} \end{aligned} \tag{1}$$

where $Y_{i,p,t}$ is the birth outcome corresponding to newborn i, whose mother's province of residence is p, *conceived* in the year-month t, $Casualties^T_{p,t}$ is the number of bomb casualties in trimester T of pregnancy in province p, and $u_{i,p,t}$ is a random error term. Year-month of conception is estimated using the approach in Brown (2012): month of birth minus gestational age minus 2 weeks divided by 4, and increased by 12 if the difference is less than 1. Conception year is then either the year of birth or the birth year less one if the conception month is larger than the birth month.[19]

We use a battery of birth outcomes: birth weight (in grams), low birth weight (1 if birth weight less than 2,500 grams), prematurity ($<$ 37 weeks), "normality" (absence of complications during the pregnancy or labor) and gender of the child. As pointed out recently by Currie and Rossin-Slater (2013), measured effects of stressful events on birth weight, low birth-weight and prematurity may be unstable across econometric specifications, and it is preferable to use additional indicators of newborn health, such as the probability of abnormal conditions of the newborn (here we use "normality"). In addition, and following Brown (2012), we also consider gender as a potential outcome of exposure to terrorism while in utero, since maternal stress may impact the sex ratio by reducing male births (Catalano et al., 2006; Sanders and Stoecker, 2015).

Our most naïve regressions include both mother's province of residence fixed effects (δ_p) and year-month

[18] Our analysis uses variation at the province level rather than the municipality level. While this may dilute the estimated effect –not everyone is equally affected within a province– it overcomes two main limitations of increasing the granularity of our analysis. First, and foremost, while there are more than 8,000 municipalities in Spain, in the Registry of Live Births municipality is only available for 754 municipalities (less than 10% of the municipalities). This implies a dramatic reduction in sample size: a drop of 1,386,456 of live births. Second, migration within provinces (across municipalities) is more important than migration across provinces (migration within provinces was 44% of total (internal) migration during 1981-1991, and 35% of total (internal) migration during 1991-2001, see Table 2 in Susino (2011, p.57)), which may contaminate our estimates if defining exposure at the municipality level. Estimates based on municipality are available upon request.

[19] 2 weeks are subtracted because conception usually occurs 2 weeks after the last normal menstrual period.

of *conception* fixed effects (γ_t), while our most complete regressions include a vector of control variables ($X_{i,p,t}$) –birth order (parity) categories, mother's age categories, mother's marital status indicator, mother's occupational categories, father's occupational categories (with one category if there is no father), indicator for delivery in a hospital or clinic, and size of the municipality of residence categories– and province-specific linear time (year-month of *conception*) trends. The vector of parameters of interest is $\boldsymbol{\beta} = (\beta_1, \beta_2, \beta_3)$, which measures the sensitivity of infant health to prenatal terrorist activity in each of the trimesters of pregnancy: each of these parameters can be thought of as capturing the "intent-to-exposure-to-terrorism" effect in each trimester of pregnancy. Standard errors are clustered at the province level (50 provinces).[20]

4 Effects on Birth Outcomes for Live Births

4.1 Main Regressions

Table 3 contains a series of regressions for five different birth outcomes –birth weight (in grams), low birth-weight, normal, male and premature (indicators)– on the number of bomb casualties in each trimester of pregnancy grouped into three different panels (A, B, C).[21] Starting with panel A, which includes mother's province of residence fixed effects and year-month of conception fixed effects, we can see that an additional bomb casualty in the first trimester of pregnancy (on average) decreases birth weight by around 0.7 grams, increases the expected number of low birth-weights by around 0.2 per 1,000 live births, decreases the predicted number of normal deliveries (without pregnancy or labor complications) by about 0.6 per 1,000 live births, and increases the number of premature babies by 0.9 per 1,000 live births.[22]

In panel B we include socio-demographic controls –mother's age categories, birth order categories, mother's occupational categories, father's occupational categories, mother's marital status indicator, medical center/hospital delivery indicator, and municipality size categories– and obtain similar results, both qualitatively and quantitatively. Finally, to soak up any province-specific time trends, panel C adds the interaction of mother's province of residence fixed effects with a time trend (year-month of conception). Admittedly, the introduction of province specific year-month time trends "kills" most of the variation, perhaps too much. Remarkably enough, however, the statistical significance of our estimates survive to this stringent adjustment (except for the effect on prematurity). All point estimates remain in the same ballpark, but the

[20] The provinces vary in population size, from 90,378 inhabitants in Soria to 5,478,405 inhabitants in Madrid, with an average (median) size of 817,970 (544,459) inhabitants and a standard deviation of 997,609 (residents of all ages, January 1st 2002, INE).

[21] Juarez (2015) shows that while low birth weight is similarly reported in hospital data (provided by medical personnel) and INE data (5.83% vs. 5.53%), small-for-gestational age –a better measure of intrauterine growth restriction– is overestimated by the INE (1.76% vs. 1.00%). On this grounds, it is better to use separate measures of birth weight and gestational length, in particular, low birth weight and prematurity. Results using small-for-gestational age are available upon request.

[22] Similar results are obtained if using *total* casualties rather than *bomb* casualties, or bomb casualties per attack. Results available upon request.

one concerning average birth weight, which gets reduced to almost one third of its original magnitude.

Table 3: Regressions of Birth Outcomes – 1980-2003

	BW (in grams)	LBW (per 1,000)	Normal (per 1,000)	Male (per 1,000)	Premature (per 1,000)
A. Year-Month FE & Province FE					
Bomb Casualties 1st trimester of pregnancy	−0.674***	0.187**	−0.631***	−0.138	0.976**
	(0.194)	(0.083)	(0.194)	(0.123)	(0.468)
Bomb Casualties 2nd trimester of pregnancy	−0.504	−0.118	−0.287	−0.379	0.311*
	(0.404)	(0.148)	(0.275)	(0.230)	(0.171)
Bomb Casualties 3rd trimester of pregnancy	−0.392	0.017	0.252	0.276	−0.029
	(0.484)	(0.105)	(0.454)	(0.212)	(0.266)
F-test $H_0 : \beta_1 = \beta_2 = \beta_3$	0.34	4.86**	3.43**	0.39	1.73
p-value	[0.714]	[0.012]	[0.040]	[0.680]	[0.187]
Number of live births	6,327,753	6,327,753	6,641,478	6,641,478	6,641,478
B. (A) & Socio-Demographic Controls					
Bomb Casualties 1st trimester of pregnancy	−0.725***	0.208**	−0.571***	−0.130	0.943**
	(0.198)	(0.088)	(0.187)	(0.126)	(0.457)
Bomb Casualties 2nd trimester of pregnancy	−0.489	−0.119	−0.173	−0.376	0.272
	(0.380)	(0.154)	(0.275)	(0.232)	(0.167)
Bomb Casualties 3rd trimester of pregnancy	−0.411	0.025	0.392	−0.274	−0.070
	(0.460)	(0.106)	(0.434)	(0.214)	(0.260)
F-test $H_0 : \beta_1 = \beta_2 = \beta_3$	0.45	5.22***	4.63**	0.39	1.89
p-value	[0.643]	[0.009]	[0.014]	[0.678]	[0.163]
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470
C. (B) & Province-Specific Linear Year-Month Trends					
Bomb Casualties 1st trimester of pregnancy	−0.278**	0.145**	−0.671***	−0.093	0.653
	(0.122)	(0.061)	(0.179)	(0.120)	(0.407)
Bomb Casualties 2nd trimester of pregnancy	−0.055	−0.179	−0.272***	−0.337	0.027
	(0.202)	(0.144)	(0.098)	(0.236)	(0.099)
Bomb Casualties 3rd trimester of pregnancy	0.148	−0.055	0.253	−0.228	−0.410*
	(0.250)	(0.078)	(0.174)	(0.212)	(0.215)
F-test $H_0 : \beta_1 = \beta_2 = \beta_3$	1.07	5.63***	5.43***	0.43	2.02
p-value	[0.352]	[0.006]	[0.007]	[0.654]	[0.144]
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470

Note: Live births *conceived* between January 1980 and February 2003.
Standard errors clustered at the province level (50 provinces).
$***p - value < 0.01$, $**p - value < 0.05$, $*p - value < 0.1$

The main takeaway of Table 3 is that in utero exposure to terrorism early in pregnancy (1st trimester) appears to have detrimental effects on birth outcomes. In terms of statistical significance, we reject that the coefficients are the same across trimesters for low birth weight and normality (as revealed by the F-statistics of the corresponding tests of equality of coefficients). In terms of magnitudes, according to our most conservative estimates, and assuming linearity, ten additional bomb casualties would decrease average birth weight by about 3 grams (around 0.006 standard deviations) and increase low birth weight by about 1.5 per 1,000 live births. If we break down the sample by gender, which does not seem to be affected by exposure to terrorism during pregnancy, we find similar effects for both boys and girls.[23]

Both the magnitudes of estimated effects and the fact that they are found for the first trimester of pregnancy are consistent with the estimates available in the literature linking in utero exposure to conflict or terrorism with birth outcomes (Camacho, 2008; Brown, 2012; Mansour and Rees, 2012).[24] A plausible biological explanation of our findings is that exposure to terrorism leads to the release of stress hormones, such as norepinephrine and cortisol, that impair fetal growth as a result of hypothalamic pituitary axis dysregulation, which is particularly detrimental during the first trimester (Schneider et al., 1999; den Bergh et al., 2005; Gluckman and Hanson, 2004).

We conclude with an important remark. The estimates in Table 3, such as the 0.278 grams per bomb casualty in the first trimester of pregnancy, refer to the effect of "exposure to terrorism" for the population of pregnant women (and their babies) as a *whole*, or the "intent-to-exposure-to-terrorism" effect. Given that a lot of (pregnant) women in any province were unlikely to be at risk of being affected by bombings, scaling up this "intent-to-exposure-to-terrorism" effect is likely to yield a substantial "exposure-to-terrorism-on-the-exposed" effect, the effect of exposure to terrorism on birth outcomes among those mothers (and their babies) actually exposed to terrorism.

4.2 Threats to our Identification Strategy

4.2.1 Confounding economic factors

One may be worried that our estimates of β_1, β_2, β_3 in equation (1) are biased by omitting measures of the economic situation (e.g., unemployment rates) in each of the trimesters of pregnancy, if bomb casualties are related to local economic conditions. In the US, Dehejia and Lleras-Muney (2004) find that babies conceived in times of high unemployment had a reduced incidence of low birth weight due to both selection and improvements in health behavior during recessions. More recently, Aparicio and González-Luna (2013) document that in Spain babies are born healthier when the local unemployment rate is high. To account for the potential bias due to omitted economic factors, in Table A1 (online appendix) we estimate the following regressions

[23]If anything, our results indicate stronger effects for girls. Results available upon request.

[24]The medical literature provides mixed evidence on the relative importance of early versus late pregnancy stress exposure (Schulte et al., 1990; de Weerth and Buitelaar, 2005; Hedegaard et al., 1993; Schneider et al., 1999).

$$Y_{i,p,t} = \alpha + \beta_1 Casualties^1_{p,t} + \beta_2 Casualties^2_{p,t} + \beta_3 Casualties^3_{p,t}$$
$$+ \pi_1 UR^1_{p,t} + \pi_2 UR^2_{p,t} + \pi_3 UR^3_{p,t} + \delta_p + \gamma_t + (\theta_p \times t) + \tau X_{i,p,t} + u_{i,p,t} \quad (2)$$

where $UR^T_{p,t}$ is the unemployment rate in trimester T of pregnancy in province p, from the *Encuesta de Población Activa*.[25] Two results stand out in this table. First, our estimates are (almost) identical to our main estimates (Table 3, panel C), suggesting that bomb casualties and unemployment rates (economic conditions) are essentially uncorrelated, at least after accounting for province, time and province-specific linear time trends. Second, babies exposed to high unemployment rates (in the first trimester of pregnancy) have better health outcomes at birth.

4.2.2 Missing conception length

Since conception length is not available for all live births (it is missing for 32% of live births), we cannot measure the timing of exposure to terrorism for all live births by counting forward from date of conception. Still, for all live births we can measure exposure by counting backward from date of birth. This is the approach researchers are forced to rely on when length of gestation is not available (e.g., Bozzoli and Quintana-Domeque, 2014; Mansour and Rees, 2012; Oliveira and Quintana-Domeque, 2016). When defining the timing of exposure in this imperfect, alternative manner, we estimate regressions of the form

$$Y_{i,p,t} = \widetilde{\alpha} + \widetilde{\beta}_{8-6} Casualties^{8-6}_{p,t} + \widetilde{\beta}_{5-3} Casualties^{5-3}_{p,t} + \widetilde{\beta}_{2-0} Casualties^{2-0}_{p,t}$$
$$+ \widetilde{\delta}_p + \widetilde{\gamma}_t + (\widetilde{\theta}_p \times t) + \widetilde{\tau} X_{i,p,t} + \epsilon_{i,p,t} \quad (3)$$

where $Y_{i,p,t}$ is the birth outcome corresponding to newborn i, whose mother's province of residence is p, *born* in the year-month t, $Casualties^{C-A}_{p,t}$ is the number of bomb casualties in C to A months *before* birth in province p, and $\epsilon_{i,p,t}$ is a random error term. Our most naïve regressions include both mother's province of residence fixed effects ($\widetilde{\delta}_p$) and year-month of *birth* fixed effects ($\widetilde{\gamma}_t$), while our most complete regressions include a vector of control variables ($X_{i,p,t}$) and province-specific linear time (year-month of *birth*) trends. The vector of parameters of interest now is $\widetilde{\boldsymbol{\beta}} = (\widetilde{\beta}_{8-6}, \widetilde{\beta}_{5-3}, \widetilde{\beta}_{2-0})$, which measures the sensitivity of infant health to prenatal terrorist activity in each of the "approximately measured" trimesters of pregnancy.

In Table A2 (online appendix) we estimate our most complete specification (i.e., with province-specific linear time trends), but using only information on the date of birth as a robustness check. The new point

[25] http://goo.gl/ZXKurf

estimates (panel II) are qualitatively very similar (panel I), which is quite reassuring given both the different methodologies (date of birth versus date of conception) and the sample size discrepancies (10 million versus 6 million). It seems that, if anything, using date of birth rather than conception date results in *attenuated* estimated effects of terrorism on birth outcomes. Indeed, if we re-estimate the regressions based on date of birth for the same sample using date of conception (panel III), we get essentially attenuated results.

4.2.3 Accounting for Cumulated Bomb Casualties until pregnancy

Our analysis so far has assumed that bomb casualties are relevant for birth outcomes *only* when happening during pregnancy. However, terrorism *before* pregnancy may have effects on birth outcomes. Controlling for the cumulated number of bomb casualties before pregnancy could either decrease or increase the estimated magnitudes of in utero exposure to terrorism on birth outcomes, depending on whether accounting for past terrorist activity makes bomb casualties in utero more expected (and presumably less stressful), or reinforces the in utero effects because of cumulative stress. In Table A3 (online appendix) we add the cumulated bomb casualties until pregnancy and show that, if anything, our previous findings underestimated the effects of in utero exposure to terrorism.

4.2.4 Placebo Test: Bomb casualties after birth

If terrorist attacks were unexpected, we should not find that terrorist attacks *after* birth affect birth outcomes. In Table A4 (online appendix) we add the number of bomb casualties in the first trimester *after* birth. The results in this table are virtually equal to our main estimates (Table 3, panel C), and, reassuringly, none of the point estimates on the placebo variables is statistically significant, except for prematurity at the 10 % level.[26] This refutability test supports our identification strategy.

4.2.5 Statistical Significance and Additional Placebos

Our large sample comes at a potential cost, finding statistically significant effects that are of little economic relevance. While we are clustering at the province level, a more conservative approach is to collapse our data at the month-year-province level while still clustering at the province level (Angrist and Pischke, 2009). Doing that we move from more than 6 million observations to 13,900 observations. As we can see in panel I of Table A5 (online appendix), the standard errors remain essentially unchanged, so that the statistical significance of our results survives this adjustment.

In panel II of Table A5 we perform an additional placebo test: *randomly* allocating the number of bomb

[26] Similar results are obtained if we replace the number of bomb casualties in the first trimester *after* birth with those in the first nine months after birth.

casualties across the 13,900 month-year-province cells. We perform 1,000 random reallocations and for each reallocation we estimate the marginal effects for each trimester of pregnancy of bomb casualties on each of the birth outcomes under analysis (based on the specification in panel I of Table 3). While the distribution for the estimated marginal effects for the 1st trimester are plotted together with the marginal effects of panel I of Table 3 in Figures A1, A2, A3, A4 and A5, the averages, standard errors and 95%-confidence intervals of these "simulated" marginal effects are displayed in panel II of Table A5. The bottom line of this simulation exercise is that we do *not* find effects of in utero exposure to terrorism when *randomly* allocating bombs.

4.2.6 Region-specific effects

One may be concerned that the effect of terrorism is region-specific.[27] In particular, one may wonder whether our estimates are driven by just one region –the Basque Country is the one with the highest level of terrorist activity– and its three provinces (Alava, Guipúzcoa, and Vizcaya), so that the other provinces do *not* play any role in our analysis. In panel I of Table A6 (online appendix) we can see that, excluding the Basque Country, we still obtain the same empirical results as in Table 3 (Panel C). By a similar token, we may inquire about what happens if we just focus on provinces with at least one bomb casualty, so that we exclude "safe" provinces. This amounts to excluding 35 out of 50 provinces. The point estimates reported in panel III of Table A6 are similar to the ones reported in panel C of Table 3.[28]

4.2.7 Accounting for indirect treatment effects

One key assumption behind our identification strategy is that mothers are only "sensitive" to bomb casualties in their area of residence. However, it may well be that not only terrorist activity in the mother's province of residence but in neighboring provinces is relevant for birth outcomes. To assess whether such effects are contaminating our previous estimates, we now proceed in two different ways. First, we include three additional variables that capture bomb casualties occurring "close" to the mother's province of residence: (i) in neighboring (adjacent) provinces and (ii) within 300 km (which is a bit more than half the distance –60%– between Barcelona and Madrid). In Table A7 (online appendix), panels I and II, we estimate regressions of the form

[27] We investigated heterogeneous effects along other dimensions. For example, depending on the husband's occupation: armed-forces vs. rest of occupations. The main conclusion of such analysis is that our previous findings are not driven by newborns from armed forces families. Results available upon request.

[28] p-values using wild cluster-bootstrap are available upon request.

$$
\begin{aligned}
Y_{i,p,t} = \alpha &+ \beta_1 Casualties^1_{p,t} + \beta_2 Casualties^2_{p,t} + \beta_3 Casualties^3_{p,t} \\
&+ \rho_1 \widetilde{Casualties}^1_{p,t} + \rho_2 \widetilde{Casualties}^2_{p,t} + \rho_3 \widetilde{Casualties}^3_{p,t} \\
&+ \delta_p + \gamma_t + (\theta_p \times t) + \tau X_{i,p,t} + u_{i,p,t}
\end{aligned} \tag{4}
$$

where $\widetilde{Casualties}^T_{p,t}$ is the number of bomb casualties in trimester T of pregnancy close to province p (adjacent provinces in panel I, within 300 km in panel II). Second, we allow *pregnant women whose province is not affected by bomb casualties* to be exposed to bomb casualties in the *closest province* affected by bomb casualties, in panel III, estimating regressions of the form

$$
\begin{aligned}
Y_{i,p,t} = \alpha + \beta_1 Casualties^1_{j,t} \times \exp\left(-\frac{distance_j}{100}\right) &+ \beta_2 Casualties^2_{j,t} \times \exp\left(-\frac{distance_j}{100}\right) \\
&+ \beta_3 Casualties^3_{j,t} \times \exp\left(-\frac{distance_j}{100}\right) \\
&+ \delta_p + \gamma_t + (\theta_p \times t) + \tau X_{i,p,t} + u_{i,p,t}
\end{aligned} \tag{5}
$$

where $distance_j$ is either 0 (if the number of bomb casualties in the mother's province of residence p is positive) or the distance (in km) between the mother's province of residence p and the closest province with a positive number of bomb casualties j, and $Casualties_j$ refer to either the number of bomb casualties in the mother's province of residence p or those in the closest province j. The negative exponential form of the impact of distance to bomb casualties on birth outcomes is chosen because stressful responses are likely to *decay* with physical distance from the site of the attack.[29]

The results in the table show that after accounting for potential "indirect treatment effects" we obtain similar qualitative results, supporting our assumption on the mother's province of residence being the relevant "catchment" area. While everyone is aware of terrorism through "national" news (e.g., the correlation between the fraction of news on ETA terrorism published in *El Mundo* and bomb casualties is 0.4139, using the available data from January 1996 to February 2003), exposure to the news of bomb casualties through friends, neighbors and coworkers is likely to considerably raise the fear of terrorism (as is the case for news

[29] Schuster et al. (2001) show that the fraction of adults reporting substantial stress 3-5 days after September 11 was 61% among those within 100 miles from the World Trade Center (WTC), 48% among those within 101-1000 miles from the WTC, and 36% among those more than 1,000 miles from the WTC. Consistent with these findings, Schlenger et al. (2002) conclude that the major burden of probable post-traumatic stress disorder in the second month following September 11 terrorist attacks among adults was closely related to direct exposure to the events and that the prevalence on the NYC metropolitan area was much higher than elsewhere in the US. In addition, they document that the overall level of clinically significant psychological distress in the second month following the attacks, was within normal limits for the country as a whole. Focusing on a much smaller scale and probably less threatening and terrifying attack, the Oklahoma bombing (with nearly 170 deaths), Smith et al. (1999) find that 3 to 4 months after the attack, 43% of individuals living in Oklahoma City reported 4 or more stress symptoms compared with 11% of individuals living in Indianapolis.

on crime and violence, Skogan and Maxfield, 1981).

4.2.8 Non-linear effects

Finally, equation (1) assumes that the effect of bomb casualties on birth outcomes is linear. While this could be a reasonable approximation to the true functional form between birth outcomes and bomb casualties, we relax this functional form assumption and explore the effects of terrorism by intensity in Table A8 (online appendix). We replace our count bomb casualties' variables with variables taking value 1 if the number of bomb casualties in the trimester is equal or higher than 10 (and 0 otherwise) in panel I, with variables taking value 1 if the number of bomb casualties in the trimester is equal or higher than 5 (and 0 otherwise) in panel II, and with variables taking value 1 if the number of bomb casualties in the trimester is equal or higher than 1 (and 0 otherwise) in panel III.

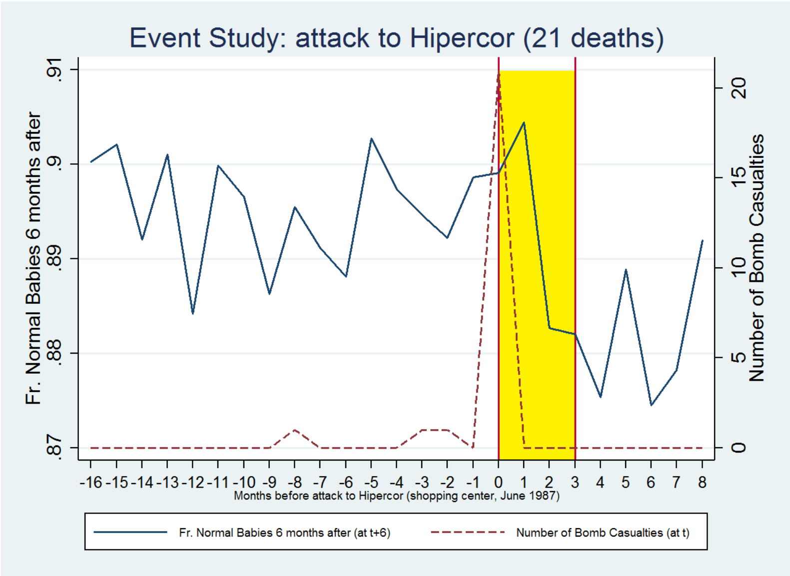
The results reveal that babies exposed in the first trimester of pregnancy to 10 casualties or more are on average (almost) 10 grams lighter. Similarly, the number of babies that are low birth-weight increases by (almost) 7 per 1,000 live births when exposed to 10 casualties or more during the first trimester of pregnancy. Looking at the rest of the panels, we can see that our main results seem to be driven by exposure to a "large" number of bomb casualties (at least 5).

5 An Event Study: The Hipercor Bombing of 1987

While our main results are robust to a host of potential threats to validity, we have shown that they are likely to be driven by province-month-year cells with relatively high number of bomb casualties (at least 5). In this section we focus our attention to the most devastating ETA terrorist attack: the Hipercor bombing of 1987. This terrorist attack occurred on 19 June 1987 in the Hipercor shopping centre on Avinguda Meridiana, Barcelona, Spain. The bombing (a car bomb attack) killed 21 people and injured 45, representing the deadliest attack in ETA's history.

The evolution of child normality before and after Hipercor in Barcelona. Figure 8 displays the evolution of the number of bomb casualties in Barcelona (province) from 16 months before the Hipercor bombing until 8 months after together with the evolution of the fraction of normal babies in Barcelona (province) from 10 months before the Hipercor boming until 14 months after. One pattern stands out in this figure: The drop in the fraction of normal babies among those exposed to the Hipercor bombing in the first trimester of pregnancy, the time window painted in yellow.

Figure 4: Normal newborns and bomb casualties in Barcelona around the Hipercor bombing



Difference-in-Difference. We now implement a difference-in-difference strategy by estimating the following regression

$$\begin{aligned} Y_{i,p,t} = \alpha + \beta BCN_{i,p} + \gamma_1 TRIM^1_{i,t} + \gamma_2 TRIM^2_{i,t} + \gamma_3 TRIM^3_{i,t} + \\ + \delta_1 TRIM^1_{i,t} \times BCN_{i,p} + \delta_2 TRIM^2_{i,t} \times BCN_{i,p} + \delta_3 TRIM^3_{i,t} \times BCN_{i,p} + \tau X_{i,p,t} + u_{i,p,t} \end{aligned} \quad (6)$$

where $Y_{i,p,t}$ is the birth outcome corresponding to newborn i, whose mother's province of residence is p, conceived in the year-month t; $BCN_{i,p} = 1$ if the mother's residence p of newborn i is Barcelona *province*, and 0 if the mother's residence p of newborn i is *not* Barcelona province; $TRIM^j_{i,t} = 1$ if newborn i was in her j trimester of pregnancy at time t, and 0 otherwise; $X_{i,p,t}$ is a vector of control variables: birth order (parity) categories, mother's age categories, mother's marital status indicator, mother's occupational categories, father's occupational categories (with one category if there is no father), indicator for delivery in a hospital or clinic, and size of the municipality of residence categories. δ_j is the (adjusted) difference-in-difference estimand. Standard errors are clustered at the province level.

We focus on newborns conceived in October-December 1985, January-March 1986, April-June 1986, October-December 1986, January-March 1987 and April-June 1987. Babies conceived in October-December 1986 were (intended to be) exposed to the Hipercor bombing of 19 June 1987 in their *third* trimester of pregnancy; babies conceived in January-March 1986 were (intended to be) exposed to the Hipercor bombing of 19 June 1987 in their *second* trimester of pregnancy; finally, babies conceived in April-June 1987 were (intended to be) exposed to the Hipercor bombing of 19 June 1987 in their *first* trimester of pregnancy.

Table 4: Regressions of Birth Outcomes - The Hipercor Bombing of 1987

	BW (in grams)	LBW (per 1,000)	Normal (per 1,000)	Male (per 1,000)	Premature (per 1,000)
A. Without Socio-Demographic Controls					
$TRIM^1 \times BCN$	−6.240	10.478***	−27.811***	−5.252**	7.606*
	(4.440)	(2.171)	(2.972)	(2.410)	(4.059)
$TRIM^2 \times BCN$	−9.082*	3.913**	−9.976***	1.615	6.536
	(4.663)	(1.818)	(2.417)	(3.343)	(3.975)
$TRIM^3 \times BCN$	−1.754	4.128**	2.887	2.858	1.245
	(3.733)	(1.768)	(1.835)	(2.923)	(3.590)
Observations	404,857	404,857	429,601	429,601	429,601
B. With Socio-Demographic Controls					
$TRIM^1 \times BCN$	−11.548**	11.634***	−29.859***	−5.283**	8.079**
	(4.713)	(2.226)	(2.578)	(2.395)	(3.906)
$TRIM^2 \times BCN$	−13.449***	4.927**	−11.621***	1.550	6.869*
	(4.844)	(1.873)	(2.446)	(3.310)	(3.848)
$TRIM^3 \times BCN$	−6.629	4.878**	0.952	2.840	1.573
	(4.235)	(1.837)	(1.583)	(2.877)	(3.497)
Observations	404,857	404,857	429,601	429,601	429,601

Note: Newborns conceived in October-December 1985, January-March 1986, April-June 1986, October-December 1986, January-March 1987 and April-June 1987.
Standard errors clustered at the province level (50 provinces).
$***p - value < 0.01$, $**p - value < 0.05$, $*p - value < 0.1$

The difference-in-difference estimates in Table 4 indicate that in utero (intended) exposure to the Hipercor bombing of 1987 was detrimental for birth outcomes. We find very strong effects for the first trimester of pregnancy on the probability of being low birth weight (11.6 per 1,000 live births) and on the normality indicator (−30 per 1,000 live births). In addition, we find a reduction in the likelihood of the newborn being a male of about 5 per 1,000 live births, which is consistent with very stressful events being particularly detrimental for boys. We also find negative effects on birth weight (about 12 grams) and positive effects on prematurity (about 8 per 1,000 live births), which are also found for the second trimester of pregnancy. The fact that (intended) exposure to the Hipercor bombing of 1987 was especially detrimental for *both* low birth weight and prematurity *early* in pregnancy and on the *sex ratio* (for the first trimester of pregnancy) reinforces the interpretation of ETA terrorist attacks acting as maternal stressors.

6 Assessing Mechanisms

The effects unveiled so far could be (partially or totally) mediated, compensated or reinforced through selection effects due to behavioral responses, biological responses, or a combination of both. In this section, we try to answer the following questions:

1. Does exposure to terrorism increase stress?
2. Does exposure to terrorism increase smoking?
3. Does exposure to terrorism during conception affect fertility?
4. Does exposure to terrorism during conception affect the type of women who conceive?
5. Does exposure to terrorism affect fetal mortality?
6. Does exposure to terrorism affect migration patterns?

6.1 Terrorism, Health, Stress and Smoking

Stress during pregnancy could have negative effects on the fetus through neuroendocrine changes, changes in immune function, and/or through behavioral channels (Dunkel-Schetter, 2011). While there is some evidence linking mental distress to terrorism exposure (e.g., Dustmann and Fasani, 2016), we lack the required information to measure the relationship between mental distress and exposure to ETA terrorism. Mental distress is typically measured using the 12-item General Health Questionnaire (Goldberg, 1978), however, the Spanish National Health Survey did not start collecting such information until 2006. Still, we can investigate the association between self-reported health status in the last 12 months and exposure to terrorism in the last 12 months.

Table 5 shows that, for women, one bomb casualty in the last 12 months is associated with an increase in the probability of reporting bad or very bad health of 0.002 points, which represents 6% of the prevalence of bad/very bad health (3.6%). For men, no statistically significant relationship is found. These results are consistent with *stress* suppressing the immune system, thereby making pregnant mothers more susceptible to sickness; this can cause high blood pressure, which increases the chance of having pre-term labor or a low birth weight infant.

Table 5: Regressions of Health and Smoking

	Bad Health Status		Smoking Status	
	Women	Men	Women	Men
Bomb casualties in the last 12 months	0.0022*	0.0005	0.0076*	0.0011
	(0.0011)	(0.0012)	(0.0045)	(0.0047)
Unemployment rate in the last 12 months	−0.0005	−0.0001	0.0042*	0.0005
	(0.0008)	(0.0008)	(0.0022)	(0.0026)
Mean	0.036	0.029	0.40	0.52
Observations	16,192	16,437	16,139	16,386

Note: Individuals age 16-49. ENSE: 1993, 1995, 1997, 2001.

Bad health status equals 1 if health status is reported to be bad or very bad.

Smoking status equals 1 if daily smoker or occasional smoker.

Regressions include year and province fixed effects.

Standard errors clustered at the province level (50 provinces).

***$p - value < 0.01$, **$p - value < 0.05$, *$p - value < 0.1$

Table A9 (online appendix) shows that the correlation between self-reported health status and *different* measures of stress is quite substantial and (remarkably) stable in 2006 and 2011, the pre-crisis (2006) and post-crisis (2011) years in Spain. Hence, we see the findings in Table 5 together with the correlations reported in Table A9 as suggestive evidence for the existence of a *first-stage*, by which exposure to terrorism increases (maternal) stress.

An additional mechanism through which stress could affect a developing fetus is through behavioral responses, such as smoking cigarettes, which can also have adverse effects on the health of the fetus. For example, Lien and Evans (2005), find that maternal smoking reduces mean birth weight by 182 grams using an instrumental variables approach. Unfortunately, in our administrative data on birth outcomes and their mothers, we do not have information on maternal behaviors, so we cannot observe how exposure to bomb casualties affects maternal inputs such as smoking. However, we can investigate the relationship between smoking and exposure to terrorism using data from the Spanish National Health Survey.

In Table 5 we can see that exposure to terrorism is positively associated with being a smoker for women of childbearing age. This positive relationship between smoking and bomb casualties is consistent with terrorism triggering a stressful response. For men, as in the case of health status, no relationship is found between smoking and exposure to terrorism. Indeed, all these findings are consistent with exposure to terrorism increasing stress for women, but not for men.

6.2 Terrorism, Fertility and Mother Characteristics

Exposure to terrorism may affect fertility (Berrebi and Ostwald, 2015). On the one hand, if bombings affect people's perception of staying in public places, terrorism may induce individuals (and couples) to stay at home. If that is the case, couples are also more likely to engage in procreation activities, increasing fertility. On the other hand, terrorism could make people to postpone fertility, or the same stress generated by terrorism may decrease the probability of conception (Lynch et al., 2014), reducing fertility in both cases. In Table 6, column (1), we investigate the effect of bomb casualties in the three months before the first trimester of pregnancy ("conception period") on the number of (log) live births. We find no effect of exposure to terrorism on fertility.

Table 6: Regressions of Log Live Births and Mothers' Characteristics

	Fertility	**Mothers' Characteristics**	
	Log Live births	Married (per 1,000)	Age
Bomb casualties trimester of conception[b]	0.007	0.599***	0.007*
	(0.005)	(0.158)	(0.004)
Unemployment rate trimester of conception[b]	0.009	0.660	−0.003
	(0.007)	(0.722)	(0.006)
Observations (month-year-province cells)	13,900	13,900	13,900

Note: Regressions include month-year fixed effects, province fixed effects and province-specific linear year-month trends.

[b] trimester of conception is defined as the trimester before the 1st trimester of pregnancy.

Standard errors clustered at the province level (50 provinces).

$***p-value < 0.01$, $**p-value < 0.05$, $*p-value < 0.1$

In columns (2) and (3) we investigate whether the characteristics of women who conceived during bombings differ from those of their counterparts. Interestingly, these columns reveal compositional changes of women conceiving during terrorist attacks. In terms of marital status, it seems that women conceiving during bombing periods are more likely to be married. A bomb casualty during conception time increases the probability that women who are conceiving are married by 0.599 (per 1,000 births). Since being married is positively associated with birth outcomes,[30] this would suggest that terrorism induces "positive" selection. Regarding mother's age, we observe that a bomb casualty during conception time increases the age of

[30]Babies of married women are (on average) 44 grams heavier (which is the coefficient on being married (not reported) in panel C of Table 3).

conceiving women by 0.008 years. This is a tiny effect, but again, given the average mother's age, and that the relationship between birth weight and age is non-monotonic (with a minimum of −47 grams for women aged 16-19 and a peak of 18 grams at 30-34, with respect to women aged 45-49),[31] this would suggest that, on average, if there is selective fertility, this will tend to be positive. In other words, selection into "treatment" (based on unobservable factors related to being married and age) would bias us *against* finding adverse effects of in utero exposure to terrorism on birth outcomes.

6.3 Terrorism and Fetal Deaths

Exposure to terrorism may increase fetal deaths.[32] This is because many of the bio-active mediators of maternal stress contribute to the pathophysiology of stillbirth (Silver and Ruiz, 2013). Table 7 shows that exposure to bomb casualties in the 1st and 3rd trimester of pregnancy increase fetal deaths. While the interpretation of the coefficient on the 1st trimester of pregnancy can be explained along the lines of miscarriages (social stress during early pregnancy tends to result in pregnancy loss, Brunton (2013)), the interpretation regarding the 3rd trimester is not straightforward, for one thing, many stillbirths occur during the 3rd trimester. Perhaps, the main message of this table is that our estimated effects of terrorism on birth outcomes for live births are likely to be lower bounds of the "true" effects, if fetal mortality generates positive selection of fetuses into live births, such as the weakest are culled (Bozzoli, Deaton, and Quintana-Domeque, 2009).

[31] Coefficients on age categories (not reported) in panel C of Table 3.

[32] Fetal Deaths Microdata available at `http://goo.gl/JZElBY`. Abortions (either spontaneous or voluntary pregnancy interruptions, which were legalized on July 1985) could be affected by terrorism. Although there is yearly data on abortions (available from 1987) at the province level, its quality is debatable. Estimated effects of bomb casualties in a province on abortions one year later are available upon request.

Table 7: Regressions of Log Still Births

	Log Still Births
Bomb casualties 1st trimester of pregnancy	0.019*
	(0.010)
Bomb casualties 2nd trimester of pregnancy	0.018
	(0.012)
Bomb casualties 3rd trimester of pregnancy	0.019**
	(0.009)
Unemployment rate 1st trimester of pregnancy	0.003
	(0.004)
Unemployment rate 2nd trimester of pregnancy	−0.013***
	(0.004)
Unemployment rate 3rd trimester of pregnancy	−0.004
	(0.009)
Observations (month-year-province cells)	13,900

Note: Regressions include month-year fixed effects, province fixed effects
and province-specific linear year-month trends.
Log still births has been redefined as log(still births + 1).
[b] trimester of conception is defined as the trimester before the 1st trimester of pregnancy.
Standard errors clustered at the province level (50 provinces).
***$p - value < 0.01$, **$p - value < 0.05$, *$p - value < 0.1$

6.4 Terrorism and Migration

Finally, terrorist activity may well be an important determinant of migration decisions. Abadie and Gardeazabal (2003), using the synthetic-control method approach, show how terrorism in the Basque Country transformed the patterns of population growth from positive to negative. Whether this is relevant or not for other Spanish regions can be explored using population (counts) data.[33] Admittedly, our analysis is limited in scope, if anything because we only have information on population counts at the province and year level, so that monthly variation does not play any role in our estimations.

[33]Population data obtained from *Estimaciones Intercensales de Población* (INE).

Table 8: Regressions of Log Population Size

	Log Female population 25-54 year t province p	Log Male population 25-54 year t province p
Bomb casualties year $t-1$ province p	0.001	0.002
	(0.001)	(0.002)
Unemployment rate year $t-1$ province p	-0.007***	-0.007***
	(0.001)	(0.001)
Observations (year-province cells)	1,150	1,150

Note: Regressions include year and province fixed effects.

Standard errors clustered at the province level (50 provinces).

$^{***}p-value<0.01$, $^{**}p-value<0.05$, $^{*}p-value<0.1$

Table 8 displays the results of our migration analysis: while we do not find that bomb casualties in the previous year at the province level explain the current (log) of inhabitants aged 25-54, the unemployment rate in the previous year is negatively related with the (log) population size. These correlations are consistent with terrorism playing an irrelevant role in explaining *inter-province* migration decisions, while provincial economic conditions being important driving forces behind migration patterns.[34] While this is reassuring for our estimates, we must acknowledge that our test has little power since it is based on population counts in provinces.[35]

7 Discussion

Are the previous estimated effects relevant for long-term outcomes? This is a question of paramount importance, since its answer sheds light on how early-life health disparities may perpetuate economic inequality in adulthood (Currie, 2011; Aizer and Currie, 2014). As recently emphasized by Persson and Rossin-Slater (2015), in utero exposure to maternal stress is one possible causal factor at a critical stage of human development for both short and long-term outcomes. Unfortunately, the study of long-term outcomes in the present case is limited by two main issues, namely, data limitations, and post-natal differences.

With regard to data limitations, while one could in principle use the Spanish Census 2011, which is the main source of information that we can use to investigate a limited number of long-term outcomes (mainly, educational attainment and employment status), the Census only contains information on the

[34]This does not clash with the possibility that terrorism is relevant in explaining *intra-province* migration decisions, that is, migration across municipalities.

[35]The concern is not that all (or many) women would leave a province but that women who are pregnant (or likely to get pregnant) and fear the bombings would selectively migrate when they are pregnant (possibly with their partners) and possibly return after birth. These more subtle but important behavioral responses are unlikely to be captured in the test we provide.

individual region of birth, not on her mother's region of residence (during pregnancy), and it does not contain information on individual's gestational length. Hence, we would inevitably introduce measurement error at both the region and timing of exposure.

With regard to post-natal differences, the main problem when analyzing long-term effects is that moving away from birth will lead to additional confounding processes, as outcomes could be due to the primary birth effect, or due to changes in the environment of the child's early years. In particular, long-term estimated effects can arise from post-natal differences that were induced by the terrorist shock that occurred during pregnancy, rather than by the difference in the uterine environment. Moreover, if we were to estimate the long-term outcomes of exposure to the Hipercor bombing of 1987 in Barcelona (with 21 casualties), which had substantial effects on birth outcomes, the resulting estimates would be contaminated by the positive effects of the Barcelona Olympic Games of 1992, which represented a total transformation of Barcelona (Brunet, 2005). The results of such an analysis are available from the authors upon request, but they seem to capture the *positive* effects of Barcelona 1992.[36]

While previous studies on in utero exposure to terrorism have not investigated the long-term consequences for children, more recently, Persson and Rossin-Slater (2015) and Black, Devereux and Salvanes (2016) have estimated the impact of the deaths of maternal parents during pregnancy on long-term outcomes. Interestingly, none of these studies finds effects on earnings in adulthood (or even educational attainment in the case of Black, Devereux and Salvanes, 2016). However, Persson and Rossin-Slater (2015) find that exposure to the death of a maternal relative increases take-up of anti-anxiety and depression medication during adulthood. Whether the effects of in utero exposure to terrorism on long-term outcomes are relevant is an open question.

Persson and Rossin-Slater (2015) document a reduction in average birth weight of around 11 grams in Sweden, while Black, Devereux and Salvanes (2016) find a reduction of around 22 grams in Norway. One of the main advantages of these studies is that exposure to the stressful event is *accurate*: they can identify whether a mother is exposed to a death of a maternal relative during pregnancy. Unfortunately, exposure to terrorism (or bomb casualties) is a different matter. We do not really know who is "exposed". Still, we have found that 12 bomb casualties in the last 12 months in the province of residence of an individual increases her probability of reporting bad/very bad health by 0.0264 points (12×0.0022). If we take 0.0264 as the fraction of *pregnant* women affected by terrorism, and combine it with the in utero exposure to 12 bomb casualties in 12 months, which decreases average birth weight by 1.112 grams (4×0.278), then an

[36] Here we are mentioning the Hipercor bombing of 1987 because is the deadliest ETA terrorist attack, however, the same critique applies to the analysis of long-term outcomes of other attacks pre-1992, which are precisely those that allow us to have enough time elapsed since in utero exposure to terrorism to investigate long-term outcomes. In 2011, those born in 1992 were 19 year old.

estimate of the "treatment-on-the-treated" –the effect of "being exposed to terrorism" for the babies of mothers affected by terrorism– can be obtained as the ratio of these two estimates: $\frac{1.112}{0.0264} = 42.12$ grams. This is almost four times the estimate in Sweden and almost twice that in Norway. Hence, if one is willing to assume that the long-term outcome response is proportional to the impact on birth weight,[37] according to our back-of-the-envelope calculation, we would expect the effects on long-term outcomes to be more important (not less) for in utero exposure to terrorism than for in utero exposure to the death of a maternal relative.

8 Conclusion

We estimate the effects of in utero exposure to a sustained terrorist conflict on human capital at birth, finding detrimental effects on birth outcomes: in terms of average birth weight (lower), prevalence of low birth weight (higher) and fraction of normal babies (lower). While our results are robust to a host of potential threats to validity, we show that they are likely to be driven by province-month-year cells with relatively high number of bomb casualties (at least 5). Focusing on the Hipercor bombing of 1987 in Barcelona, the deadliest attack in ETA's history, we show that in utero exposure to this terrorist attack had a negative impact on birth outcomes.

We present some evidence suggesting that exposure to bomb casualties may increase stress and smoking among women, but not among men. Exposure to terrorism during conception does not affect total fertility, but there seems to be a compositional change: during bombing periods, those women who conceive are more likely to be married, and married women tend to have better birth outcomes, on average. We also find that exposure to bomb casualties increases fetal deaths, which is consistent with the fact that many of the bio-active mediators of maternal stress contribute to the pathophysiology of stillbirth. Hence, given the positive selective fertility and the increase in fetal deaths, we believe our estimates of exposure to terrorism during pregnancy on birth outcomes are likely to be *downward* biased.

Unfortunately, our setting is not the ideal one to measure long-term effects of exposure to terrorism, if only because the deadliest ETA attack –which is more likely to have long lasting effects– is the one that happened in Barcelona 1987. However, babies born in 1987 were exposed to the positive transformation that Barcelona experienced with the Olympic Games in 1992. Any attempt to measure the long-term effects of exposure to such terrorist attack is likely to be (positively) contaminated by the effects of the Games. Whether in utero exposure to terrorism has long-term effects is an important question for future research.

[37]However, Almond et al. (2005) highlight that the previous studies' findings of significant impacts of birth weight on later adult outcomes may be driven more by an interaction between postnatal investments and initial birth weight than by the effects of birth weight (or prenatal investments) per se.

References

Abadie, A. and J. Gardeazabal (2003): "The Economic Costs of Conflict: A Case Study of the Basque Country," *American Economic Review*, 93, 113–132.

Aizer, A. and J. Currie (2014): "The Intergenerational Transmission of Inequality: Maternal Disadvantage and Health at Birth," *Science*, 344, 856–861.

Aizer, A., L. Stroud, and S. Bucks (2012): "Maternal Stress and Child Outcomes: Evidence from Siblings," *NBER Working Paper No 18422*.

Almond, D., K. Chay, and D. Lee (2005): "The Costs of Low Birth Weight," *Quarterly Journal of Economics*, 120, 1031–1083.

Almond, D. and J. Currie (2011): *Human Capital Development before Age Five*, Elsevier, vol. 4 of *Handbook of Labor Economics*, chap. 15, 1315–1486.

Angrist, J. D. and J.-S. Pischke (2009): "Mostly Harmless Econometrics: An Empiricist's Companion," *Princeton University Press*.

Aparicio, A. and L. Gonzalez-Luna (2013): "Recessions and Babies' Health," *Working Paper, Universitat Pompeu Fabra*.

Austin, M. and L. Leader (2000): "Maternal stress and obstetric and infant outcomes: Epidemiological findings and neuroendocrine mechanisms," *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 40, 331–337.

Becker, G. and Y. Rubinstein (2011): "Fear and the Response to Terrorism: An Economic Analysis," *University of Chicago, mimeo*.

Behrman, J. and M. Rosenzweig (2004): "Returns to Birthweight," *Review of Economics and Statistics*, 86, 586–601.

Berkowitz, G., M. Wolff, T. Janevic, I. Holzman, R. Yehuda, and P. Landrigan (2003): "The World Trade Center Disaster and Intrauterine Growth Restriction," *Journal of the American Medical Association*, 290, 595–596.

Berrebi, C. and J. Ostwald (2015): "Terrorism and fertility: evidence for a causal influence of terrorism on fertility," *Oxford Economic Papers*, 67, 63–82.

Beydoun, H. and A. Saftlas (2008): "Physical and Mental Health Outcomes of Prenatal Maternal Stress in Human and Animal Studies: A Review of Recent Evidence," *Paediatric and Perinatal Epidemiology*, 22, 438–466.

Bhalotra, S. and D. Clarke (2014): "The Twins Instrument and Family Size," *University of Essex, mimeo.*

Black, S., P. Devereux, and K. Salvanes (2007): "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes," *Quarterly Journal of Economics*, 122, 409–439.

——— (2016): "Does Grief Transfer across Generations? Bereavements during Pregnancy and Child Outcomes," *American Economic Journal: Applied Economics*, 8, 193–223.

Bozzoli, C., A. Deaton, and C. Quintana-Domeque (2009): "Adult height and childhood disease," *Demography*, 46, 647–669.

Bozzoli, C. and C. Quintana-Domeque (2014): "The Weight of the Crisis: Evidence from Newborns in Argentina," *Review of Economics and Statistics*, 96, 550–562.

Bram, J., J. Orr, and C. Rapaport (2002): "Measuring the Effect of the September 11 Attack on New York City," *Federal Reserve Bank of New York Economic Policy Review*, 8, 5–20.

Brown, R. (2012): "The Intergenerational Impact of Terror: Does the 9/11 Tragedy Reverberate into the Outcomes of the Next Generation," *Duke University, mimeo.*

Brunet, F. (2005): "The economic impact of the Barcelona Olympic Games, 1986-2004 Barcelona: the legacy of the Games 1992-2002," *Working Paper, Universitat Autònoma de Barcelona.*

Brunton, P. (2013): "Effects of maternal exposure to social stress during pregnancy: consequences for mother and offspring," *Reproduction*, 146, R175–R189.

Camacho, A. (2008): "Stress and Birth Weight: Evidence from Terrorist Attacks," *American Economic Review, Papers & Proceedings*, 98, 511–15.

Catalano, R., T. Bruckner, A. Marks, and B. Eskenazi (2006): "Exogenous Shocks to the Human Sex Ratio: the Case of September 11, 2001 in New York City," *Human Reproduction*, 21, 3127–3131.

CIS (2013): "Barómetro de la Percepción de los Principales Problemas de España," Available at http://www.cis.es. Accessed 13/02/2014.

Currie, J. (2011): "Inequality at Birth: Some Causes and Consequences," *American Economic Review*, 101, 1–22.

Currie, J. and M. Rossin-Slater (2013): "Weathering the storm: Hurricanes and birth outcomes," *Journal of Health Economics*, 32, 487–503.

Currie, J. and H. Schwandt (2015): "The 9/11 Dust Cloud and Pregnancy Outcomes: A Reconsideration," *Journal of Human Resources*.

de la Calle, L. and I. Sánchez-Cuenca (2006): "The Production of Terrorist Violence: Analyzing Target Selection Within the IRA and ETA," *Working Paper. Instituto Juan March.*

de Oliveira, V. H. and C. Quintana-Domeque (2016): "Natural disasters and early human development: Hurricane Catarina and birth outcomes in Brazil," *University of Oxford, mimeo.*

de Weerth, C. and J. Buitelaar (2005): "Physiological Stress Recreativity in Human Pregnancy. A Review," *Neuroscience and Behavioral Reviews*, 29, 295–312.

Dehejia, R. and A. Lleras-Muney (2004): "Booms, Busts, and Babies' Health," *The Quarterly Journal of Economics*, 119, 1091–1130.

den Bergh, B. V., E. Mulder, M. Mennes, and V. Glover (2005): "Antenatal maternal anxiety and stress and the neurobehavioural development of the fetus and child: links and possible mechanisms. A review." *Neuroscience and Biobehavioral Reviews*, 29, 237–258.

Dunkel-Schetter, C. (2011): "Psychological science on pregnancy: Stress processes, biopsychosocial models, and emerging research issues," *Annual Review of Psychology*, 62, 531–558.

Dustmann, C. and F. Fasani (2016): "The Effect of Local Area Crime on Mental Health," *Economic Journal.*

Eskenazi, B., A. Marks, R. Catalano, T. Bruckner, and P. Toniolo (2007): "Low birthweight in New York city and upstate New York following the events of September 11th," *Human Reproduction*, 22, 3013–3020.

Gluckman, P. and M. Hanson (2004): "The Fetal Matrix: Evolution, Development and Disease," *Cambridge University Press.*

Goldberg, D. (1978): "Manual of the General Health Questionnaire," *Windsor, England: NFER Publishing.*

Heckman, J. (2007): "The economics, technology, and neuroscience of human capability formation," *PNAS*, 104, 13250–13255.

Hedegaard, M., T. Henriksen, S. Sabore, and N. Secher (1993): "Physiological Distress in Pregnancy and Preterm Delivery," *British Medical Journal*, 307, 234–239.

Hobel, C. and J. Culhane (2003): "Role of psychosocial and nutritional stress on poor pregnancy outcome," *Journal of Nutrition*, 133, 1709S–1717S.

Juárez, S. (2015): "Calidad de los datos del Instituto Nacional de Estadística para la elaboración de los indicadores de salud perinatal: pequeño y grande para su edad gestacional," *Revista Española de Salud Pública*, 89, 85–91.

Juárez, S., T. Alonso-Ortíz, D. R.-F. nas, and F. Bolúmar (2012): "The quality of vital statistics for studying perinatal health: the Spanish case," *Paediatric and Perinatal Epidemiology*, 26, 310–315.

Koppensteiner, M. F. and M. Manacorda (2016): "Violence and birth outcomes: Evidence from homicides in Brazil," *Journal of Development Economics*, 119, 16–33.

Krueger, A. (2007): *What Makes a Terrorist. Economics and the Roots of Terrorism*, Princeton University Press.

LaFree, G., L. Dugan, M. Xie, and P. Singh (2012): "Spatial and Temporal Patterns of Terrorist Attacks by ETA 1970 to 2007," *Journal of Quantitative Criminology*, 28, 7–29.

Landrigan, P. (2001): "Health Consequences of the 11 September 2001 Attacks," *Environmental Health Perspectives*, 109, A514–15.

Lauderdale, D. (2006): "Birth outcomes for Arabic-named women in California before and after September 11," *Demography*, 43, 185–201.

Lederman, S., V. Rauh, L. Weiss, J. Stein, H. L, M. Becker, and F. Perera (2004): "The effects of the World Trade Center event on birth outcomes among term deliveries at three lower Manhattan hospitals," *Environmental Health Perspectives*, 112, 1772–1778.

Lien, D. and W. Evans (2005): "Estimating the Impact of Large Cigarette Tax Hikes: The Case of Maternal Smoking and Infant Birth Weight," *Journal of Human Resources*, 40, 373–392.

Lynch, C., R. Sundaram, J. Maisog, A. Sweeney, and G. B. Louis (2014): "Preconception stress increases the risk of infertility: results from a couple-based prospective cohort study–the LIFE study," *Human Reproduction*, 29, 1067–75.

Mansour, H. and D. I. Rees (2012): "Armed conflict and birth weight: Evidence from the al-Aqsa Intifada," *Journal of Development Economics*, 99, 190–199.

McCormick, M. C. (1985): "The Contribution of Low Birth Weight to Infant Mortality and Childhood Morbidity," *New England Journal of Medicine*, 312, 82–90.

Montalvo, J. G. (2011): "Voting after the bombings: A natural experiment on the effect of terrorist attacks on democratic elections," *Review of Economics and Statistics*, 93, 1146–1154.

Nijdam, M. J., B. P. R. Gersons, and M. Olff (2010): "Dutch politicians' coping with terrorist threat," *The British Journal of Psychiatry*, 197, 328–329.

Paarlberg, K., A. Vingerhoets, J. Passchier, G. Dekker, A. Heinen, and H. van Geijn (1999): "Psychosocial predictors of low birthweight: a prospective study," *British Journal of Obstetrics and Gynaecology*, 106, 834–841.

Persson, P. and M. Rossin-Slater (2015): "Family Ruptures, Stress, and the Mental Health of the Next Generation," *mimeo*.

Sanders, N. and C. Stoecker (2015): "Where have all the young men gone? Using sex ratios to measure fetal death rates," *Journal of Health Economics*, 41, 30–45.

Schlenger, W., J. Caddell, L. Ebert, B. Jordan, K. Rourke, D. Wilson, L. Thalji, J. Dennis, J. Fairbank, and R. Kulka (2002): "Psychological reactions to terrorist attacks: findings from the National Study of Americans' reactions to September 11," *Journal of the American Medical Association*, 288, 581–588.

Schneider, M., E. Roughton, A. Koehler, and G. Lubach (1999): "Growth and Development following Prenatal Stress Exposure in Primates: An Examination of Ontogenetic Vulnerability," *Child Development*, 70, 263–274.

Schulte, H., D. Weisner, and B. Allolio (1990): "The Cortricotropin Releasing Hormone Test in Late Pregnancy: Lack of Adrenocorticotropin and Cortisol Response," *Clinical Endocrinology*, 33, 99–106.

Schuster, M., B. Stein, L. Jaycox, R. Collins, G. Marshall, M. Elliott, A. Zhou, D. Kanouse, J. Morrison, and S. Berry (2001): "A national survey of stress reactions after the September 11, 2001, terrorist attacks," *New England Journal of Medicine*, 345, 1507–1512.

Sherrieb, K. and F. Norris (2013): "Public health consequences of terrorism on maternal-child health in New York City and Madrid," *Journal of Urban Health*, 90, 369–387.

Silver, R. and J. Ruiz (2013): "Invited commentary: Maternal stress and stillbirth - Another piece of the puzzle," *American Journal of Epidemiology*, 177, 228–299.

Skogan, W. and M. Maxfield (1981): "Coping with Crime: Individual and Neighborhood Reactions," *Beverly Hills: Sage Publications.*

Smith, D., E. Christiansen, R. Vincent, and N. Hann (1999): "Population effects of the bombing of Oklahoma City," *Journal of the Oklahoma State Medical Association*, 92, 193–198.

Susino, J. (2011): "La evolución de las migraciones interiores en España: una evaluación de las fuentes demográficas disponibles," *Papers*, 96, 853–881.

Torche, F. (2011): "The Effect of Maternal Stress on Birth Outcomes: Exploiting a Natural Experiment," *Demography*, 48, 1473–1491.

Torche, F. and A. Villarreal (2014): "Prenatal Exposure to Violence and Birth Weight in Mexico: Selectivity, Exposure, and Behavioral Responses," *American Sociological Review*, 79, 966–992.

Wadhwa, P., C. Dunkel-Schetter, A. Chicz-DeMet, M. Porto, and C. Sandman (1996): "Prenatal psychosocial factor and the neuroendocrine axis in human pregnancy," *Psychosomatic Medicine*, 58, 432–446.

Weinstock, M. (2001): "Alterations induced by gestational stress in brain morphology and behaviour of the offspring," *Progress in Neurobiology*, 65, 427–451.

Welberg, L., J. Sekl, and M. Homes (2001): "Prenatal Glucocorticoid Programming of Brian Corticosteroid Receptors and Corticotrophin-Releasing Hormone: Possible Implications for Behaviour," *Neuroscience*, 104, 71–79.

ONLINE APPENDIX (Supplementary Material)

The Hidden Costs of Terrorism:
The Effects on Human Capital at Birth

This online appendix contains supplementary material of the article *"The Hidden Costs of Terrorism: The Effects on Human Capital at Birth"* by Climent Quintana-Domeque and Pedro Ródenas-Serrano.

The supplementary material is organized in two sections:

- A.1 Threats to Our Identification Strategy (Tables A1-A8 and Figure A1)
- A.2 Measures of Stress (Table A9)

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- Pedro Ródenas-Serrano (`rodenas@ua.es`).

A.1 Threats to Our Identification Strategy

Table A1: Regressions of Birth Outcomes on Bomb Casualties and Unemployment Rates

	BW (in grams)	LBW (per 1,000)	Normal (per 1,000)	Male (per 1,000)	Premature (per 1,000)
Bomb Casualties 1st trimester of pregnancy	−0.251*	0.146**	−0.618***	−0.090	0.662
	(0.127)	(0.059)	(0.161)	(0.120)	(0.408)
Bomb Casualties 2nd trimester of pregnancy	−0.038	−0.181	−0.246**	−0.339	−0.020
	(0.188)	(0.139)	(0.108)	(0.236)	(0.101)
Bomb Casualties 3rd trimester of pregnancy	0.154	−0.055	0.269	−0.224	−0.410*
	(0.231)	(0.076)	(0.203)	(0.217)	(0.219)
Unemployment rate 1st trimester of pregnancy	0.628*	−0.209**	0.721*	−0.001	0.178
	(0.315)	(0.093)	(0.394)	(0.155)	(0.176)
Unemployment rate 2nd trimester of pregnancy	−0.013	0.138	0.283*	0.241	−0.138
	(0.240)	(0.111)	(0.158)	(0.236)	(0.146)
Unemployment rate 3rd trimester of pregnancy	0.399	−0.015	0.603	−0.100	0.207**
	(0.325)	(0.099)	(0.566)	(0.152)	(0.099)
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470

Note: Live births *conceived* between January 1980 and February 2003.
Econometric specification: Table 3 (panel C).
Standard errors clustered at the province level (50 provinces).
***$p - value < 0.01$, **$p - value < 0.05$, *$p - value < 0.1$

Table A2: Regressions of Birth Outcomes on Bomb Casualties: Conception Date vs. Date of Birth

	BW (in grams)	LBW (per 1,000)	Normal (per 1,000)	Male (per 1,000)	Premature (per 1,000)
I. Prenatal exposure using date of conception					
Bomb Casualties 1st trimester of pregnancy	−0.278**	0.145**	−0.671***	−0.093	0.653
	(0.122)	(0.061)	(0.179)	(0.120)	(0.407)
Bomb Casualties 2nd trimester of pregnancy	−0.055	−0.179	−0.272***	−0.337	0.027
	(0.202)	(0.144)	(0.098)	(0.236)	(0.099)
Bomb Casualties 3rd trimester of pregnancy	0.148	−0.055	0.253	−0.228	−0.410*
	(0.250)	(0.078)	(0.174)	(0.212)	(0.215)
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470
II. Prenatal exposure using date of birth					
Bomb Casualties 6-8 months before birth	−0.211*	0.067	−0.396***	−0.040	0.169
	(0.116)	(0.058)	(0.213)	(0.088)	(0.208)
Bomb Casualties 3-5 months before birth	−0.193	−0.000	−0.018	−0.218	0.314
	(0.149)	(0.116)	(0.180)	(0.215)	(0.210)
Bomb Casualties 0-2 months before birth	0.391	−0.034	−0.128	−0.210	−0.007
	(0.312)	(0.104)	(0.130)	(0.203)	(0.168)
Number of live births	8,368,967	8,368,967	9,789,870	9,789,870	9,789,870
III. Prenatal exposure using date of birth (sample in I)					
Bomb Casualties 6-8 months before birth	−0.159	0.024	−0.543***	−0.141	0.436
	(0.149)	(0.050)	(0.144)	(0.123)	(0.358)
Bomb Casualties 3-5 months before birth	−0.196	−0.060	0.149	−0.286	0.198
	(0.158)	(0.126)	(0.152)	(0.318)	(0.188)
Bomb Casualties 0-2 months before birth	0.565	−0.068	0.084	−0.309***	−0,340*
	(0.375)	(0.105)	(0.140)	(0.115)	(0.197)
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470

Note: Live births *conceived* between January 1980 and February 2003.
Econometric specification: Table 3 (panel C).
Standard errors clustered at the province level (50 provinces).
***$p-value < 0.01$, **$p-value < 0.05$, *$p-value < 0.1$

Table A3: Regressions of Birth Outcomes on Bomb Casualties accounting for *Cumulated* Bomb Casualties

	BW (in grams)	LBW (per 1,000)	Normal (per 1,000)	Male (per 1,000)	Premature (per 1,000)
Bomb Casualties 1st trimester of pregnancy	−0.513***	0.179*	−1.529**	−0.013	0.488
	(0.193)	(0.102)	(0.612)	(0.124)	(0.319)
Bomb Casualties 2nd trimester of pregnancy	−0.277	−0.181	−1.244**	−0.291	−0.129
	(0.288)	(0.170)	(0.491)	(0.224)	(0.143)
Bomb Casualties 3rd trimester of pregnancy	0.040	−0.045	−0.851**	−0.231	−0.336
	(0.360)	(0.118)	(0.354)	(0.222)	(0.232)
Cumulated Number of Bomb Casualties until 1st trimester	−0.701***	−0.156***	−1.398**	−0.026	0.073
	(0.157)	(0.041)	(0.594)	(0.053)	(0.120)
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470

Note: Live births *conceived* between January 1980 and February 2003.
Econometric specification: Table 3 (panel C).
Standard errors clustered at the province level (50 provinces).
***$p-value < 0.01$, **$p-value < 0.05$, *$p-value < 0.1$

Table A4: Regressions of Birth Outcomes on Bomb Casualties during pregnancy and *after* birth

	BW (in grams)	LBW (per 1,000)	Normal (per 1,000)	Male (per 1,000)	Premature (per 1,000)
Bomb Casualties 1st trimester of pregnancy	−0.271**	0.142**	−0.671***	−0.090	0.645
	(0.119)	(0.063)	(0.182)	(0.120)	(0.410)
Bomb Casualties 2nd trimester of pregnancy	−0.054	−0.179	−0.272***	−0.337	−0.027
	(0.204)	(0.145)	(0.098)	(0.235)	(0.100)
Bomb Casualties 3rd trimester of pregnancy	0.140	−0.053	0.253	−0.232	−0.400*
	(0.242)	(0.076)	(0.175)	(0.211)	(0.212)
Placebo: Bomb Casualties 1st trimester *after* birth	0.294	−0.087	0.007	0.103	−0.332*
	(0.365)	(0.132)	(0.149)	(0.069)	(0.170)
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470

Note: Live births *conceived* between January 1980 and February 2003.
Econometric specification: Table 3 (panel C).
Standard errors clustered at the province level (50 provinces).
$^{***}p-value < 0.01$, $^{**}p-value < 0.05$, $^{*}p-value < 0.1$

Table A5: Regressions of Birth Outcomes on Bomb Casualties, collapsing at the month-year-province level

I. Collapsed: Observed bomb casualties	BW (in grams)	LBW (per 1,000)	Normal (per 1,000)	Male (per 1,000)	Premature (per 1,000)
Bomb Casualties 1st trimester of pregnancy	−0.674***	0.187**	−0.631***	−0.138	0.976**
	(0.196)	(0.085)	(0.196)	(0.125)	(0.473)
F-test all coefficients equal zero	**Ho: No effect of 1st trimester of pregnancy** $F_{5,45} = 5.93$ $p - value = 0.0003$				
Observations (month-year-province cells)	13,900	13,900	13,900	13,900	13,900
II. Collapse: Randomized bomb casualties					
Bomb Casualties 1st trimester of pregnancy	−0.006	−0.003	−0.007	−0.022	0.002
Standard error	(0.019)	(0.007)	(0.018)	(0.013)	(0.013)
Confidence interval 95%	[-0.044,0.032]	[-0.017,0.010]	[-0.043,0.028]	[-0.048,0.005]	[-0.023,0.027]
Number of replications	1,000	1,000	1,000	1,000	1,000
Observations (month-year-province cells)	13,900	13,900	13,900	13,900	13,900

Note: Live births *conceived* between January 1980 and February 2003.
Econometric specification: Table 3 (panel A) collapsed at the month-year-province level weighted by the number of observations within month-year-province cell.
Standard errors clustered at the province level (50 provinces).
***$p - value < 0.01$, **$p - value < 0.05$, *$p - value < 0.1$

Table A6: Regressions of Birth Outcomes on Bomb Casualties by Regional Groups

	BW (in grams)	LBW (per 1,000)	Normal (per 1,000)	Male (per 1,000)	Premature (per 1,000)
I. Excluding the Basque Country♣					
Bomb Casualties 1st trimester of pregnancy	−0.303*	0.136***	−0.662***	−0.042	0.740
	(0.159)	(0.049)	(0.159)	(0.118)	(0.449)
Bomb Casualties 2nd trimester of pregnancy	−0.113	−0.131	−0.280***	−0.353	0.027
	(0.143)	(0.091)	(0.101)	(0.217)	(0.114)
Bomb Casualties 3rd trimester of pregnancy	0.047	−0.007	0.213	−0.173	−0.371*
	(0.168)	(0.065)	(0.186)	(0.201)	(0.194)
Number of live births	5,964,339	5,964,339	6,261,457	6,261,457	6,261,457
II. Excluding Provinces without Bomb Casualties♠					
Bomb Casualties 1st trimester of pregnancy	−0.348**	0.190**	−0.541**	−0.027	0.410
	(0.125)	(0.088)	(0.228)	(0.145)	(0.306)
Bomb Casualties 2nd trimester of pregnancy	−0.034	−0.226	−0.187	−0.446*	−0.293
	(0.375)	(0.183)	(0.173)	(0.222)	(0.172)
Bomb Casualties 3rd trimester of pregnancy	0.368	−0.208	0.297	−0.278	−0.658*
	(0.476)	(0.157)	(0.187)	(0.196)	(0.313)
Number of live births	3,366,840	3,366,840	3,513,030	3,513,030	3,513,030

Note: Live births *conceived* between January 1980 and February 2003.
Econometric specification: Table 3 (panel C).
Standard errors clustered at the province level (♣ 47 provinces, ♠ 15 provinces).
$***p-value < 0.01$, $**p-value < 0.05$, $*p-value < 0.1$

Table A7: Regressions of Birth Outcomes on Bomb Casualties accounting for Indirect Treatment Effects

	BW (in grams)	LBW (per 1,000)	Normal (per 1,000)	Male (per 1,000)	Premature (per 1,000)
I. Bomb Casualties in Adjacent Provinces					
Bomb Casualties 1st trimester of pregnancy	−0.281**	0.139**	−0.678***	−0.098	0.656
	(0.119)	(0.059)	(0.178)	(0.122)	(0.404)
Bomb Casualties 2nd trimester of pregnancy	−0.056	−0.188	−0.276***	−0.338	−0.020
	(0.204)	(0.144)	(0.101)	(0.236)	(0.098)
Bomb Casualties 3rd trimester of pregnancy	0.143	−0.054	0.255	−0.232	−0.400*
	(0.251)	(0.077)	(0.179)	(0.212)	(0.216)
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470
II. Bomb Casualties within 300 km					
Bomb Casualties 1st trimester of pregnancy	−0.310**	0.147**	−0.673***	−0.054	0.651
	(0.123)	(0.073)	(0.197)	(0.120)	(0.427)
Bomb Casualties 2nd trimester of pregnancy	−0.087	−0.222	−0.248**	−0.350	−0.011
	(0.205)	(0.165)	(0.110)	(0.238)	(0.115)
Bomb Casualties 3rd trimester of pregnancy	0.152	−0.068	0.259	−0.261	−0.390*
	(0.255)	(0.087)	(0.190)	(0.225)	(0.224)
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470
III. Bomb Casualties decreasing effect with distance					
Bomb Casualties 1st trimester of pregnancy $\times \exp\left(-\frac{distance}{100}\right)$	−0.202	0.057	−0.581***	−0.218*	0.503***
	(0.157)	(0.071)	(0.152)	(0.131)	(0.191)
Bomb Casualties 2nd trimester of pregnancy $\times \exp\left(-\frac{distance}{100}\right)$	0.108	−0.259**	−0.298***	−0.074	−0.090
	(0.227)	(0.120)	(0.110)	(0.127)	(0.125)
Bomb Casualties 3rd trimester of pregnancy $\times \exp\left(-\frac{distance}{100}\right)$	0.002	−0.090	0.067	−0.113	−0.315
	(0.177)	(0.076)	(0.193)	(0.124)	(0.224)
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470

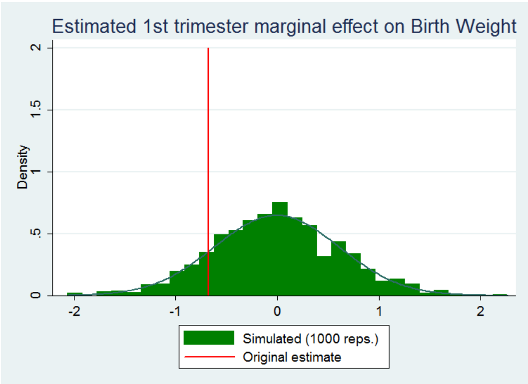
Note: Live births *conceived* between January 1980 and February 2003.
Econometric specification in panels I and II: Equation (4).
Econometric specification in panel III: Equation (5).
Panel III: Bomb casualties refer to the bomb casualties in the province of residence or (if zero) in the closest province.
Panel III: *distance* is either 0 (if the number of bomb casualties in the mother's province of residence is positive) or the distance between the mother's province of residence and the closest province with a positive number of bomb casualties.
Standard errors clustered at the province level (50 provinces).
$^{***}p-value < 0.01$, $^{**}p-value < 0.05$, $^{*}p-value < 0.1$

Table A8: Regressions of Birth Outcomes on Bomb Casualties using Intensity Indicators

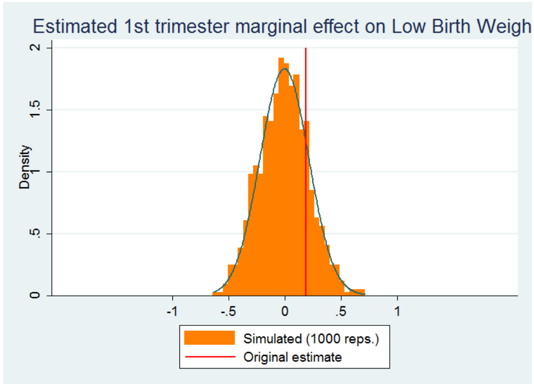
	BW (in grams)	LBW (per 1,000)	Normal (per 1,000)	Male (per 1,000)	Premature (per 1,000)
I. Indicators for Trimesters with *High* Intense Terrorism					
1(Bomb Casualties 1st trimester of pregnancy $\geq$ 10)	−9.54***	6.54***	−5.23**	0.29	19.09**
	(3.01)	(0.87)	(2.09)	(4.66)	(8.76)
1(Bomb Casualties 2nd trimester of pregnancy $\geq$ 10)	0.283	−2.44	7.16**	−7.69***	6.75*
	(3.71)	(1.73)	(3.28)	(2.83)	(3.69)
1(Bomb Casualties 3rd trimester of pregnancy $\geq$ 10)	2.65	−2.65	11.16	−5.02	−5.29
	(4.72)	(2.87)	(7.90)	(3.03)	(6.30)
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470
II. Indicators for Trimesters with *Medium* Intense Terrorism					
1(Bomb Casualties 1st trimester of pregnancy $\geq$ 5)	−3.82**	0.56	−6.7	0.78	7.81***
	(1.56)	(0.52)	(4.6)	(1.2)	(2.68)
1(Bomb Casualties 2nd trimester of pregnancy $\geq$ 5)	−0.570	−1.85	−6.5**	−5.4**	−1.81
	(1.48)	(1.35)	(3.0)	(2.2)	(1.17)
1(Bomb Casualties 3rd trimester of pregnancy $\geq$ 5)	0.408	0.43	0.67	−3.2**	−3.15
	(2.40)	(0.74)	(1.1)	(1.3)	(1.94)
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470
III. Indicators for Trimesters with *Low* Intense Terrorism					
1(Bomb Casualties 1st trimester of pregnancy $\geq$ 1)	0.793	−0.065	−1.71	−1.43	2.22**
	(0.996)	(0.435)	(1.03)	(1.12)	(0.876)
1(Bomb Casualties 2nd trimester of pregnancy $\geq$ 1)	1.36	−1.10	−2.30**	−0.544	−0.69
	(1.64)	(0.658)	(1.09)	(0.646)	(0.872)
1(Bomb Casualties 3rd trimester of pregnancy $\geq$ 1)	2.06	−0.787*	−0.279	−1.14	−2.33*
	(1.47)	(0.450)	(1.30)	(1.14)	(1.26)
Number of live births	6,295,035	6,295,035	6,607,470	6,607,470	6,607,470

Note: Live births *conceived* between January 1980 and February 2003.
Econometric specification: Table 3 (panel C).
Standard errors clustered at the province level (50 provinces).
$***p-value < 0.01$, $**p-value < 0.05$, $*p-value < 0.1$

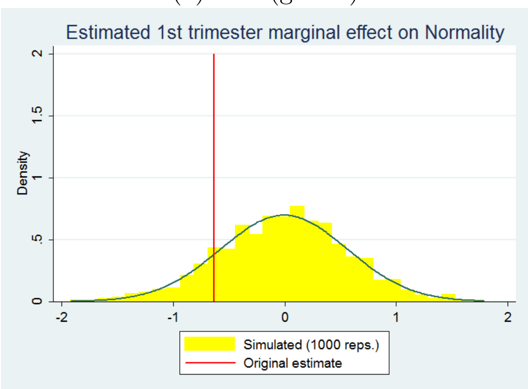
Figure A1: Estimated vs. Simulated 1st Trimester Marginal Effects



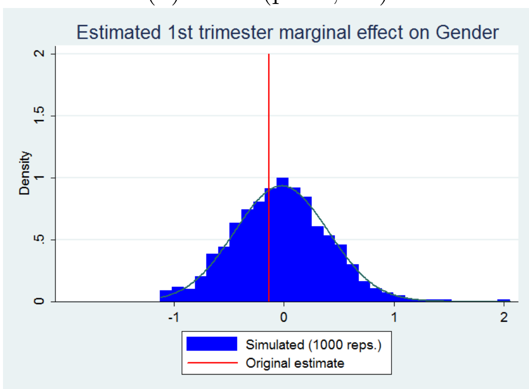
(a) BW (grams)



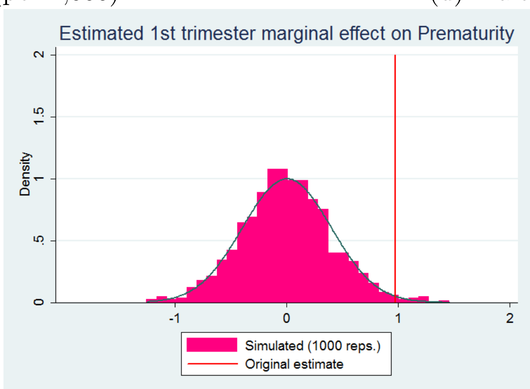
(b) LBW (per 1,000)



(c) Normal (per 1,000)



(d) Male (per 1,000)



(e) Premature (per 1,000)

Note: The estimated 1st trimester marginal effects are taken from Table 3 (panel A). Simulations: Bombs are randomly allocated (1,000 times) across month-year-province cells.

A.2 Measures of Stress

We measure stress using the 12-Item General Health Questionnaire (GHQ-12). The GHQ-12 questionnaire administered in the ENSE 2006 and 2011 contains the following questions:

Have you recently ...

1. *Been able to concentrate on whatever you are doing?*
2. *Lost much sleep over worry?*
3. *Felt that you were playing a useful part in things?*
4. *Felt capable of making decisions about things?*
5. *Felt constantly under strain?*
6. *Felt that you could not overcome your difficulties?*
7. *Been able to enjoy your normal day-to-day activities?*
8. *Been able to face up to your problems?*
9. *Been feeling unhappy and depressed?*
10. *Been losing self-confidence in yourself?*
11. *Been thinking of yourself as a worthless person?*
12. *Been feeling reasonably happy, all things considered?*

The potential answers to these questions are:

- For (1), (3), (4), (7), (8), and (12): More than usual [0] / as usual [1] / less than usual [2] / much less than usual [3].
- For (2), (5), (6), (9), (10) and (11): Less than usual [0] / no more than usual [1] / rather more than usual [2] / much more than usual [3].

Sánchez-López and Dresch (2008), following the approach by Graetz (1991), obtain three (clinically meaningful) factors in their analysis of the GHQ-12 for a sample from the general Spanish population. For our purposes, the relevant factor loading determined by Sánchez-López and Dresch (2008) is the one they call "Stress", which contains the following three items (questions) of the GHQ-12: (2), (5), and (9). We create our first measure of stress as the sum to the answers of these three questions, so that the minimum is 0 ("no stressed at all") and the maximum is 9 ("highly stressed").

We also use the relevant factor loading determined by Graetz (1991), "Anxiety and depression", which contains the previous three items (2, 5, and 9) plus (6). Hence, our second measure of stress is the sum of the answers to these four questions, so that the minimum is 0 ("no stressed at all") and the maximum is 12 ("highly stressed").

Table A9: Correlations of Bad Health with Stress Measures

	Women		**Men**	
	2006	2011	2006	2011
Corr(Bad Health, $Stress_1$)	0.2392***	0.2307***	0.2090***	0.1865***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Corr(Bad Health, $Stress_2$)	0.2491***	0.2399***	0.2200***	0.1918***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Corr(Bad Health, $Stress_3$)	0.2870***	0.2861***	0.2813***	0.2427***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Observations	8,450	5,005	6,005	4,967

Note: Individuals age 16-49. ENSE: 2006, 2011.
Bad health status equals 1 if health status is reported to be bad or very bad.
$Stress_1$ is based on Sánchez-López and Dresch (2008): (0,9).
$Stress_2$ is based on Graetz (1991): (0,12).
$Stress_3$ is the GHQ-12: (0,36).
$^{***}p - value < 0.01$, $^{**}p - value < 0.05$, $^{*}p - value < 0.1$

References

Graetz, B. (1991): “Multidimensional properties of the General Health Questionnaire,” *Social Psychiatry and Psychiatric Epidemiology*, 26.

Sánchez-López, M. and V. Dresch (2008): “The 12-Item General Health Questionnaire (GHQ-12): Reliability, external validity and factor structure in the Spanish population,” *Psicothema*, 20, 839–843.