

Impact of Terrorism on Child Sex at Birth: Evidence from Pakistan

Khusrav Gaibulloev^a, Gerel Oyun^b, Javed Younas^a

^a. Department of Economics, American University of Sharjah, P.O. Box 26666, Sharjah, UAE

^b. Independent scholar, Dallas, TX, USA

Corresponding author (Javed Younas): jyounas@aus.edu

February 2020

Abstract

Using insights from the literature on psychology and medicine, we examine the impact of stress induced by terrorism on child sex at birth. The psychological and social stressors associated with terrorist events prior to conception trigger changes in maternal (and paternal) hormones that have an implication for birth outcomes. We extract data on 11,331 live births conceived between 2007 and 2012 from Pakistan Demographic and Health Survey 2012-2013. The individual birth data are matched with household information from the same survey. The district-level data come from the Pakistan Social and Living Standards Measurement Survey and the monthly terrorist incidents information are taken from Global Terrorism Database. The analysis relies on two sources of variations: mothers' exposure to terrorism prior to conception and districts that experienced terrorism. District-level analysis shows that terrorist events decrease the number of live male births and increase the number of live female births. We confirm this finding with individual birth data by showing that terrorist attacks prior to conception reduce the likelihood of a male birth. These results provide microeconomic evidence of potential long-term impact of terrorism on fertility and population dynamics. In societies with strong preference towards boys, the reduction in the number of male births can have implications for selective abortions. Moreover, these findings calls for a better understanding of the link between such shocks and adult life outcomes including health, education and income.

JEL Classification Codes: D74, F52, H56, J10

Keywords: Terrorism, conflict, child sex at birth, maternal stress, birth outcomes



IMPACT OF TERRORISM ON CHILD SEX AT BIRTH: EVIDENCE FROM PAKISTAN

Khusrav Gaibulloev, Gerel Oyun and Javed Younas

Javed Younas

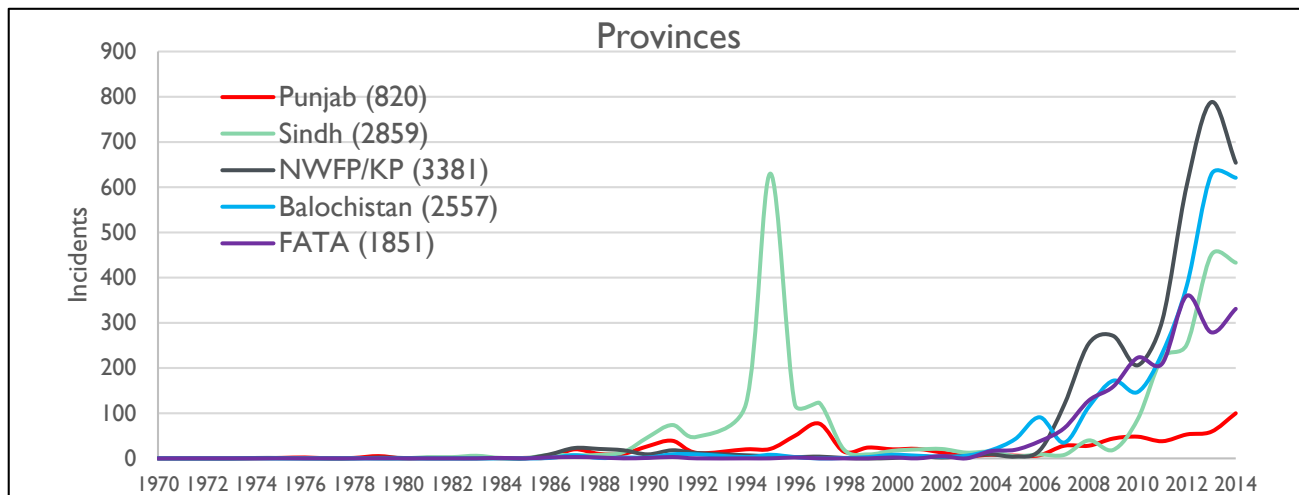
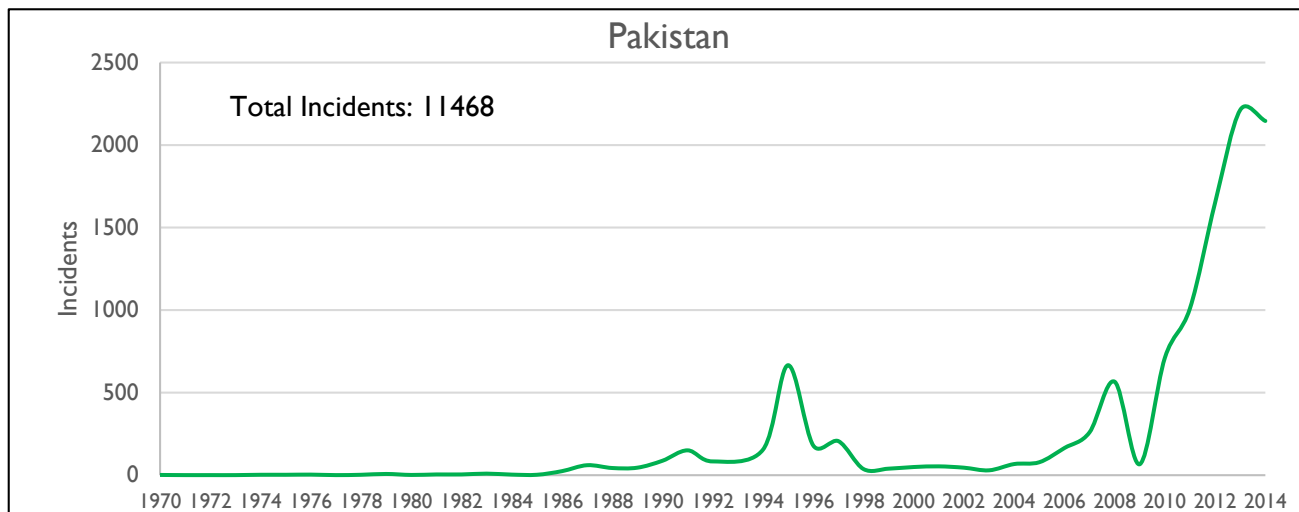
Prepared for the AALIMS-Yale Conference on the Political
Economy of the Muslim World

April 2020

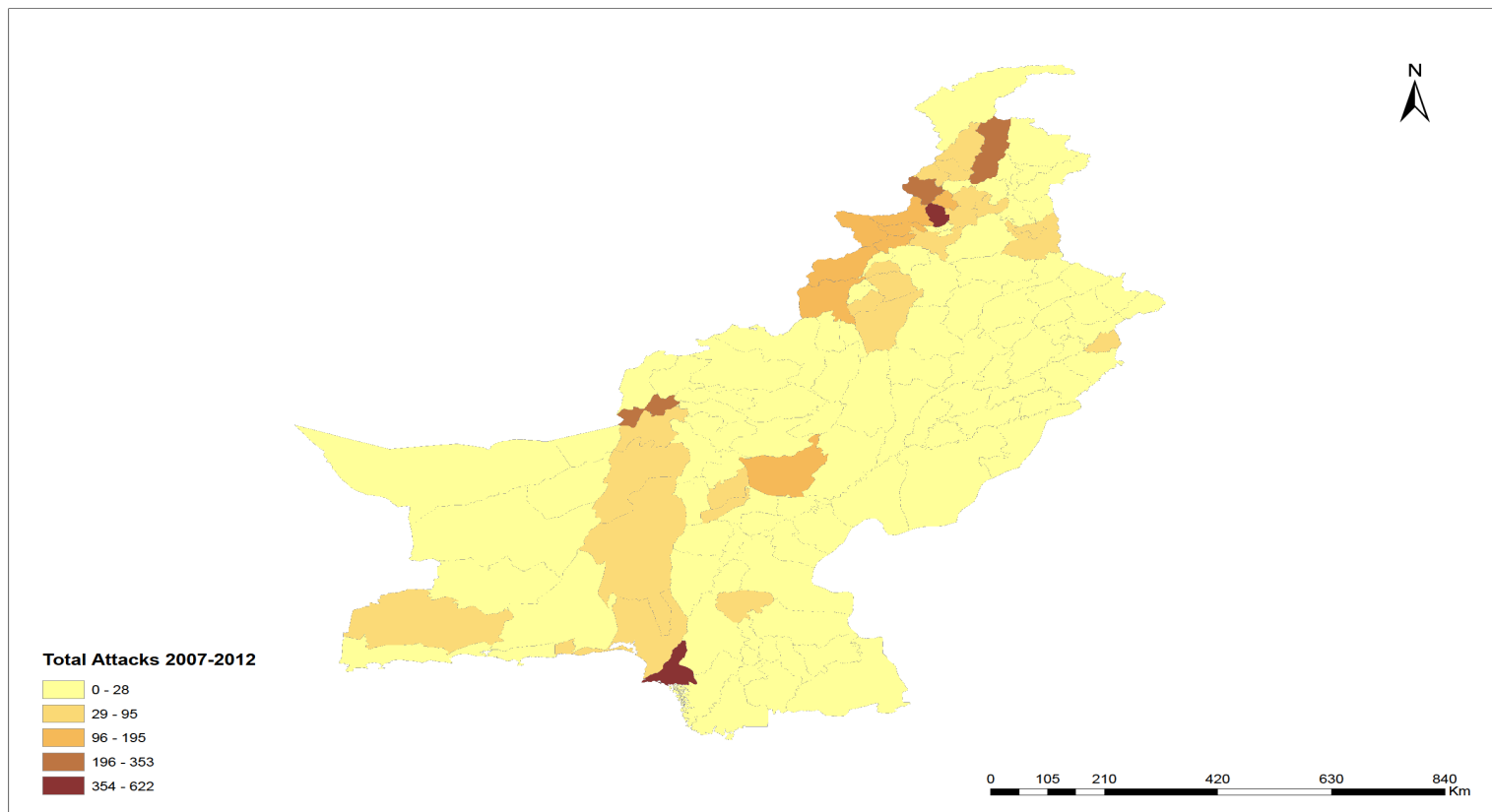
OUTLINE

- ◆ Stats on Terrorism
- ◆ Motivation
- ◆ Summary of Findings
- ◆ Literature
- ◆ Effect of Shocks at Birth
- ◆ Data and Method
- ◆ Results
- ◆ Discussion
- ◆ Robustness
- ◆ Puzzle

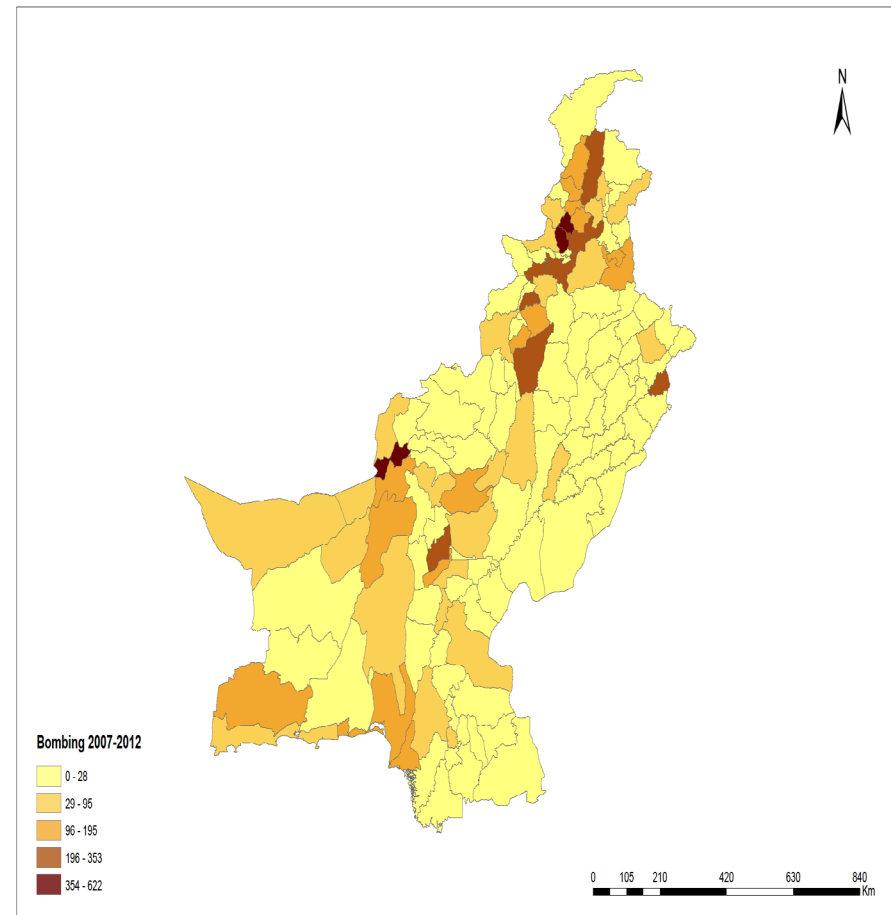
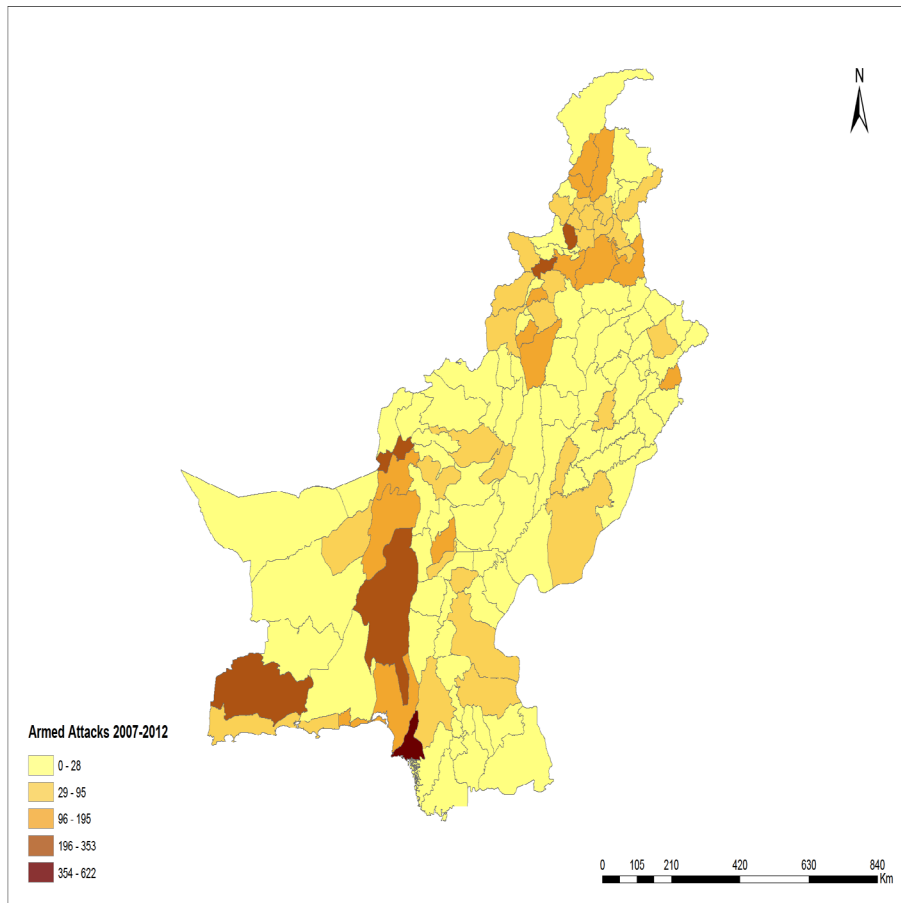
AGGREGATE TERRORISM INCIDENTS



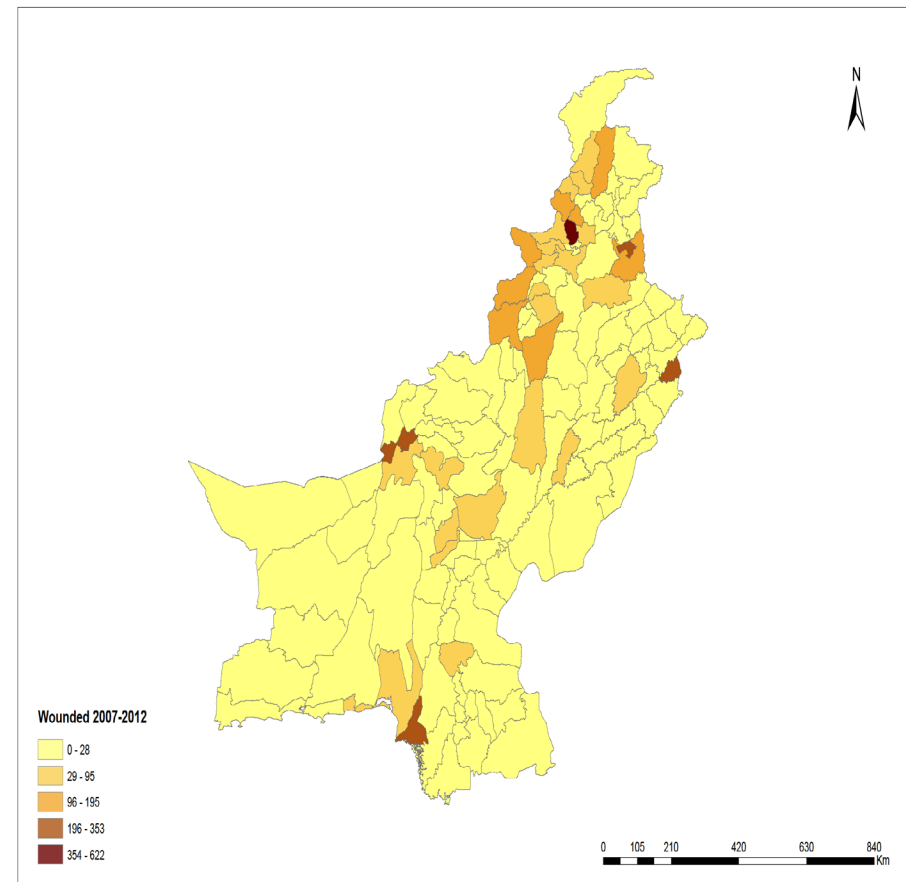
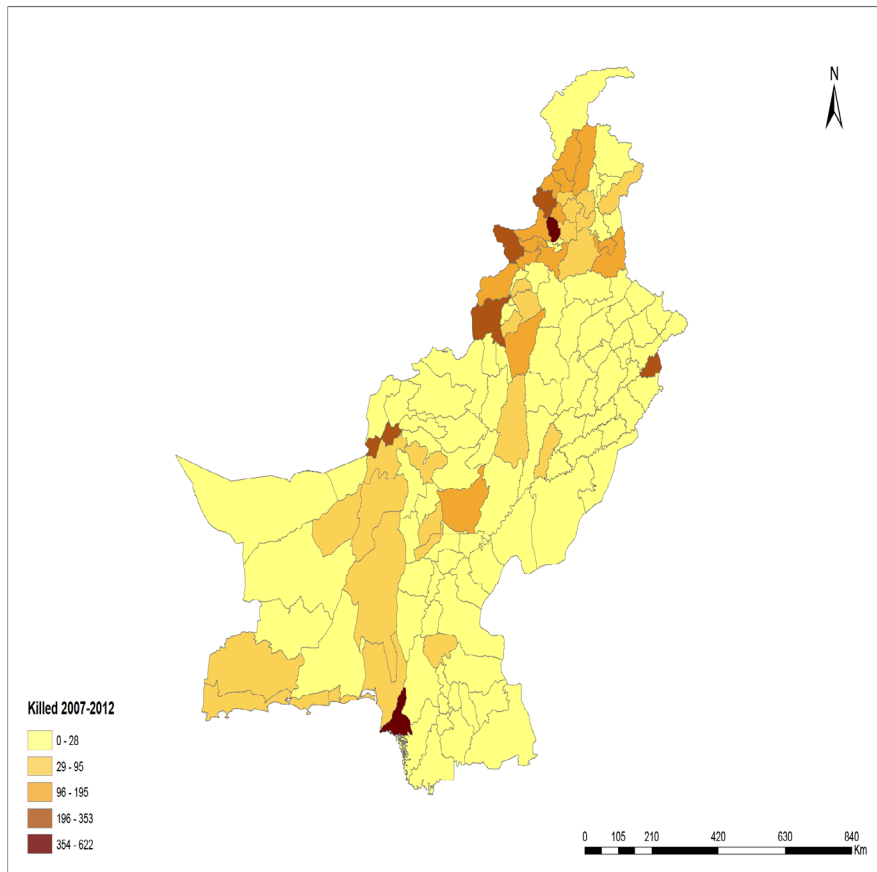
DISTRICT LEVEL INCIDENTS, 2007-2012



DISTRICT LEVEL ARMED ATTACKS AND BOMBING, 2007-2012



DISTRICT LEVEL FATALITIES AND INJURIES, 2007-2012



MOTIVATION

- ◆ The fetal origins hypothesis: unfavorable intrauterine conditions of a fetus have negative long-term consequences on a personal accumulation of human capital (Almond and Currie 2011)
- ◆ Exposure to stress (e.g., conflict) affects birth outcomes and sex ratio (e.g., Camacho 2008; Valente 2015)
- ◆ What if an exposure to exogenous stressful life events just *prior* to pregnancy influences the sex ratio?
 - ◆ Social science studies mostly focus on stress during pregnancy and birth outcomes
 - ◆ However, evidence from medical literature suggests that stressful events before conception can also impact the ratio of male to female newborns

MOTIVATION

Sex (male to female) ratio and exposure to terrorist attacks (2007-2012)

Pakistan	Our Sample			
	All	Experienced attacks	Did not experience attacks	Diff (p-value)
0.52	0.51	Pre-conception		
		0.487	0.514	0.011
		1st trimester		
		0.511	0.507	0.676

MOTIVATION

- ◆ Contributes to economics of terrorism literature
 - ◆ Macroeconomic effects (Abadie & Gardeazabal 2003, 2008; Bandyopadhyay et al. 2014; Blomberg et al. 2004; Gaibullov, Sandler & Sul 2014)
 - ◆ Macroeconomic consequences appear to be small and transient (Arce 2019; Gaibullov & Sandler 2019)
 - ◆ Micro evidence suggests significant impacts on life satisfaction (Frey et al. 2009)
 - ◆ Indirect effects (through fear and stress) can be disproportionately higher than direct effects (Becker and Rubinstein 2004)
 - ◆ Limited research on terrorism and birth outcomes
- ◆ If acute pre-conception stress induced by exogenous shocks influences the sex ratio, then the link between these shocks and outcomes in adult life (certain disease and earnings) that are correlated with sex, should be examined.

SUMMARY

- ◆ Insights from the literature on psychology and medicine imply that psychological and social stressors associated with terrorist events prior to conception trigger changes in parental hormones that affect sex ratio at birth
- ◆ We extract data on 11,331 live births and 1757 fetal losses conceived between 2007 and 2012 (DHS 2012-2013) and match it with district-level monthly terrorist events in Pakistan (GTD), and household and district characteristics.
- ◆ Empirical findings suggest that
 - ◆ Terrorism-induced stress *prior* to conception reduces the likelihood of male births
 - ◆ The effect is positive on the number of female births and negative on the number of male births
 - ◆ Exposure to terrorist shocks increases the chances of fetal death
 - ◆ The effect of terrorism on the size of newborn is not statistically significant

LITERATURE REVIEW

- ◆ Medical literature: stressful events both prior to and during pregnancy impact the sex ratio
 - ◆ Parental hormones around the time of a child's conception and male-skewed fetal deaths due to maternal stress are important for sex at birth (James & Grech 2017)
 - ◆ Chronic stress prior to conception alters sex ratio (Chason et al. 2012)
 - ◆ Acute stress in men reduces sperm motility – lower chance of conceiving boy (Fukuda et al. 1996)
 - ◆ Male fetuses are at a greater risk of intrauterine growth restriction, preterm birth and fetal death (Clifton 2010)

LITERATURE REVIEW

- ◆ Political instability (conflicts & terrorism) interfere with birth outcomes in humans
 - ◆ lower birth weight (Eskenazi et al. 2007, Camacho 2008, Mansour and Rees 2012)
 - ◆ male fetal death, miscarriages and poor birth outcomes (Bruckner et al. 2010; Lauderdale 2006; Valente 2015)
 - ◆ higher odds of female births (Valente 2015)
 - ◆ lower fertility (Berrebi and Ostwald 2014)
- ◆ Other shocks, such as natural disasters and economic downturns, also affects birth outcomes
 - ◆ lower birth weight (Burlando 2014; Carlson 2015); lower sex ratio at birth (Catalano 2003); shorter duration of pregnancy (Torche and Kleinhaus 2011)
- ◆ Few focus on sex ratio, terrorism; focus mainly on shocks during pregnancy
 - ◆ Fukuda et al. (1998): pre-conception stress due to the Kobe earthquake lowers sex ratio at birth

THE EFFECT OF SHOCK ON HUMAN SEX RATIO

Exogenous Shocks

- ⑩ Prior to conception
- ⑩ During pregnancy
- ⑩ (*in utero*)

Factors

- ⑩ Primary sex ratio
- ⑩ (at conception)
- ⑩ Fetal losses

Outcomes

- ⑩ Secondary sex ratio
- ⑩ (at birth)
- ⑩ Baby birth health

DATA

- ◆ 11,763 births and 1757 fetal losses to 7190 women, household characteristics (Pakistan DHS 2012-2013); their conception month/year is estimated and their districts are identified. Visitors are excluded.
- ◆ Monthly terrorism incidents for each (117) district (GTD 2015)
- ◆ District characteristics (Pakistan Social and Living Standards Measurement Surveys 2006-2007, 2008-2009 and 2010-2011)
- ◆ Dependent variables: births (total and separated by sex) for each district; dummy variable for male birth
- ◆ Independent variables: terrorism dummy, the number of incidents (log) and casualties (a month prior to conception, during pregnancy)
- ◆ Control variables: Individual (birth order, inbreeding, smoking, age, multiple birth, education, wealth, urban); district (POP, income, employment, public service, electricity, education (male, female))

METHOD

- ◆ Sources of variations to exploit
 - ◆ women's exposure to terrorism (some no, some yes and with different degrees); siblings' exposure to terrorism (mother fixed effects)
 - ◆ the varying number of attacks across districts
- ◆ District-level analysis (Y = the number of births/the number of male births/the number of female births in district d , conceived in month m , year t)

$$Y_{dtm} = \alpha + \beta Terr_{dt,m-1} + \Lambda X_t + \tau_p + \mu_d + \eta_m + \theta_t + \varepsilon_{dtm}$$

- ◆ Individual birth analysis ($Y=1$ if male birth; LPM)

$$Y_{idtm} = \alpha + \beta Terr_{dt,m-1} + \Lambda X_t + \Gamma Z_i + \tau_p + \mu_d + \eta_m + \theta_t + v_{idtm}$$

RESULTS (DISTRICT-LEVEL)

Table 1. The effect of terrorism on live births: district-level analysis

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Total births	Male births	Male births	Female births	Female births	Female births
Terror dummy	0.005 (0.008)			0.059** (0.025)		
Terror log		-0.012 (0.029)			0.048** (0.020)	
Casualties log			-0.008 (0.010)			0.028*** (0.008)
District controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects						
<i>Province</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>District</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Month (conc)</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year (conc)</i>	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4324	4324	4324	4324	4324	4324

Note: Significance levels: *** is <.01, ** is <.05, and * is <.10. Cluster-robust standard errors (clustered by districts) are in parentheses.

RESULTS (INDIVIDUAL BIRTH)

Table 2. The effect of terrorism on probability of male birth: individual birth data

	Model 1	Model 2	Model 3	Model 4	Model 5
Terror	-0.003 (0.004)		-0.015*** (0.005)		
Terror squared			0.001*** (0.000)		
Terror dummy		-0.039** (0.016)			
Terror log			-0.029* (0.016)		
Casualties log					-0.014** (0.005)
Individual controls	Yes	Yes	Yes	Yes	Yes
District controls	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes
<i>Province</i>	Yes	Yes	Yes	Yes	Yes
<i>District</i>	Yes	Yes	Yes	Yes	Yes
<i>Month (conc)</i>	Yes	Yes	Yes	Yes	Yes
<i>Year (conc)</i>	Yes	Yes	Yes	Yes	Yes
Observations	9757	9757	9757	9757	9757

Note: Significance levels: *** is <.01, ** is <.05, and * is <.10. Cluster-robust standard errors (clustered by districts) are in parentheses.

Table 3. The effect of terrorism on sex at birth

	District level			Individual level		
	Model 1 Male births	Model 2 Female births	Model 3 Female births	Model 1 Sex at birth	Model 2 Sex at birth	Model 3 Sex at birth
Terror	-0.004 (0.008)	0.030*** (0.010)		-0.023** (0.009)	-0.019*** (0.006)	
Terror squared		-0.001*** (0.000)		0.001*** (0.000)	0.001*** (0.000)	
Terror 1st trimester	0.002 (0.002)	-0.000 (0.002)		0.001 (0.002)	0.001 (0.001)	
Terror 2nd trimester	-0.001 (0.002)	-0.002 (0.002)		0.001 (0.002)	0.001 (0.001)	
Terror 3rd trimester	0.001 (0.001)	0.001 (0.002)		0.000 (0.002)	-0.000 (0.001)	
Terror log			0.046* (0.027)			-0.037** (0.016)
Terror log 1st trimester			0.011 (0.015)			0.005 (0.010)
Terror log 2nd trimester			-0.004 (0.015)			0.006 (0.010)
Terror log 3rd trimester			-0.006 (0.014)			0.006 (0.009)
Individual controls	No	No	No	Yes	Yes	Yes
District controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes	Yes
District	Yes	Yes	Yes	Yes	Yes	Yes
Month (conc)	Yes	Yes	Yes	Yes	Yes	Yes
Year (conc)	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4324	4324	4324	9757	9757	9757

Note: Significance levels: *** is <.01, ** is <.05, and * is <.10. Cluster-robust standard errors (clustered by districts) are in parentheses. Model 1 of Individual birth is a survey regression that accounts for sampling weights, primary sampling unit cluster, and stratification in obtaining point estimates and standard errors.

Terrorism is relatively frequent in Pakistan (Table below)

- ◆ Identify months with the number of attacks above the district average

Individual mother's unobserved heterogeneity

- ◆ Track siblings: mother fixed-effects regression (reduced sample)

The number and types of terrorist attacks in Pakistan

Year	World	Pakistan						
	Total Attacks	Total Attacks	Assassin	Kidnap	Bombing	Assault	Infrastruct	Suicide
2001	1906	53	5	0	33	13	1	0
2002	1333	45	3	1	31	10	0	2
2003	1278	29	5	1	13	10	0	2
2004	1166	67	5	1	50	11	0	3
2005	2017	78	5	1	60	11	0	5
2006	2758	164	7	4	126	26	1	4
2007	3242	259	10	22	177	41	7	38
2008	4805	566	19	73	294	120	42	29
2009	4721	666	29	56	416	120	18	26
2010	4826	711	44	79	377	178	17	25
2011	5076	1011	42	71	553	303	25	28
2012	8522	1651	75	69	1035	423	18	35
2013	12036	2213	161	116	1318	518	64	47
2014	16903	2146	123	108	1201	640	36	35

Notes: Assaults means armed assault. To save space, we only report the most common types of attacks. Source: Global Terrorism Database of National Consortium for the Study of Terrorism and Responses to Terrorism, 2015.

Table 4. The effect of terrorist shocks (terror>average) on the probability of male birth

	Model 1	Model 2	Mother fixed-effects		
			Model 3	Model 4	Model 5 FE logit
Terror	-0.044*** (0.015)	-0.044*** (0.015)	-0.080* (0.043)	-0.086** (0.044)	-0.213* (0.109)
Terror 1st trimester		0.004 (0.014)		0.012 (0.038)	0.029 (0.092)
Terror 2nd trimester		-0.000 (0.012)		0.001 (0.038)	0.007 (0.091)
Terror 3rd trimester		0.005 (0.012)		0.033 (0.037)	0.087 (0.093)
Individual controls	Yes	Yes	No	No	No
District controls	Yes	Yes	No	Yes	Yes
Fixed effects					
<i>Province</i>	Yes	Yes	No	No	No
<i>District</i>	Yes	Yes	No	No	No
<i>Month (conc)</i>	Yes	Yes	No	No	No
<i>Year (conc)</i>	Yes	Yes	No	No	No
<i>Mother</i>	No	No	Yes	Yes	Yes
<i>Year-month (conc)</i>	No	No	Yes	Yes	Yes
Observations	9757	9757	4162	4162	4162

Note: Significance levels: *** is <.01, ** is <.05, and * is <.10. Cluster-robust standard errors (clustered on districts (Models 1-2) or mothers (Models 3-5)) are in parentheses. Terror is a dummy for above the average monthly attacks in a district-year. Number of mothers in mother fixed-effects regressions: 1808.

FETAL LOSSES

- ◆ Terrorist shocks can affect the sex ratio at birth by altering primary sex allocation and/or causing fetal losses.
 - ◆ Add data on losses: 1757 fetal losses
 - ◆ 75% losses during first 4 months of pregnancy
- ◆ Track 1416 mothers who had fetal losses, but also gave live births (over the five years): mother fixed-effects regression (reduced sample)

Table 5. The effect of terrorist shocks on the probability of fetal death

	Model 1	Model 2	Model 3	Model 4
Terror pre-conception	0.064** (0.025)			0.060*** (0.021)
Terror month of conception		0.037 (0.027)		0.029 (0.021)
Terror 1st month of pregnancy			0.039 (0.026)	0.034 (0.022)
Individual controls	Yes	Yes	Yes	Yes
District controls	Yes	Yes	Yes	Yes
Fixed effects				
<i>District</i>	Yes	Yes	Yes	Yes
<i>Month (conc)</i>	Yes	Yes	Yes	Yes
<i>Year (conc)</i>	Yes	Yes	Yes	Yes
Observations	11345	11345	11345	11345

Note: Significance levels: *** is <.01, ** is <.05, and * is <.10. Cluster-robust standard errors (clustered on districts) are in parentheses. Terror is a dummy for frequent attacks (above the average monthly attacks in a district-year).

Table 6. Terrorist shocks and the probability of fetal death: mother FE regressions

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6 FE logit
Terror pre-conception	0.111*** (0.034)			0.100*** (0.034)	0.111*** (0.035)	0.331*** (0.111)
Terror month of conception		0.070** (0.035)		0.053 (0.036)	0.050 (0.037)	0.138 (0.112)
Terror 1 st month of pregnancy			0.048 (0.035)	0.027 (0.036)	0.028 (0.037)	0.088 (0.111)
District controls	No	No	No	No	Yes	Yes
Mother FE	Yes	Yes	Yes	Yes	Yes	Yes
Month-year (conc) FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3910	3910	3910	3910	3529	3476
N of mothers	1416	1416	1416	1416	1299	1262

Note: Significance levels: *** is <.01, ** is <.05, and * is <.10. Cluster-robust standard errors (clustered on mothers) are in parentheses. Terror is a dummy for frequent attacks (above the average monthly attacks in a given district-year).

SCARRING OR CULLING? (ALMOND & CURRIE 2011)

Adverse shocks may

- ◆ “scar” survivors – poor health
- ◆ make survivors healthier (positive selection)
- ◆ health at birth: worsens, improves or no effect (Valente 2015)

Table 7. Terrorist shocks and the probability of small birth size: mother FE regressions

	Model 1	Model 2	Model 3	Model 4	Model 6 FE panel	Model 7 FE logit
Terror pre-conception	-0.004 (0.017)				-0.005 (0.018)	-0.057 (0.178)
Terror 1 st trim of pregnancy		-0.017 (0.014)			-0.010 (0.015)	-0.072 (0.151)
Terror 2 nd trim of pregnancy			-0.004 (0.015)		-0.004 (0.015)	0.001 (0.149)
Terror 3 rd trim of pregnancy				-0.001 (0.015)	-0.001 (0.015)	-0.050 (0.144)
District controls	No	No	No	No	Yes	Yes
Mother FE	Yes	Yes	Yes	Yes	Yes	Yes
Month-year (conc) FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7210	7210	7210	7210	6293	1552
N of mothers	3295	3295	3295	3295	2915	677

Note: Significance levels: *** is <.01, ** is <.05, and * is <.10. Cluster-robust standard errors (clustered on mothers) are in parentheses. Terror is a dummy for frequent attacks (above the average monthly attacks in a given district-year).

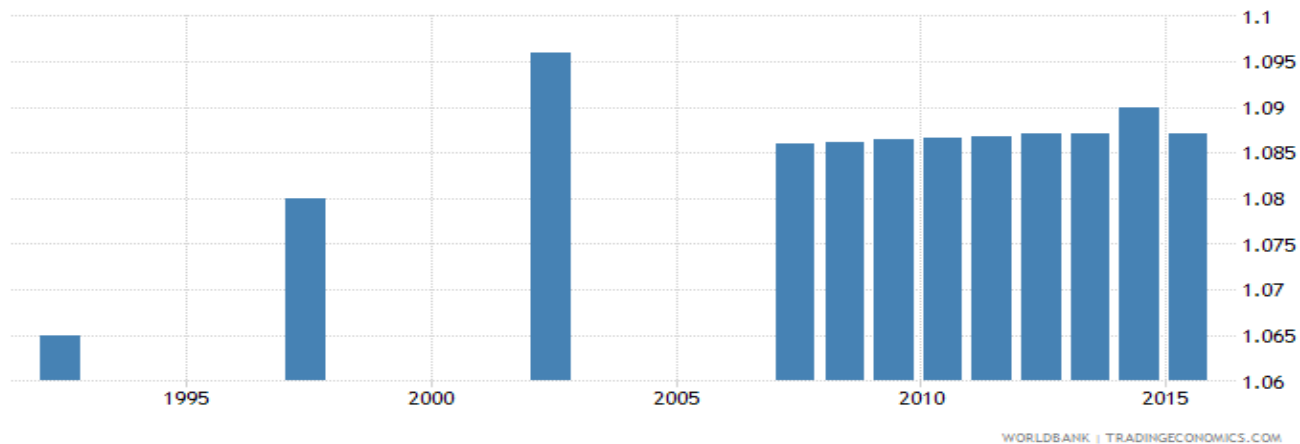
DISCUSSION

- ◆ Exposure to terrorist shocks prior to conception reduces the likelihood of male births and increases the probability of fetal death.
- ◆ *In utero* exposure to terrorist shocks has a positive effect on fetal losses but the effect is not robust.
- ◆ If necessary fetal health endowment to survive (and birth outcomes) differ by sex, then we need to better understand whether these differences translate into dissimilar human capital outcomes in adulthood.
- ◆ Valente (2015)
- ◆ Things to consider
 - ◆ Internal migration
 - ◆ Spillover
 - ◆ Stillbirth vs. miscarriage
 - ◆ In utero exposure
 - ◆ Sex ratio at death & primary sex ratio

ROBUSTNESS

- ◆ District level:
 - ◆ Poisson
- ◆ Individual birth:
 - ◆ sampling weights; survey regression; province-district pair & conception year-month pair effects with two-way clustered standard errors; logit regression

PUZZLE



- ◆ “Missing women,” Sen (1990)
- ◆ The number of missing women in Pakistan is 4.9 million, Klasen and Wink (2002)
- ◆ Sex-based discrimination, sex-selective abortions??
- ◆ “From Jan 2017 to Apr 2018, Edhi foundation and Chhipa Welfare organization have found 345 such new born babies dumped in garbage in Karachi only and 99 percent of them were girls,” (Durrani, The News, Apr 26, 2018)
- ◆ Pakistan Population Council Report (2014) estimates 2.25 million abortions annually and an abortion rate of 50 per 1,000 women ages 15 to 49

DESCRIPTIVE STATISTICS

Table 1. Descriptive statistics of variables at individual level

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Child sex	11331	0.51	0.50	0	1
Terror	11331	0.62	2.13	0	39
Birth order	11331	3.59	2.42	1	16
Multiple birth	11331	0.03	0.23	0	3
Inbreeding	11325	6.26	5.96	0	12.5
Smoking mother	11307	0.07	0.26	0	1
Age mother	11331	3.08	1.23	1	7
Age father	11187	4.11	1.52	1	10
Education mother	11331	1.38	1.84	0	5
Education father	11302	2.43	1.98	0	8
Wealth	11331	2.87	1.43	1	5
Urban	11331	0.42	0.49	0	1

DESCRIPTIVE STATISTICS (DISTRICT)

Table 2. Descriptive statistics of variables at district level

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Total births	4879	2.32	1.88	1	20
Total births log	4879	0.62	0.63	0	3
Male births	4879	1.18	1.24	0	15
Male births log	4879	0.65	0.51	0	2.77
Female births	4879	1.14	1.18	0	12
Female births log	4879	0.63	0.50	0	2.56
Terror	4879	0.41	1.76	0	39
Terror log	4879	0.17	0.45	0	3.69
Terror dummy	4879	0.15	0.36	0	1
Terr casualties	4879	3.13	21.42	0	613
Terr casualties log	4879	0.26	0.86	0	6.42
Population log	4879	13.88	1.14	11.36	16.14
Higher edu female	4324	33.52	20.66	0	77.17
Higher edu male	4324	63.71	11.84	17.97	86.90
Income	4324	9391.54	4241.19	1868.06	40708.25
Employment	4324	34.42	7.23	13.43	63.29
Public services	4324	3.38	1.70	0.13	8.28
Electricity	4324	90.53	14.06	10.26	100