The role of conflict in sex discrimination: The case of missing girls[*]

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ABSTRACT: The role of conflict has been largely overlooked in the literature on ”missing girls” and son preference. We argue that threat of conflict can be perceived as a menace for group selection, where group selective pressures reinforce preference for sons as the defenders of the group, whilst the incentives at the group level outweigh the incentives at the individual level. We test our hypotheses in the context of Nagorno Karabakh conflict between Armenia and Azerbaijan, as these countries have shown highly skewed sex ratios at birth in the recent decades. Using a unique municipality level data from Armenia with difference-in-differences estimation method, we find that during the ceasefire breaches sex-ratios at birth increased in the municipalities closer to the conflict epicenter. We check for the mechanism at the individual-level and show that those individuals who fear conflict the most express stronger preference for sons. Our findings are robust to various alternative measures and estimations.

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1. INTRODUCTION

The issue of ”missing girls” - females who would have been alive if their birth or survival had not been intentionally interrupted - has received much attention from the academics since Amartya Sen’s series of papers in the late 1980s. This work estimated that about 100 million women were “missing”, referring to the number of women in China who did not survive due to unequal access to healthcare and nutrition during childhood (Sen, 1990). The deviation from natural sex ratios at birth (around 105 boys for 100 girls per 1000 births) is viewed as a sign of revealed preference for sons in the society. The unusual sex ratios at birth in China and India have received considerable attention in the relevant literature. Son preference has been evaluated in terms of attitudes (Westoff and Rindfuss, 1974; Cleland et al., 1983; Haughton and Haughton, 1998; Kureishi and Wakabayashi, 2011), cultural norms (Li et al., 2000; Das Gupta et al., 2003; Fogarty and Feldman, 2011) and actions (Park, 1983; Sen, 1990; Coale, 1991; Klasen, 1994). Not only is such type of sex-discrimination a violation of human rights, it is also a sign for the existence of deep gender inequalities in the society (Branisa et al., 2014), which leads to limited opportunities for equal participation in the economy for half of the population (Sen, 1989). In the long run, gender bias in the economy translates into loss in economic growth and development (Lagerlöf, 2003).

Scholars have argued that the costs and benefits associated with boys and girls (Ben-Porath and Welch, 1976; Rosenzweig and Schultz, 1982) and parents’ perception of males as the most productive sex lead to son bias in the society (Ahn, 1995). By the same token, evidence shows that deterioration of women’s household bargaining power (Klasen, 1998) and their relatively low earnings potential (Qian, 2008) endangers female survival. Similarly, Rose (1999) and Das Gupta et al. (2003) suggest that the expected old age support from adult male children is one of the factors leading to the persistence of son bias in China, India, and South Korea.

Edlund (1999) puts it in a different perspective by modeling son preference in the context of marriage markets in India, suggesting that high income, upper class families have stronger preference for sons because the probability of mating is the highest for a well-off male. In her paper, Edlund (1999) adapts a related theory from a biological literature on parental ability to vary offspring sex ratios according to their expected reproductive success (Trivers and Willard, 1973). Her model suggests that beyond economic drivers, son preference is regarded as a long-term survival strategy for populations that pass on the family lineage through a male offspring. In fact, many studies on son preference argue that patrilineal kinship system is the underlying cause for sex ratio imbalances in Asian countries, which have experienced sharp fertility decline (and economic growth) in the recent decades (Das Gupta et al., 2003; Ebenstein, 2010; Li et al., 2011).

Moreover, Jayachandran (2017) shows that once the fertility declines, the strong preference for having at least one son in India leads to highly skewed sex ratios at birth due to sex-selective abortions. Yet, the conflict literature also shows that fertility decline can be a behavioral response towards an ongoing or expected conflict (see the literature review by Buvinic et al. (2013)). This suggests that there can be an evolutionary bias through which the expectation of conflict can lead to fertility decline followed by highly skewed sex ratios at birth.

Therefore, we hypothesize that the threat of conflict puts pressure on group survival and leads to exacerbated preference for male births (son preference) due to the perception that males are the group defenders. And this leads to highly skewed sex ratios at birth given the fertility decline. This especially applies to patrilineal kinship systems where the responsibility for carrying the lineage is granted to a male offspring. We find empirical support for our argument using a quasi-natural experiment involving Armenia, which has experienced one of the world's highest skewed sex ratios at birth (World Bank, 2015; Jack, 2017) and is one of the parties in the Nagorno Karabakh conflict.

Armenia presents an ideal case for testing our hypotheses derived from the main argument in this paper. It is a country involved in an ethnic and territorial conflict, where ceasefire breaches transmit constant threat to group survival. It is very small in size and homogeneous in terms of ethnicity, religion, language, equal rights (formally), patrilineal kinship system and very low levels of fertility. Also, access to ultrasound technology is given and sex-selective abortions are quite widespread (DHS, 2012). Moreover, we have two sets of unique data from Armenia that compliment each other. The first one is a municipality level panel data, which helps us to investigate the effect of ceasefire breaches on sex-ratios at birth. The second one is an individual level cross-sectional data that helps us to test for the mechanism through which such an effect takes place at the personal level.

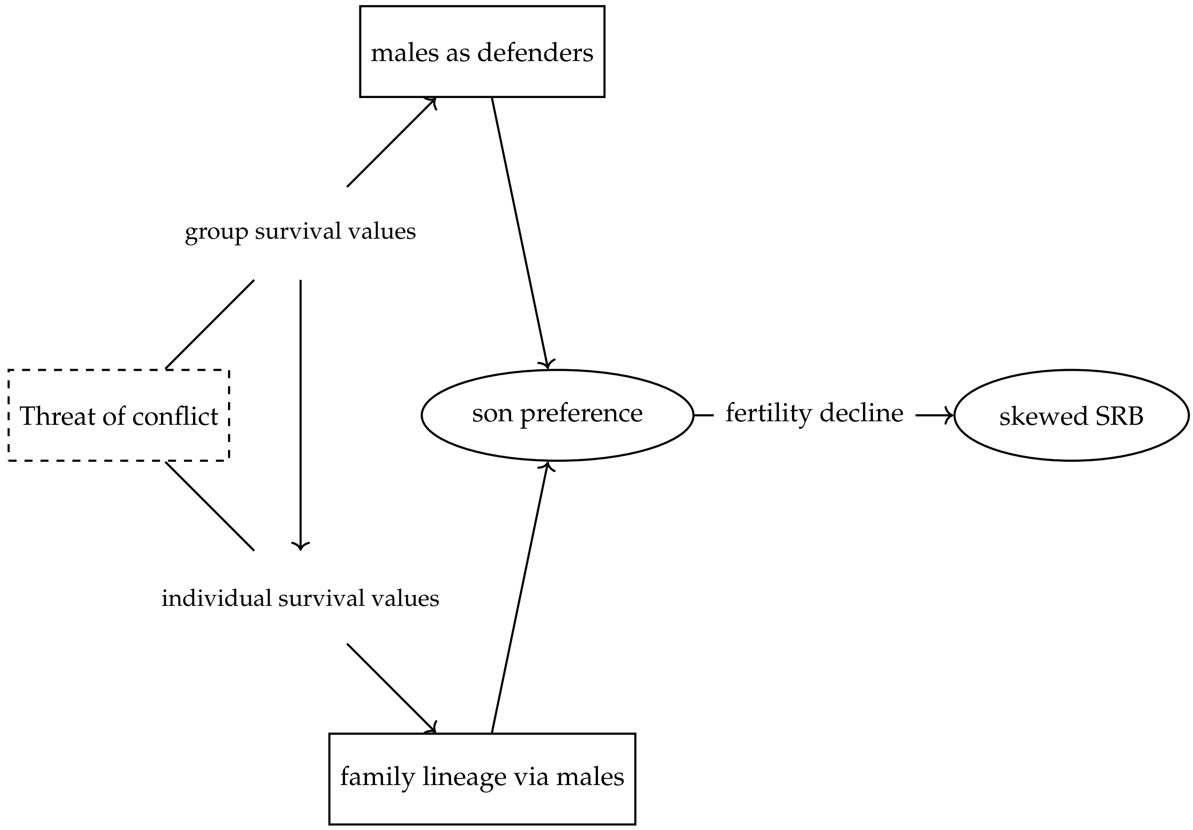
The rest of the paper reads as follows: In section 2 we argue that the fear of conflict and group survival pressures lead to exacerbation of son preference and highly skewed sex-ratios at birth, which leads us to derive two testable hypotheses. In section 3 we motivate the case of studying Nagorno Karabakh conflict for the purpose of our analysis. Section 4 presents the municipality level panel data and results from difference-in-differences analysis, showing that municipalities closer to conflict zone experience about 15 points higher sex ratios at birth in the period of ceasefire breaches. As per our argument, section 5 tests for the mechanism explaining the effect found in the municipality level analysis. The findings from the mirco level data show that individuals that fear conflict the most are 20 percent more likely to prefer sons over daughters.The final section concludes the paper.

2. Conceptual Framework

We argue that conflict is perceived as a threat to a group survival, where collective values outweigh individual values and exacerbate the preference for sons, as illustrated in Figure 1. Given fertility constraints and ability to manipulate the sex of one's offspring (sex-selective abortions), sex-ratios at birth start to deviate from its *natural* ratio. This is particularly relevant in patrilineal and patriarchal systems where preference for sons is traditionally determined.

McDermott et al. (2008) model choices and preferences related to the *survival of offspring*, which relate to life and death, reproduction and survival of the related ones. The authors suggest that in such conditions the individuals are more risk-seeking. According to (McDermott et al., 2008), situations when such fundamental choices need to be altered are not usual, however they exist under conditions of famines, combats, and other disasters associated with political contexts. In terms of preferences Voors et al. (2012) find that individuals who have been exposed to violent conflict are more risk-seeking and altruistic, confirming

Figure 1: Threat of conflict, son preference and sex ratios at birth



the predictions made by McDermott et al. (2008).[1] Das Gupta and Shuzhuo (1999) show that in China and South Korea, the largest number of girls ”missing” coincides with the episodes of war, famine and fertility decline in these regions in the mid 20th century. In the case of India, there is evidence that the large share of ”missing girls” comes from Northern part of the country (Das Gupta and Shuzhuo, 1999), which includes the regions exposed to ethnic and territorial conflict (e.g. Punjab and Kashmir insurgencies).

The preference for sons can be interpreted as a risky one. First, choosing a son over a daughter means sacrificing one of the pregnancies since only the former is perceived to increase the likelihood of the group's survival.[2] Second, selecting to have a son is a dangerous choice as the likelihood of males dying in the conflict is higher.

Evidence from experimental economics shows that in the presence of an external threat to a group's survival, individual preferences are derived from in-group preferences (Weisel and Zultan, 2016), which lead to a higher probability of group-conforming behaviour among the in-group individuals. In contrast, when the threat is at an individual level, the individual preferences are not overwritten by in-group preferences. Hence, one can deduce that

[1]A recent study by Ramos-Toro (2018) provides some evidence on adverse effects of conflict on gender inequality index.

[2]One might argue that the choice over a male offspring is not rational from an individual (mother's) perspective when a war is expected. However, as we argue, increased number of males is more likely to ensure the survival of the group - a perception that is shared among the group members due to the past histories of conflict, for example. This shared perception or norm puts pressure on individuals to reproduce a male offspring.

perceived external threat to a group survival such as conflict, can lead to choices that are more group-conforming or traditional, such as son preference.

Therefore, we argue that the threat of conflict in patrilineal societies makes the valuation of males as defenders of the group more salient. This exacerbates son bias in the society and leads to increased preference for a male offspring at the group level (Li et al., 2000). In result, framed by the group values, individuals perceive male offspring as the optimal choice for reproduction and group survival. In the presence of fertility decline, which itself adds an additional constraint over the individual choices, the increased preference for sons is manifested in the skewed sex ratios at birth given the access to modern technology.[3]

The biological literature explains the imbalances in sex ratios at birth during and (shortly) after war periods based on stress hormones, coital frequency and timing. However, the findings of this literature are rather ambiguous[4] and the predicted consequences for higher or lower sex-ratios at birth disappear shortly after the war.[5] In the case of such biological causes the historical equilibrium around 105 is expected to be restated in the long run, once the trigger is removed. Most importantly, the biological explanations are valid only when the sex ratios at birth cannot be manipulated.[6]

Thus, we test two hypotheses in line with our argument. *Hypothesis 1* tests the direct effect of threat of conflict, measured by the distance to the conflict zone, on the sex ratios at birth.

Hypothesis 1. The threat of conflict can lead to higher sex ratios at birth. [7]

Next, we argue that threat of conflict implies fear of war, which leads to group-survival preferences at the individual level. This in turn generates excessive preference for sons in a patrilineal societies, where males are perceived as the defenders of the group. Hence, we derive the second hypothesis to test this mechanism derived from our conceptual framework.

Hypothesis 2. The fear of conflict at the individual level exacerbates the initial preference for sons.

[3] Li et al. (2000) find that once fertility is maintained at the low levels, horizontal transmission (e.g., media, family and friends) of son-biased values increases the sex ratios at birth in regions where son bias has been initially high, but does not affect those individuals in regions where son-bias has been initially low.

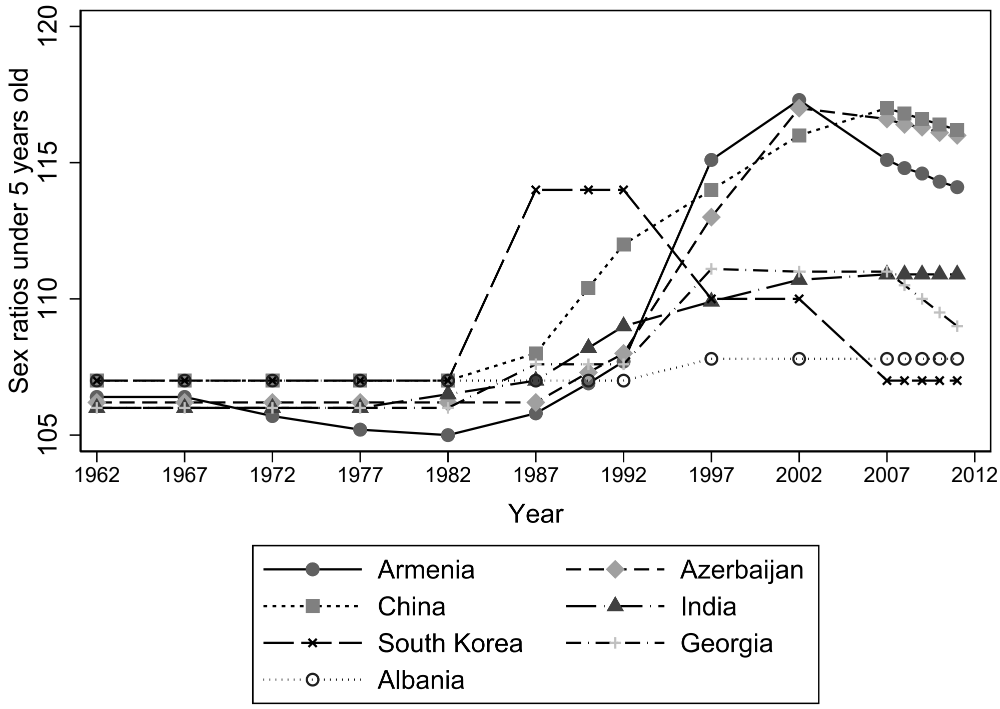
[4] According to Kemper (1994) and James (1997), higher coital frequency in the early stages of cycle increases the probability of having a male offspring and such behaviour is common when soldiers return home. Meanwhile, James (2009) and James and Valentine (2014) suggest that changes in stress hormones can explain the fall in sex ratios observed during and shortly after a wartime. However, when these two explanations are combined - psychological stress during war and coital rates right after war - the biological effect of wartime on sex-ratios at birth is rather unclear.

[5] In the context of World War II, Bethmann and Kvasnicka (2014) argue that tight marriage markets led to an increase in the percentage of boys among the newborns in Bavarian communities in Germany during and shortly after the war. However, they do not explore the mechanisms at play. Further empirical evidence from Tajikistan during the civil war in 1992-1997, from Bosnia-Herzegovina during the Yugoslavian war in 1991-1995, and the famine in Ukraine in 1933-1936, show that these episodes were followed by increases in male-female sex ratios at birth (Adamets, 2002; Hohmann et al., 2010). These effects faded away couple of years after the war and end of the famine.

[6] Note that highly skewed sex ratios at birth are not observed when there is no fertility decline as families then engage in stopping behaviour once a boy is born.

[7] This hypothesis assumes fertility below the replacement level and access to prenatal ultrasound technology.

Figure 2: Trends in highly skewed sex ratios under 5 years old, selected countries



Note. Sex ratios at birth (male births over female births) from 1962 to 2012 for countries with relatively high values, five year averages. Source: World Development Indicators (World Bank, 2015).

We test these hypotheses in the context of Nagorno Karabakh (also known as Republic of Artsakh) conflict between Armenia and Azerbaijan. The next section describes the context in detail.[8]

3. Context and Background

Since 1990s sex ratios at birth have been increasing beyond the boundaries of East and South Asia. As data from the World Bank (2015) show, the three countries in the South Caucasus and also a few in the Southeast Europe have seen sharp increases in sex ratios at birth.[9]As Figure 2 reveals, the sex ratios under 5 years old are in fact the highest in Armenia and Azerbaijan compared to the other countries in the two regions, reaching the levels observed in China.

These regions have also experienced recent conflicts. Among these are the Bosnian war (1992-1995), the Albanian civil war (1997) and the Kosovo war (1998-1999) in Southeast Europe. Conflicts in the South Caucasus include the Abkhazia conflict (1998), the Adjaria conflict (2004), the Kodori conflict (2006), the Russia-Georgia conflict (2008), and lastly, the

[8]Due to the data limitations we cannot directly test the magnitude of the correlation between distance to the conflict zone and the fear of conflict at the individual level.

[9]This study interchangeably uses sex ratios at birth and sex ratios at 0-4 ages. When it comes to data used in the analysis, it should be understood as sex ratios at 0-4 ages, i.e. under 5 years old.

conflict over the Nagorno-Karabakh region involving Armenia and Azerbaijan (Nagorno-Karabakh war 1992-1994), which also remains unresolved to date.

As media analysis and conflict resolution documents on Nagorno Karabakh point out, the threat of a conflict is a primary concern in Armenia not only at the governmental level, but also among the population (”Yeni Nesil” Journalists Union and Yerevan Press Club, 2009; De Waal, 2010; International Crisis Group, 2011). From the Armenian perspective, the conflict over Nagorno Karabakh is viewed as both ethnic and territorial issue related to national (group) identity. Hence, individuals within the group (Armenians) may regard this as a threat to a group’s (nation’s) survival.[10]

Background: Nagorno-Karabakh (NK), a majority Armenian-populated region, was assigned to Soviet Azerbaijan in the 1920s by the USSR government (The World Factbook, 2017) and since then was an autonomous region within Azerbaijan Soviet Socialist Republic (SSR). [11] In 1988, NK declared a union with Armenian SSR, and later in 1991, independence from Azerbaijan SSR (De Waal, 2003). However, neither the union with Armenia in 1988, nor the independence referendum were officially recognized by Baku as the referendum was boycotted by Azerbaijani population in NK. It was also regarded as unconstitutional by Azerbaijani government, based on Soviet constitution *de jure* in force at the time (De Waal, 2003; Freizer, 2014). This rejection led to a full blown war between Armenia and Azerbaijan over NK and led to massive displacements and ethnic killings on both sides (De Waal, 2003, 2010). Figure A1 in the *Appendix 1* shows the time-line of the events related to the Nagorno Karabakh conflict, and figure 3 presents the map of Nagorno Karabakh highlighting the territorial situation at the time of ceasefire agreement. From the Armenian and NK political standpoint, NK has been legally separated from Azerbaijan since December 1991 referendum and has been *de facto* independent as the 1992-1994 war resulted in Azerbaijan’s withdrawal from NK. Yet, the government of Azerbaijan rejects the referendum and the change of its territorial landscape and regards NK as an inseparable part of its territory (Freizer, 2014).

Ceasefire period: The ceasefire agreement in May, 1994 put a hold onto full-scale war. Yet, the clashes between Armenian and Azerbaijani troops have been increasing since 2008 in their frequency and intensity (International Crisis Group, 2011). The 2009 International Crisis Group, which is engaged with NK conflict resolution, warned on the difficulty of sustaining the Nagorno-Karabakh status quo (International Crisis Group, 2009), while the 2011 report (International Crisis Group, 2011) called for an urgent action to prevent a war between Armenia and Azerbaijan: ”An arms race, escalating front-line clashes, vitriolic war rhetoric and a virtual breakdown in peace talks are increasing the chance Armenia and Azerbaijan will go back to war over Nagorno-Karabakh. Preventing this is urgent” (p.1).

[10]Armenia has a largely homogeneous population in terms of ethnicity (98.1% Armenians), language (Armenian: 97.9%) and religion (92.1% Apostolic Christians)(The World Factbook, 2017). In addition, the relatively small size of the Republic of Armenia (population of 3,045,191), compared to Azerbaijan (population of 9,961,396; ethnic Azerbaijani: 91.6%; Azeri language: 92.5%; Shia Muslim: 96.9%) indicates that an ethnic and territorial conflict is likely to increase the perceived threat for a group’s survival according to the conceptual framework described in Section 2.

[11]In 1989, before the outbreak of Nagorno Karabakh war and the collapse of the Soviet Union, about 72 percent of the population in Nagorno Karabakh were Armenians and around 22 percent Azeris (USSR, 1991).

Figure 3: Nagorno Karabakh conflict: The map of unresolved territorial disputes

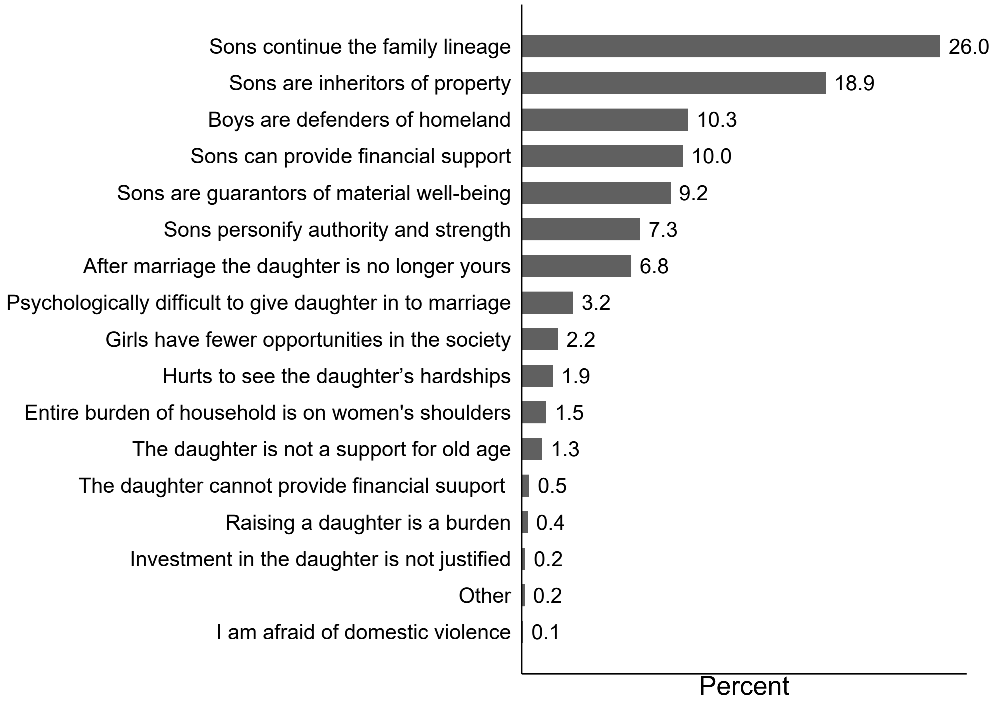
Note. Source: De Waal (2010), p.161

The role of males: Horizontal cultural transmission of group survival values is at play in the context of Nagorno Karabakh conflict. In particular, the Nagorno Karabakh conflict has indirectly created an environment were males are valued as the defenders of the country (Dudwick, 2015). A United Nations Population Fund (UNFPA) report from 2011 household and women survey on sex-selective abortions in Armenia (Abrahamyan et al., 2012), shows that the third most frequently given reason for son preference is: ”boys are defenders of homeland” (Figure 4). In addition, the published report shows that the prevalence of son preference in an individual's immediate environment (friends, neighbors) is higher than that of within own nuclear family (Abrahamyan et al., 2012, p.28).

Other contributing factors:Armenia has been characterized with low levels of fertility since late 1980s. Since 2000, it has been around 1.5, below the replacement level, with negligible variations from one year to another (World Bank, 2015). Moreover, due to various reasons, abortions in Armenia and in the wider South Caucasus have become a common method for controlling fertility levels and achieving desired sex composition of offspring (Michael et al., 2013; Dudwick, 2015), which is reflected in highly skewed sex ratios at birth. Hence, Armenia presents an highly relevant setting to test the link between threat of conflict, son preference and skewed sex ratios at birth.

In the next section we exploit a quasi-natural feature of ceasefire breaches to test *hypothesis 1*. Thereafter, we use an individual-level survey data from Armenia to test for the mechanism stated in *hypothesis 2*.

Figure 4: Reasons for son preference: Armenian households, 2011



Note. The source is the household survey conducted in 2011 within the framework of Strengthening Sexual and Reproductive Health Services project (Abrahamyan et al., 2012). Responses are based on survey question asked in the sub-sample of women who express son preference: "Why does your family give preference to sons rather than to daughters?" More than one answer could be given.

4. Ceasefire violations and sex ratios at birth

In this section we test *hypothesis 1* from section 2 using difference-in-differences estimation method at the municipality level before and after the ceasefire breaches over Nagorno Karabakh conflict between Armenia and Azerbaijan.

Data. The outcome variable we are interested in at the municipality level is the sex ratios at birth. We use a unique data on sex ratios from 2001 and 2011 population censuses of Armenia, provided by the National Statistical Service of Armenia. The dataset comprises of 76 municipalities, including the capital city of Armenia, Yerevan.[12]

In the census data the age of individuals is not reported in a singular way but in terms of age groups with five-year intervals, such as 0-4, 5-9, 10-14, 15-19, 20-24, and so on. Hence, we use this data and retrospectively calculate the sex ratio under five years old, based on the number of boys and girls that would be under five years old in the following periods: 1987-1991, 1992-1996, 1997-2001, 2002-2006, and 2007-2011. We then match this data with with pre- and post-ceasefire periods.[13] One drawback of this aggregation is that it ignores

[12]Armenia has 11 administrative divisions, including 10 provinces (marzes) and the capital - Yerevan. The median number of municipalities in a province is 6, with a minimum number of 3 and maximum of 15 across the provinces.

[13]If individuals have migrated but not officially changed their residence status before the birth of the child, then their migration is not registered in the *de jure* data.

the child mortality within 0-4 age group, however it is likely to be low as infant mortality rate in Armenia was below the world average in 1990 (37.9 infants per 1000 live births) and it decreased further to 15.3 in 2011 (World Bank, 2015).[14] Note that the ceasefire agreement was in 1994, but in our study the period stretches to 1996 due to the matching with the age group intervals.

Our latent (explanatory) variable of interest at the municipality level is the perceived threat of conflict associated with the post-war ceasefire breaches. In the post-war period, the ceasefire breaches did not take place at any of the municipalities in Armenia but rather in Nagorno Karabakh and at the line of contact (see Figure 3). Nevertheless, the threat of conflict is highly present among the Armenian population in the Republic of Armenia. A panel data on perceived threat of conflict at the municipality level is not available but that, nevertheless, would have been endogenous, making it difficult to identify the causal relationship. In terms of an exogenous variable, geographic distance is commonly used in the literature as an instrument or a proxy variable for measuring differences in conflict exposure or access to markets (Voors et al., 2012; Verwimp and Van Bavel, 2013).

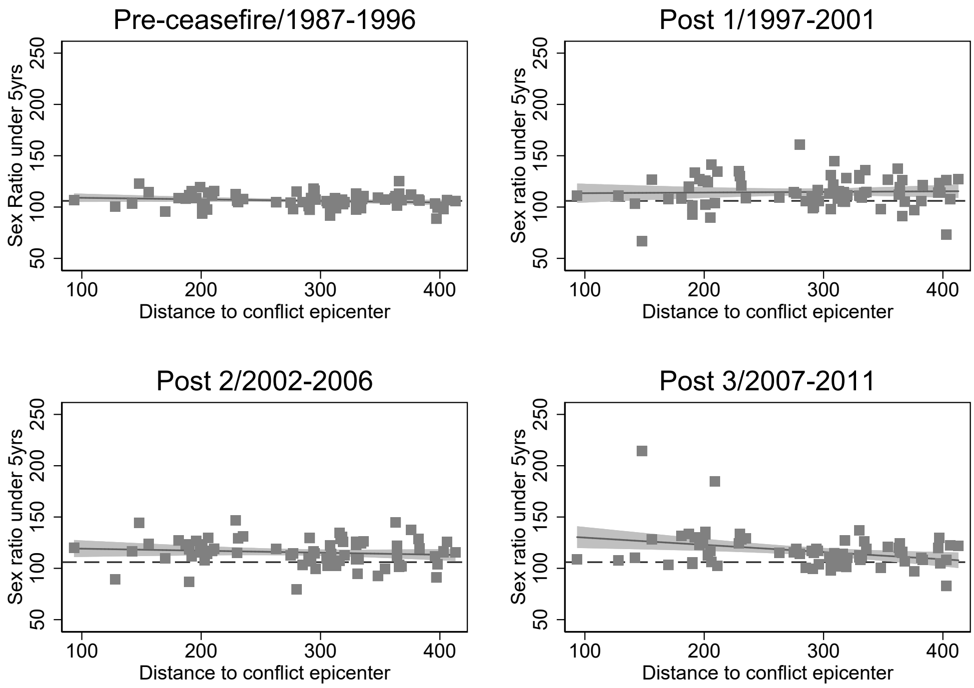
Therefore, we expect variation in the perceived threat of conflict based on the distance between the municipality and the conflict epicenter. Figure A2 in the *Appendix 1* depicts data from the Uppsala Conflct Data Program (UCDP), which shows that most of the battle-related deaths during the war took place around *Stepanakert* and its surrounding villages. As shown in Figure A3, also, in the post-ceasefire period the largest number of battle-related deaths were in the proximity of Stepanakert at the line of contact. Stepanakert is the capital of Nagorno Karabakh, it was also the capital of this region during the Soviet Union (Stepanakert is referred as Khankendi from Azeribaijan's perspective). Thus, we use travel distance (in km) to political epicenter of conflict (Stepanakert) - as proxy measure for perceived threat of conflict at the municipality level.

When it comes to skewed sex ratios at birth that are known to be due to sex-selective abortions (DHS, 2012), one of the relevant control variables would be access to ultrasound technology. Since there is no actual data at the municipality level on the local availability of ultrasound technology, we assume that the most reliable technologies would be first located in clinics located in the capital of Armenia, Yerevan . Hence, we measure the degree of access to ultrasound technology by calculating the travel distance to Yerevan (see its location in Figure 3), which is also the early adopter of new technologies.

In Figure 5 we look at linear prediction plots for the correlation between distance to conflict epicenter and sex ratios at birth in four periods. The horizontal dashed line in the middle shows the natural sex ratio at birth, which is 106 male births for 100 female births per 1000 births (this number corresponds to the world average and is usually seen as the natural sex ratio at birth). The black squares show the municipalities in terms of sex ratios at birth and distance to the conflict epicenter. The upper left graph shows that there is no correlation between travel distance to conflict epicenter and sex ratios at birth in the pre-ceasefire period, which we also do not expect. In the post-ceasefire period there is a larger deviation from the natural ratio that starts in Post 1 (1997-2001) period and continues increasing in Post 2 (2002-2006) and Post 3 (2007-2011) periods. Moreover, in the last period (Post 3/2007-2011)

[14] The world average infant mortality rate in 1990 was 60.7 per 1000 live births.

Figure 5: Travel distance to conflict epicenter and sex ratios under 5 years old in pre- and post-ceasefire periods



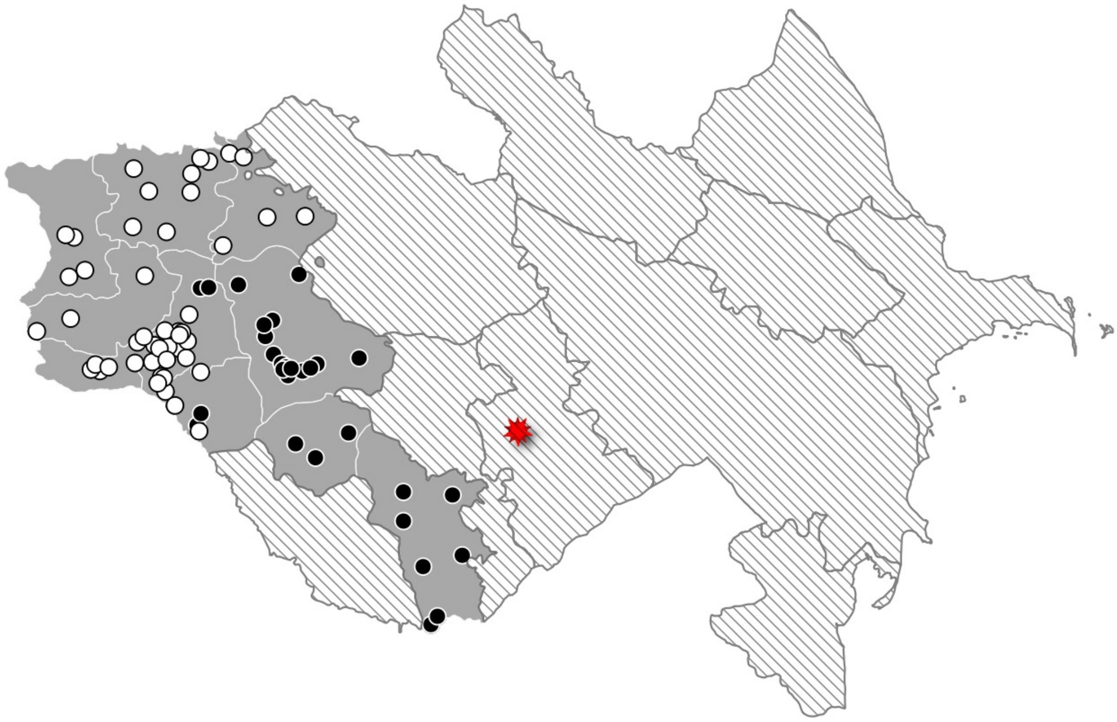
Note.Linear prediction plots with 95 percent confidence intervals for the outcome variable SRB in pre- and three post-ceasefire periods. The vertical axes denote sex ratios under 5-years old. The horizontal axes denote distance to the epicenter of conflict zone- Stepanakert - for each municipality in the sample. The gray squares denote observations for each municipality in the sample. The dashed line in each graph represents sex ratios at 106, which was the natural normal before the war.

one can observe a clear negative correlation between distance to conflict epicenter and sex ratios at birth, which is the period when ceasefire breaches intensified.

Based on these observations, we divide our sample of municipalities into treatment and control groups, and take the average distance to the conflict epicenter as the cut-off point, which is arbitrary but we address in the tests for robustness in the empirical part. Municipalities are assigned to the treatment group if their distance to to epicenter is less than the cut-off, otherwise they belong to the control group. See the map of 'treated' and 'control' municipalities in Figure 6.

Figure 7 shows gives an idea about the pre-trends in sex ratios at birth in municipalities assigned to treatment and control groups. One can observe that the sex ratios at birth in the treatment group are at a higher level than in the control group. Yet, the treatment and control groups have a common trend before the ceasefire (Post 1/97-01), but in the first to second post-ceasefire periods (Post 2/02-06) there is a slight divergence. From the second to the third post-ceasefire period (Post 3/07-11) we observe quite divergent paths between treatment and control municipalities, where the SRB increases even further in the treatment group while it decreases in the control group. This figure shows that as the ceasefire breaches

Figure 6: Treatment and control municipalities



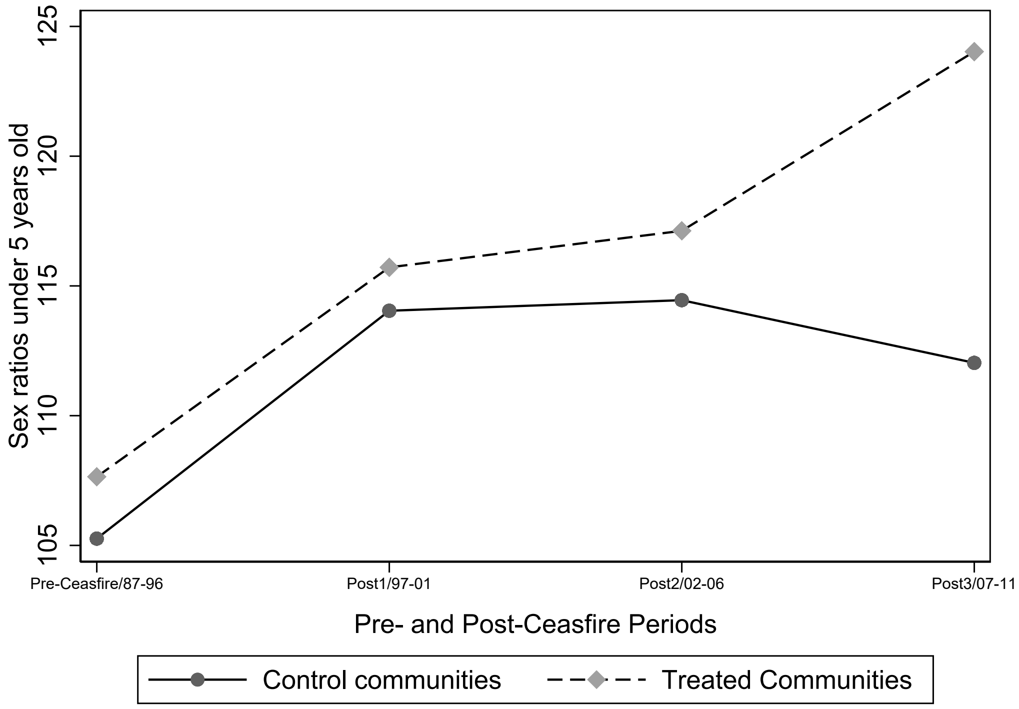
Note. The geographic area of Armenia is highlighted with dark gray background and the geographic area of Azerbaijan is highlighted with a lined pattern. Black dots denote municipalities in the treatment group and white dots denote municipalities in the control group. Selection into 'treatment' is based on an arbitrary cut-off point, which is the mean travel distance to the epicenter of conflict - Stepanakert, denoted with red. Notice the epicenter is one-sided and is located beyond the official Armenian borders, as it is the political center of Nagorno Karabakh region, which is within the official borders of Azerbaijan.

intensify the trends become dissimilar and the divergence in sex ratios at birth between the two groups becomes larger.

With this descriptive analysis at hand, which supports our hypothesis, next we use difference-in-differences estimation approach in an attempt to identify the effects of threat of conflict on the sex ratios at birth, as a manifestation of son preference.

Estimation. We use difference-in-difference estimation strategy to identify the effects of ceasefire breaches - threat of conflict- on the sex-ratios at birth in treatment and control municipalities, using data for pre- and post-ceasefire periods. On the one hand, the aggregation of the war period with the pre-war period normalizes the distribution of the sex-ratios at birth before the ceasefire, and, on the other hand this solves any possible serial correlation problems before the treatment at a municipality level (Bertrand et al., 2004). Although we use three post-ceasefire periods, the period of our interest is the last, third period, when the ceasefire breaches intensified. The outcome variable here is the sex-ratios under 5 years old at the municipality level, while treatment and control municipalities are defined based on the distance to the epicenter of conflict as described above.

Figure 7: Trends in sex ratios under 5 years old in treatment and control municipalities



Note.Trends in sex-ratios at birth under 5 years old (horizontal line) in the municipalities assigned to treatment and control group for the pre- and three post-ceasfire periods.

We estimate a panel data regression of the following form:

$$SRB_{ct} = \alpha + \beta Treat_c + \sum_{t=1}^{3} \gamma_t Post_t + \sum_{t=1}^{3} \theta_t (Treat_c * Post_t) + \delta CloseCapital_c + \\ + \sum_{t=1}^{3} \zeta_t (Post_t * CloseCapital_c) + \sum_{c=1}^{N} \eta_c (C_c * t) + \mu_c + \epsilon_{ct} \tag{1}$$

where SRB_{ct} is the outcome variable - male over female sex ratios under 5 years old - in municipality c in period t. α is the constant term that denotes the differences in average SRB_{ct} when $t = 0$. $Treat_c$ equals 1 if the municipality c is in the treatment group, otherwise it is in the control group and equals 0. $Post_t$ are the period dummies after the ceasefire. The reference period is the pre-ceasefire period ($t = 0$). $\sum_{t=1}^{3} \theta_t (Treat_c * Post_t)$ interaction term is the difference-in-differences estimator for each post-ceasefire period. It identifies the periodic average effects of ceasefire breaches on the municipalities in the treatment group relative to those in the control group.

$CloseCapital_c$ is travel distance to the capital city of Armenia (Yerevan) from each municipality and $\sum_{t=1}^{3} \zeta_t (Post_t * CloseCapital_c)$ denotes period interaction terms with the distance to the capital city of Armenia (Yerevan).[15] These variables tease out the municipality level

[15]Migration out of the municipalities is not included due to unavailability of data, which should rather result in a downward bias in our estimates.

differences in access to ultrasound technology. They also control for other municipality-specific, time-invariant and linearly time-varying factors that correlate with the remoteness of the municipality, such as distance to the labor and product markets, access to better education and health facilities, migration tendencies, and etc. These additional distance variables and interaction terms strengthen the identification strategy.

The term $\sum_{c=1}^{N} \eta_c(C_c * t)$ captures the municipality level linear time trend that we include to control for the time-varying (linear) municipality-specific effects. This term also relaxes the common trend assumption of the difference-in-difference setting, even though a graphical illustration suggests that it holds. μ_c denotes municipality level fixed effects to control for time-invariant and municipality-specific factors such as differences in altitude, historical differences in mode of development (agricultural/industrial), type of residence (urban/rural), and alike. ϵ_{ct} is the error term clustered at the municipality level (Bertrand et al., 2004).

Thus, in equation 1, the identification comes from within municipality deviations from pre-existing municipality-specific time trends caused by the ceasefire breaches ($Post_3 * Treat_c$). We control for unobserved municipality-specific time-invariant effects (μ_c), municipality-specific time trends ($\sum_{c=1}^{N} \eta_c(C_c * t)$), general time trends common for all municipalities ($Post_t$) and other non-NK related factors changing over time ($\sum_{t=1}^{3} \zeta_t(Post_t * CloseCapital_c)$).[16]

We are mainly interested in the coefficient of the interaction term of $Post_t * Treat_c$ when $t = 3$: we expect to observe the 'treatment effect' in the period from 2007-2011 when ceasefire breaches intensified (International Crisis Group, 2011).

Results. Table 1 presents the main results for the municipality level analysis based on equation 1. In column 1 of Table 1 we estimate the differential effects of post ceasefire periods on the treatment and control municipalities without controlling for the distance to capital city - Yerevan. The coefficient of the interaction term Treat=1×Post=3 shows that in the third period after the ceasefire, when the clashes started to intensify, the sex ratios at birth increased by 9 points in the treatment municipalities relative to the control municipalities, statistically significant at the five percent level.

In column 2 of Table 1, we separately test the effects of access to ultrasound technology ($ClosetoCaptial$) and non-NK conflict related factors on SRB by excluding the $Treat$ variable. $ClosetoCaptial$ is a binary variable that equals 1 if a municipality's distance to the capital city Yerevan is less than the sample average. The results in column 2 show that distance to Yerevan is associated with an increase in SRB only in the first period after the ceasefire. Beyond the first period, the distance to the capital city of Armenia does not explain the differences in SRB across municipalities. That is any other factors that are correlated with the a municipality's distance to Yerevan do not have any differential impact on sex ratios at birth in municipalities closer or further away from the conflict epicenter.

In column 3 of Table 1 we add the interaction terms of $\sum_{t=1}^{3} \theta_t(Treat_c * Post_t)$, and observe that the period effects for Post=1 and Post=2 are smaller compared to the results in column 1, which implies that much of the increase in SRB during the first post-ceasefire periods is

[16] Data from Armenia Demographic and Health Surveys (DHS) shows that fertility ratios across Armenian provinces and municipalities do not differ from each other at conventional levels of statistical significance, based on own calculation of authors. DHS data and the census data used in the analysis match only on 40 municipalities, i.e. cities and towns. The rest of the DHS locations are very small villages with less than 5000 inhabitants(DHS, 2012).

Table 1: Post-ceasefire effects using treatment and control groups

Control variables	(1)	(2)	(3)	(4)
Post=1	8.782***	4.334	2.082	-5.188
	(2.245)	(3.044)	(4.064)	(4.615)
Post=2	9.711***	7.928***	6.965*	-6.944**
	(2.078)	(2.111)	(3.616)	(3.389)
Post=3	7.296***	12.965***	7.452**	-13.307***
	(1.766)	(3.695)	(3.286)	(1.896)
Treat=1 × Post=1	-0.711		3.686	6.453
	(4.020)		(4.405)	(5.870)
Treat=1 × Post=2	-0.233		1.576	6.079
	(3.383)		(4.372)	(4.075)
Treat=1 × Post=3	9.088**		9.021**	15.604***
	(4.511)		(4.325)	(2.207)
Close to Capital =1 × Post=1		7.935**	9.543**	15.153***
		(3.714)	(4.202)	(5.162)
Close to Capital=1 × Post=2		3.194	3.885	16.766***
		(3.271)	(4.241)	(3.718)
Close to Capital=1 × Post=3		-4.204	-0.371	19.226***
		(4.089)	(3.651)	(2.118)
Constant	106.035***	106.070***	106.064***	106.237***
	(0.869)	(0.877)	(0.858)	(0.967)
Municipality time trend	No	No	No	Yes
Municipality FE	Yes	Yes	Yes	Yes
Number of municipalities	76	76	76	76
Observations	298	298	298	298

Note.The dependent variable is SRB: male over female sex ratios at 0-4 ages. Standard errors are clustered at the municipality level. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels.

not related to NK conflict. Nevertheless, in the third period we observe that the treatment group, municipalities close to the conflict epicenter, experienced additional increase in the SRB (Treat=1×Post=3) statistically significant at the 5 percent level.

While Figure 7 shows that common trends assumption holds for the treatment and control groups, in column 4 we relax this assumption by including municipality-specific linear time trends as defined in equation 1. Once the municipality-specific time trends are included, we observe that the size of the treatment effect in the third period increases by 6 points, statistically significant at the 1 percent level. In addition, the interaction terms with the $Closeto Captial$ also become statistically significant in all three periods. Thus, the marginal effect for the treatment municipalities is 15 points higher SRB (e.g. 121) in the third period when ceasefire violations started to intensify (2007-2011).

In Table 2 we test for the robustness of the result reported in column 4 of Table 1. As figure 5 shows, there are two municipalities in the sample that seem to be outliers in the Post 3 period. Therefore, in column 1 of Table 2 we re-estimate the model by excluding the two outliers. Our main results remain robust to this change.

Table 2: Municipality model: Robustness tests

Control variables	(1) w/o outliers	(2) 25th percentile	(3) placebo
Post=1	-3.705	0.091	5.896*
	(4.397)	(3.015)	(3.329)
Post=2	-5.909*	-7.670***	2.641
	(3.300)	(2.254)	(2.559)
Post=3	-13.158***	-15.910***	2.672**
	(1.885)	(1.333)	(1.284)
Treat=1 × Post=1	10.109**		
	(4.930)		
Treat=1 × Post=2	8.632**		
	(3.574)		
Treat=1 × Post=3	15.972***		
	(2.180)		
Close to Capital=1 × Post=1	12.979***		9.037*
	(4.761)		(5.298)
Close to Capital=1 × Post=2	15.247***		7.415**
	(3.534)		(3.597)
Close to Capital=1 × Post=3	19.008***		7.515***
	(2.095)		(2.242)
Treat25=1 × Post=1		4.890	
		(4.757)	
Treat25=1 × Post=2		10.266***	
		(3.436)	
Treat25=1 × Post=3		18.293***	
		(1.823)	
Close to Capital25=1 × Post=1		10.846**	
		(4.764)	
Close to Capital25=1 × Post=2		18.558***	
		(3.357)	
Close to Capital25=1 × Post=3		21.798***	
		(1.793)	
GyumriDist=1 × Post=1			-5.365
			(5.540)
GyumriDist=1 × Post=2			-0.692
			(3.799)
GyumriDist=1 × Post=3			-4.248*
			(2.352)
Constant	105.941***	105.941***	105.941***
	(0.693)	(0.707)	(0.697)
Municipality time trend	YES	YES	YES
Municipality FE	YES	YES	YES
Number of municipalities	74	74	74
Observations	290	290	290

Note.The dependent variable is SRB: male over female sex ratios at 0-4 ages. Standard errors are clustered at the municipality level. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels.

Since the landmass of Armenia is quite small, a few of the municipalities are in the treatment group and also in the group that is Close to Capital. To deal with this issue of confounding effects, we re-assign the municipalities into two different groups based on the cut-off of 25th percentile instead of the mean distance. Thus, those municipalities that are in the 25th percentile of the distance to conflict region are assigned to the treatment group, Treat25. Similarly, those municipalities that are in the 25th percentile of the distance to the capital - Yerevan - are assigned to the Close to Capital25 group. This change in the cut-off point also addresses concerns related to the arbitrary choice of the average distance for the cut-off point in the main estimations. Results in Column 2 of Table 2 show that in the second and the third periods the SRB is 10 and 18 points higher in the Treat25 group, statistically significant at the 1 percent level. This implies that at a closer proximity the perceived threat of conflict is larger and observable also in the second post-ceasefire period. This further supports our argument and the choice in proxy variable for the threat of conflict.

Last but not least, in column 3 of Table 2, we run a *falsification* test by wrongly defining the treatment group as those municipalities who have less than average distance to a northern city in Armenia that is close to the Turkish border, Gyumri, also the second largest city in Armenia. While Armenia has historically-determined testy relationship with Turkey, there has been no recent conflict on that border, hence, we do not expect any strong and positive effects in this case. The results on the interaction term between *GyumriDist* and the period dummies do not show any statistically significant relationship. In third period, there is a small and negative relationship between distance to Gyumri and SRB, statistically significant at the 10 percent level. This *falsification* test confirms that our results are not driven by some type of unobserved heterogeneity correlated with distance itself but rather with the fact that being close to the conflict region leads to an increase in SRB. Based on our argument this is due to the differences in the perceived threat of conflict, while distance to the conflict epicenter is a proxy measure for that.

The next section tests *hypothesis 2* on the underlying mechanism of the link between ceasefire breaches, threat of conflict and sex ratios at birth, which is motivated by our argument illustrated in Section 2 .

5. Mechanism: Fear of conflict and preference for sons

We test *hypothesis 2* by studying the individual-level correlations between son preference and the fear of war.

Data. We use a unique data drawn from the Caucasus Barometer (CB), an annual nationally-representative household survey on a wide range of demographic, social, economic and political variables conducted by the Caucasus Research Resource Centers (CRRC) since 2004. The CB is one of the few high-quality datasets in the countries of the South Caucasus and has been used in other published studies on the region (e.g., Habibov and Afandi, 2011; Antinyan, 2016; Mavisakalyan and Meinecke, 2016; Mavisakalyan, 2018).

We use the 2010 wave of the survey since it includes information on the respondents' son bias not available in the other waves. This also matches the last period of the intense ceasefire breaches analyzed at the municipality level in Section 4. Our sample consists of adults aged 18-80 years old, comprising 97% of the raw sample.[17] The baseline analysis includes 1,676 non-missing observations.[18]

Table B1 in the *Appendix 2* presents the descriptive statistics for the main variables used in the analysis. We define *fear of conflict* using questions on the prioritization of the two (out of eighteen given) most important issues facing the country. In particular, the variable FEAR OF CONFLICT takes on the value 1 if a respondent reported either Insurance of Peace or Territorial Integrity as one of their top concerns and 0 otherwise. In our sample 21 per cent of people have a *fear of conflict*.

We denote the dependent variable for son preference as SON BIAS, which equals 1 if the respondent's preferred sex for a single-child family is a boy and 0 otherwise. While 54 per cent of all respondents have preference for sons, it is significantly more prevalent among those who have FEAR OF CONFLICT compared to those who do not (a difference of 14 percentage points) as shown in Table B1.

Our analysis controls for the standard demographic and socio-economic characteristics of individuals as well as for the urban/rural residence, see B1 in *Appendix 2*. We allow the preferences for the sex of the offspring to differ by the respondents' gender, age and family status by including control variables for these characteristics.[19] We additionally control for the education level of individuals, which appear to be positively correlated with the fear of conflict: Of all individuals with university degree, twenty-two per cent do not have a fear of conflict while 27 per cent have a fear of conflict (see Table B1).[20] This goes against a possible argument that fear of conflict can be related to the lack of education. Similarly, the descriptive statistics in Table B1 show that among individuals who have fear of conflict, 43 per cent are employed; this is considerably higher than the employment rate of 38 per cent among those with no fear of conflict. Moreover, the share of individuals with self-reported good economic standing is slightly higher among those who have fear of conflict compared to those who do not have it. Thus, the descriptive data in Table B1 in the *Appendix 2* shows that larger share of highly educated, employed and economically well-off individuals have fear of conflict.

Estimation. We evaluate the baseline relationship between fear of conflict and son bias by constructing an estimation model in which the propensity for son bias, $Bias_i^*$ for an individual i is assumed to depend on the fear of conflict, $Fear_i$ together with series of additional

[17] The remaining 3 per cent are those over the age of 80. The results are largely insensitive to the presence of these individuals.

[18] The number of missing observations for the key variables of interest is small; e.g. data on the variables used in the construction of measures for son bias and conflict as a primary concern are missing for 0.64 per cent of individuals only.

[19] While we distinguish between individuals with or without a partner, we do not include the number of children as a control in the baseline regressions since differences in the fertility decisions are endogenous in our context. Controlling for the number of children the respondent actually has for the ideal number of children s/he thinks a family should have does not change the results; these variables are also insignificant throughout. The results are available upon request.

[20] The definitions are based on the number of years of education associated with the three levels of attainment, following the approach taken in previous studies (Duncan and Mavisakalyan, 2015; Mavisakalyan, 2018).

controls X_i for demographic, socio-economic and location characteristics. Unobserved factors ε_i further contribute to the propensity for son bias, leading to an equation of the form

$$Bias_i^* = X_i\beta + \delta Fear_i + \varepsilon_i \text{ for all } i = 1, ..., N. \tag{2}$$

Observed son bias $Bias_i$ is assumed to relate to latent propensity through the criterion $Bias_i = 1(Bias_i^* \geq 0)$, so that the probability of having a son bias under an assumption of normality for ε_i becomes

$$Pr(Bias_i = 1|X_i, Fear_i) = \Phi(X_i\beta + \delta Fear_i), \tag{3}$$

with marginal effect of fear of conflict derived from the estimated model thus:

$$\frac{\partial Pr(Bias_i = 1|X_i, Fear_i)}{\partial Fear_i} = \delta\phi(X_i\beta + \delta Fear_i). \tag{4}$$

Results. Table 3 presents the marginal effects in equation (4) evaluated at the sample means. We start with a parsimonious specification which excludes the additional controls X_i. Consistent with the descriptive statistics, the estimated marginal effect for this parsimonious model reported in column 1 confirms a significant and positive relationship between FEAR OF CONFLICT and SON BIAS.

Next, we add a set of control variables one by one to identify which observable variables influence the correlation between FEAR OF CONFLICT and SON BIAS. The results reported in column 2 demonstrate that males are more likely to hold a son bias than females. Interestingly, age is negatively related to the probability of son bias, while having a partner has no statistically significant effect. Controlling for these variables does not affect the positive and statistically significant relationship between FEAR OF CONFLICT and SON BIAS.

Educational attainment of individuals is accounted for in the estimates reported in column 3, where the reference group is individuals with no education. It can be observed that university-educated individuals are less likely to hold son bias relative to those with lower educational attainment. While the estimates on EDUC$\leq$ 10 and EDUC 11-14 are economically and statistically significant, their inclusion leaves the estimated marginal effect on FEAR OF CONFLICT largely unaffected. In column 4 we report the marginal effects with further control variables for the employment and relative overall economic standing of individuals. We do not find a significant relationship between these variables and SON BIAS, while the significant positive effect of FEAR OF CONFLICT persists. These findings imply that the result from the descriptive statistics (see Table B1) on the higher prevalence of fear of conflict among the more educated, employed and economically well off does not have a statistical power to offset the stand-alone effect of FEAR OF CONFLICT on SON BIAS.

Last but not least, in the last column of Table 3 we account for the possible differences in son bias driven by urban and rural population. We observe that those who live in rural areas are more likely to have a son bias, relative to those living in the urban areas, statistically significant at the one per cent level. This result partly drives the relationship between FEAR OF CONFLICT and SON BIAS as we observe reduction in the size of the coefficient on the FEAR OF CONFLICT. Thus, the marginal effect of changing FEAR OF CONFLICT from zero to one, after accounting for the entire list of baseline covariates, is equal to 12.2 percentage points. This implies that the probability of having a son bias is almost 23 per cent higher for those with fear of conflict.

These results establish a statistically significant and positive relationship between FEAR OF CONFLICT and SON BIAS, after controlling for a set of observable characteristics. In addition, in *Appendix 2* we demonstrate that the correlation largely persists when alternative measures of FEAR OF CONFLICT (see Table B2) and SON BIAS (see Table B3) are employed as well as when we limit the analysis to specific groups of individual based on education, gender and age groups (see Table B4).

These results support our second hypothesis and suggest that the effect of conflict proximity on the sex ratios at birth found in Section 4 can be explained by stronger preference for sons among those that have stronger concerns over peace and territorial integrity in their country, and subsequently, about the group survival. However, we recognize that in this cross-sectional setting there are unobserved characteristics not captured in the baseline regressions, which may lead to biased estimates. Therefore, in the next section we check for the robustness of our findings by addressing these biases using instrumental variable as well as matching approach.

Tests for robustness. We (partly) address the issue of omitted variable bias by adding proxy variables for unobserved factors that could be correlated with the unexplained components of SON BIAS. The results of this analysis are presented in Panel A of Table 4. Column 1 in Table 4 restates the results of the baseline model with no additional controls.

One of the most suspected omitted variables in the analysis could be nationalist attitudes among individuals who also happen to have stronger concerns for peace and territorial integrity, coded as FEAR OF CONFLICT in this study. In fact, as the results in column 2 of Table 4 show only the variable on RACIAL TOLERANCE, which is our proxy measure for conservative and nationalist attitudes, has statistically significant (and negative) effect on SON BIAS. It is constructed based on individual's approval of marriage with Chinese people. The choice of this population group is largely driven by the data availability (e.g. there is no information on attitudes to African people in the dataset).

Other proxy variables, such as proficiency of Russian language (RUSSIAN FLUENT, RUSSIAN NATIVE), which measures broader dimension of human capital in the post-Soviet context (Duncan and Mavisakalyan, 2015; Mavisakalyan, 2017), number of overseas trips in the past five years and religiosity (NO OVERSEAS TRIPS and RELIGIOUS MAJORITY), which are alternative proxy measures of conservative attitudes, as well as measures of individual vulnerability (HAS CLOSE PEOPLE, FEELS EMPTINESS) and relevant institutional trust (DISTRUCT IN ARMY), are not statistically significant, and hence do not change the main effect of FEAR OF CONFLICT on SON BIAS.

In result, the estimated marginal effect on FEAR OF CONFLICT is positive and statistically significant at the one per cent level, although it drops from 12.2 to 10.8 after including these additional controls. This is also an economically significant effect, implying that the probability of having a son bias is 20 per cent higher for those who have fear of conflict.

This approach of controlling for previously omitted characteristics of individuals potentially mitigates the influence of some (observable) sources of endogeneity, however it does not eliminate it entirely, especially when it comes to unobservable and time-varying factors,

Table 3: Baseline individual model — probit marginal effects

Control variables	(1)	(2)	(3)	(4)	(5)
FEAR OF CONFLICT	0.138***	0.140***	0.146***	0.145***	0.122***
	(0.028)	(0.029)	(0.029)	(0.029)	(0.030)
MALE		0.108***	0.110***	0.109***	0.098***
		(0.025)	(0.025)	(0.026)	(0.026)
AGE		-0.002**	-0.002**	-0.002**	-0.001*
		(0.001)	(0.001)	(0.001)	(0.001)
PARTNERED		0.043	0.043	0.035	0.010
		(0.027)	(0.027)	(0.027)	(0.028)
EDUC$\leq$ 10			0.150***	0.151***	0.090**
			(0.031)	(0.033)	(0.035)
EDUC 11-14			0.125***	0.131***	0.105***
			(0.032)	(0.033)	(0.034)
EMPLOYED				0.008	0.030
				(0.028)	(0.028)
POOR STANDING				-0.021	-0.000
				(0.044)	(0.044)
FAIR STANDING				0.047	0.058
				(0.038)	(0.038)
OTHER URBAN					-0.015
					(0.032)
RURAL					0.228***
					(0.030)
Pseudo R^2	0.010	0.023	0.033	0.035	0.069
N	1723	1696	1693	1676	1676

Note.— Dependent variable is SON BIAS. Marginal effects for a discrete change of a variable from 0 to 1 for a person with FEAR OF CONFLICT=0; controls are fixed at sample means. Standard errors in parentheses. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels.

which is the limitation of cross-sectional analysis and observational data. Nevertheless, we want to further address the biases to the extent possible by estimating a bivariate probit model using instrumental variable and matching methods.

Given the limitations of the data, we identify one plausibly exogenous instrument in our application, HISTORY OF FORCED DISPLACEMENT. This is a dummy variable that takes 1 for individuals who were either themselves forced to move or were displaced during the Communist regime or had a household member who was exposed to such forced displacement, and 0 otherwise. The underlying intuition here is that such historical experience may predispose individuals for fear of similar events in the future; it should not however affect the son preference directly. We exploit this variable to estimate a bivariate probit model, where it is included in the equation of FEAR OF CONFLICT but excluded from the equation of SON BIAS. The results reported in Panel B of Table 4 confirm the positive significant relationship between FEAR OF CONFLICT and SON BIAS. In support of our identification strategy, we find a statistically significant coefficient for the effect of HISTORY OF FORCED DISPLACEMENT on the FEAR OF CONFLICT, which is not shown in the Table.

Table 4: Individual model with comprehensive controls

Control variables	(1)	(2)	(3)	(4)	(5)	(6)
	A: Univariate probit estimates					
FEAR OF CONFLICT	0.122***	0.121***	0.119***	0.107***	0.104***	0.108***
	(0.030)	(0.030)	(0.030)	(0.032)	(0.033)	(0.033)
RUSSIAN FLUENT		-0.013	-0.011	-0.027	-0.030	-0.036
		(0.039)	(0.039)	(0.042)	(0.043)	(0.043)
RUSSIAN NATIVE		-0.084	-0.102	-0.108	-0.111	-0.126
		(0.076)	(0.078)	(0.084)	(0.084)	(0.086)
NO OVERSEAS TRIPS			0.010	0.026	0.025	0.028
			(0.029)	(0.032)	(0.032)	(0.032)
RACIAL TOLERANCE			-0.084***	-0.071**	-0.075**	-0.074**
			(0.030)	(0.032)	(0.032)	(0.033)
RELIGIOUS MAJORITY				0.006	0.007	-0.008
				(0.072)	(0.072)	(0.074)
VERY RELIGIOUS				-0.027	-0.024	-0.018
				(0.029)	(0.029)	(0.030)
HAS CLOSE PEOPLE					-0.015	-0.001
					(0.040)	(0.041)
FEELS EMPTINESS					-0.008	-0.002
					(0.029)	(0.029)
DISTRUST IN ARMY						0.038
						(0.034)
Baseline controls included	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.069	0.070	0.074	0.077	0.074	0.074
N	1676	1671	1649	1430	1409	1387
	B: Bivariate probit estimates					
FEAR OF CONFLICT						0.066*
						(0.036)
Comprehensive controls included						Yes
N						1363

Note.— Dependent variable is SON BIAS. Panel A reports the marginal effects for a discrete change of a variable from 0 to 1 for a person with FEAR OF CONFLICT=0. Panel B reports the bivariate predicted probability; controls are fixed at sample means. Standard errors in parentheses. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels. In the bivariate probit model, HISTORY OF FORCED DISPLACEMENT is excluded from the equation of SON BIAS but is included in the equation of FEAR OF CONFLICT with an estimated coefficient of 0.334 significant at 1 percent level.

Yet, the exclusion restriction underlying this approach would be violated if there is a possibility that the HISTORY OF FORCED DISPLACEMENT affects SON BIAS through mechanisms other than FEAR OF CONFLICT. Hence, we take a third strategy to reduce the bias by employing a matching approach to examine the impact of FEAR OF CONFLICT on SON BIAS for individuals who have a fear of conflict (treatment group), compared to those who do not have such fear (control group) but are as similar as possible in terms of observable characteristics that affect the outcome variable of interest.

$$\tau_{ATT}(x) = E[Bias(1)|T = 1, X = x] - E[Bias(1)|T = 0, X = x] \quad (5)$$

where *Bias* is our outcome variable, T indicates whether an individual is explosed to treatment $(T = 1)$ or not $(T = 0)$ and x is a vector of relevant characteristics that affect the outcome variable. First, we employ entropy balancing to select matches for the units exposed to treatment (Hainmueller, 2012). Entropy balancing is in a way a generalization of conventional matching approaches since it employs a synthetic control group that represents ”a virtually perfect image of the treatment group” (Neuenkirch and Neumeier, 2016, p. 113). Second, we follow a more traditional approach employing propensity score matching (Rosenbaum and Rubin, 1983).

Table 5: Matching estimations

	(1)	(2)	(3)
FEAR OF CONFLICT	0.093***	0.104**	0.095**
	(0.026)	(0.046)	(0.041)
N	1387	1387	1387

Note.—Column 1 reports average treatment effects on the treated obtained by weighted least squares regressions where observations in the treatment group have a weight of 1 and observations in the control group have a positive weight obtained from matching using entropy balancing; the full set of matching covariates are included as control variables. Column 2 and column 3 report the average treatment effects from Kernel and radius matching estimators with bandwidth = 0.0009 and with standard errors calculated from bootstrapping with 50 replications; the propensity scores are calculated using the entire set of comprehensive controls from Table 4; * denotes significance at 10 percent level; ** at 5 percent level; *** at 1 percent level.

The results of this analysis are presented in Table 5. First, we report the estimates of average treatment based on entropy balancing (column 1). In columns 2 and 3 we report the average treatment effects from kernel and radius matching estimators. The estimated effects in all three cases are statistically significant and similar in magnitude. This further confirms that FEAR OF CONFLICT has a non-zero and positive association with preference for sons.

In the next section we discuss to what extent our empirical findings support the conceptual framework in this study and point out the limitations in the analysis driven by the data availability. Furthermore, we link our findings to possible policy implications.

6. CONCLUDING REMARKS

This study shows that the threat of conflict is an important contributor to increased son preference and highly skewed sex ratios at birth, given the favorable environment. We argue that by raising group survival concerns, the threat of conflict has the potential to exacerbate son bias in a patrilineal society where the fertility is below the replacement level, access to ultrasonography is available and abortion is seen as means to regulate fertility and offspring composition. These factors make the results somewhat context-specific as not in all countries all the contributing factors are present, especially the last one. We test our argument in a context of ceasefire breaches related to Nagorno Karabach conflict between Armenia and Azerbaijan and for the case of Armenian population, where all contributing factors are present.

We use a unique data on sex ratios at birth at the municipality level in Armenia and the exogenous variation in the distance to the conflict epicenter, as a proxy variable for the perceived threat of conflict, to estimate a difference-in-differences model. Our findings show that in the post-ceasefire period municipalities in the close-proximity to the conflict epicenter experienced 15 points higher sex ratios at birth (under five years old) in the period of intense ceasefire breaches. We further explore and test the mechanism laid out conceptually using individual level data from a nationally representative survey to estimate a bivariate probit model followed by instrumental variable and matching methods. We find that increased preference for sons at the individual level is correlated with stronger fear over conflict (son bias is 20 per cent higher for individuals who are concerned about conflict). Various checks for robustness support our main findings.

Albeit context-specific, our argument could be extended to the cases of missing girls in East and South-East Asia. For example, in the context of China the group survival concern can be due to the one-child policy that disproportionately affected the Han population group in China (Li et al., 2011), thus the one-child policy could have bee seen as a threat to the survival of the Han population. In India, the ongoing threat of conflicts affecting the populations in Kashmir and Punjab regions could have contributed to the group survival concerns in those regions that resulted in extremely high sex-ratios at birth. Similarly, the intense militarization in South Korea up to 1990s as well as recent conflicts and ceasefire violations in Eastern Europe and the South Caucasus are likely to have increased survival concerns within the affected population groups and contributed to the increased preference for sons. These are of course mere speculations that could be studied in future research.

It is paramount to relate our argument to countries in conflict where the fertility rate is above or at the replacement level and/or abortions are not widespread (i.e. several countries in Central Asia, Africa and Middle East). In this case one would not necessarily observe highly skewed sex ratios at birth but rather a stopping behavior: in all female births fertility would extend until at least one boy is born.

Overall, our findings point towards potentially damaging consequences of conflict in the long-run in terms of deep and historical determinants of gender equality. A possible policy suggestion based on our results is to provide greater gender-equity-focused public education and awareness campaigns in areas previously affected by conflict.

In sum, this paper offers a novel explanation for increased son preference and skewed sex ratios at birth. It provides an empirical evidence for it, showing that the initial level of son bias is exacerbated when there is a threat of conflict, which is perceived to endanger the survival of a population group.

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Appendices

FOR ONLINE PUBLICATION

Appendix A: Municipality level. Figure A1 shows the timeline of the events related to the Nagorno Karabakh conflict between Armenia and Azerbaijan.

Figure A1: Nagorno Karabakh conflict: Timeline of events

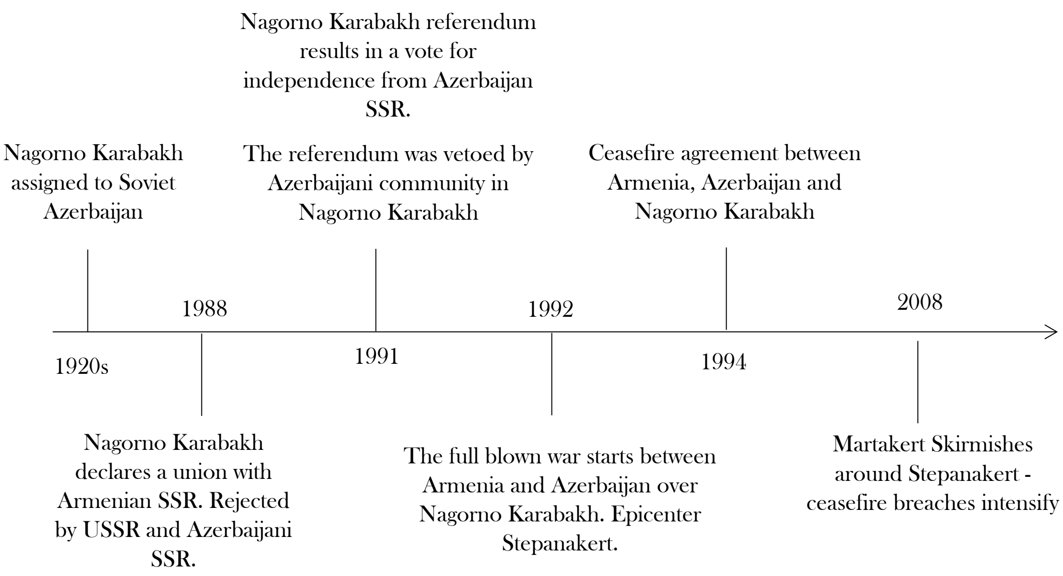
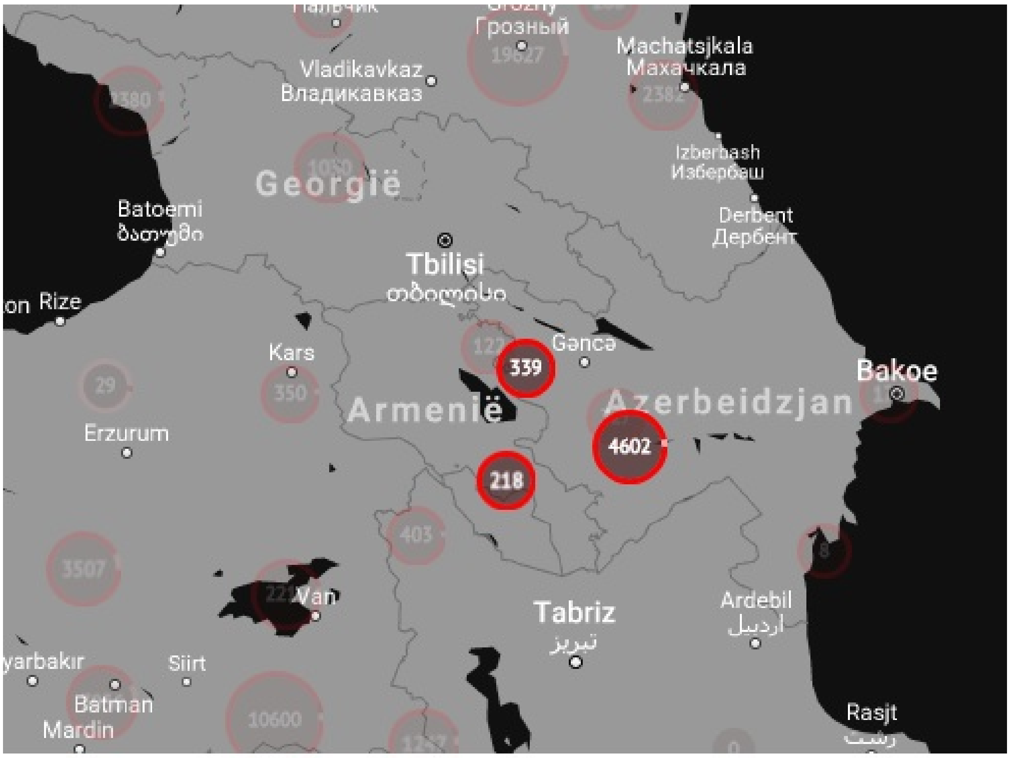


Figure A2 and figure A3 show the actual locations of battle-related deaths related to Nagorno Karabakh conflict using Uppsala Conflict Data Project. In Table A1 we present the municipality-level regression analysis using continuous measures of distances. Column 1 of Table A1 displays the effects of each treatment period on the outcome variable SRB. The results show that with each subsequent period, sex ratios at birth have been increasing in all municipalities in Armenia (statistically significant at the one percent level). Column 2 adds an interaction term with Distance to Conflict, a continuous variable measured in kilometers. The estimates of the coefficients on the interaction terms suggest that there is no statistically significant relationship between unit increase in distance to the center of conflict region (Stepanakert) and sex ratios at birth (SRB). We observe similar results in column 3, when period dummies interacted with Close to Capital (Yerevan) are controlled for. Thus, the results from columns 2-3 show that neither access to technology nor proximity to the conflict individually explain changes in SRB. To pursue our hypothesis further, in column 4 we consider the effect of Distance to Conflict Epicenter on SRB, when Distance to Capital is also included in the regressions. We observe that in period 3, a 100 kilometer decrease in the distance to conflict epicenter(closer to Stepanakert) leads to SRB values close to 113, statistically significant at the five percent level (Post=3 $\times$ Distance to Conflict).

Figure A2: Battle-related deaths related to Nagorno Karabkah conflict: 1987-2011



Note.The map sourced from Uppsala Conflict Data Project website shows the locations and number of battle-related deaths related to Nagorno Karabkah conflict. During the entire period the total number of battle-related deaths is around 5000 and the vast majority of those fatalities took place around Stepanakert, center of Nagorno Karabakh. URL: http://ucdp.uu.se/

Figure A3: Battle-related deaths in the post-ceasefire period: 1996-2011

Note.The map sourced from Uppsala Conflict Data Project shows the locations and number of battle-related deaths in the post-ceasefire period. The battle-related deaths took place east to Armenian borders, where Nagorno Karaakh is located, and the majority of fatalities in this period took place around Stepanakert, at the line of contact. In fact, the number of battle-related deaths from 2007-2011 was 30, and 29 of these took place in the proximity of Stepanakert, at the line of contact. URL: http://ucdp.uu.se/

Table A1: Municipality model: Post-ceasefire effects using continuous distance measures

Control variables	(1)	(2)	(3)	(4)
Post=1	8.511***	2.392	12.565***	11.891
	(2.171)	(8.505)	(2.759)	(11.089)
Post=2	9.625***	9.928*	11.338***	15.287*
	(1.901)	(5.338)	(2.471)	(7.820)
Post=3	10.912***	25.808**	11.689***	35.043***
	(2.375)	(10.579)	(2.599)	(11.306)
Post=1 × Distance to Conflict		0.021		0.002
		(0.028)		(0.032)
Post=2 × Distance to Conflict		-0.001		-0.012
		(0.018)		(0.022)
Post=3 × Distance to Conflict		-0.052		-0.071**
		(0.033)		(0.034)
Post=1 × Distance to Capital			-0.040	-0.039
			(0.029)	(0.033)
Post=2 × Distance to Capital			-0.017	-0.022
			(0.017)	(0.021)
Post=3 × Distance to Capital			-0.008	-0.038
			(0.028)	(0.026)
Constant	96.528***	106.042***	106.061***	106.061***
	(1.033)	(0.875)	(0.874)	(0.859)
Municipality FE	YES	YES	YES	YES
Number of municipalities	76	76	76	76
Observations	298	298	298	298

Note. The dependent variable is SRB: male over female sex ratios at 0-4 ages. Distance to Conflict is a continuous variable that measures travel distance in kilometers from each municipality to the the conflict epicenter - Stepanakert *c*. Distance to Capital is a continuous variable that measures travel distance in kilometers to the capital of Armenia - Yerevan - from each municipality *c*. Distance to Conflict is a proxy measure for the perceived threat of conflict and Distance to Capital is a proxy variable for the ease of access to ultrasound technologies. Post=1, Post=2 and Post=3 denote three periods following the ceasefire agreement. Standard errors are clustered at the municipality level. *Denotes significance at 10 per cent; **at 5 percent; ***at 1 percent levels.

Appendix B: Individual level. Here we present summary statistics and additional robustness tests used in the individual-level analysis.

Table B1 presents the descriptives statistics of the variables used in the individual level regressions.

Table B1: Individual-level descriptive statistics

Variables	Definition	Mean (s.d.) No Fear	Fear	All
FEAR OF CONFLICT	0-1 binary variable; equals 1 if the peace/territorial integrity are rated as key national issues	0	1	0.21 (0.41)
SON BIAS	0-1 binary variable; equals 1 if the preferred gender for a single-child family is a boy	0.51 (0.50)	0.65 (0.48)	0.54 (0.50)
MALE	0-1 binary variable; equals 1 if respondent is a male	0.49 (0.50)	0.52 (0.50)	0.50 (0.50)
AGE	Respondent's age in years	40.87 (16.42)	42.96 (15.83)	41.30 (16.32)
PARTNERED	0-1 binary variable; equals 1 if respondent has a partner	0.66 (0.47)	0.69 (0.46)	0.67 (0.47)
EDUC$\leq$ 10	0-1 binary variable; equals 1 if respondent has at most 10 years of education	0.43 (0.50)	0.36 (0.48)	0.42 (0.49)
EDUC 11-14	0-1 binary variable; equals 1 if respondent has between 11 and 14 years of education	0.35 (0.48)	0.38 (0.48)	0.35 (0.48)
EDUC$\geq$ 15	0-1 binary variable; equals 1 if respondent has 15 or more years of education	0.22 (0.42)	0.27 (0.44)	0.23 (0.42)
EMPLOYED	0-1 binary variable; equals 1 if respondent reports having a job	0.38 (0.48)	0.43 (0.50)	0.39 (0.49)
POOR STANDING	0-1 binary variable; equals 1 if household's perceived economic standing is relatively poor	0.22 (0.41)	0.16 (0.37)	0.21 (0.40)
FAIR STANDING	0-1 binary variable; equals 1 if household's perceived economic standing is relatively fair	0.65 (0.48)	0.68 (0.47)	0.65 (0.48)
GOOD STANDING	0-1 binary variable; equals 1 if household's perceived economic standing is relatively good	0.14 (0.35)	0.16 (0.36)	0.14 (0.35)
CAPITAL CITY	0-1 binary variable; equals 1 if respondent lives in capital city	0.34 (0.48)	0.31 (0.46)	0.34 (0.47)
OTHER URBAN	0-1 binary variable; equals 1 if respondent lives in urban area	0.34 (0.47)	0.30 (0.46)	0.33 (0.47)
RURAL	0-1 binary variable; equals 1 if respondent lives in rural area	0.31 (0.46)	0.39 (0.49)	0.33 (0.47)
N		1318	358	1676

Note.—Means are representative of the population. Standard deviations in parentheses.

Alternative measurement of key variables. In the main text we established a strong positive association between FEAR OF CONFLICT and SON BIAS. Here we explore whether this result is sensitive to the way our key measures are defined.

In Table B2 we study the robustness of the results to the definition of FEAR OF CONFLICT we use. To allow for comparisons, column 1 restates the baseline estimates with full set of controls (these are identical to those reported in column 5 of Table 3). Next, we disaggregate FEAR OF CONFLICT along two dimensions. First, we investigate whether the degree of concern with peace or territorial integrity matters by refining our measure to distinguish between those who identify these matters as a first or as a second priority. The results using dummies for these two groups are reported in column 2 (omitted category are those who do not perceive peace/national security to be a key national issue). We estimate positive marginal effects on both of these variables, however only that on CONFLICT 1ST CONCERN is statistically significant. Second, we introduce a distinction between those who think peace is a key national issue and those who think territorial integrity is. In column 3 we report the results of regressions that include dummies for these groups as the key explanatory variables. The marginal effects on both PEACE AS CONCERN and INTEGRITY AS CONCERN are positive and significant.

Table B2: Individual model with alternative independent variables — probit marginal effects

Control variables	(1)	(2)	(3)
FEAR OF CONFLICT	0.122***		
	(0.030)		
CONFLICT 1ST CONCERN		0.126***	
		(0.035)	
CONFLICT 2ND CONCERN		0.072	
		(0.046)	
PEACE AS CONCERN			0.096***
			(0.035)
INTEGRITY AS CONCERN			0.123***
			(0.046)
Pseudo R^2	0.069	0.069	0.069
N	1676	1676	1676

Note.— Dependent variable is SON BIAS. CONFLICT 1ST CONCERN/CONFLICT 2ND CONCERN is 0-1 binary variables which equals to 1 if the peace/territorial integrity are rated as the 1st/2nd national issue; PEACE AS CONCERN is 0-1 binary variables which equals to 1 if peace is rated as the 1st/2nd national issue; INTEGRITY AS CONCERN is 0-1 binary variables which equals to 1 if territorial integrity is rated as the 1st/2nd national issue. Marginal effects for a discrete change of a variable from 0 to 1 for a person with FEAR OF CONFLICT=0 (CONFLICT 1ST CONCERN=0; CONFLICT 2ND CONCERN=0; PEACE AS CONCERN=0; INTEGRITY AS CONCERN=0); controls are fixed at sample means. Standard errors in parentheses. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels.

Second, we explore whether FEAR OF CONFLICT has an effect on other dimensions of gender bias beyond its effect on son bias at birth. We therefore employ alternative dependent variables in the analysis reported in Table B3 (column 1 restates the baseline estimates). The

Caucasus Barometer 2010 contains rich information on the respondents attitudes on gender roles. Based on this information, we generate dummy variables to distinguish the following individuals from others: (i) those who believe a university education is more important for a boy than for a girl; (ii) those who think men should have more right to a job when jobs are scarce; (iii) those who think the man should normally be the breadwinner in the family; and (iv) those who believe the man should be the decision-maker in the family. The results of the regressions using these measures of gender bias as the dependent variables are reported in columns 2 to 5 of Table B3. They suggest that the negative effects of the FEAR OF CONFLICT potentially extend to other dimensions of gender bias including the beliefs around the rights for education, jobs and earnings, but not around the decision-making in the household - the marginal effect on FEAR OF CONFLICT when MEN SHOULD BE THE DECISION-MAKER is employed as the dependent variable is insignificant (column (5)).

Table B3: Individual model with alternative dependent variables— probit marginal effects

Control variables	(1)	(2)	(3)	(4)	(5)
FEAR OF CONFLICT	0.122***	0.067**	0.063**	0.044**	0.014
	(0.030)	(0.029)	(0.029)	(0.021)	(0.027)
Baseline controls included	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.069	0.031	0.037	0.028	0.044
N	1676	1641	1628	1686	1678

Note.— Dependent variable is: SON BIAS in column (1); EDUCATION IS MORE IMPORTANT FOR BOYS in column (2); MEN SHOULD HAVE MORE RIGHT TO JOBS in column (3); MEN SHOULD BE THE BREADWINNER in column (4), MEN SHOULD BE THE DECISION-MAKER in column (5). Marginal effects for a discrete change of a variable from 0 to 1 for a person with FEAR OF CONFLICT=0; controls are fixed at sample means. Standard errors in parentheses. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels.

Analysis by different sub-samples. The analysis in the previous sub-section extended the baseline results by employing alternative measures of the dependent variable and the independent variable of interest. Here, we further explore the possible heterogeneity in the effect of FEAR OF CONFLICT according to several observable characteristics of individuals. The results of this exercise are summarized in Table B4.

First, we consider whether males and females respond differently to fear of conflict by re-estimating the baseline model separately for the two groups. The results reported in the first two columns of Table B4 confirm that the positive significant relationship between FEAR OF CONFLICT and SON BIAS is observed in the sub-samples of both males and females. However, the magnitude of this effect is stronger for males: the marginal effect of changing the dummy FEAR OF CONFLICT from 0 to 1 is 14.9 percentage points in the sub-sample of males, and 7.6 percentage points in the sub-sample of females.

Second, we explore the possible heterogeneity by age group. To that end, we re-estimate the baseline model in the sub-samples of relatively older (46-80 years old) and younger (18-45 years old) individuals. In both sub-samples, FEAR OF CONFLICT is associated with an increased probability of SON BIAS. The effect is particularly pronounced in the older cohort:

the marginal effect of FEAR OF CONFLICT on SON BIAS is 14.1 among 46-80 years-olds and 10.3 among 18-45 years-olds.

Finally, in the last two columns of Table B4 we analyze the relationship between FEAR OF CONFLICT and SON BIAS by educational attainment, distinguishing between those without and with post-school education. While in both samples we confirm the baseline finding, interestingly, we estimate a larger marginal effect of FEAR OF CONFLICT on SON BIAS among individuals with post-secondary education. For individuals with at most 10 years of education, the marginal effect of changing the variable FEAR OF CONFLICT from 0 to 1 is equal to 10.2; for those with 11 or more years of education (corresponding to the tertiary education years) it is equal to 13.8, confirming our findings from the descriptive analysis.

Table B4: Individual models by different sub-samples - probit marginal effects

Control variables	(1)	(2)	(3)	(4)	(5)	(6)
FEAR OF CONFLICT	0.149***	0.076*	0.141***	0.103**	0.102**	0.138***
	(0.040)	(0.044)	(0.042)	(0.044)	(0.047)	(0.039)
Baseline controls included	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.080	0.059	0.085	0.065	0.065	0.074
N	824	852	864	812	695	981

Note.— Dependent variable is: SON BIAS. Sample is limited to: males in column (1); females in column (2); 46-80 years-old individuals in column (3); 18-45 years-old individuals in column (4); individuals with at most 10 years of education in column (5) and individuals 11 or more years of education in column (6). Marginal effects for a discrete change of a variable from 0 to 1 for a person with FEAR OF CONFLICT=0; controls are fixed at sample means. Standard errors in parentheses. *Denotes significance at 10 percent; **at 5 percent; ***at 1 percent levels.