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Abstract

This paper analyzes historical census data from the final Soviet census in 1989. We find that, even in the absence of sex-selective abortions, the fertility decisions of Armenian, Georgian, and Azeri parents living in Russia in the late 1970s and the 1980s were significantly more son-biased than those of other ethnic groups in Russia. This finding suggests that the observed increase in the sex ratio at birth in the Caucasus since the end of the Soviet Union at least partially reflects a deep-rooted cultural preference for sons. Moreover, this result supports one of the key hypotheses of gene-culture coevolution, namely the claim that cultural evolutionary processes can shape selection on the basic components of genetic fitness.

JEL-Codes: J130, J160, Z100.

Keywords: son preference, sex ratio, sex-selective abortions, historical census data, Caucasus, gene-culture coevolution.

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I Introduction

Following the dissolution of the Soviet Union, sex ratios at birth increased in several of its successor states. This increase in the number of boys born for every 100 girls was most pronounced in Armenia and its neighboring countries in the Caucasus. Today, Armenia has one of the most distorted sex ratios in the world, while in other parts of the former Soviet Union, such as the Baltics and Eastern Europe, the sex ratio at birth remains undistorted.

What explains the observed rise in the sex ratio at birth in the Caucasus? Do heightened sex ratios reflect deeply rooted cultural preferences for sons, or are they a consequence of a more recent shift towards son-biased fertility preferences? In this paper, we make use of historical census data from Soviet-era Russia to argue that heightened sex ratios in the Caucasus are likely a modern-day manifestation of a deep-rooted culture of son preference among Armenian, Georgian, and Azeri parents.

Identifying the drivers behind increasing sex ratios is challenging, because son-biased fertility preferences do not always lead to heightened sex ratios. Specifically, heightened sex ratios at birth require three separate conditions (Lesthaeghe and Vanderhoeft, 2001; Guilmoto, 2009). First, parents must have son-biased fertility preferences. This usually takes the form of wanting at least one son. Second, fertility rates must be low so that parents face a significant risk of ending up without a son unless they actively engage in sex selection. And third, parents must be able and willing to engage in sex selection. Since sex-selective abortions are the predominant form of prenatal sex selection, this third condition implies that parents must have access to obstetric sonography or other technologies to determine the sex of the fetus, and that abortions must be a sufficiently well-accepted form of family planning. Contemporary Armenia meets all three conditions (Schief et al., 2021).

The sex ratio at birth in the Caucasus has not always been distorted. Up to the early 1990s, the recorded sex ratios at birth in Armenia, Georgia, and Azerbaijan remained close to their natural levels of 105 boys per 100 girls. This is not surprising given that obstetric sonography was not widely available, and even strongly son-biased parents could not have affected the population-level sex ratio at birth. Therefore, we cannot compare historically undistorted sex ratios to contemporary sex ratios and conclude that the change reveals a cultural shift toward son-biased fertility preferences.

Regarding the availability of medical ultrasound, Duthé et al. (2012) report based on their private communications that ultrasound technology began to appear in the Caucasus in the late 1980s and was fully introduced in most hospitals by the mid 1990s. Hohmann et al. (2014) also report that sex-screening methods became quickly available following the dissolution of the Soviet Union. Michael et al. (2013) explains the limited availability of ultrasound machines in the Soviet period by a lack of indigenous manufacturing capacity and Western restrictions on the export of technology with potential military use.

Without sex selection, how else might son-biased preferences present themselves? Most simply, parents can increase the probability of having a son by having more children. This behavior leads to so-called stopping rules, in which parents continue to

have children until they have a son. While this fertility strategy does not affect the sex ratio of the population, it does affect the sex composition of children *within* households. We can thus analyze historical fertility outcomes to document son preferences even when sex ratios are uninformative.

For this paper, we have compiled and analyzed an illuminating data set, namely the 1989 census of households living in the Russian Soviet Federative Socialist Republic. The data allow us to compare the fertility outcomes of parents from different cultural origins who lived in Soviet-era Russia and had children during the late 1970s and the 1980s, a time before the population-level sex ratios in their homelands became distorted. Comparing the fertility outcomes of Armenians, Georgians, and Azeris to those of other ethnicities reveals which of two basic possibilities is most likely. Namely, modern-day differences in sex ratios at birth across post-Soviet societies reflect either a recent divergence in son bias that attended the collapse of the Soviet Union and the upheaval that followed, or they reflect more deeply-rooted cultural differences that were present among different ethnic groups in Russia before the Soviet collapse.

Our paper contributes to the literature on son preference in the Caucasus (Duthé et al., 2012; Guilmoto, 2013; Meslé et al., 2007; Michael et al., 2013; Schief et al., 2021). Previous research has documented distorted sex ratios, discussed the role of sex-selective abortions, and measured son preferences using questionnaire items or implicit association tests. All the papers in this literature point to the increased availability of medical ultrasound as an important part of any explanation of the increase in the sex ratio during the 1990s. At the same time, these papers also raise the possibility that cultural evolution may have been unfolding quickly at the time. For example, did concurrent developments like the worsening of female political representation, decaying labor market conditions, or an increase in violent conflicts cause an unprecedented preference for sons among parents in the newly independent states of the South Caucasus? We cannot answer this question simply by noting that sex ratios at birth increased dramatically from the 1990s. This is a general problem associated with identifying cultural variation either through time or across space. Culture often covaries with other variables, and this can limit the scope for separating cultural variation in preferences, beliefs, and behaviors from other sources of variation related to institutions and environments. We attempt to do so by limiting our comparisons to different ethnic groups all living in Russia prior to the widespread availability of medical ultrasound. From a methodological perspective, our paper thus adds to the growing literature that attempts to identify the causal role of culture by observing the behavior of migrants who have different origins but live under a single set of institutions in their common host country (Fernández, 2011; Almond et al., 2013). In doing so, we provide evidence for a culture of son preference among Armenian, Georgian, and Azeri parents that predates both the expanded availability of medical ultrasound as well as the political and cultural developments associated with the dissolution of the Soviet Union.

II Data

Our data are a 5% random sample from the 1989 Census in the Russian Soviet Federative Socialist Republic. The unit of analysis in the census is a household. A household is defined as a set of individuals who live together in a given apartment. If multiple families share a communal apartment, they were counted as separate households. For each household member, we observe their gender, date of birth, and ethnicity.

We impose several sample restrictions. First, to be included in our sample, a household must have children, and the oldest child must not be older than 14 years. Unfortunately, the census data do not report all the children ever born to a couple and instead simply list the children living in the household at the time of the census. By imposing an age limit of 14 years on the oldest child, we are unlikely to include households with children who have already moved out. This age limit also means that we consider children born between 1974 and 1989. Finally, the sample is restricted to families with less than 6 children.

The set of children recorded in the census may not always be the same as the set of children born to a given couple, given the possibility of adoption, mortality, or alternative living arrangements. However, such discrepancies are likely minor, and we will therefore interpret the sex composition of children in the household recorded in the census as the sex composition of children born to a given couple.

III Empirical strategy

Our goal is to examine the existence of a culture of son preference among Armenian, Georgian, and Azeri parents that predates the rise in the sex ratios at birth in the Caucasus. Evidence of historical son preference among Armenian, Georgian, and Azeri parents, and the lack of such evidence for parents in other cultures, would suggest that the rise in the sex ratio at birth in the Caucasus reflects deeply-rooted cultural preferences rather than recent shifts towards son-biased fertility preferences. To produce such evidence, we analyze fertility outcomes of parents in Soviet-era Russia and show that Armenian, Georgian, and Azeri parents appear more son biased than Eastern Europeans or Central Asians.

Comparing the fertility outcomes of parents within Soviet-era Russia has an important advantage over comparing the fertility outcomes of parents across different Soviet republics. To the extent that labor markets or local institutions in Armenia, Georgia, and Azerbaijan differed from those in other Soviet republics in ways that incentivized parents to have sons, it is conceivable that incentives, rather than a culture of son preference, caused fertility outcomes to be more son-biased in the Caucasus. Comparing fertility outcomes among parents who all lived in Soviet-era Russia alleviates this concern. This strategy of comparing individuals of different cultural backgrounds living in the same institutional setting is called the epidemiological approach and has become a standard tool to isolate the causal role of culture (Fernández and Fogli, 2009; Fernández, 2011).

Papers relying on the epidemiological approach often study second-generation migrants because first-generation migrants are likely more strongly selected on specific traits and may not be representative of individuals in their country of origin. Our analyses are based on all households recorded as living in Soviet-era Russia at the time of the 1989 census. Although our data will certainly also contain first-generation migrants, many households will have lived in Russia for more than one generation. Another weakness of our data is the lack of information on the place of residence, education, or household income, which unfortunately prevents us from statistically controlling for the socio-economic characteristics of the parents in our sample.

III.1 Inferring son preferences from fertility outcomes

When parents decide whether or not to have another child, they take into account their current family composition. For example, all things equal, parents with more children are less likely to have another child compared to parents with fewer children because the former are more likely to have reached their desired family size. In addition to the number of existing children, parents with sex-biased fertility preferences also take into account their sex composition. As a result, parents with a strong desire to have at least one son are more likely to have a third child when their first two children are girls. Hence, we can infer son bias from observed fertility outcomes even if sex-selective abortions are unavailable and the sex ratio in the population is not distorted.

We focus on the decision to have a third child. The decision to have a second child is unlikely to reveal any son bias because the vast majority of parents in our context want to have at least two children, independent of their sex. Investigating the fertility decisions of parents with three or more children is problematic because large families are rare. Moreover, most families with three children will already have a son.

We compute the odds of having three or more children at the time of the 1989 census for different parents who are grouped according to the sex of their first two children. The first group is made up of parents whose first two children are girls. The second group are parents whose first two children are boys. And the third group are parents whose first two children are of mixed sex.

Our analysis proceeds by comparing the odds for different groups. For example, to see whether parents without a son are more likely have a third child compared to parents who already have a son, we compute the log odds ratio,

$$\ln \left(\frac{N_{\text{no son}}^{\text{third child}} / N_{\text{no son}}^{\text{no third child}}}{N_{\text{son}}^{\text{third child}} / N_{\text{son}}^{\text{no third child}}} \right), \quad (1)$$

where $N_{\text{no son}}^{\text{third child}}$ is the number of households with at least three children and no son among the first two children. Similarly, $N_{\text{no son}}^{\text{no third child}}$ is the number of households without a third child and no son among the first two children, $N_{\text{son}}^{\text{third child}}$ is the number of households with at least three children and at least one son among the first two children, and $N_{\text{son}}^{\text{no third child}}$ is the number of households without a third child but at least one son among the first two children. If parents do not care whether their children are sons or daughters, then their decisions to have another child depend exclusively on the

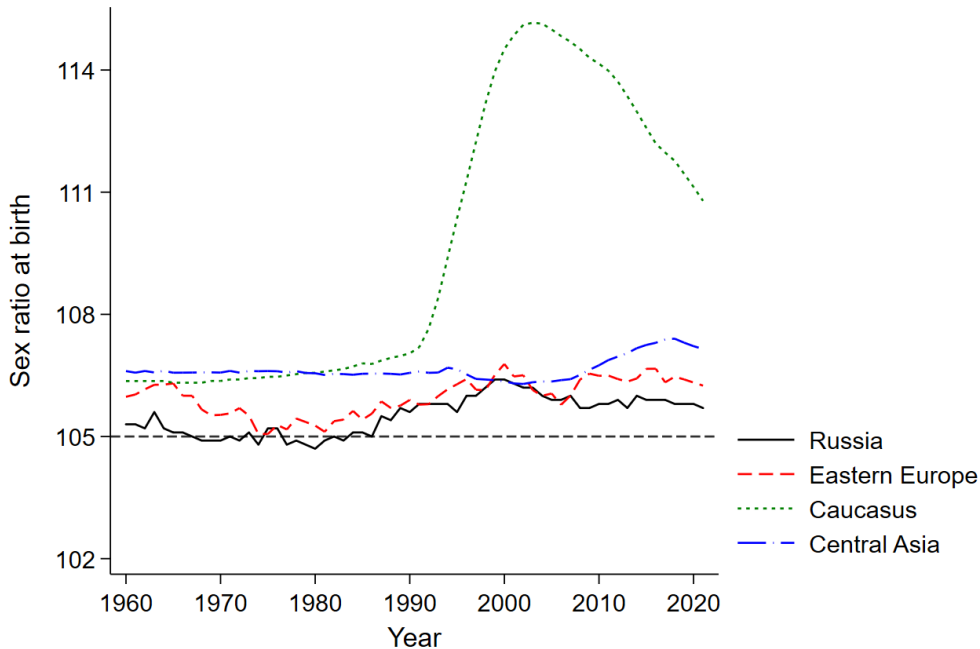


Figure 1: Sex ratios at birth (number of boys per 100 girls). Source: United Nations Population Division. The sex ratio at birth for a given region is computed as the average of the country-level sex ratios weighted by population size.

number of current children, and the log odds ratios should all be equal to 0. Deviations from zero indicate a statistical association between the sex composition among the first two children and the existence of a third child.

Our data allow us to compute the odds ratios by ethnicity. While the data distinguish between 176 different ethnicities, most have very few observations, and we restrict our attention to the following: Russians, Estonians, Latvians, Lithuanians, Belorussians, Ukrainians, Moldovans, Goergians, Armenians, Azeris, Turkmens, Uzbeks, Tajiks, Kazakhs, and Kyrgyz. We further group these ethnicities into four regions based on their homelands; Russia, Eastern Europe (Estonians, Latvians, Lithuanians, Belorussians, Ukrainians, and Moldovans), Causacus (Goergians, Armenians, and Azeris), and Central Asia (Turkmens, Uzbeks, Tajiks, Kazakhs, and Kyrgyz). Figure 1 shows the evolution of the sex ratio at birth in these four regions.

IV Results

Figure 2 shows point estimates for different log odds ratios along with 95% confidence intervals. The black circle-shaped markers show log ratio of the odds of having a third child for parents with no son relative to parents with at least one son among the first two children. Similarly, the blue diamond-shaped markers show the log ratio of the odds of having a third child for parents with no daughter relative to parents with at

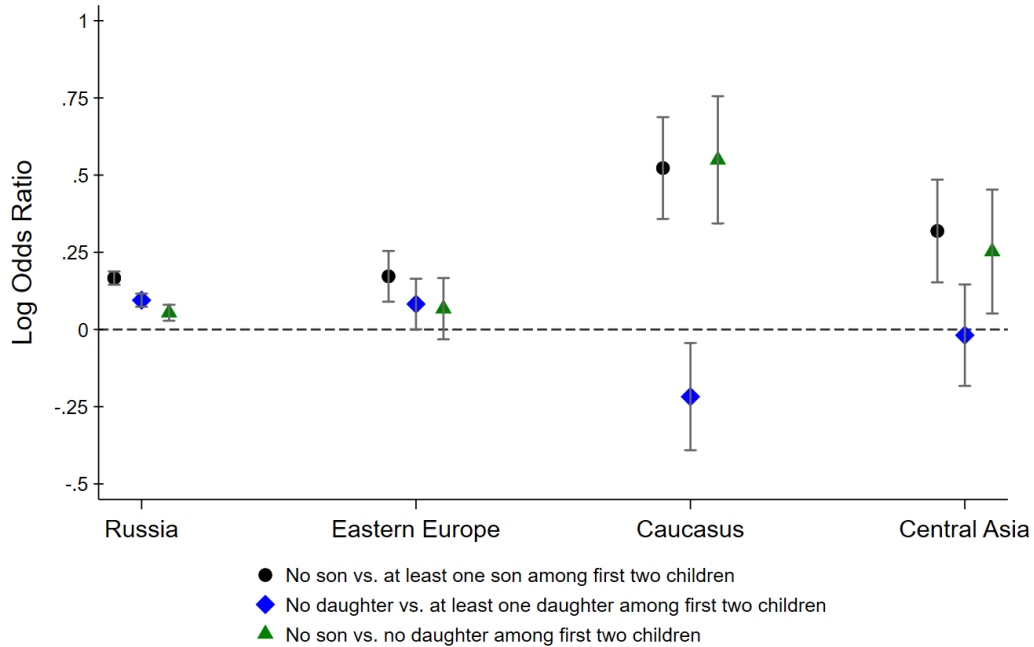


Figure 2: Log odds ratios. Confidence intervals are computed at the 95% level.

least one son among the first two children. If parents have a preference for a gender mix among their children, these log odds ratios may be larger than zero, even if parents do not generally prefer sons over daughters (or vice versa). To isolate son preference, the green triangle-shaped markers show the log ratio of the odds of having a third child for parents with no son relative to parents with no daughters.

For Russians, all three log odds ratios are larger than 0, suggesting that Russian parents have 1) a preference for at least one son, 2) a preference for at least one daughter, and 3) a stronger preference for sons than for daughters. The inferred son preference among Russian parents is relatively weak, however, with parents of two girls being only moderately more likely to have a third child compared to parents of two boys. We find very similar odds ratios for Eastern Europeans, although somewhat less precisely estimated. The odds ratios for Central Asians are more suggestive of son preference, although we cannot reject the hypothesis that they are the same as the odds ratios for Russians. It is Armenians, Georgians, and Azeris who really stand out. The fertility outcomes of parents from the Caucasus region show strong son bias, with parents whose first two children were girls being 1.75 times more likely to have had a third child than parents whose first two children were boys.

In Table 1, we report the sex ratios and average number of children for the same set of ethnicities. As expected, the sex ratios are similar across groups, and a natural sex ratio of 105 boys for every 100 girls cannot be statistically rejected for any group. It is also noteworthy that the average number of children for parents from the Caucasus region is somewhat higher than for Russian or Eastern European parents. This may be

	Russia	Eastern Europe	Caucasus	Central Asia
Number of HHs in sample	700,359	47,065	6,493	5,371
Avg number of children per HH	1.55	1.54	1.74	1.87
Sex Ratio (boys/girls)	1.03	1.04	1.06	1.05

Table 1: Summary statistics

partly a consequence of son bias that induces parents to have more children to ensure the birth of a son.

V Discussion

Over the past decades, parents in Armenia, Georgia, and Azerbaijan have resorted to sex-selective abortions to influence the sex composition of their children. As a result, the number of boys born for every 100 girls has increased to levels far beyond the natural sex ratio at birth. Heightened sex ratios first emerged in the 1990s following the dissolution of the Soviet Union, which brought about important changes in the social and economic structure of post-Soviet societies. What caused this increase in sex ratios? On the one hand, the strengthening of national identities and religiosity, the sharp increase in economic insecurity, the new reliance on male labor migration, and the diminished representation of women in political position may all have occurred alongside a shift in fertility preferences toward an increased valuation of sons over daughters. On the other hand, the 1990s also saw a plummeting of fertility levels and a greatly expanded availability of medical ultrasound so that parental preferences for sons would for the first time be reflected in heightened sex ratios. Against this backdrop, it is unclear *ex ante* whether the increasing sex ratios at birth during the 1990s reflected a contemporary shift toward more son-biased fertility preferences or rather a newfound ability to meet deeply-rooted cultural preferences for sons by preferentially aborting female fetuses.

Using microdata from the 1989 Census in the Russian Soviet Federative Socialist Republic, we show that the fertility decisions of Armenian, Georgian, and Azeri parents in the late 1970s and the 1980s were much more son-biased than the fertility decisions of Russians, Eastern Europeans, and Central Asians. We interpret this finding as evidence that the recent increase in the sex ratio at birth in the Caucasus is at least partially reflecting deep-rooted cultural preferences for sons.

Interestingly, this result supports – tentatively – one of the key hypotheses of gene-culture coevolution, namely the claim that cultural evolutionary processes can reshape selection on genes in ways that would not otherwise occur (Richerson and Boyd, 2008). If distorted sex ratios are a manifestation of the same son-biased culture that we identify in Soviet-era Russia, then presumably the culturally evolved choices behind these biased sex ratios are now generating novel selection pressures on the genes that influence the primary sex ratio at fertilization (Kumm et al., 1994; Laland et al., 1995; Kumm and

Feldman, 1997). In particular, as sex ratios at birth started to climb in the 1990s, families were setting the stage for an excess of marriageable men and a shortage of marriageable women in the 2020s. They were setting the stage for a system out of equilibrium from the perspective of natural selection and the associated primary sex ratio it favors.

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