CERGE
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Charles University Prague

Essays in Development Economics

Ella Sargsyan

Dissertation

Prague, June 2024

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To all the “missing” women...

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Abstract

This dissertation investigates effective household coping strategies during profound economic shocks, as well as the impact of violent conflicts and natural disasters on parents' child gender preferences in developing countries.

In light of rising concerns about food insecurity caused by a variety of crises, the first chapter investigates effective coping strategies households can employ to mitigate the lasting impacts of income shocks and associated nutrition deficits. We uncover a previously unexplored coping mechanism - home production - and establish the extent of its effectiveness in mitigating the negative effects of crises on child health. To do so, we focus on the transition period after the collapse of the Soviet Union and investigate the role of household production of potatoes. Specifically, utilizing individual-level data from Russia, Kazakhstan, and other post-Soviet countries and exploiting the variation in the soil suitability index, we establish that households that grew potatoes on land more suitable for their cultivation were able to reduce the negative effects of transition shock on the health of their children as measured by adult height and height-for-age z-score. Our findings suggest that targeted nutritional interventions are needed to mitigate long-term adverse health impacts on children in times of catastrophic economic shocks, particularly in areas where households face limitations in home production.

The second chapter explores whether and how long-run exposure to violent conflicts contributes to and shapes the child gender preferences of parents. To conduct the analysis, I use temporal and spatial variations in conflicts in Nigeria and combine the Uppsala Conflict Data Program and the Demographic and Health Surveys Program. The results show that the effect of long-run exposure to violent conflicts on stated preferences (attitudes) for boys is not homogeneous. While conflict events with low or no civilian deaths increase preferences for sons, violence targeted at civilians works in the opposite direction and decreases preferences for boys. I find no evidence of translating these preferences into behaviour via sex-selective abortions. Instead, evidence shows that parents use the stopping rule to achieve the desired gender composition of children. Further, my analysis also indicates that, in the districts affected by conflict, parents have a positive bias towards boys in terms of their postnatal health investment.

The final chapter investigates the enduring effects of natural disasters on parental gender preferences, focusing on the activated memory of the 1988 Armenian Earthquake. This chapter proposes a novel explanation for skewed sex ratios, suggesting that natural disasters can exert enduring effects on women's child gender preferences. Leveraging data from four rounds of Demographic and Health Surveys in Armenia and exploiting the plausible exogeneity of interview timing, my research uncovers a significant impact of the reactivated memory of the 1988 Armenian Earthquake on women's stated preferences for male children. Specifically, women interviewed on or around December 7 – the day marking the earthquake victims' commemoration – express a 3-percentage-point higher preference for sons. Further analysis reveals that women from the most affected region, Shirak, exhibit an even stronger preference for boys, with a noteworthy 12-percentage-point increase. These effects are particularly pronounced among women who are already mothers, suggesting a lasting imprint of the earthquake's memory on child gender preferences.

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Czech Republic, Prague — Ella Sargsyan
June 2024

Introduction

This dissertation studies the responses of households in developing countries amidst times of upheaval, ranging from profound economic crises to violent conflicts and natural disasters. Specifically, the first chapter explores effective coping strategies employed by households during periods of income shocks, addressing food and nutritional deficits. The second and third chapters investigate how violent conflicts and natural disasters can affect the preferences of women for the gender of their children.

In collaboration with my coauthors, the first chapter uncovers a previously unexplored coping strategy used by households during the transition period following the collapse of the Soviet Union. While existing literature predominantly focuses on the consequences of the transition, there is limited evidence regarding the coping mechanisms used by households in mitigating the negative effects of food insecurity and nutritional deficiencies during such turbulent times. Leveraging comprehensive data spanning nearly all post-Soviet countries, coupled with the variation in soil suitability indices across regions, our analysis employs fixed effects, cohort comparison, and instrumental variable approaches to demonstrate several key findings: Firstly, we reveal that the adult height of children, a proxy for long-term health outcomes, exposed to the transition is less adversely impacted by income shocks if they reside in areas more suitable for potato cultivation. Secondly, focusing on specific regions such as Russia and Kazakhstan, we illustrate that the agricultural home production of potatoes is an effective coping mechanism if grown on more suitable land – e.g. moving a household from non-suitable land to land with median suitability index increases the height of children from the household by 2.5 cm. Thirdly, we provide suggestive evidence indicating the direct nutritional benefits of consuming home-grown potatoes, underscoring their role beyond mere economic exchange or barter commodities. This chapter not only enriches the literature on household coping strategies during economic crises but also contributes to the literature on the determinants of child health outcomes, as well as the literature studying transition economies.

The second and third chapters of this dissertation revolve around the determinants of women's preferences for the gender of their children. Many Asian and African countries are characterized with a strong preference for boys, leading to a large number of "missing" women in some countries. In light of that, the second chapter investigates the effect of violent conflicts on women's stated and realized preferences for the gender of their children, as well as the investment in children's postnatal health. I use individual-level data from the Demographic and Health Surveys in Nigeria and event-level conflict data from the Uppsala Conflict Data Program to conduct my analysis. The identification strategy in this study exploits the temporal and spatial variation in the exposure to conflict events in different regions of Nigeria. The results establish that violent conflicts have a differential effect on the stated preferences for boys depending on the type of the conflict and the occurrence of civilian death. Further, the research reveals that changed preferences translate into behavior via two mechanisms: 1) stopping rules – used to achieve the desired composition of children, and 2) skewed investment in the postnatal health of children measured by the probability of receiving vaccination. Overall, this research contributes to the literature by suggesting a novel mechanism to explain the child gender preferences of parents and makes a step forward in understanding and unraveling the origins and persistence of gender gaps in developing countries.

In the third chapter, I study the effect of the activated memory of natural disasters, specifically the 1988 Armenian Earthquake, on the stated child gender preferences of women in Armenia. Since gaining independence in 1991, Armenia has experienced high rates of male-to-female ratio at birth. I base the analyses of this paper on individual-level data from four rounds of the Demographic and Health Surveys conducted in Armenia. The main identification strategy exploits the plausible exogeneity in the interview timing and compares the stated preferences of women interviewed on or near December 7 – the day of commemoration of the earthquake victims – with the stated preferences of women interviewed on all other days. The proposed mechanism through which being interviewed on or around December 7 affects the stated preference of women is the activated memory of the devastating earthquake and human and physical loss. The findings indicate that treated women have a 3-percentage-point higher preference for male children. Through the heterogeneity analysis, I further demonstrate that this preference is even stronger for women from the Shirak region, which hosts the city most affected by the earthquake. Women interviewed on or around December 7 from the Shirak region report an additional 12-percentage-point higher preference for boys. Additionally, I find that the higher preference is mostly driven by women who are already mothers. This study contributes to the literature by proposing a novel mechanism behind the skewed preference for the gender of children, potentially making a step forward in understanding the reasons contributing to the number of "missing" females in developing countries.

Chapter 1

Potato to the Rescue: Home Production and Child Nutrition during Deep Economic Crises [1]

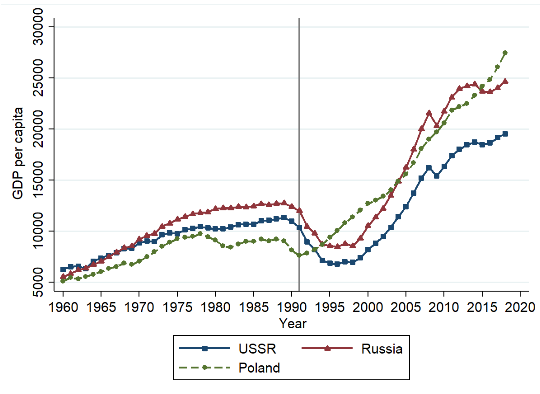
1.1 Introduction

Recent global events, including increasing climate change, the COVID-19 pandemic, and the war in Ukraine have heightened concerns regarding global food security (De Winne & Peersman, 2021; Bogmans et al., 2021; Artuc et al., 2022). This underscores the significance of investigating effective coping strategies that households can employ in response to severe economic crises resulting in food and nutritional deficits. The deficits in calorie intake contribute to increased incidence of starvation and malnutrition among young children. Childhood malnutrition, in turn, has been associated with various adverse economic and health outcomes in adulthood (Victora et al., 2008; Maluccio et al., 2009; Currie & Almond, 2011; Gertler et al., 2014; Van den Berg et al., 2016). Therefore, it is critical to identify coping strategies that can provide sufficient nutrition during crises and mitigate the adverse effects of economic shocks. This study focuses on children's health outcomes as sufficient nutrition intake in early life is crucial for cognitive performance, adult health, and reduced probability of infectious diseases, and ultimately contributes to significant improvements in economic productivity (Glewwe et al., 2001; Currie & Almond, 2011).

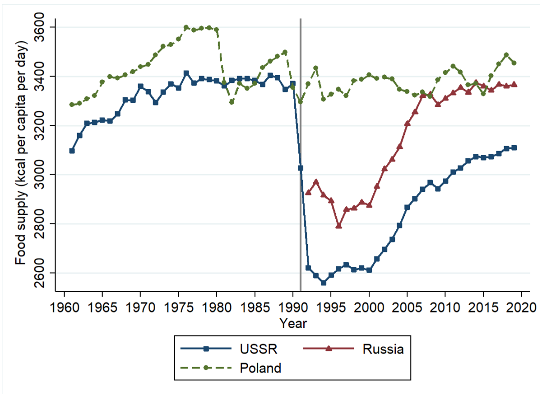
After the collapse of the Soviet Union, many former communist countries underwent

[1] **Co-authored with Anna Pestova and Mikhail Mamonov (Toulouse Business School).**

a painful transition period from planned to market economies. Disruption of trade links between former USSR republics, job losses, hyperinflation following price liberalization, depreciated savings, and decreased real incomes resulted in widespread poverty. Such catastrophic economic downturns and declines in output (Blanchard & Kremer, 1997) can cause a serious deficit in caloric intake among populations due to decreased food consumption and a deterioration in the diet structure, including reduced intake of meat, fish, dairy products, vegetables, and fruits (see Figure 1.1).[2] Because children born during or exposed to the transition period in the 1990s were among the most vulnerable groups of the population, worsened diets contributed to their health deterioration (Adsera et al., 2021). While previous studies have explored the consequences of transition (Klugman et al., 1997; Campos & Coricelli, 2002; Guriev & Zhuravskaya, 2009; Guriev & Melnikov, 2018; Adsera et al., 2021), limited research has focused on investigating the coping strategies employed by individuals and households in former communist countries and the degree to which these strategies effectively mitigated the adverse effects of negative economic shocks on their health and well-being.



(a) GDP per capita



(b) Daily supply of calories

Figure 1.1: GDP Per Capita and Daily Supply of Calories in the USSR, Russia, and Poland.
Note: This figure depicts the GDP-per-capita (subfigure (a)) and daily supply of calories (subfigure (b)) in the USSR, Russia, and Poland before and during the transition. The data for the daily supply of calories in the USSR after the collapse is computed by averaging data across all post-Soviet countries. Poland, which was not a part of the USSR, underwent a relatively mild transition and is presented here for comparison.
Source: Authors' calculations using data from OurWorldInData.org.

This study uncovers a hitherto neglected channel in the academic discussion, household agricultural production, or home gardening, specifically the value of home-grown potatoes as a coping strategy to adapt to income shocks and nutritional deficits. The

[2]As can be inferred from Figure 1.1, the most acute phase of the transition crisis was in 1991-2001. Given our focus on transition and health, in most of the analysis below, we concentrate on this period.

prevalent response among households in Russia to the query "how do you manage to survive?" amid the transition period was notably centered on the significance of potato consumption (Ries, 2009). Although other home crops were grown, the household production of potatoes was the most significant in alleviating the food crisis, because it was the only food product that showed steady growth in consumption during the 1990s in Russia, as seen in Figure 1.2. Home consumption of potatoes reached its peak in 1993, after the collapse of the Soviet Union and the subsequent severe economic crisis, resulting in increased consumption of the more affordable source of calories that could be readily produced by households.

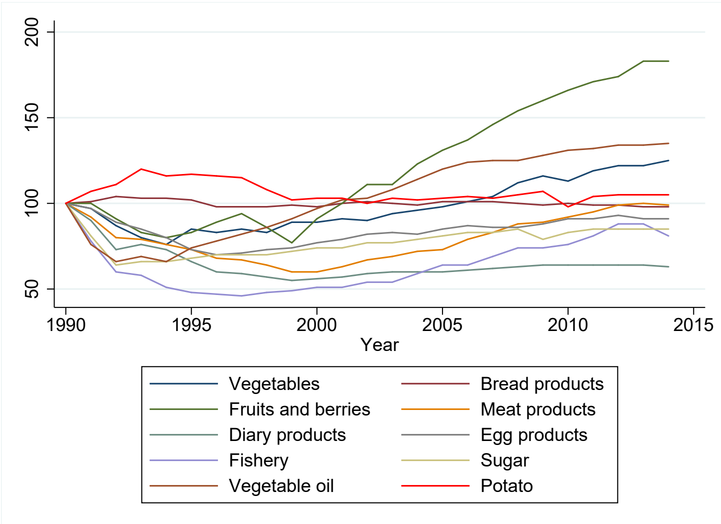


Figure 1.2: Food Consumption in Russia.
Note: The figure illustrates how the consumption of various food products in Russia has changed over time, expressed as a percentage of the levels observed in 1990.
Source: Authors' calculations using Data from Rosstat, Health care in Russia (2001, 2015)

According to Nunn & Qian (2011) and Cook (2014), the introduction of potatoes played a crucial role in the urbanization and population growth of the Old World. Their studies suggest that one of the mechanisms behind the positive effect of potatoes was the improved health of the population resulting from increased nutrition intake from potatoes. Potatoes are known for being highly nutritious: they are rich in vitamins, minerals, protein, and complex carbohydrates (Lang, 2001). The UN Food and Agriculture Organization (FAO) declared 2008 the "International Year of the Potato" recognizing that potatoes are a vital part of the global food system, and will play an ever greater role in strengthening world food security and alleviating poverty. Compared to other major crops, the potato offers numerous advantages: it yields more nutritious food at a faster rate, requires less land for cultivation, and can thrive in harsher climates. Remarkably, up to 85 percent of the potato plant is edible human food, a considerably higher proportion than many cereals, which typically only have around 50 percent.

In this paper, we build upon the mechanism suggested by Nunn & Qian (2011) and test the hypothesis that households that grew potatoes on lands more suitable for potato cultivation during the transition period of the 1990s were able to alleviate the negative effect of poverty, particularly malnutrition, on the health of their children as proxied by their height-for-age z-scores and adult height.[3]

The empirical approach in this study exploits the spatial variations in soil suitability for growing potatoes and other products across regions in Russia, Kazakhstan, and other former communist countries. We start by providing suggestive evidence through the analysis of cross-country variations, utilizing data from the 2016 Life in Transition Survey (LiTS), which covers 14 of the 15 post-Soviet countries. Our focus centers on comparison of the adult height of children who were aged five and under during the transition year[4], differentiating those residing in regions with relatively suitable lands from those in regions with less suitable lands. Our findings indicate that the negative effect of the transition period on the nutrition status, as measured by adult height, of children aged five and below during the transition year was less severe for those individuals who lived in regions more suitable for potato cultivation. We also show that adults who were aged five and below during the transition year report worse health conditions than their older peers. The difference, however, is dampened for those adults who lived on suitable lands.

To test our main hypothesis regarding the home production of potatoes, we use data from the Russian Longitudinal Monitoring Survey (RLMS) - a high-quality individual-level panel that has tracked households since 1994. In particular, to estimate the short-run effect of potato cultivation on a child's height-for-age z-score, we concentrate on the period of 1994-2001 and construct an individual fixed-effects model, where we interact the soil suitability index for potato cultivation with an indicator for whether a household grew potatoes during the previous year. Our findings show that when households grew potatoes on lands with an average suitability index, as opposed to non-suitable lands, the height difference between children in households that did not grow potatoes and those

[3]Height-for-age z-scores and adult height are generally accepted as good indicators of the short and long-run nutritional and health status of children, as height reflects the accumulation of past outcomes.

[4]We define the transition year as the year in which the EBRD Transition Indicator for Price Liberalisation reached a value of three for the first time in a given country. This approach follows that of Adsera et al. (2021).

that did was reduced to 0.3 cm.[5] To estimate the long-run effect of home production of potatoes on adult height, we restrict the sample to adults observed from 2001-2017 and use a cohort study. We interact the soil suitability index for potato cultivation with a variable indicating how many years a household grew potatoes during the period of 1994-2001 and an indicator for a child being exposed to the transition.[6] Our findings reveal that households of adults who were most affected during the transition period adopted a strategy of growing potatoes on their private lands. Similarly, aligning with the short-term outcomes, cultivating potatoes on lands with an average suitability index, rather than on unsuitable lands, contributed to narrowing the height disparity between adults born during the transition year in households that grew potatoes and those that did not. Additionally, we utilize cross-sectional data from the Kazakhstan Living Standards Measurement Survey (KLSMS) conducted by the World Bank in 1996 to perform robustness analyses. In contrast to the Russian Longitudinal Monitoring Survey, this data allows us to employ a 2SLS approach and use the soil suitability index for potato cultivation as an instrument for household potato production. The results indicate that children from households that grew potatoes had on average one standard deviation greater height, which translates into 5.6 cm.

We suggest that the main mechanism behind the positive effect of growing potatoes on suitable lands is that in regions more suitable for potato cultivation, households had more opportunities to substitute expensive and scarce food with affordable potatoes grown on private plots. Another plausible mechanism by which the cultivation of potatoes might have mitigated the adverse effects of the transition on children's health is through its potential use as a barter commodity, enabling households to procure other essential goods. Our analyses in Section 5 offer suggestive evidence supporting the direct mechanism of potato cultivation, specifically the positive impact of consuming potatoes.

This research is related to the existing literature in several ways. First, by testing the effectiveness of home production, we contribute to the literature studying coping strategies used by households in adaptation to income shocks (Gerry & Li, 2010; Sk-

[5] According to our results, Russian children living in households that grew potatoes during the transition years were, on average, 2.8 cm shorter in the short run, which we attribute to a negative selection into growing potatoes by households who were most affected by the economic shock.

[6] We define three measures of exposure: 1) for children born during the transition year (BT), 2) for children born or one year old during the transition year (BT1), and 3) for children born, one year old, or two years old during the transition year (BT2). We define the transition year as the year in which the EBRD Transition Indicator for Price Liberalisation reached a value of 3 for the first time. In the case of Russia, this was 1992. This approach follows that of Adsera et al. (2021).

oufias, 2003; Aragón et al., 2021; McKenzie, 2003; Carter & Maluccio, 2003; Handa & King, 2003). Our study contributes to this body of literature by investigating and confirming the efficacy of a coping strategy overlooked in academic discourse: agricultural home production. Moreover, we contribute to the literature on the determinants of child health outcomes and the effects of malnutrition (Bailey et al., 2018; Bozzoli et al., 2009; Deaton, 2007; Van den Berg et al., 2016). By analyzing a specific episode that concurrently impacted multiple countries and millions of households, our study enhances the current body of evidence illustrating the adverse effects of the economic crises on child health. Finally, our study adds to the literature on regional heterogeneity of the effects of economic shocks and transitions on households and individuals by highlighting the importance of targeted interventions in regions where conditions are not favorable for agricultural home production(Guriev & Zhuravskaya, 2009; Adsera et al., 2021).

It is important to acknowledge that this study focuses on a specific context of a profound economic shock. We recognize the vast literature in development economics that emphasizes the long-term benefits of structural transformation and economic diversification for poverty reduction and improved well-being (Gollin et al., 2014). Our findings on home production as a coping strategy should not be interpreted as advocating for subsistence farming as a long-term solution. Instead, our contribution lies in highlighting its potential as a temporary measure during periods of significant economic disruption that deviate from the trajectory of structural transformation or that impact an already industrialized country. By demonstrating the effectiveness of home production in mitigating immediate negative effects on child health, this study suggests its potential as a stopgap measure to protect the health of vulnerable populations during periods of crisis. However, to ensure long-term resilience and sustained improvements in well-being, economic diversification remains crucial.

1.2 Background

During the transition crisis of the 1990s, Russia experienced a two-fold decline in GDP per capita (Guriev & Zhuravskaya, 2009; Khvan et al., 2020). Russian households faced a dramatic decline in income and an unprecedented rise in income inequality (Gerber & Hout, 1998). Coupled with high inflation after price liberalization in the early 1990s and growing unemployment (Koen & DeMasi, 1997; Svejnar, 2002) households' ability to purchase consumption goods also shrank in consequence.

A worsened diet may be one reason for the deterioration of the general health of Russian citizens in the 1990s. For example, the adult morbidity rate per 1,000 inhabitants grew from 616 in 1992 to 736 in 2000. The most vulnerable populations to decreases in food consumption are pregnant women, mothers, and young children. The number of mothers who experienced anemia grew from 65.1 per 1,000 births in 1992 to 267.9 in 2000; complications during childbirth grew from 93.1 to 133.7 per 1,000 births during the same period. Child morbidity by endocrine system diseases, blood-formation organs and immune system diseases, digestive diseases, and musculoskeletal system diseases peaked in 2002 and then decreased steadily. The latter may have arisen from poor nutrition for expectant mothers and young children in the 1990s and early 2000s.

When there is no efficient public safety net system, poorer households employ strategies to overcome poverty. Therefore, to substitute for expensive consumption goods produced in the formal sector of the economy, many Russian households switched to private production of animal and vegetable products including potatoes (grown in household plots) in the 1990s and early 2000s. Figure 1.A1 depicts the share of households growing different types of crops in Russia. More than 60% of surveyed households in the RLMS data reported that they grew potatoes in the 1990s. During the same period, fewer than 1% of households reported privately producing grains (not reported in Figure 1.A1 due to scales).

The shift to home production of potatoes is also reflected in increasing areas of household plots used for potato cultivation: in Russia, such areas grew by 66% from 1,805 thousand hectares in 1990 to 2,998 thousand hectares in 1995. Overall, the area devoted to potatoes in household plots compared to those in farms and other formal agricultural organizations increased from 57.8% in 1990 to 87.9% in 1995. This means that almost 90% of all potatoes produced in the mid-1990s were produced privately on household-owned or rented land, and that the area of such land expanded dramatically in the wake of the food crisis. However, the extent to which inhabitants of different Russian regions were able to take advantage of growing potatoes is closely tied to soil suitability of lands for potato cultivation, with the central part of the country and the Volga region being the most suitable, while the northern regions, Siberia, and the Far East less suitable. (Figure 1.3).

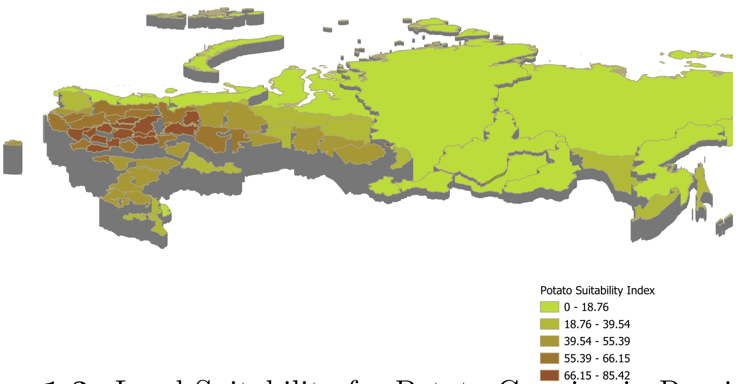


Figure 1.3: Land Suitability for Potato Growing in Russia.
Notes: The map illustrates the soil suitability index for potato cultivations in Russian oblasts. The higher levels of soil suitability are indicated by darker colors and the height of the polygons.
Source: Authors' calculations using data from FAO.

1.3 Data and Descriptive Analysis

We use three types of survey data in our analysis: the 2016 Life in Transition Survey, the Russian Longitudinal Monitoring Survey, and the Kazakhstan Living Standards Measurement Survey. To perform our analysis, we matched all three data sources with the Food and Agriculture Organization (FAO)'s Global AgroEcological Zones (GAEZ) v4 data on soil suitability for different crops. We also merge the Russian Longitudinal Monitoring Survey and the Kazakhstan Living Standards Measurement Survey data with the reference population height data from the World Health Organization to construct one of our main dependent variables (height-for-age z-score).

1.3.1 Soil Suitability

Our main identification strategy exploits spatial variation in the soil suitability index for cultivating potatoes and other crops. We use the soil suitability index for growing white potatoes, cabbage, tomato, beets, and carrots from the Food and Agriculture Organization (FAO)'s Global AgroEcological Zones (GAEZ) v4 database, specifically from theme 4 of the project. The suitability index is a composite measure, combining agro-climatic potential yields with results from soil and terrain evaluations. This data provides a detailed assessment of suitability for cultivating these crops, structured in a regular raster format of 5 arc-minute grid cells (approximately 9 x 9 km at the equator). We aggregated this data to different levels: to the second administrative division level for each country in the Life in Transition Survey, to the primary sample unit level for the Russian Longitudinal Monitoring Survey data, and to a 20km buffer around the centroid of household locations for the Kazakhstan Living Standards Measurement Survey data.

1.3.2 World Health Organization: Growth Reference Data

One of our main outcome variables is children's z-score for height conditional on age and gender, which has been widely used in recent economic literature to proxy a child's health and nutritional status (Steckel, 1995; Minoiu & Shemyakina, 2014a; Bundervoet et al., 2009a; Adsera et al., 2021). This variable is generally accepted as a good indicator of the long-run nutritional and health status of children, as height reflects the accumulation of past outcomes. To compute height-for-age z-scores for each child, we use data from World Health Organization's Growth Reference data[7], which contains median height and standard deviation of the reference population by child age (in months) and gender. The z-score is constructed as the standardized difference between the child's actual height (as reported by parents) and the median height of the international reference population of the same age and gender.

1.3.3 Life in Transition Survey Data and Descriptive Analysis

To provide a broader context and motivation for our main analysis, we start by examining households in all post-Soviet countries (except Turkmenistan) using the data from the Life in Transition Survey (LiTS). LiTS is a joint project of the EBRD and the World Bank, that collected data in three rounds: 2006, 2010, and 2016. We use data from the 2016 round because it is the first to contain both self-reported and measured data on individuals' height. The survey polled households in 34 countries, including 14 post-Soviet ones (excluding Turkmenistan). We use data on the 14 post-Soviet countries. The survey was conducted in over 1,000 primary sampling units (PSUs) in each post-Soviet country, for which geographical coordinates are available. Along with other characteristics, the dataset also includes measured height for some respondents, enabling us to verify the accuracy of self-reported data (see Figure 1.A2 in the Appendix 1.A).

The transition from a planned to a market economy occurred in all post-Soviet countries, though the timing of reforms varied. We define the transition year as the year in which the EBRD Transition Indicator for Price Liberalisation reached a value of 3 for the

[7]retrieved from `https://www.who.int/toolkits/growth-reference-data-for-5to19-years/indicators/height-for-age` and `https://www.who.int/toolkits/child-growth-standards/standards/length-height-for-age`

first time in a given country. This approach is borrowed from Adsera et al. (2021). We then use the variation in the timing of the transition years to compare cohorts born before the transition period with those who were under the age of five during the transition, residing in areas with varying degrees of suitability for potato cultivation. Our suggestive analysis in this section builds on the results from Adsera et al. (2021)[8], and further demonstrates that children under the age of five living on lands relatively more suitable for potato cultivation experienced a smaller negative effect on their height during the transition period. This provides a foundation for us to test our main hypothesis concerning the effectiveness of home production as a coping strategy during times of economic hardship.

We merge the household-level data from the LiTS survey with the soil suitability data for potato cultivation from the Food and Agriculture Organization (FAO)'s Global AgroEcological Zones (GAEZ) v4 data. To match the soil suitability data with PSUs, we aggregate the data to the second administrative division level for each country. Figure 1.4 depicts the map of the soil suitability for potato cultivation across the 14 post-Soviet countries together with the location of PSUs and second administrative division levels. The summary statistics of the data we use in the descriptive analysis of this section are presented in Table 1.B1 of the Appendix 1.B.

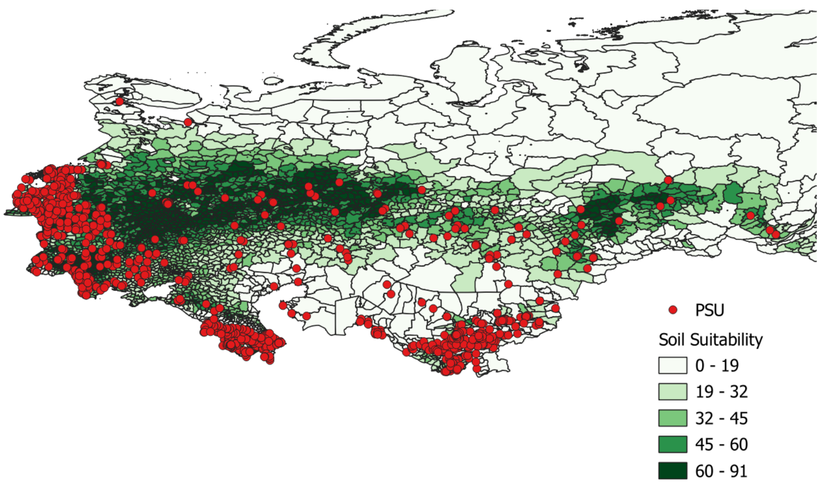


Figure 1.4: Variation in Soil Suitability in 14 Post-Soviet Countries and PSUs.
Note: The map illustrates the soil suitability index for potato cultivation on the 2nd administrative division level of 14 post-Soviet countries and the location of the primary sampling units. The higher levels of soil suitability are indicated by darker colors and the locations of PSUs by red dots.
Source: Authors' calculations using data from FAO and LiTS.

[8]Using the data from the Life in Transition Survey, Adsera et al. (2021) demonstrated that cohorts born around the start of the transition were shorter than their older or younger peers in adulthood.

Below, we present the empirical specification we use to uncover the trends in the relationship between the adult height and self-reported health status of children aged five and under during the transition year and the suitability of the land they live on for potato cultivation. Specifically, we compare the adult height and health of children who live on relatively suitable lands to otherwise similar children who live on less suitable lands.

$$Y_{icy} = \alpha_c + \beta \times BelowAge5 + \delta SoilSuitability_{cp} + \lambda BelowAge5 \times SoilSuitability +$$

$$+\gamma X_i + \theta_c y + u_{icy}$$

in which Y_{icy} is either adult height or the self-reported health status of individual i, born in year y in country c; $BelowAge5$ is an indicator variable that takes a value of 1 if the individual was five years old or younger during the transition year; $SoilSuitability_{cp}$ is the soil suitability index in country c PSU p; X_i includes individual-specific characteristics, such as age, gender, religion, and mother's education; α_c are country fixed effects and $\theta_c y$ are country-specific linear time trends. In our estimation, we cluster standard errors at the PSU level. We perform the analysis for individuals living in urban areas aged 21 and above for height comparison and 18 and above for health comparison. The shift to home production of goods during the transition shock was more pronounced in urban areas, as HHs residing in rural areas more often engage in home agriculture. In fact, our results confirm this hypothesis, because we do not find any significant effects when we include rural areas.[9]

Figure 1.5 plots the 95% confidence intervals for the residual adult height of children against the soil suitability for potato cultivation after controlling for individual-specific characteristics, country-fixed effects, and country-specific linear time trends. The red lines display the confidence intervals for the residual adult height of children aged five and below during the transition year, while the green lines depict the confidence intervals for older cohorts. The plot shows that the height of children aged five and below increases as the soil suitability index increases, whereas the height of older cohorts remains relatively stable across different suitability levels.

Table 1.1 presents the results of the econometric analysis of the above specification. All four columns control for individual-specific characteristics, including age, gender, religion, and mother's education, as well as the soil suitability index of other crops, such

[9]To further support our focus on the urban areas, Figure 1.A3 shows that owning a summerhouse (dacha) in Russia is a good predictor of growing potatoes during the transition years, and it also demonstrates that the majority of households with a dacha primarily reside in urban areas.

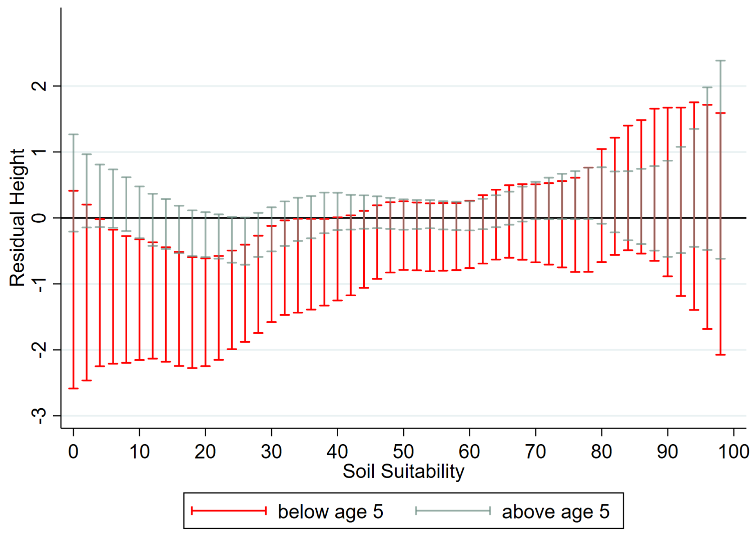


Figure 1.5: Height and Soil Suitability
Note: The figure shows 95% confidence intervals from Kernel-weighted local polynomial regression (using Epanechnikov kernel) of adult height on soil suitability index for potato cultivation after controlling for individual specific characteristics, country fixed effects, and country-specific linear time trends.

as cabbage, carrots, tomatoes, and beets. Country-fixed effects and country-specific time trends are also included in the model. The standard errors are clustered at the PSU level. Our findings indicate that in 2016, adults, adults who were aged five and younger during the transition year were on average 1.4-1.6cm shorter than older cohorts in adulthood.[10] This result is consistent with Adsera et al. (2021). However, we also observe that for individuals living on relatively more suitable lands for potato cultivation, the resulting decrease in adult height is smaller. Specifically, individuals living on lands with an average suitability index (45.28) close the height gap to 0.4cm (column 1 of Table 1.1). Columns 2 and 3 of Table 1.1 present the results of a similar analysis conducted for a self-reported assessment of current health. Health is measured as a categorical variable taking values from 1 to 5, with 1 denoting "Very Bad" and 5 corresponding to "Very Good". Consistent with the results in the first two columns, individuals who were five and younger during the transition years report less favorable current health conditions on average than do their older counterparts.[11] Examining the effects of living on lands with different suitability levels for potato cultivation reveals an important detail. Living in regions characterized

[10]We report results from a similar analysis for adults who were aged four and younger, and those who were aged six and younger in Table 1.B2 in the Appendix 1.B.

[11]We report results from a similar analysis for adults who were aged four and younger, and those who were aged six and younger in Table 1.B3 in the Appendix 1.B.

by soil suitability levels that favor agriculture acts as a mitigating factor, attenuating the otherwise negative impact on self-reported health.

Table 1.1: Estimation Results of Living on Suitable Lands on Adult Height and Health

	Height(cm)		Health(1-5)	
BelowAge5	-1.423**	-1.615**	-0.234***	-0.199***
	(0.618)	(0.657)	(0.058)	(0.062)
Suitability Index	-0.012	-0.013	-0.000	-0.000
	(0.026)	(0.027)	(0.003)	(0.003)
BelowAge5 × Suitability Index	0.022**	0.026**	0.004***	0.003***
	(0.011)	(0.012)	(0.001)	(0.001)
Controls	✓	✓	✓	✓
Country FE		✓		✓
Country-Specific time trends	✓	✓	✓	✓
Observations	6163	6163	7266	7266
Districts	480	480	485	485

Note: Using the sample of individuals aged 21-55 (18-55) in 14 post-Soviet countries in 2016, this table compares the adult height (health) of children aged five and below during the transition years with their older counterparts. It also shows that children who lived on more suitable lands for potato cultivation had a smaller decrease in their height (health status). *BelowAge5* is an indicator variable for an individual being below the age of five during the transition year, *Suitability Index* is the soil suitability index for white potato cultivation. The list of controls in all specifications includes age, gender, religion, mother's education, and suitability of other crops, such as cabbage, carrots, tomatoes, and beets. Standard errors are clustered on the PSU level.

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

To ensure that the cohort comparison is reliable, in Table 1.1 we use the sample of individuals aged 21-55 in 2016. However, we report similar results for the samples of individuals aged 21-65 and 21-99 (full sample) in Table 1.B4 and 1.B5.

For a more nuanced understanding of the differences between the adult height and health gaps at different levels of soil suitability, Figure 1.6 illustrates the disparities across the 25th, 50th, and 75th percentiles of soil suitability levels.

The findings offer preliminary evidence that suggests residing in areas suitable for potato cultivation may have played a mitigating role in the adverse effects of the economic transition on adult health. For a more comprehensive understanding of the underlying mechanisms, our subsequent analyses concentrate on the specific cases of Russia and

Kazakhstan, where we investigate whether home production, particularly of potatoes, played a substantial role in contributing to this alleviation.

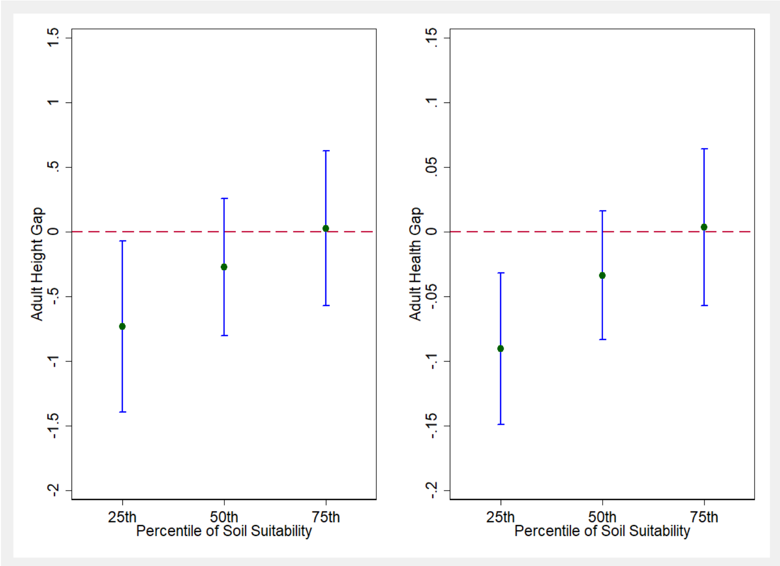


Figure 1.6: Adult Height and Health Gap Using LiTS Data

Note: This figure shows the marginal effects and their 95% confidence intervals for height (to the left) and for health (to the right) calculated at 25th, 50th and 75th percentiles of the soil suitability level for potato cultivation.

1.3.4 Russian Longitudinal Monitoring Survey

To test our main hypothesis we primarily use Russian Longitudinal Monitoring Survey data. This is a nationally representative panel data specifically designed to monitor how the reforms in the Russian Federation affect the health and economic welfare of households and individuals. Individual surveys contain self-reported information on the health of household members, including all the children in the household. For our purposes, we use 1) the reported height measures of children to construct the child's z-score for height conditional on age and gender; and 2) the self-reported height measures of adults. In addition to a variety of other characteristics, the household surveys include information about plot cultivation and potato growing, which we use to construct our main explanatory variables. We also utilize the RLMS Constructed Variables dataset, which contains constructed total and specific income, expenditure, and similar variables for households, which we use not only as controls in our main regressions, but also to test the randomness of soil suitability for potato cultivation. Our final dataset contains 38 regions with a suitability index ranging from 0 to 77.36 with a mean value of 50.6. The summary statistics of the key variables are presented in Table 1.B6.

Stylized Facts from the RLMS Data

To contextualize our analysis, Figure 1.7 portrays the dynamic shifts in the height-for-age z-scores of children from 1994 to 2017, juxtaposed with the probability of households engaging in potato cultivation during the same time span. The figure illustrates that, in the early aftermath of the Soviet Union's dissolution, the health of children as reflected in the height-for-age z-score is clearly low, potentially due to inadequate nutrition. Concurrently, the figure highlights a significant prevalence of households undertaking potato cultivation during this period, implying a strategic response to address nutritional challenges. This dual depiction underscores the possible interplay between household coping strategies, particularly potato cultivation, and the health outcomes of children during a critical transitional period.

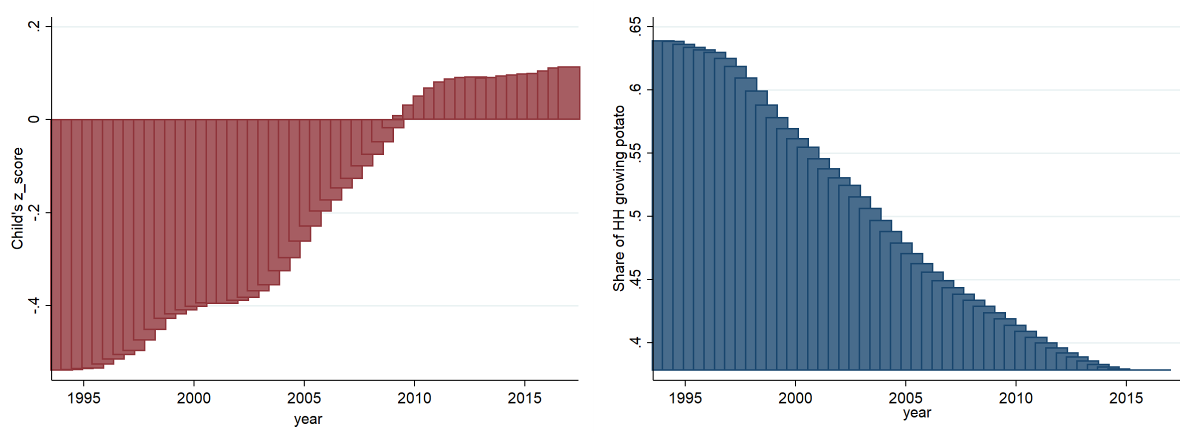


Figure 1.7: Average Height-for-age Z-scores and Share of HHs Growing Potatoes by Year.
Note: This figure depicts the evolution of child height-for-age z-score (to the left) and the share of households growing potatoes (to the right) during 1994-2017. Height-for-age z-score is computed as a standardized difference of -self-reported height and median height of the reference population (WHO).
Source: Authors' calculations based on data from RLMS.

Figure 1.8 presents a further breakdown of the trend in the probability of potato cultivation based on land suitability, distinguishing between suitable and non-suitable lands. We define non-suitable lands as areas with a suitability index below 20. The data clearly demonstrates that the likelihood of potato cultivation was notably higher in regions with more suitable lands, providing suggestive evidence that households strategically aimed to counter the decline in their diets by cultivating potatoes in areas where it would yield more favorable outcomes.

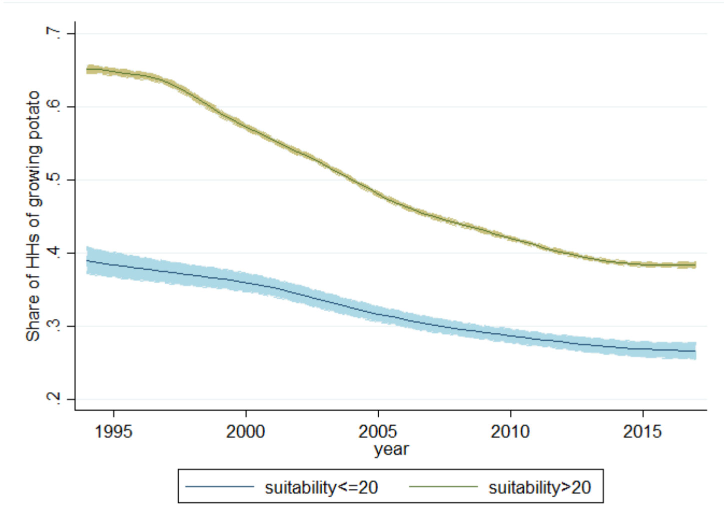


Figure 1.8: Share of HHs Growing Potatoes by Land Suitability.
Notes: Kernel-weighted local polynomial regression (using Epanechnikov kernel) of the probability of growing potato by year and land suitability.
Source: Authors' calculations based on data from RLMS.

In Figure 1.9, we present the evolution of the height-for-age z-scores for the period 1994-2017. In the first figure (to the left), households are divided by whether they grew potatoes or not. In the second figure (to the right) households are divided into three distinct groups: 1) families that did not grow potatoes, 2) families that grew potatoes on lands with below average suitability index, and 3) families that grew potatoes on lands with above average suitability index. An observable trend emerges: children from households that did not grow potatoes have, on average, higher z-scores than children from households that did. We attribute this difference to a selection effect based on income or wealth. Relatively wealthier households did not need to grow potatoes to maintain their consumption levels after the collapse of the Soviet Union, and, therefore, the health of their children was relatively better to begin with. While households facing more challenging conditions resorted to cultivating potatoes on their private plots in response to declining consumption. The efficacy of this coping strategy, however, depended on the soil suitability of the land. Specifically, households cultivating potatoes on more suitable lands experienced a reduction in the observed gap.

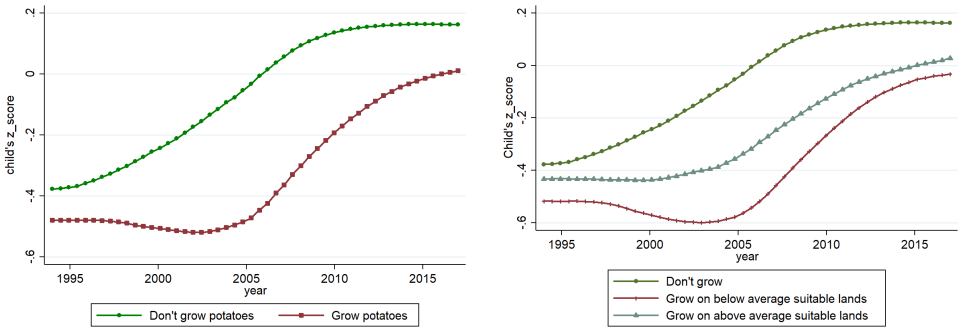


Figure 1.9: The Evolution of Children's Z-scores by HH Groups.
Notes: The first figure depicts the Kernel-weighted local polynomial regression (using Epanechnikov kernel) of the children's z-scores in two groups: 1) families that did not grow potatoes, and 2) families that grew potatoes. The second figure depicts the Kernel-weighted local polynomial regression (using Epanechnikov kernel) of children's z-scores by three groups: 1) families that did not grow potatoes, 2) families that grew potatoes on lands with below average suitability index, and 3) families that grew potatoes on lands with above average suitability index.
Source: Authors' calculations using data from RLMS.

1.3.5 Kazakhstan Living Standards Measurement Survey

In addition to the RLMS data, we also use cross-sectional data from the Kazakhstan Living Standards Measurement Survey (KLSMS) conducted by the World Bank in 1996. This is a nationwide survey that covers 7224 individuals from 1996 households. The advantage of these data over the RLSM is that it provides the geographic coordinates of HH location on the city/village level, amounting to in total of 135 locations. In contrast to the RLSM data, this effectively allows us to use the variation in soil suitability for potato cultivation across the locations as an instrument for growing potatoes.

To depict the spatial variation in the soil suitability index for potato cultivation, we map the locations of the households together with the suitability levels of the 2nd administrative division of the country around these locations in Figure 1.10. Higher and darker regions indicate better soil suitability levels.

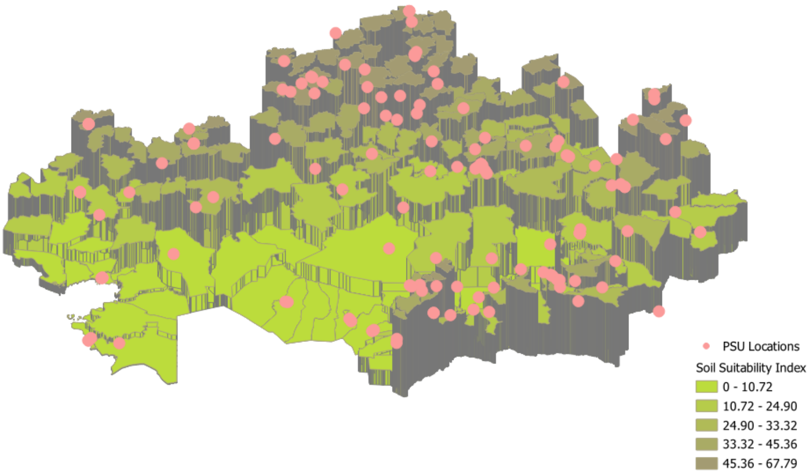


Figure 1.10: HH Locations and Soil Suitability in Kazakhstan

Note: The map illustrates the soil suitability index for potato cultivations in the second administrative division levels in Kazakhstan and the locations of localities from KLSMS. The higher levels of soil suitability are indicated by darker colors and the height of the polygons and the locations are indicated by pink dots.

Source: Authors' calculations using data from FAO's Global AgroEcological Zone v4 data and Kazakhstan Living Standards. Measurement Survey 1996

To match the soil suitability index to household locations on a more granular than the second administrative division level, we create a buffer around the centroid of the locations with a radius of 20km[12] and aggregate the grid-level suitability data for these buffers. The resulting data contains 135 locations with a suitability index ranging from 0 to 73, with a mean value of 34. The summary statistics of the key variables are presented in Table 1.B7.

In Figure 1.11, we depict the probability of households engaging in potato cultivation at different levels of soil suitability. The data indicate that households residing in regions with higher suitability are more likely to be involved in growing potatoes. This observation forms the basis for our main identification strategy in section 1.4.3.

[12] Our results stay the same if we change the radius to 15 or 25km. These are available upon request.

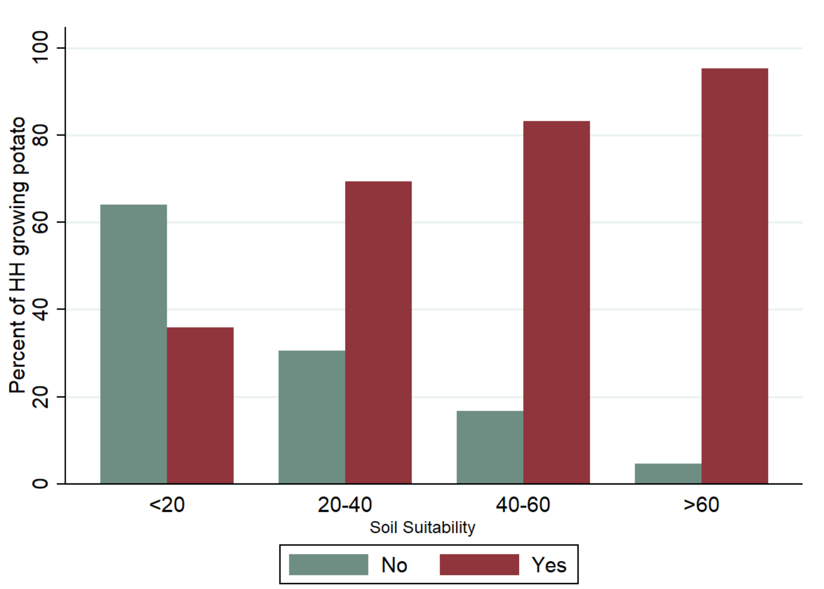


Figure 1.11: Probability of Growing Potatoes by Soil Suitability

Source: Authors' calculations using data from FAO's Global AgroEcological Zone 2002 and Kazakhstan Living Standards Measurement Survey 1996

1.4 Empirical Design and Results

1.4.1 Baseline Analyses

In our baseline analysis, we concentrate on the adaptation of households in Russia during the transition period utilizing comprehensive data from the Russian Longitudinal Monitoring Survey (RLMS). Thanks to the availability of detailed household-level panel data, in addition to analyzing the adult height of children exposed to the transition, we can also track the evolution of their height-for-age z-scores as children during the transition years.

Our main identification strategy relies on the use of the variation in the soil suitability index of different regions in Russia. We start by building and expanding on the results obtained in Adsera et al. (2021).[13] We define three indicators for children being exposed

[13]In their paper using the RLMS data, Adsera et al. (2021) show that adults born at the start of the transition period (1992 in the case of Russia) are shorter than their counterparts born before and after the transition. Table 1.B8 replicates this result using the sample of adults observed in the RLMS data after 2001. In line with Adsera et al. (2021), it shows that adults born at the start of the transition are on average 1-1.4cm shorter than their older or younger cohorts in adulthood.

to the transition: 1) for children born during the transition year (BT), 2) for children born or one year old during the transition year (BT1), and 3) for children born, one year old, or two years old during the transition year (BT2). We next examine the effectiveness of home production of potatoes as a coping strategy employed by households during the transition years. Specifically, we compare the height of children born during the transition period in households that grew potatoes on more suitable lands with those born in households that grew potatoes on less suitable lands.

The first specification in this section aims to test the long-run effects of home production of potatoes on health as proxied by self-reported adult height. For this, we concentrate on the sample of adults we observe in the RLMS dataset after 2001, and check whether and how growing potatoes in 1994-2001 affected the height of cohorts born during the transition year (born or one year old and born or one year or two years old) versus their older and younger counterparts. We construct and estimate the following model:

$$Height_{irt} = \alpha + \lambda_r + \beta ET_{ir} + \delta_1 \cdot Potato1994-2001_{ir} + \delta_2 \cdot ET_{ir} \times Potato1994-2001_{ir} +$$

$$+\delta_3 \cdot Potato1994-2001_{ir} \times Suitability\ index_r +$$

$$+\delta_4 \cdot ET_{ir} \times Potato1994-2001_{ir} \times Suitability\ index_r + X\gamma + \epsilon_{irt}$$

where $Height_{ir}$ is the adult's self-reported height; ET_{ir} stands for whether individual i was exposed to the transition as a child and is measured as an indicator of whether individual i is 1) born during the transition year, 2) born or one year old during the transition year, and 3) born, one year old, or two years old during the transition year; $Potato1994-2001_{ir}$ is a variable indicating for how many years the HH was growing potatoes in the period 1994-2001; $Suitability\ index_r$ is the soil suitability index for white potato cultivation in the region r; and X includes individual's gender, age, type of settlement (urban/rural), number of family members, HH total real income, linear time trend, and mother's height in the most restrictive specification. Each adult appears in this specification only once, and we cluster the standard errors on the PSU level.

The results from our first specification are reported in Table 1.2. Our first observation from the findings underscores that the effectiveness of growing potatoes as a coping strategy is limited to its impact on children. This is first evident from the insignificant coefficient estimates on $Potato1994-2001_{ir}$ and the interaction between $Potato1994-2001_{ir}$ and $Suitability\ index_r$, suggesting that the overall impact on the population is limited. Second, the significant coefficient estimate on the interaction between *ET* and *Grew potato 1994-2001* suggests that growing potatoes affected adults exposed to the transition as children. Furthermore, the negative coefficient estimate on the interaction term between *ET* and *Grew Potato 1994-2001* suggests a potential height differential between individuals who were exposed to the transition as children but whose households did not adopt potato growing versus those who did. This finding could be indicative of selection bias. Households most affected by the transition might have been more likely to adopt potato growing as a coping strategy, leading to a non-random distribution of treatment (potato growing) across the exposed population (children during the transition). Our inclusion of total household income as a control variable may not fully address this selection bias, as it only accounts for current income levels and not the underlying factors that may have influenced the decision to grow potatoes in the first place. Consequently, children born during the transition to families engaged in potato cultivation tend to be 1.4-2cm shorter compared to their younger and older counterparts. However, when we consider the role of land suitability for potato cultivation, we find that growing potatoes on lands well-suited for such cultivation does emerge as a mitigating factor and narrows the observed height gap. This is explicitly reflected in the positive and statistically significant coefficient estimate of the triple interaction term between *ET*, *Grew potato 1994-2001*, and *Suitability index* variables. Notably, growing potatoes on lands with an average suitability index completely closes the height gap for adults born in the transition year (column 1 of Table 1.2). These results remain robust even after controlling for the mother's height (columns 4-6 of Table 1.2), which accounts for genetic influence on height. We further demonstrate the adult height gaps between children born during the transition from households that grew potatoes on lands with different percentiles of soil suitability index in Figure 1.12.

Table 1.2: Long-run Effects of Potato Cultivation on Adult Height

	Self-reported adult height (cm)					
	(0 yrs)	(0-1 yrs)	(0-2 yrs)	(0 yrs)	(0-1 yrs)	(0-2 yrs)
Exposed to Transition	0.263	-0.463	0.563	1.341	-0.831	-0.554
	(0.813)	(0.813)	(0.793)	(0.987)	(0.777)	(0.835)
Grew potato 1994-2001	0.019	0.026	0.032	0.280*	0.298*	0.299*
	(0.176)	(0.178)	(0.180)	(0.151)	(0.156)	(0.154)
Grew potato 1994-2001 × SI	-0.001	-0.002	-0.002	-0.004	-0.004	-0.005
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
ET × Grew potato 1994-2001	-2.033***	-1.489**	-1.401**	-1.937***	-1.223***	-1.595***
	(0.723)	(0.559)	(0.541)	(0.509)	(0.274)	(0.294)
ET × Grew potato 1994-2001 × SI	0.041**	0.031***	0.032***	0.032**	0.030***	0.028***
	(0.016)	(0.010)	(0.009)	(0.013)	(0.005)	(0.005)
Mother's height				0.399***	0.399***	0.399***
				(0.030)	(0.030)	(0.030)
Controls	✓	✓	✓	✓	✓	✓
Linear time trend	✓	✓	✓	✓	✓	✓
PSU FE	✓	✓	✓	✓	✓	✓
N	9479	9479	9479	2351	2351	2351
R^2	0.511	0.511	0.512	0.531	0.532	0.532
Mean Suitability	50.6	50.6	50.6	50.6	50.6	50.6

Note: Using the sample of all adults observed in RLMS data after 2001, this table shows the adult height gaps between individuals born during the transition, born or one year old, and born, one year old or two years old during the transition in HHs that did grow potatoes in the period 1994-2001 versus the individuals in HHs that did not grow potatoes. It further shows the effect of growing potatoes on more suitable lands (captured by the triple interaction term). *ET* stands for whether an individual was exposed to the transition as a child. We use three measures for the exposure to the transition: 1) born during the transition year (columns 1 and 4), 2) born or one year old during the transition year (columns 2 and 5), and born, one year old, or two years old during the transition year (columns 3 and 6). *Grew potato 1994-2001* shows how many years a HH grew potatoes during 1994-2001. *SI* is the soil suitability index for potato cultivation. The list of controls in all specifications includes gender, age, type of settlement (urban/rural), number of family members, and HH total real income. Standard errors are clustered on the PSU level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

In subsequent analyses, our focus shifts to examining the short-term impact of household potato cultivation on the progression of children's height-for-age z-scores during the transition period, which serves as a proxy for nutritional status. To accomplish this, we construct and estimate a two-way fixed effects model that controls for individual-specific and time-fixed effects. Specifically, we estimate the following model:

$$Y_{irt} = \alpha_i + \lambda_t + \beta \cdot Potato_{irt-1} + \delta \cdot Potato_{irt-1} \times Suitability\ index_r + X\gamma + \epsilon_{irt}$$

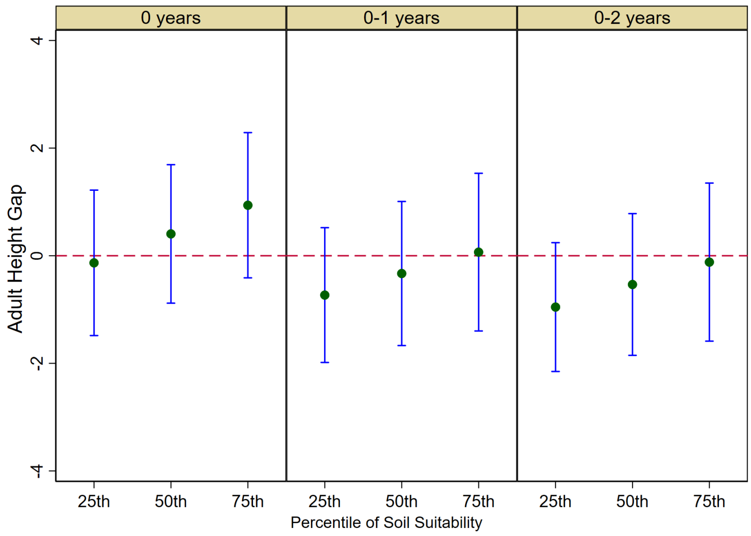


Figure 1.12: Adult Height Gap Using RLMS Data
Note: This figure shows the marginal effects and their 95% confidence intervals for adult height calculated at the 25th, 50th and 75th percentiles of the soil suitability level for potato cultivation.

where Y_{irt} is either the height-for-age z-score or the indicator of being stunted for child i in region r at time period t; α_i captures individual fixed effects; λ_t captures year fixed effects; $Potato_{irt-1}$ is an indicator variable whether family i grew potatoes in region r at time period $t-1$; $Suitability\ index_r$ stands for the soil suitability value for region r; and X is a vector of control variables, including child age, the number of family members, total HH income, and PSU-level annual night lights.

Note that we use the lag of the indicator for growing potatoes. This choice is motivated by the fact that households typically store potatoes for year-round consumption, and therefore, the nutritional impact on a child's health will manifest with a certain time delay. Our analyses focus on data from the period 1994-2001, the years most heavily influenced by the transition.[14].

The results of the short-run analysis appear in Table 1.3 below. The first finding we observe is that children from families who grew potatoes have on average 0.5 standard deviations lower height-for-age z-score. This translates into a 2.75cm lower height for children. We attribute this effect to a selection bias based on income or wealth effect. That is, comparably wealthier families did not grow potatoes, as they could afford to buy the products they needed. However, we can see that growing potatoes on more suitable lands helped to close this gap. This is demonstrated by the positive and significant

[14]We perform the same analysis for 2002-2017 as a placebo test; the results appear in Table 1.B10.

coefficient estimate on the interaction term. The gap was alleviated by 0.44 standard deviations for children from HHs that grew potatoes on lands with an average suitability index, which decreases the difference to 0.31cm. This finding is robust to adding year-fixed effects as well as PSU-specific time trends to the specification. To address any concern that our comparison of families that used land for home production with those that did not is unreliable, we run the same specification only on the sample of families who reported that they did use their land for home agriculture. The results of this estimation are reported in the last column of Table 1.3, and are stable and larger in magnitude than those in the full sample. To illustrate the closing gap, Figure 1.13 depicts the average gaps in children's height calculated at the 25th, 50th, and 75th percentiles of the soil suitability level.

Table 1.3: Short-run Effects of Potato Cultivation on Child Height-for-age Z-score

	Height-for-age z-score			
	(1)	(2)	(3)	(4)
Grew potato	-0.479***	-0.482***	-0.501***	-0.603***
	(0.172)	(0.167)	(0.169)	(0.206)
Grew potato × Suitability index	0.009**	0.009***	0.009**	0.009**
	(0.003)	(0.003)	(0.003)	(0.004)
Controls	✓	✓	✓	✓
Ind. FE	✓	✓	✓	✓
Year FE		✓	✓	✓
PSU-specific time trends			✓	
Num. of ind.	2642	2642	2642	1937
Num. of obs.	5426	5426	5426	3753
Within R^2	0.007	0.010	0.029	0.011
Prob>F	0.006	0.012		0.003
Mean Suitability	50.6	50.6	50.6	50.6

Note: Using the sample of children observed in RLMS data from 1994-2001, this table shows the gaps in the height-for-age z-scores of children from HHs that engaged in potato cultivation versus HHs that did not. It further shows the effectiveness of growing potatoes on more suitable lands in alleviating the gap between children from HHS who grew potatoes and the ones who did not (captured by the interaction term). The last column uses the sample of children from HHs who reported that they used agricultural lands for home production. The list of controls in all specifications includes the child's age, the number of family members in the HH, total HH income, and PSU-level annual night lights. Standard errors are clustered on the PSU level.

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

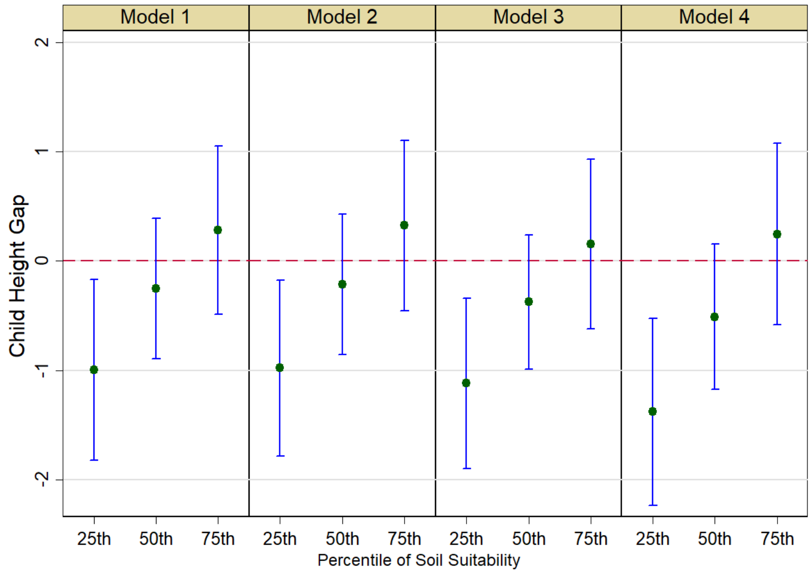


Figure 1.13: Child Height Gap Using RLMS Data
Note: Marginal effects and their 95% confidence intervals calculated at the 25th, 50th, and 75th percentiles of the soil suitability level for potato cultivation.

One of the threats to the identification is a potential difference between households that grew potatoes on less suitable lands versus those that grew on more suitable lands. To partially address this concern, we check whether there are differences based on observable HH characteristics. We estimate different household characteristics on the indicator for growing potatoes and the interaction term of growing potatoes with the suitability index using a fixed effect model, where we control for time and PSU fixed effects. The coefficient of interest is the one on the interaction term. The results of these regressions are presented in Table 1.B9 in the Appendix 1.B. Panels A and B show that the interaction term of growing potatoes with the soil suitability index is not significant in any specification. This implies that HHs that grew potatoes on less suitable lands are not significantly different from those that grow on more significant lands, at least based on the observable characteristics.

We conduct a similar analysis for the indicator of a child being stunted, which takes a value of 1 if the height-for-age z-score of a child is below -2 standard deviations. The regression results are presented in Table 1.4. According to our findings, growing potatoes increases the probability of a child being stunted by 0.1 points. However, similarly to the results obtained for z-scores, the interaction term with the soil suitability index reduces the probability of being stunted. Specifically, growing potatoes on land with an average suitability index decreases the probability by 0.09, nearly eliminating the gap. Figure

1.A4 in the Appendix 1.A illustrates the closing of the gap for the 25th, 50th, and 75th percentiles of the soil suitability level.

Table 1.4: Short-run Effects of Potato Cultivation on Probability of Being Stunted

	Indicator for being stunted			
	(1)	(2)	(3)	(4)
Grew potato	0.108**	0.109**	0.114**	0.124***
	(0.046)	(0.046)	(0.048)	(0.043)
Grew potato × Suitability index	-0.002**	-0.002*	-0.002*	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
Controls	✓	✓	✓	✓
Ind. FE	✓	✓	✓	✓
Year FE		✓	✓	✓
PSU-specific time trends			✓	
Num. of ind.	2642	2642	2642	1937
Num. of obs.	5426	5426	5426	3753
Within R^2	0.007	0.008	0.018	0.009
Prob>F	0.003	0.002		0.005

Note: Using the sample of children observed in RLMS data from 1994-2001, this table shows the gaps in the probability of being stunted (height-for-age z-score<-2) of children from HHs that engaged in potato cultivation versus the ones that did not. It further shows the effectiveness of growing potatoes on more suitable lands in alleviating the gap between children from HHs that grew potatoes and those that did not (captured by the interaction term). The last column uses the sample of children from HHs that reported using agricultural lands for home production. The list of controls in all specifications includes the child's age, the number of family members in the HH, total HH income, and PSU-level annual night lights. Standard errors are clustered on the PSU level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

1.4.2 Omitted Correlates of Soil Suitability

The key assumption for the identification strategy in our baseline specification implies that the soil suitability for potato cultivation does not affect the nutrition status of children through other channels. An example of a violation of this assumption would be that regions with more suitable lands are also more (less) economically developed. This would in turn mean that children from HHs who live on relatively more suitable lands have better (worse) nutrition status. Thus, to verify our assumption and rule out the described channel of the effect of the soil suitability on a child's height-for-age z-score, we average certain income characteristics of HHs across the primary sampling units and estimate the effect of the soil suitability index for potato cultivation on these characteristics.

Additionally, we obtain PSU-level statistics on wages, the share of profitable firms, the share of the population that is female, and the share of public employees from Multistat[15] and check whether these variables are correlated with the soil suitability index. To check the correlations with different PSU-level characteristics we use the following random effects model:

$$Y_{rt} = \alpha + \lambda_t + \beta Suitability\ index_r + \epsilon_{rt}$$

where Y_{rt} is the average total HH income, expenditures, and savings; regional poverty groups, wages, share of profitable firms, share of the population that is female, and the share of public employees in the region r at time period t; λ_t is year fixed effects; and $Suitability\ index_r$ is the soil suitability value for region r.

The results of the regression analysis are presented in Table 1.5. Panel A displays random effects estimation results of average HH characteristics of primary sampling units and Panel B displays the same results of PSU level characteristics on soil suitability index for potato cultivation.

Table 1.5: Estimation Results for PSU Characteristics

Panel A

	Total Income	Total Expenditures	Total Savings	Poverty Group
Suitability Index	-59.51	-60.65	-4.293**	0.001
	(40.71)	(78.05)	(2.100)	(0.002)
Year FE	✓	✓	✓	✓
N	912	912	912	912

Panel B

	Wage	Share of profitable firms	Share of females	Share of public employees
Suitability Index	-51.64	0.020	0.000	0.000
	(87.83)	(0.046)	(0.000)	(0.001)
Year FE	✓	✓	✓	✓
N	420	420	382	390

Note: Panel A displays random effects estimation results of average HH income characteristics of primary sampling units on the soil suitability index for potato cultivation, while Panel B does the same for random effects estimation results of PSU level characteristics. Time-fixed effects are included in all specifications. Clustered standard errors in parenthesis.

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

[15]Data retrieved from `http://multistat.ru/`

The results indicate that the soil suitability index is not significant in any specification except the one with total savings, implying no correlation between the soil suitability index and the level of development of PSUs. Figures 1.14 and 1.15 below depict the correlations of the soil suitability index with all dependent variables.

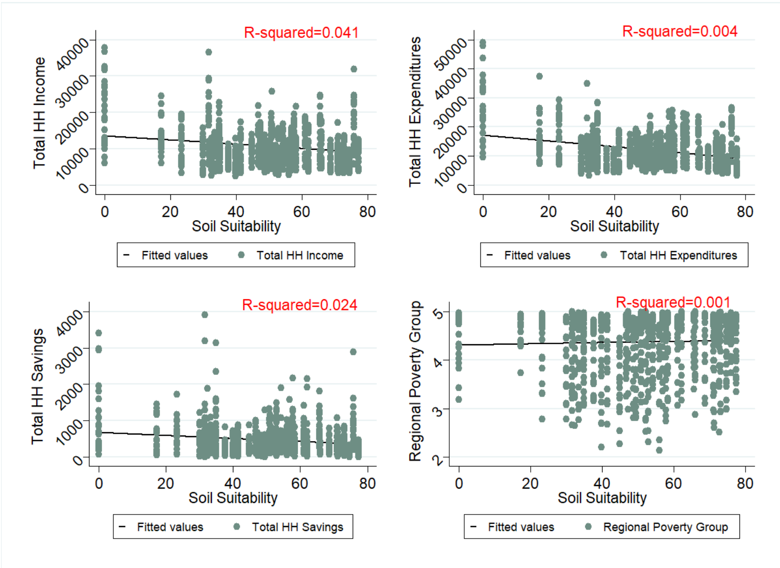


Figure 1.14: PSU Characteristics by Suitability Index
Notes: Correlation between primary sampling unit characteristics, averaged across RLMS HHs, and the soil suitability index for potato cultivation.
Data source: Authors' calculations using data from RLMS and FAO.

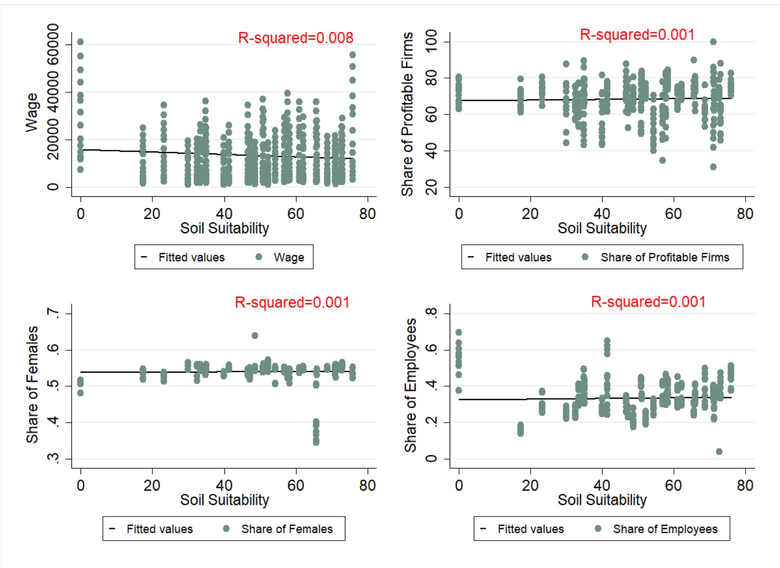


Figure 1.15: PSU Characteristics by Suitability index
Notes: Correlation between primary sampling unit characteristics and the soil suitability index for potato cultivation.
Data source: Authors' calculations using data from Multistat and FAO.

1.4.3 Placebo

Additionally, we conduct a placebo test, in which we apply our specification for the short-run effect of growing potatoes on children's z-score and add indicators for growing other crops together with the interaction terms of growing these crops with their corresponding suitability indexes. In all specifications we control for growing potatoes to avoid an omitted variable bias, as growing potatoes in many cases implies also growing other crops. We also use a specification in which we include all crops together. The results of the placebo tests are presented in Table 1.6 below, and indicate that none of the other placebo crops have any effect on the z-score of children.

Furthermore, we observe no significant effect of growing crops on suitable lands, with the exception of cabbage, where the interaction term is moderately significant. These findings further confirm the hypothesis that growing potatoes was an effective strategy used by households to compensate for the food deficit they faced during the transition years.

We implement a second type of placebo test by utilizing RLMS data spanning from 2002 to 2017 and employing a specification akin to that used in the short-run analysis. Table 1.B10 presents the results from these regressions. The findings here highlight an important distinction: not only do the magnitudes of the effects notably diminish, but we also observe a lack of statistical significance both for growing potatoes and the interaction term during the post-transition period when the economy began to recover. This suggests that the effectiveness of home production of potatoes in mitigating negative effects on child health was more prominent during the transition years, characterized by economic difficulties, and became less significant as the economy began to improve after the transition period.

Table 1.6: Estimation Results on Z-score from Placebo Tests for 1994-2001

	Height-for-age z-score					
Grew potato	-0.501***	-0.460**	-0.440**	-0.473**	-0.475**	-0.463**
	(0.169)	(0.171)	(0.178)	(0.202)	(0.178)	(0.192)
Grew potato× Potato Suitability	0.009**	0.007**	0.007**	0.009**	0.009**	0.009**
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Grew cabbage		-0.225				-0.158
		(0.135)				(0.169)
Grew cabbage × Cabbage Suitability		0.005*				0.005*
		(0.003)				(0.003)
Grew tomato			-0.171			-0.147
			(0.106)			(0.114)
Grew tomato × Tomato Suitability			0.004			0.004
			(0.004)			(0.004)
Grew beets				-0.097		-0.061
				(0.194)		(0.231)
Grew beets × Beet Suitability				0.000		-0.001
				(0.004)		(0.004)
Grew carrot					-0.062	0.073
					(0.124)	(0.113)
Grew carrot × Carrot Suitability					0.000	-0.003
					(0.003)	(0.002)
Controls	✓	✓	✓	✓	✓	✓
Ind. FE & Year FE	✓	✓	✓	✓	✓	✓
PSU-specific time trends	✓	✓	✓	✓	✓	✓
Num. of ind.	2642	2642	2642	2642	2642	2642
Num. of obs.	5426	5422	5423	5421	5422	5419
Within R^2	0.029	0.030	0.029	0.029	0.029	0.032

Note: This table performs a placebo test and shows that growing other crops, as well as the interaction term with the soil suitability indexes, is not correlated with the height-for-age z-scores of children exposed to the transition period. The list of controls includes the child's age, the number of family members, total HH income, and PSU-level annual night lights. Standard errors are clustered on the PSU level.

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

1.4.4 Extension: Results from Kazakhstan

To address potential endogeneity concerns and establish a causal relationship between potato cultivation and health outcomes, we adopt a two-stage least squares approach, using soil suitability as an instrumental variable for potato cultivation. By utilizing this instrumental variable, we aim to isolate the exogenous variation in potato cultivation driven by differences in soil suitability, allowing us to uncover the true impact of home production of potatoes on health outcomes during the transition period.

To estimate the effect of home production of potatoes on the health outcomes of children, we use the below specifications:

First Stage

$$Grow\_Potato_{il} = \alpha + \beta * suitability_l + X\gamma + u_{il}$$

Second Stage

$$Y_{il} = \alpha + \beta \cdot Grow\_Potato_{il} + X\gamma + \lambda year\_of\_birth + \epsilon_{il}$$

where Y_{il} is either a child's z-score or an indicator of whether a child is classified as stunted (height-for-age z-score of below -2 standard deviations); in the most restrictive specification X includes the mother's and father's height, gender of the child, the number of family members, an indicator for whether HH is considered poor, an indicator of whether the mother has more than a high school education, annual HH per capita expenditures, and an indicator for settlement type (rural/urban).

The results of the 2-stage approach are presented in Table 1.7 below. The first column shows the results from the first stage. As expected, soil suitability is a good predictor of potato cultivation by households. An increase of 10 points in soil suitability level increases the probability of growing potatoes by 0.1. Columns 2 to 5 show the results of the second stage with different controls. Even in the most restrictive specification where we control for mother's and father's height, and for the linear trends of the year of birth, the effect of growing potatoes is still positive and significant. The last column shows the results from an OLS regression. Our 2SLS estimates should be interpreted as Local Average Treatment Effects (LATE). This means that the estimated effect represents the average height gain (approximately 5.6 cm) for children from households that chose to grow potatoes because their land had suitable soil. This effect may not be generalizable to children from the average household. Given the more moderate effect size observed for potato growing on highly suitable land in our previous chapters using RLMS data, this LATE estimate from 2SLS likely represents a larger effect than the Average Treatment Effect (ATE) for the entire population.

Table 1.7: Estimation Results from the Two-stage Approach

	Grew potato	**Height-for-age z-score**				
	(1st stage)	(2SLS)	(2SLS)	(2SLS)	(2SLS)	(OLS)
Suitability index	0.008***					
	(0.001)					
Grew potato		1.047**	1.005**	0.840**	0.751*	0.087
		(0.421)	(0.409)	(0.418)	(0.419)	(0.151)
Grew potato× Suitability index						0.004
						(0.003)
Mother's height			0.036***	0.030***	0.030***	0.028***
			(0.006)	(0.006)	(0.006)	(0.006)
Father's height				0.025***	0.026***	0.027***
				(0.009)	(0.009)	(0.008)
Year of birth					0.032***	0.034***
					(0.011)	(0.011)
Other controls	✓	✓	✓	✓	✓	✓
N	1539	1539	1496	1361	1361	1361
R^2		0.249	0.280	0.311	0.324	0.134
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000
Prob>A-R Wald test		0.007	0.011	0.039	0.068	

Note: This table uses data on children from the Kazakhstan Living Standards Measurement Survey conducted in 1996. The first column contains the results of the first stage, where the dependent variable is an indicator of whether the HH grew potatoes during the previous 12 months. Columns 2 to 5 show the results of the second stage, where the dependent variable is a child's z-score. An OLS analog of the 2nd stage is reported in column 6. The list of other controls includes the gender of the child, the number of family members, an indicator for whether HH is considered poor, an indicator of whether the mother has more than a high school education, annual HH per capita expenditures, and an indicator for settlement type (rural/urban). Clustered standard errors are in parenthesis.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

In Table 1.8 we report the results of a similar analysis conducted for the probability of being stunted. In this case, our results remain stable across all the specifications, except for when we control for the year of birth. According to these results, a HH growing potatoes decreases the probability a child will be stunted by 0.2 points on average.

Overall, the results in this section provide further confirmation and confidence of the findings obtained using RLMS data on Russian households.

Table 1.8: Estimation Results from the Two-stage Approach

	Grew potato	**Indicator for being stunted**				
	(1st stage)	(2SLS)	(2SLS)	(2SLS)	(2SLS)	(OLS)
Suitability index	0.008***					
	(0.001)					
Grew potato		-0.239**	-0.214*	-0.211*	-0.168	-0.027
		(0.107)	(0.109)	(0.118)	(0.117)	(0.037)
Grew potato× Suitability index						-0.001
						(0.001)
Mother's height			-0.003**	-0.003**	-0.003**	-0.003*
			(0.001)	(0.002)	(0.001)	(0.001)
Father's height				-0.000	-0.001	-0.001
				(0.002)	(0.002)	(0.002)
Year of Birth					-0.016***	-0.016***
					(0.003)	(0.003)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
N	1539	1539	1496	1361	1361	1361
R^2		0.234	0.242	0.247	0.279	0.081
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000
Prob>A-R Wald test		0.016	0.035	0.048	0.121	

Note: This table uses data on children from the Kazakhstan Living Standards Measurement Survey conducted in 1996. The first column contains the results of the first stage, where the dependent variable is an indicator of whether the HH grew potatoes during the previous 12 months. Columns 2 to 5 show the results of the second stage, where the dependent variable is an indicator of whether a child is stunted (height-for-age z-score below -2). An OLS analog of the 2nd stage is reported in column 6. The list of other controls includes the gender of the child, the number of family members, an indicator for whether HH is considered poor, an indicator of whether the mother has more than a high school education, annual HH per capita expenditures, and an indicator for settlement type (rural/urban). Clustered standard errors are in parenthesis.

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

1.5 Mechanisms

In examining the potential mechanisms underlying the relationship between potato cultivation and child health, we build our insights on mechanisms suggested by Nunn & Qian (2011). A primary channel through which potato cultivation could impact a child's well-being directly is via its nutritional effects arising from the consumption of potatoes. Potatoes are known to be highly nutritious: they are rich in vitamins, minerals, protein, and complex carbohydrates Lang (2001). In a setting of food scarcity, the quality of potatoes positions them as a substantive dietary contributor. However, several other mechanisms should be considered in addition to the direct nutritional benefits from consumption of potatoes. Firstly, potatoes can serve as a barter commodity, facilitating household acquisition of other essential food products. Secondly, the saved expenditures attributed to homegrown potatoes might redirect resources toward increased consumption of other goods essential for overall nutrition. Lastly, a potential economic dimension emerges through the prospect of selling potatoes, introducing a dynamic that could influence household income and, consequently, positively impact child health.

In this section, we provide suggestive evidence in favor of the direct nutritional effect of potato consumption on children's health. First, to rule out the mechanism of increased income from selling homegrown potatoes, it is worth mentioning that only six percent of households that grew potatoes during 1994-2001 report selling potatoes in the RLMS data. To provide more evidence, we construct and estimate a specification similar to the one from section 4.1, analyzing the long-run effects of potato cultivation on suitable lands on adult height. We use the specification below, and add an interaction term for an adult exposed to the economic transition as a child and his/her HH selling potatoes in the 1994-2001 period.

$$Height_{irt} = \alpha + \lambda_r + \beta ET_{ir} + \delta_1 \cdot Potato1994-2001_{ir} + \delta_2 \cdot ET_{ir} \times Potato1994-2001_{ir} +$$

$$+\delta_3 \cdot ET_{ir} \times Sold\_Potatoes1994-2001_{ir} + \delta_4 \cdot Potato1994-2001_{ir} \times Suitability\ index_r +$$

$$+\delta_5 \cdot ET_{ir} \times Potato1994-2001_{ir} \times Suitability\ index_r + X\gamma + \epsilon_{irt}$$

where $Height_{ir}$ is the adult's self-reported height; ET_{ir} indicates whether individual i was exposed to the transition as a child and is measured as an indicator of whether individual i is 1) born during the transition year, 2) born or one year old during the transition year, and 3) born, one year old, or two years old during the transition year; $Sold\_Potatoes1994-2001_{ir}$ is a variable indicating how many years a HH grew potatoes between 1994-2001; $Potato1994-2001_{ir}$ is a variable indicating how many years a HH sold potatoes 1994-2001; $Suitability\ index_r$ is the soil suitability index for white potato cultivation in the region r; and X includes the individual's gender and age, the type of settlement (urban/rural), number of family members, total real HH income, and a linear time trend. For this specification, we use all adults observed in RLSM data after 2001. Each adult appears only once, and we cluster the standard errors on the PSU level.

The results of the analysis are presented in Table 1.9 below. The interaction term between exposure to the transition and selling potatoes in 1994-2001 is insignificant for all three measures of exposure. This provides further suggestive evidence that selling potatoes was not a mechanism through which the cultivation of potatoes improved children's health during the transition period.

In the following analysis in this section, our focus is on excluding the possibility that savings on expenditures attributed to homegrown potatoes play a role in increasing consumption of other essential food products. We show that households engaged in potato cultivation do not exhibit a higher likelihood of purchasing other food products or allocating more of their budget to expenditures on other goods. For this examination, we adopt a fixed effects model, incorporating fixed effects at the levels of household, time, and primary sampling units. We use all households observed in the RLMS data during 1994-2001. Our control variables include the number of HH members, the total real HH income, and the number of children below the age of seven. The results of this analysis are presented in Table 1.B11. We also observe no significant difference in the variety of purchased food products (column 9 of Table 1.B11).

Lastly, to rule out the mechanism of potatoes serving as a barter commodity, we check whether households engaged in potato cultivation are more likely to have other essential food products and whether the amount of the products they have depends on growing potatoes. For that, we estimate a fixed effects model controlling for household, year, and primary sampling unit fixed effects. The results of these regressions are reported in Table 1.B12. We observe no significant change in the likelihood of having food products other than potatoes or larger amounts of these products owned by households. We also see no significant change in the variety of different products owned by households (column 9 of Table 1.B12).

All three exercises described in this section provide suggestive evidence in favor of the direct nutritional benefits from the consumption of potatoes for those households that grew potatoes on suitable lands.

Table 1.9: Long-run Effects of Potato Cultivation on Adult Height

	Self-reported adult height (cm)		
	(0 years)	(0-1 years)	(0-2 years)
Exposed to Transition	0.270	-0.461	-0.798
	(0.827)	(0.814)	(0.788)
Grew potato 1994-2001	0.019	0.026	0.032
	(0.176)	(0.178)	(0.181)
Grew potato 1994-2001 × Suitability index	-0.001	-0.002	-0.002
	(0.003)	(0.003)	(0.003)
ET × Sold Potatoes 1994-2001	0.167	0.371	0.782
	(1.332)	(0.754)	(0.507)
ET × Grew potato 1994-2001	-2.037***	-1.531**	-1.458**
	(0.750)	(0.642)	(0.579)
ET × Grew potato 1994-2001 × Suit. index	0.041**	0.031***	0.032***
	(0.015)	(0.011)	(0.010)
Controls	✓	✓	✓
Linear time trend	✓	✓	✓
PSU FE	✓	✓	✓
N	9479	9479	9479
R^2	0.511	0.511	0.512

Note: Using the sample of all adults observed in RLMS data after 2001, this table shows that selling potatoes during 1994-2001 is not correlated with the adult height of children exposed to the transition period (captured by interaction term between *ET* and *Sold Potatoes 1994-2001*). *ET* stands for whether an individual was exposed to the transition as a child. We use three measures for exposure to the transition: 1) born during the transition year (columns 1 and 4), 2) born or one year old during the transition year (columns 2 and 5), and born, one year old, or two years old during the transition year (columns 3 and 6). *Grew potato 1994-2001* shows how many years a HH grew potatoes during 1994-2001. *Sold Potatoes 1994-2001* shows how many years the HH sold potatoes between 1994-2001. *Suitability index* is the soil suitability index for potato cultivation. The list of controls in all specifications includes gender, age, type of settlement (urban/rural), number of HH members, and HH total real income. Standard errors are clustered on the PSU level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

1.6 Conclusion

Recurring economic crises and natural disasters have emphasized the critical need to explore effective coping strategies that can be employed by households during profound economic shocks, particularly those that result in food and nutritional deficits. The collapse of the Soviet Union triggered a tumultuous transition from planned to market economies in many former communist countries, resulting in widespread poverty. This severely impacted the caloric intake and diet structure of the populations, resulting in adverse health outcomes, especially among vulnerable groups like children born during the 1990s transition period.

This study sheds light on an overlooked coping strategy in academic discussions - household agricultural production, focusing on the role of home-grown potatoes. Potatoes emerged as a crucial food source in Russia during the transition period of the 1990s, with data revealing a peak in consumption in 1993. Leveraging spatial variations in soil suitability for potato cultivation across regions in Russia, Kazakhstan, and former communist countries, we find that regions more suitable for potato cultivation experienced less severe adverse effects on the health of children during the transition. Home-grown potatoes, a staple food in this context, acted as a coping mechanism for households facing income shocks and nutritional deficits.

Our empirical approach involves analysis of cross-country variations using the 2016 Life in Transition Survey and individual-level panel data from the Russian Longitudinal Monitoring Survey. We examine the short- and long-term effects of potato cultivation on child health, finding that households experiencing income declines during the transition crisis saw improved health outcomes for their children when they engaged in potato cultivation on suitable lands. The 2SLS approach, where we use the soil suitability index as an instrument and the data from the Kazakhstan Living Standards Measurement Survey, further supports the positive impact of home-grown potatoes on child height.

Contributing to the existing literature on coping strategies during economic shocks, child health determinants, and regional heterogeneity effects, our study underscores the importance of household agricultural production, particularly the cultivation of potatoes, in mitigating the adverse effects of economic crises on household nutrition and child health. Overall, our results suggest that households adapt to profound economic crises by intensifying their efforts in home production as a means to stabilize their consumption patterns. Through this adaptive strategy, households are able to promote the health and well-being of their children. This research enhances understanding of the dynamics of coping mechanisms during crises, with potential implications for policies addressing global food security challenges.

1.A Appendix: Figures

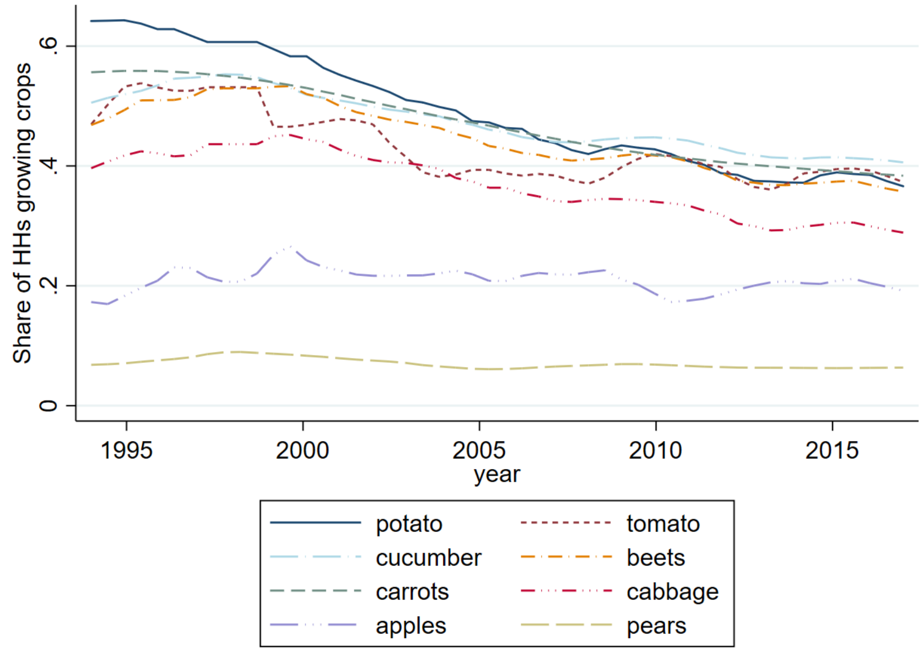


Figure 1.A1: Evolution of the Share of Households Growing Different Crops.

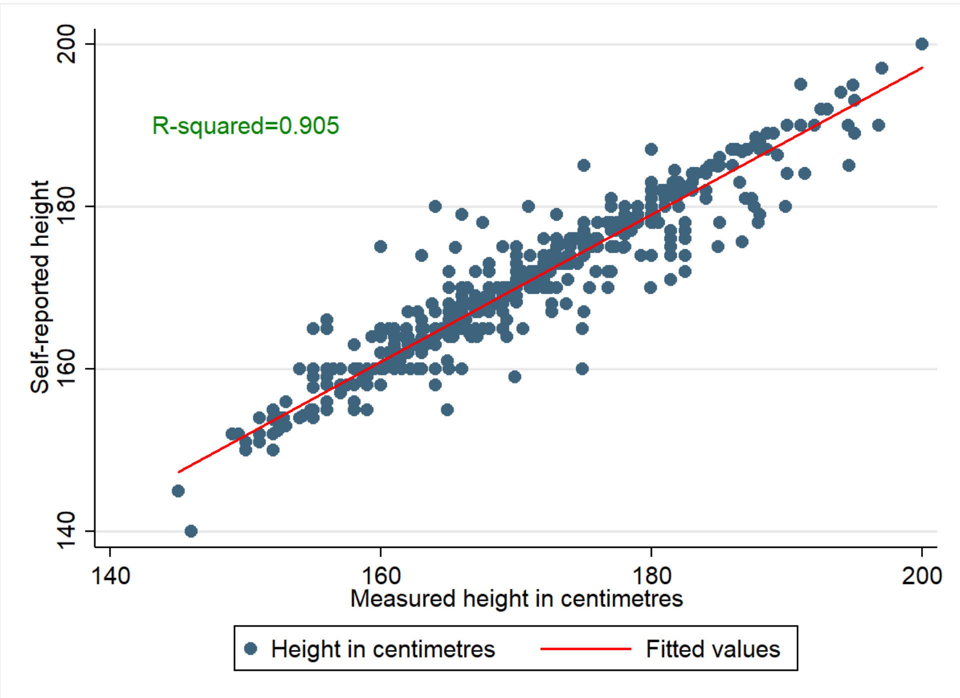


Figure 1.A2: Self-reported vs Measured Height
Note: Scatter and fitted line from the regression of self-reported height on measured height in cm.

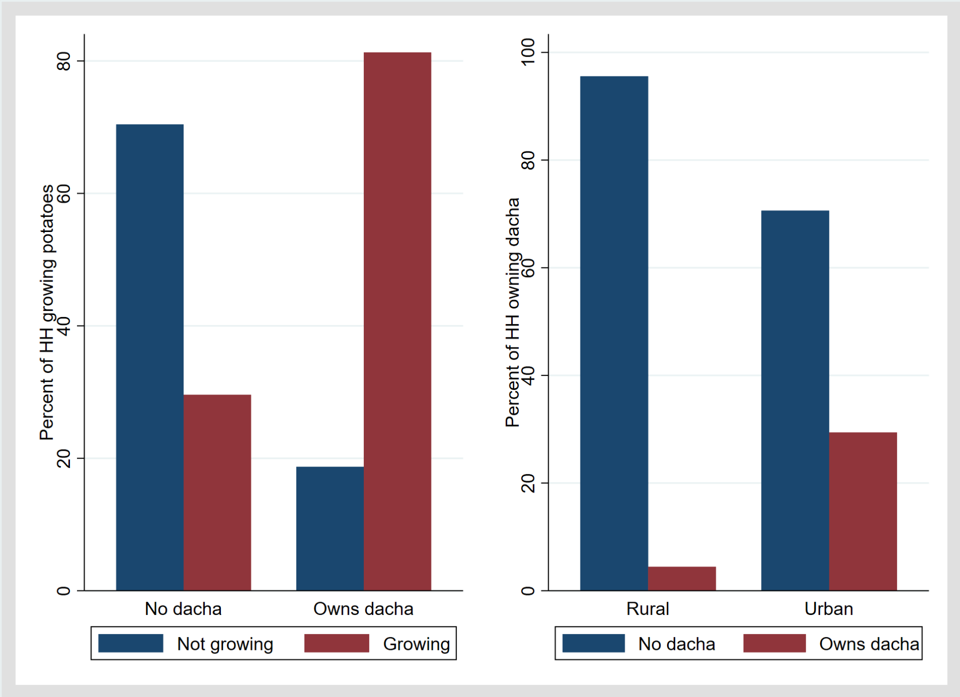


Figure 1.A3: Dacha Ownership, Potato Cultivation, and Urban Residence.

Note: Using RLMS data from 1994-2001, this figure demonstrates that owning a summerhouse (dacha) is a good predictor for growing potatoes - more than 80% of HHs that owned dacha grew potatoes (on the left). At the same time, the figure shows that HHs are more likely to own a dacha if their primary residence is in an urban area (on the right).

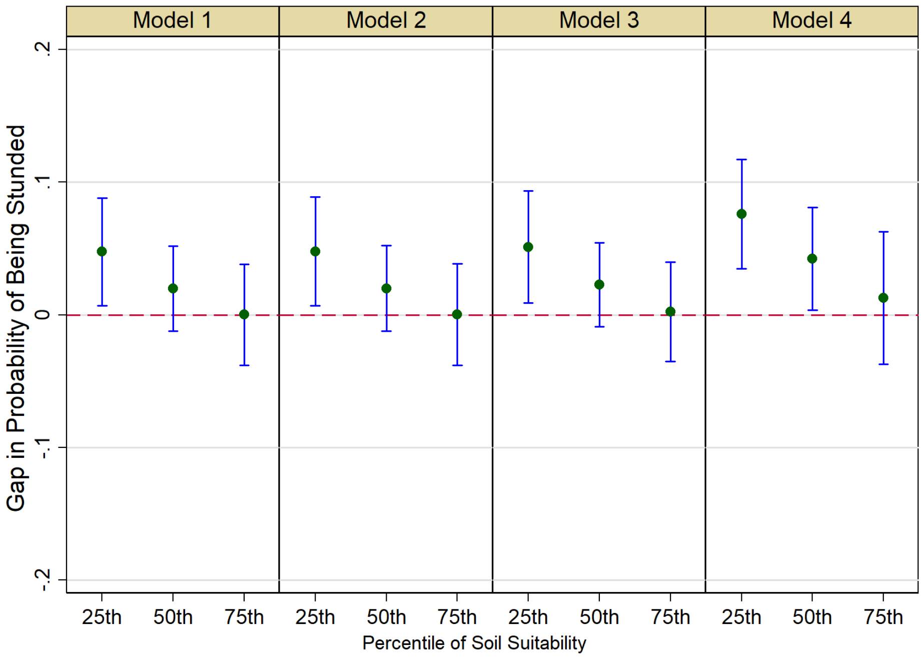


Figure 1.A4: Gap in the Probability of Being Stunted Using RLMS Data

Note: Marginal effects and their 95% confidence intervals calculated at the 25th, 50th and 75th percentiles of the soil suitability level for potato cultivation.

1.B Appendix: Tables

Table 1.B1: Summary Statistics for LiTS Data

	mean/share	sd	min	max	count
Self-reported adult height in cm	168.43	8.58	140.00	192.00	18441
Measured height in cm	168.42	9.20	145.00	199.00	330
Self-reported health status	3.28	0.89	1.00	5.00	21003
Below Age 4	0.08	0.28	0.00	1.00	21100
Below Age 5	0.10	0.30	0.00	1.00	21100
Below Age 6	0.12	0.33	0.00	1.00	21100
Suitability Index	45.28	20.49	0.00	97.98	21100
Age	47.72	17.41	18.00	95.00	21100
Gender	0.40	0.49	0.00	1.00	21100
Urban	0.57	0.50	0.00	1.00	21100
Religion					20936
Atheistic/Agnostic/None	7.39%	NA	NA	NA	1547
Buddhist	0.25%	NA	NA	NA	53
Jewish	0.24%	NA	NA	NA	50
Orthodox Christian	43.21%	NA	NA	NA	9047
Catholic	9.32%	NA	NA	NA	1951
Other Christian, including protestant	5.26%	NA	NA	NA	1101
Muslim	32.54%	NA	NA	NA	6812
Other	1.79%	NA	NA	NA	375
Mother's highest education completed					20200
No degree/No education	4.61%	NA	NA	NA	931
Primary education	12.71%	NA	NA	NA	2567
Lower secondary education	18.77%	NA	NA	NA	3791
(Upper) secondary education	31.72%	NA	NA	NA	6408
Post-secondary non-tertiary education	17.58%	NA	NA	NA	3552
Tertiary education (not a university degree)	8.64%	NA	NA	NA	1745
Bachelor's degree or more	3.77%	NA	NA	NA	761
Master's degree or PhD	2.20%	NA	NA	NA	445
N	21100				

Table 1.B2: Estimation Results of Adult Height on Living on Suitable Lands

	Height		
	(Below age 4)	(Below age 5)	(Below age 6)
BelowAge4	-1.191*		
	(0.704)		
BelowAge4 ×Suitability Index	0.012		
	(0.013)		
BelowAge5		-1.747***	
		(0.635)	
BelowAge5 × Suitability Index		0.024**	
		(0.012)	
BelowAge6			-1.439**
			(0.591)
BelowAge6 × Suitability Index			0.021*
			(0.011)
Suitability Index	0.010	0.008	0.008
	(0.006)	(0.006)	(0.006)
Controls	✓	✓	✓
Country FE	✓	✓	✓
Country-Specific time trends	✓	✓	✓
Observations	7862	7862	7862
Districts	482	482	482
Within R^2	0.329	0.329	0.329

Note: In all specifications, the dependent variable is adult height in cm. All columns use the sample of individuals aged 21-65. The list of controls includes age, gender, religion, and mother's education. Standard errors are clustered on the PSU level.

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

Table 1.B3: Estimation Results of Self-reported Health on Living on Suitable Lands

	Health		
	(Below age 4)	(Below age 5)	(Below age 6)
BelowAge4	-0.167***		
	(0.048)		
BelowAge4 ×Suitability Index	0.002**		
	(0.001)		
BelowAge5		-0.210***	
		(0.055)	
BelowAge5 × Suitability Index		0.003**	
		(0.001)	
BelowAge6			-0.208***
			(0.055)
BelowAge6 × Suitability Index			0.003***
			(0.001)
Suitability Index	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)
Controls	✓	✓	✓
Country FE	✓	✓	✓
Country-Specific time trends	✓	✓	✓
Observations	9178	9178	9178
Districts	485	485	485
Within R^2	0.181	0.181	0.181

Note: In all specifications, the dependent variable is self-reported health status. All columns use the sample of individuals aged 18-65. The list of controls includes age, gender, religion, and mother's education. Standard errors are clustered on the PSU level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 1.B4: Estimation Results of Living on Suitable Lands on Adult Height and Health

	Height(cm)		Health(1-5)	
BelowAge5	-1.396**	-1.675***	-0.242***	-0.214***
	(0.612)	(0.630)	(0.058)	(0.059)
Soil Suitability	-0.002	-0.001	-0.000	0.000
	(0.022)	(0.023)	(0.003)	(0.003)
BelowAge5×Soil Suitability	0.017	0.023**	0.004***	0.003***
	(0.011)	(0.012)	(0.001)	(0.001)
Controls	✓	✓	✓	✓
Country FE		✓		✓
Country-Specific time trends	✓	✓	✓	✓
Observations	7862	7862	9178	9178
Districts	482	482	485	485

Note: Using the sample of individuals aged 21-65 (18-65) in 14 post-Soviet countries in 2016, this table compares the adult height (health) of children who were aged five and younger during the transition years with their older counterparts. Additionally, it shows that children who lived on more suitable lands for potato cultivation experienced smaller decreases in their height (health status). *BelowAge5* is an indicator variable for an individual being below the age of five during the transition year, *Suitability Index* is the soil suitability index for white potato cultivation. The list of controls in all specifications includes age, gender, religion, mother's education, and suitability of other crops, including cabbage, carrots, tomatoes, and beets. Standard errors are clustered on the PSU level.

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

Table 1.B5: Estimation Results of Living on Suitable Lands on Adult Height and Health

	Height(cm)		Health(1-5)	
BelowAge5	-1.814***	-1.933***	-0.255***	-0.187***
	(0.613)	(0.605)	(0.058)	(0.057)
Soil Suitability	-0.010	-0.009	0.000	0.000
	(0.020)	(0.020)	(0.002)	(0.002)
BelowAge5×Soil Suitability	0.016	0.021*	0.004***	0.003**
	(0.012)	(0.011)	(0.001)	(0.001)
Controls	✓	✓	✓	✓
Country FE		✓		✓
Country-Specific time trends	✓	✓	✓	✓
Observations	9734	9734	11277	11277
Districts	482	482	485	485

Note: Using the sample of individuals aged 21-99 (18-99) in 14 post-Soviet countries in 2016, this table compares the adult height (health) of children aged five and below during the transition years with their older counterparts. Additionally, it shows that children who lived on more suitable lands for potato cultivation experienced smaller decreases in their height (health status). *BelowAge5* is an indicator variable for an individual being below the age of five during the transition year, *Suitability Index* is the soil suitability index for white potato cultivation. The list of controls in all specifications includes age, gender, religion, mother's education, and suitability of other crops, including cabbage, carrots, tomatoes, and beets. Standard errors are clustered on the PSU level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 1.B6: Summary Statistics for RLMS Data

Panel A

	(Sample of children for years 1994-1995)				
	mean	sd	min	max	count
Child's z_score	-0.42	1.45	-4.00	3.99	9544
Stunted	0.14	0.35	0.00	1.00	9544
Self-reported height	122.73	27.22	43.00	185.00	9544
Grew potatoes	0.60	0.49	0.00	1.00	8833
Suitability index	49.31	18.16	0.00	77.36	9544
Mother's height	162.72	6.05	115.00	188.00	8998
Nightlights	17.93	19.79	0.19	62.04	9544
Number of family members	4.24	1.45	2.00	13.00	9113
Child age in months	95.78	48.90	0.00	213.00	9544
Age in years	7.49	4.07	0.00	17.00	9542
Gender (1=male)	0.51	0.51	0.00	1.00	9544
Urban	0.67	0.47	0	1	9544
HH total real income	7947.70	17499.01	-4753.84	1040412.91	9113
N	9544				

Panel B

	(Sample of adults for years 2002-2017)				
	mean	sd	min	max	count
Self-reported height	168.38	9.37	52.00	207.00	34269
BT	0.01	0.10	0.00	1.00	35437
BT1	0.02	0.15	0.00	1.00	35437
BT2	0.04	0.20	0.00	1.00	35437
Grew potato 1994-2001	2.55	2.27	0.00	6.00	10603
Suitability index	52.80	17.78	0.00	77.36	35437
Mother's height	161.78	6.44	130.00	187.00	6668
Number of family members	3.32	1.61	1.00	16.00	32877
Age	42.17	17.62	21.00	104.00	35429
Gender (1=male)	0.44	0.50	0.00	1.00	35437
Urban	0.75	0.43	0.00	1.00	35437
HH total real income	14175.96	21085.31	-2314.52	1015621.38	32877
N	35437				

Table 1.B7: Summary Statistics for KLSMS Data

	mean	sd	min	max	count
Child's z_score	-0.85	1.51	-3.99	3.89	2192
Grew potato	0.72	0.45	0.00	1.00	1579
Suitability index	33.45	17.83	0.00	73.01	2134
Age	10.84	4.62	1.00	18.00	2192
Gender (1=male)	0.53	0.50	0.00	1.00	2192
HH size	4.86	1.55	1.00	11.00	2192
Poor	0.63	0.48	0.00	1.00	2192
Rural	0.55	0.50	0.00	1.00	2192
Mother has above high school education	0.08	0.27	0.00	1.00	2192
Mother's height	161.64	6.99	68.00	185.00	2120
Father's height	171.57	6.91	124.00	193.00	1858
HH per capita expenditures	51518.55	36086.52	2209.79	328961.88	2192
N	2192				

Table 1.B8: Replication of Adsera et al. (2021) for Adults Aged 21 and Above

	Self-reported adult height (cm)					
	(1)	(2)	(3)	(4)	(5)	(6)
BT	-1.086***			-0.244		
	(0.375)			(0.522)		
BT1		-1.434***			-0.664*	
		(0.241)			(0.338)	
BT2			-1.119***			-0.618**
			(0.203)			(0.279)
Mother's height				0.395***	0.395***	0.395***
				(0.018)	(0.018)	(0.018)
Controls	✓	✓	✓	✓	✓	✓
Linear time trend	✓	✓	✓	✓	✓	✓
PSU FE	✓	✓	✓	✓	✓	✓
N	37016	37016	37016	7200	7200	7200
R^2	0.507	0.507	0.507	0.538	0.538	0.538

Note: In all specifications, the dependent variable is self-reported adult height. *BT* indicates whether an individual was born during the transition year, *BT1* if an individual was born or one year old, and *BT2* was born, one year old, or two years old during the transition. The list of controls in all specifications includes gender, age, type of settlement (urban/rural), number of HH members, and total real HH income. Standard errors are clustered on the PSU level.

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

Table 1.B9: Differences Between HHs Growing on Less vs More Suitable Lands

Panel A

	HH Income	HH Savings	Urban	Regional poverty	Owns dacha dacha
Grows potato	-1936.5	-148.0	-0.217**	-0.039	0.434***
	(1547.1)	(189.2)	(0.083)	(0.0283)	(0.123)
Grows potato × Suitability Index	51.26*	2.739	0.002	-0.001	0.001
	(27.30)	(3.230)	(0.001)	(0.000)	(0.002)
HH FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
N	16255	16335	21902	21902	16123

Panel B

	Uses land	# family members	# kids <7 years	# working age males	# post work age males
Grows potato	0.904***	0.481***	-0.022	0.171***	0.057
	(0.046)	(0.118)	(0.051)	(0.054)	(0.036)
Grows potato × Suitability Index	-0.001	0.001	0.000	-0.000	0.000
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
HH FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
N	21902	21902	21902	21902	21902

Note: Both Panel A and Panel B display fixed effects estimation results of HH characteristics on the indicator of growing potatoes and the interaction term of growing potatoes with the soil suitability index. Regional poverty takes a value of 1 if an HH is below the regional poverty threshold and 0 if not. Year and PSU-fixed effects are included in all specifications. Clustered standard errors in parenthesis.

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

Table 1.B10: Estimation Results on Z-score from Placebo Tests for 2002-2017

	Height-for-age z-score					
Grew potato	-0.089	-0.072	-0.075	-0.119	-0.084	-0.140
	(0.089)	(0.087)	(0.087)	(0.098)	(0.147)	(0.091)
Grew potato× Potato Suitability	0.001	0.001	0.001	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Grew cabbage		-0.057				-0.093
		(0.115)				(0.139)
Grew cabbage × Cabbage Suitability		0.001				0.002
		(0.002)				(0.002)
Grew tomato			-0.041			-0.045
			(0.044)			(0.057)
Grew tomato × Tomato Suitability			0.001			0.001
			(0.001)			(0.001)
Grew beets				0.055		0.036
				(0.069)		(0.121)
Grew beets × Beets Suitability				-0.002		-0.001
				(0.002)		(0.002)
Grew carrot					0.111	0.126
					(0.109)	(0.097)
Grew carrot × Carrot Suitability					-0.003	-0.002
					(0.002)	(0.002)
Controls	✓	✓	✓	✓	✓	✓
Ind. FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
PSU-specific time trends	✓	✓	✓	✓	✓	✓
Num. of ind.	7248	7245	7248	7248	7398	7245
Num. of obs.	27218	27203	27215	27213	28569	27193
Within R squared	0.016	0.016	0.016	0.016	0.013	0.016

Note: This table uses RLMS data for 2002-2017 and conducts a placebo test showing that neither growing potatoes nor other crops is correlated with the height-for-age z-scores of children. Further, the interaction terms of growing crops with their respective suitability indexes do not significantly impact the height-for-age z-scores. The list of controls includes the child's age, the number of family members, and total HH income. Standard errors are clustered

Table 1.B11: Likelihood of Purchases and Expenditures on Food Products

Panel A

	Indicator of buying								
	potato	flour	bread	nuts	meat	diary	eggs	fish	# of goods
Grows potato	-0.224***	-0.054	0.009	-0.027	0.007	0.004	-0.035	-0.016	-0.275
	(0.044)	(0.057)	(0.020)	(0.057)	(0.065)	(0.058)	(0.065)	(0.061)	(0.785)
Grows potato × Suit. In.	0.001	0.001	-0.000	0.000	0.000	0.000	0.001	0.001	0.010
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.014)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
HH FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSU FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	17400	17373	17398	17391	17392	17398	17387	17388	17407

Panel B

	Total Real Expenditures on								
	potato	bread	meat	diary	eggs	fish	vegetables	fat	other
Grows potato	-365.7	51.6	-71.9	18.9	1.7	-19.5	47.5	-9.0	-20.4
	(226.1)	(57.9)	(151.9)	(67.9)	(21.3)	(29.7)	(47.4)	(48.6)	(52.9)
Grows potato × Suit. In.	4.1	0.1	2.6	-0.2	-0.02	0.7	-1.3	0.8	0.5
	(3.6)	(0.9)	(2.7)	(1.1)	(0.6)	(0.6)	(0.9)	(0.9)	(0.9)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
HH FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSU FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	17411	17411	17411	17411	17411	17411	17411	17411	17411

Note: Using a sample of households observed in RLMS data 1994-2001, Panel A of this table displays fixed effects estimation results of the indicator for buying different food products on an indicator for growing potatoes and the interaction term of growing potatoes with the soil suitability index. Panel B displays fixed effects estimation results of the total real expenditure of households for different food products on the indicator of growing potatoes and the interaction term of growing potatoes with the soil suitability index. The list of controls includes the number of family members, the total real HH income, and the number of children below the age of seven. Household, year, and PSU-fixed effects are included in all specifications. Clustered standard errors in parenthesis.

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

Table 1.B12: Likelihood of Possessing and Amounts of Food Products

Panel A

	Indicator of having								
	potato	flour	vegetables	meat	fish	eggs	oil	grain	# of goods
Grows potato	-0.006	-0.020	0.131	-0.002	-0.194**	0.005	0.063	0.042	0.431
	(0.042)	(0.051)	(0.107)	(0.094)	(0.074)	(0.104)	(0.057)	(0.043)	(0.362)
Grows potato × SI	0.001	0.001	-0.002	-0.000	0.004**	0.000	-0.000	-0.001	-0.002
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.006)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
HH FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSU FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	6424	6424	6424	6424	6424	6424	6424	6424	6424

Panel B

	Amount of								
	potato	flour	pasta	vegetables	meat	fish	eggs	oil	grain
Grows potato	148.9**	-3.1	-0.4	29.3	-1.4	0.6	-8.3	0.01	-0.5
	(56.2)	(4.1)	(0.6)	(20.7)	(1.3)	(0.6)	(5.8)	(1.0)	(0.9)
Grows potato × SI	-0.366	0.050	0.005	0.085	0.033	-0.006	0.124	-0.004	0.010
	(1.089)	(0.068)	(0.011)	(0.378)	(0.033)	(0.012)	(0.105)	(0.016)	(0.016)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
HH FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
PSU FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	5602	5114	4626	4286	2558	590	3862	3348	5438

Note: Using a sample of households observed in RLMS data 1994-2001, this table shows that households that grew potatoes do not report a higher likelihood of having food products or a variety of food (Panel A), as well as a greater amount of food products (Panel B). The list of controls includes the number of HH members, the total real HH income, and the number of children below the age of seven. Household, year, and PSU-fixed effects are included in all specifications. Clustered standard errors in parenthesis.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Chapter 2

Violent Conflicts and Child Gender Preferences of Parents: Evidence from Nigeria

2.1 Introduction

While in industrialized countries there is an emerging pattern of child gender indifference among parents (Pollard & Morgan, 2002), in some developing countries sons are more desired as they are presumed to bring greater net economic utility, to continue the family line and to serve as a simple "social security system", among other reasons. Given some of the motives behind having a son preference, it is reasonable to expect that changes in beliefs and socio-economic conditions in developing countries may have an impact on the child gender preferences of parents (see for example Almond et al., 2019; Qian, 2008).

One especially striking phenomenon that leads to alterations of beliefs and socio-economic conditions in developing countries is exposure to armed conflicts and wars (Blattman & Miguel, 2010; Bauer et al., 2016; Callen et al., 2014; Voors et al., 2012). For example, literature documents that conflicts tend to promote more traditional and group-based norms (Henrich et al., 2019; Rohner et al., 2013). While studies find changes in fertility rates in response to natural disasters and wars (Nepal et al., 2018; Rodgers et al., 2005; Saing & Kazianga, 2019), there has been little or no attempt to explore changes in child gender preferences in countries exposed to long-run conflicts. Concurrently, literature examining the factors and reasons affecting child gender preferences looks at one specific channel, e.g. how changes in income opportunities affect the preferences.

This creates an open question at the intersection of these two strands of literature: Do changes in beliefs and socio-economic conditions caused by conflicts have an impact on the child gender preferences of parents?

Using data from Nigeria, I explore a novel mechanism behind gender preferences, i.e., the extent to which long-run exposure to violent conflicts affects the child gender preferences of parents and their investment in postnatal health care. The empirical approach in this study exploits the temporal and spatial variations in long-run exposure to violent conflicts in Nigeria during the 1983-2018 period. I combine two datasets to perform the analysis. The data on conflicts comes from the Uppsala Conflict Data Program (UCDP)[1], while the second data set is from the Demographic and Health Surveys (DHS)[2] Program in Nigeria with nationally representative repeated cross-section data. To perform some of the robustness analysis, this study also utilizes data from the Armed Conflict Location and Event Data Project (ACLED)[3]. In particular, I construct time-varying district-level measures of conflict exposure for Nigerian households. Employing different econometric models, I estimate the effect of long-run exposure to conflict events on stated preferences for boys, actual realisation of gender composition and investment in the postnatal health of children.

Using a district fixed-effects model, I find that long-run exposure to violent conflicts has a differential effect on the stated preferences for boys depending on the type of the conflict and occurrence of civilian deaths. While state-based[4] and non-state[5] conflict events increase the preference for sons, one-sided violence[6] decreases it. In sum the two effects cancel each other out. One of the key differences between the first two and the third types of conflict events lies in the number of casualties among civilians. One possible explanation behind the differential effect could be described by the individual versus societal survival motives. On one hand, long-run exposure to violent conflicts

[1]Retrieved from `https://ucdp.uu.se/downloads/index.html#ged_global`

[2]Retrieved from `https://dhsprogram.com/data/available-datasets.cfm`

[3]Retrieved from `https://acleddata.com/#/dashboard`

[4]"a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle related deaths in a calendar year".

[5]"the use of armed force between two organized armed groups, neither of which is the government of a state, which results in at least 25 battle-related deaths in a year".

[6]"the deliberate use of armed force by the government of a state or by a formally organised group against civilians which results in at least 25 deaths in a year". (The source of definitions in footnotes 4, 5, and 6 is UCDP website: `https://www.pcr.uu.se/research/ucdp/definitions/`)

creates fear and uncertainty about the future, which might lead to individual or family survival threats. Conflict events that cause high rates of civilian deaths, on the other hand, not only create fear and uncertainty about the future but also have a direct impact on population numbers. In a country with a high male-to-female ratio, this might give rise to group or societal survival threats and lead to a change in preferences towards girls.

Further, I check whether and how the changed preferences translate into behaviour via three possible mechanisms suggested in the literature: sex-selective abortions, stopping rules, and skewed investments in the postnatal health of children. I find no evidence of translating the skewed preferences into behaviour via sex-selective abortions. Rather, there is evidence of using stopping rules to achieve the desired gender composition of children. More importantly, the findings indicate a positive bias towards boys in terms of postnatal health investment as measured by the probability of receiving a vaccination in districts of Nigeria more exposed to conflict.

This study makes a three-fold contribution to the literature. First, this research explores a novel mechanism to explain child gender preferences in Nigeria, the largest economy in Africa, and this might be a step forward in understanding and unraveling the origins and persistence of gender gaps in developing countries. Second, this paper advances previous research on the consequences of conflicts by identifying one of its social legacies. Third, one of the features of the DHS surveys allows me to analyse the effects of conflicts on attitudinal measures and to check whether and how attitudes translate into behaviour. While gender preferences for children have been examined rigorously in terms of behavioural measures, attitudinal measures have been less systematically analysed. Looking at both attitudinal and behavioural measures contributes to the research on the influence of attitudes on behaviours - a key question for many aspects of economic life.

2.2 Related Literature and Contribution

My research builds on the current literature in several ways. By studying the effect of conflicts on child gender preferences, this paper contributes to the literature examining the factors and reasons behind the gender differential treatment of children and, thus, the gender gap rooting from there. In this area, Qian (2008) provides evidence for the economic motivation. He shows that an increase in gender-specific income connected to the price of tea affects the survival rates of girls, as well as their educational attainment in China. Carranza (2014) argues that differences in soil texture create differential opportunities for female labor force participation, which explains the relative scarcity of girls in India. Bhalotra et al. (2018) address the question from a different angle and show that granting women inheritance rights in India increases their relative cost and leads to a stronger son preference. Almond et al. (2019) document an increase in the fraction of sons as a result of land reform in rural China. They suggest two mechanisms: the increased income of parents allows them to afford sex selection, and the greater productivity benefit of sons incentivizes parents to have more boys. The old-age-support motive behind son preference is tested by Ebenstein & Leung (2010), who explore the introduction of a voluntary old-age pension program in rural China to show that sons and formal savings are treated as substitutes, and participation in the program reduces sex ratios at birth. Thus, studies examining the reasons behind son preferences provide evidence for the hypothesis that sons are preferred because of the belief that they are able to provide better economic and social security to their parents. At the same time, the literature provides evidence that changes in beliefs and economic conditions may affect preferences. As the above studies mostly refer to the contexts of China and India, there is a gap in the literature to examine the reasons behind skewed gender preferences in countries exposed to wars and conflicts, which this paper addresses.

The literature on the consequences of conflicts is abundant, but only a small part of it relates to the social legacies of wars (Blattman & Miguel, 2010). The closest study to my research is Nepal et al. (2018), who uses data from Nepal DHS to show how exposure to a violent civil conflict in Nepal affects the quantity and quality of children, measured by fertility and health outcomes, respectively. Their results suggest that women from exposed villages temporarily increase their fertility. Concurrently, the conflict has a negative permanent effect on health (measured by height-for-age) of children due to an increased number of mouths to feed in the households. Further, they show that the negative effect on health is stronger for girls and children of higher order births. This is in line with claims that the effects of conflicts are not gender neutral and supports my hypothesis of skewed investments in children. Using time and geographic variation in the exposure to conflict, studies by Akresh et al. (2012), Minoiu & Shemyakina (2014b), Bundervoet et al. (2009b) also examine the effects of conflicts on children's health. Mansour & Rees (2012) document the negative effect of conflict on the birth weight of babies. My study delves further and tests whether conflicts have gender differential effects on fertility choices of parents.

A growing literature agrees on the disruptive effects of wars and conflicts on human capital accumulation (Blattman & Miguel, 2010). Shemyakina (2011) finds that exposure to armed conflict in Tajikistan affected the educational attainment of girls more than that of boys in the households. School age daughters from exposed regions were less likely to finish mandatory education. The conflict also negatively affected the enrollment of girls. The mechanism suggested, though not tested, is parents' fear for the safety of daughters on the way to school. This mechanism is supported by Jayachandran (2015), who emphasizes safety and "purity" concerns of parents as an underlying reason for women's and girls' constrained physical mobility. Chamarbagwala & Morán (2011) also study the effect of conflict on human capital accumulation and suggest that conflicts might worsen the gender, regional, sectoral, and ethnic gaps in schooling. The findings of my paper contribute to this strand of literature by providing evidence that conflicts can expand gender gaps, which originate even at the beginning of human life.

Another strand of conflict literature looks at the effects of violent conflicts on collective actions after a war. Bauer et al. (2016) provide a meta analysis of relevant studies and summarize the literature, stating that "evidence suggests that war affects behavior in a range of situations, real and experimental" (p.217). Further, Henrich et al. (2019) show that war increases religiosity, while Rohner et al. (2013) document that conflict increases the importance of ethnic identity. The results from these studies lend a strong support for the mechanisms behind the effects of conflicts that I test in this study, as those effects should necessarily involve changes in behaviour and beliefs among people affected by conflicts.

2.3 Mechanisms

To understand the motivation behind this analysis, this chapter discusses some channels through which conflicts can affect or alter preferences. Theories of economics have mainly assumed that people have exogenous preferences. However, recent economic literature, both theoretical and empirical, has weighed in with endogenous preferences (Bernheim et al., 2021). In particular, a substantial amount of literature shows that natural disasters, violence and wars alter people's preferences (Hanaoka et al., 2018; Cassar et al., 2017a; Callen et al., 2014; Voors et al., 2012).

Parents' preferences for children of a particular gender are formed from the gains they receive from their children. Factors affecting the utility of parents can be generalised into two groups: economic and cultural. There is substantial evidence in the literature showing that conflicts affect both these aspects. Firstly, conflicts and wars have a disruptive effect on the economy (Abadie & Gardeazabal, 2003) and create risk and uncertainty about the future (Bozzoli & Müller, 2011). Secondly, research has shown that exposure to conflicts increases the importance of ethnic identity (Rohner et al., 2013) and religiosity (Henrich et al., 2019). As suggested by the literature on child gender preferences, this might lead to the creation of, or exacerbation of an existing, son preference in a country with patriarchal values, such as Nigeria.

Another potential mechanism that might drive a shift in child gender preferences is safety and "purity" concerns for daughters (Jayachandran, 2015). Burde & Linden (2013), for example, evaluate the effects of building new schools in Afghan villages and show that girls' enrollment is affected more by the possibility of having a school inside their own village. The distance reduction closes the otherwise-large gender gap in the enrollment. During wartime, such concerns are likely to rise even further: sexual violence both by civilians and fighting groups is a common threat in times of conflicts (Annan et al., 2009). Therefore, exposure to conflicts may increase these concerns further and lead to an increase in son preference. All the above mechanisms relate to individual or family survival concerns.

Finally, the last mechanism is connected to the notion of societal survival. Conflict events that cause high rates of civilian deaths not only create fear and uncertainty about the future but also have a direct impact on population numbers, thus giving rise to group or societal survival threats. If that is the case, then the effect of conflict might become ambiguous: on one hand men are needed for protection, but on the other hand women are needed for reproductive purposes. This study contributes to the literature by providing evidence that one-sided violence (violence targeted at civilians) decreases preference for boys, motivating one possible explanation (societal survival threat) for differential effects of different conflict types.

2.4 The Setting and Identification

This research tests whether the long-run exposure to violent conflicts affects child gender preferences. An underlying potential mechanism is that the constant and long-run exposure creates fear and uncertainty about the future and affects the development of beliefs under which the preferences might form or change. Over the past decade and a half, Nigerians have been exposed to violence through numerous ethnic and religious group tensions, organized insurgencies, and government repression of different magnitudes and intensities occurring across the country. Importantly for my analysis, conflict events in Nigeria are highly regionalized and different areas are affected by various types of violent events, as the underlying determinants of the conflicts are also different. Complemented with Nigeria being the most populous country in Sub-Saharan Africa, all these complexities make the country a good candidate on which to test my research question.

Conflict regions in Nigeria can be geographically divided into 4 parts based on the type of conflict events occurring there (Abidoye & Calì, 2021). The first area is the middle belt, where a core reason for the violence is unequal access to land (clashes between farmers and pastoralists). Violent events in the northeastern parts of the country started as clashes between Muslims and Christians and continued in large part due to the activities of the Islamic militant group Boko Haram. The Niger Delta is well known for militants competing for the control of oil production centers. Finally, violence in urban areas is mostly due to political demonstrations.

Figure 2.1 illustrates the annual evolution of all conflict events and the rounds of DHS surveys conducted in Nigeria for the period of 1983-2019.

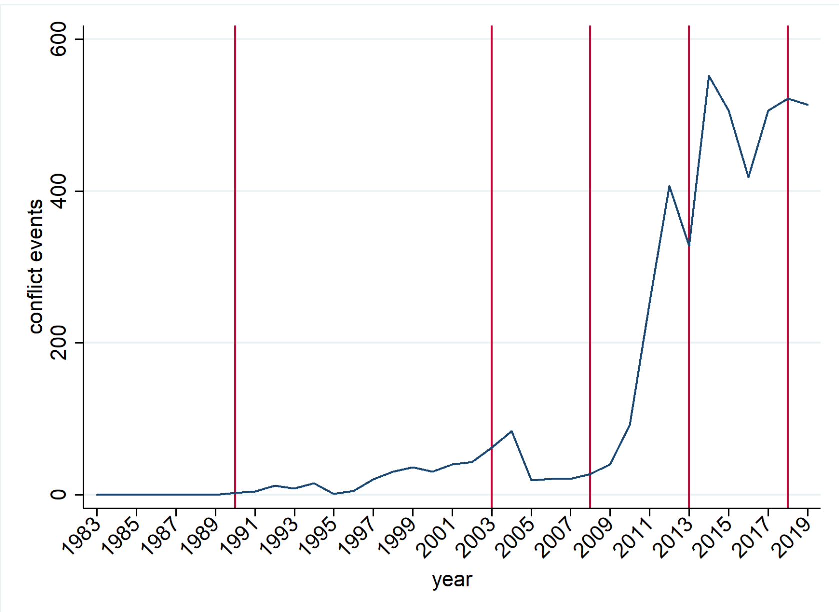


Figure 2.1: Conflict Events and DHS Rounds in Nigeria
Note: Red lines stand for the rounds of Demographic and Health Surveys conducted in Nigeria.
Source: Author's calculations based on data from the Uppsala Conflict Data Program (UCDP) and Demographic and Health Surveys in Nigeria

The DHS rounds divide the period under interest into 5 intervals with respondents who were subject to different levels of conflict exposure not only across different regions, but also over time. On average, there are seven-year gaps between the survey rounds, and in the analysis below I use this as the baseline number of years to define the main measures of conflict exposure. Thus, the identification of the exposure in this study relies on the changes in the number of conflict events in the seven-year period preceding each round of DHS interview. Additionally, I use a second source of variation in the exposure to conflict - spatial variation. To see the evolution of the spatial variation in the conflict events, I map the cumulative number of events for seven years preceding each round of DHS interview in Figure 2.2 below.

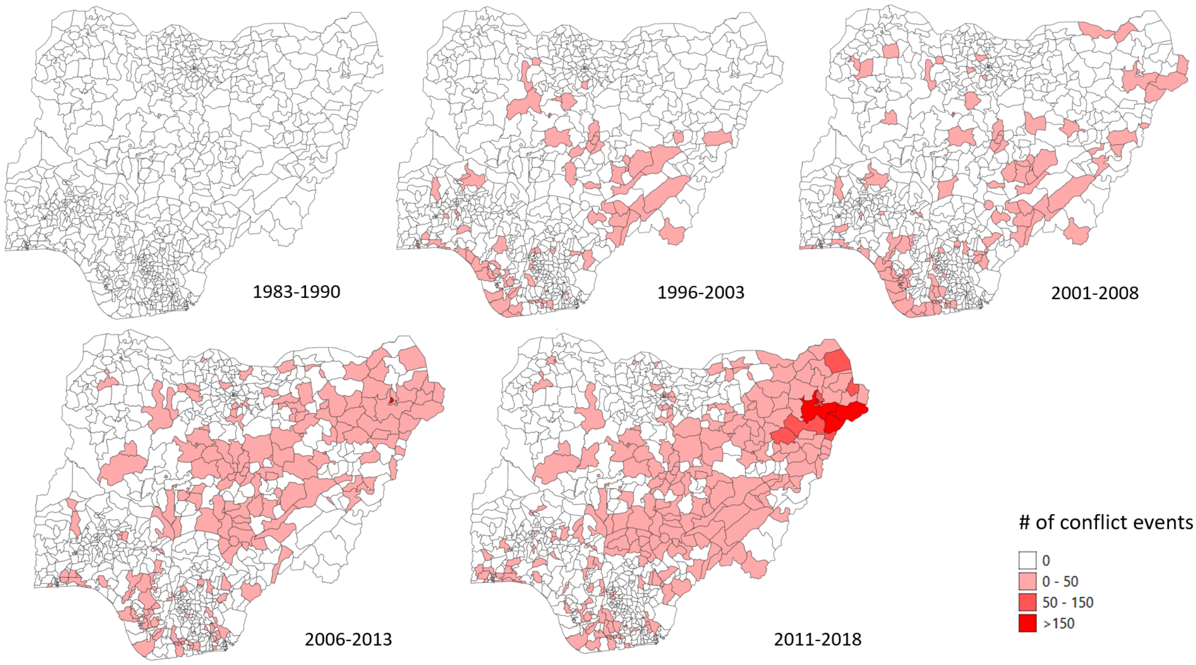


Figure 2.2: Evolution of Spatial Variation in Cumulative Number of Events in Nigeria
Note: The map illustrates the cumulative number of conflict events for the 7-year period preceding each round of DHS interview on the 2nd administrative division level of Nigeria. The higher number of conflict events are indicated by darker colors.
Source: Author's calculations based on data from the Uppsala Conflict Data Program

In contrast to many studies that concentrate on one specific conflict, my research first looks at all conflict events occurring in Nigeria in the 1983-2018 period and then dissagregates them to examine separate effects, while still controlling for other types. The first rationale behind this is that examining only one conflict episode might not capture the mechanism of fear and uncertainty about the future if the conflict is resolved. Second, ignoring other conflict events occurring simultaneously might result in biased estimates.

In this study, an individual's long-run exposure to conflict is identified by the cumulative number of events in the district of residence during the seven-year period preceding each round of interview date. Thus, the key assumption for the identification is that the evolution of the preferences in conflict-exposed districts would be the same as in non-exposed districts in the absence of conflict events. Verifying this assumption is challenging due to lack of data on households before the conflict events started to escalate. One way of checking the validity is to compare the average characteristics of conflict and non-conflict districts before the conflict events started to escalate. To do this, I compare the average HH characteristics of conflict-exposed districts with the non-exposed ones using DHS survey data from the rounds before which the number of conflict events in Nigeria was relatively low; in particular I use 1990 and 2003 rounds. Since there are already some violent events occurring before 2003, I restrict the sample to include only the districts with 0 events before 2003. Appendix Tables 2.B1, 2.B2, and 2.B3 present comparisons of average preferences, demographic characteristics, and mean difference test results for districts exposed to: (1) all conflicts, (2) state-based and non-state conflicts, and (3) violence against civilians, versus unexposed districts.

2.5 Data and Key Variables

2.5.1 Data

For the main analysis, I combine two sources of data: the Uppsala Conflict Data Program (UCDP) and Nigeria Demographic and Health Surveys (NDHS).

UCDP started collecting data on conflicts from the mid-1980s and is now the main conflict data provider. It provides panel data on worldwide conflicts covering the 1989-2018 period, where the unit of observation is an event defined as "the incidence of the use of armed force by an organized actor against another organized actor, or against civilians, resulting in at least 1 direct death in either the best, low or high estimate categories at a specific location and for a specific temporal duration" (Sundberg & Melander, 2013, p. 524). The data collection is conducted in multiple stages. First, "intelligent indexing" is used to search for all articles within specified parameters. Then the collected reports are evaluated by human coders. Second, UCDP also consults reports and data from non-governmental organizations and international organizations (such as the UN), case studies, truth commission reports, historical archives and other sources of information. The third stage is source evaluation: both the independence and transparency of the origins are examined. However, this source of conflict data is likely to provide only the lower bound of the estimates due to the lack of complete information in conflict zones.

UCDP categorizes conflict events into three mutually exclusive groups: (1) state-based armed conflict; (2) non-state conflict; and (3) one-sided violence. The dataset contains information on spatial and temporal locators within Nigeria, such as place name, administrative division, and geographic coordinates, as well as start and end dates, to allow for fine grained spatial and temporal analysis. It also provides estimates of death from each side of the conflict, as well as civilians and unknowns. This allows me to construct several measures of the long-run exposure to violent conflicts using two aspects: (1) cumulative number of all conflict events in a particular location; (2) cumulative number of events by type in a particular location; and (3) cumulative number of events with and without civilian death in a particular location.

The Demographic and Health Surveys (DHS) Program collects representative individual and household-level data on population, health, HIV, and nutrition in more than 90 developing countries. I use information from a nationally representative sample of ever-married women in the reproductive age groups of 15-49 from Nigeria, and match the sample to household characteristics from the household surveys.

To match the armed conflict events with individual and household responses of NDHS datasets, I use the geocoded GPS data routinely collected by the program. There are five rounds of surveys conducted in Nigeria (1990, 2003, 2008, 2013, and 2018).

The DHS surveys aim to produce national, urban-rural, and provincial-level representative data (each as a separate domain). The surveys undertake a two-stage, stratified, random sample design. The first stage involves creating sampling strata by dividing each administrative region into urban and rural areas, and selecting sample points (clusters) with the probability-proportional-to-size approach. The second stage implies the systematic random sampling of households.

As mentioned, NDHS provides repeated cross-sectional data. Therefore, to construct a panel, I match the data from different waves of surveys based on the 2nd administrative division level of Nigeria. I then aggregate the event-level conflict data to the 2nd administrative division level and match with the panel of women respondents.

2.5.2 Key Variables

Taking into account the average years of gaps between DHS rounds of surveys and to be able to capture an individual's long-run exposure to conflict, I construct the main measures of long-run exposure to conflicts as follows: cumulative number of all conflict events that occurred in a district seven[7] years preceding the interview; cumulative number of violence against civilians that occurred in a district seven years preceding the interview; and cumulative number of other conflict events, which include state-based and non-state events, that occurred in a district seven years preceding the interview.

These aggregated measures will capture the awareness of being under a threat even if not necessarily being an active participant. However, it is important to mention that the exposure to violence against civilians, as discussed above, might have direct implications for population numbers and create fear about societal survival.

The rationale behind separating the conflict events into two types lies in the fact that these types are characterized with different patterns of conflict-related death. While violence against civilians is characterized by a high level of casualties among civilians, other conflict events (state-based and non-state) are mostly characterized by no civilian deaths and a high level of deaths among the armed forces (see Figure 2.A1 of the Appendix 2.A). As described in the mechanisms section, the literature does not provide evidence of how the deaths of civilians (loss of one's own children and overall threat to survival) might affect preferences for the gender of children. However, economic uncertainty and risk regarding the future (individual or family survival threat) brought by state-based and non-state conflict events mostly have a positive effect on the preference for sons based on the mechanisms described above. The UCDP definitions[8] for each type of conflict is as follows:

1. *state-based conflict* - "a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle related deaths in a calendar year."

2. *non-state conflict* - "the use of armed force between two organized armed groups, neither of which is the government of a state, which results in at least 25 battle-

[7]The results are robust to varying this number to six and eight years and can be provided upon request.

[8]Source: UCDP `https://www.pcr.uu.se/research/ucdp/definitions/`

related deaths in a year."

3. *one-sided violence* - "the deliberate use of armed force by the government of a state or by a formally organised group against civilians which results in at least 25 deaths in a year."

The evolution of conflict events by each of the types is presented in Figure 2.3 below. I use four types of outcome variables in my analysis. The first type includes an attitudinal measure, which uses information on stated preferences regarding the desired number of sons and daughters. This measure is constructed as the ratio of the desired number of sons to the desired number of children multiplied by 100. I refer to this variable as *desired share of sons* throughout the text. Then, to test whether the preferences translate into behaviour, I use the information on the actual children born to each woman. The actual share of sons in families tests whether sex-selective abortions are implemented and/or the differential survival rate is present. The third type of variables are used to test the stopping rule behaviour and include the stated desire of women to have another child, the gender of the last-born child, and the number of siblings for a child in each family. Finally, I use the probability of obtaining a vaccination as a measure of postnatal health investment.

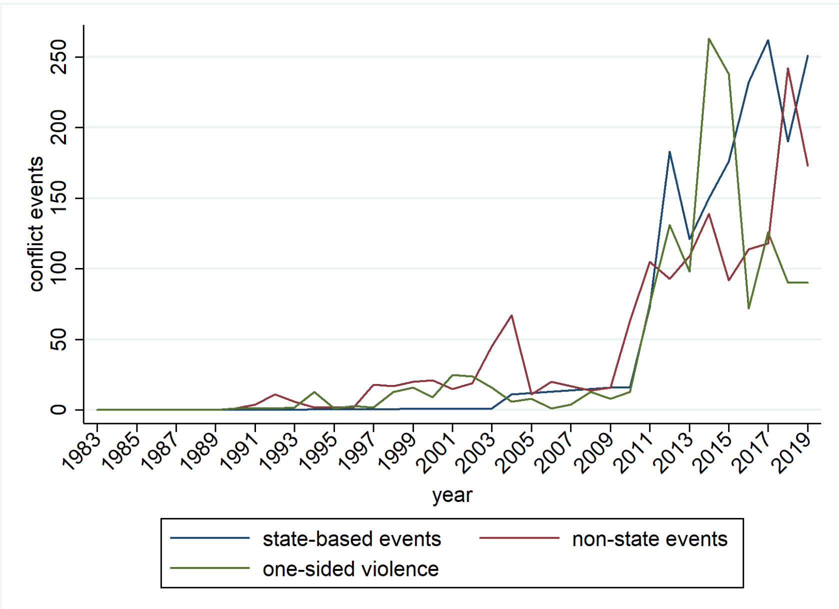


Figure 2.3: Evolution of Conflict Events by Types in Nigeria
Source: Author's calculations based on data from the Uppsala Conflict Data Program

2.6 Empirical Strategy and Results

2.6.1 Empirical Strategy

I use district fixed-effects models for my analysis. To estimate the effect of conflict exposure on the stated preferences and actual share of sons in the family, I construct the following model:

$$y_{idt} = \lambda_d + \eta_t + \delta exposure_{dt} + X\gamma + \epsilon_{idt}$$

in which y_{idt} is either the desired or actual share of sons for mother i in district d at time t; $exposure$ is one (or in some specifications several) of the measures of long-run conflict exposure; λ_d is a district fixed effect and η_t is time fixed effect; X is a vector of control variables, which includes respondent's age, household's wealth index, respondent's education level, husband's education level, religion, settlement type (urban/rural) and actual total number of sons and daughters.

Whether preferences translate into behaviour is a separate question that this research addresses. In the first described model, I use the actual share of sons. This measure can either reflect the presence of sex-selective abortions or gender differential survival rates. Additionally, literature suggests that the translation of son-favoring preferences into behaviour can be alternatively implemented via stopping rules. This rule implies that if there is a preference for a certain gender composition of children, families continue having children until the desired number of the preferred gender is attained. Stopping rules may potentially have several implications, which are used to detect the existence of son preference in the empirical literature. The first implication is that families with the most recent born child being female should be more likely to want another child than those with a recent male birth. Second, families are more likely to stop having children after a boy, which results in a higher probability of the last born child being a male in completed families[9]. The third implication of the stopping rule is that girls are more likely to be born in larger families compared to boys (Clark, 2000). This has a sibling effect, which means that in son-favoring families girls typically have a higher number of siblings than boys. This implication is easy to understand in a hypothetical example. Assume that all families in a society with a strong son-preference want to have one son. If the first child is a boy, according to the stopping rule, the family will stop having

[9] I define completed families as families that stopped having children.

children. Therefore, this child has no siblings. If the first child is a girl, then the family will continue having children until they have a boy. This will result in girls having, on average, more siblings than boys in this particular society.

To test whether the stated preferences translate into behaviour implemented via the stopping rule, I construct and estimate the following model:

$$y_{ict} = \lambda_d + \eta_t + \delta_1 exposure_{dt} + \delta_2 last\ born\ girl_{idt} + \beta_1[last\ born\ girl_{idt} \times exposure_{dt}] + X\gamma + \epsilon_{idt}$$

in which y_{idt} is either a binary variable expressing the willingness of mother i to have another child interviewed in year t in district d, or the number of siblings of the most recent born child; $last\ born\ girl_{idt}$ is 1 if the most recent child born to mother i in district d interviewed at year t is a girl; and vector X includes respondent's age, household's wealth index, respondent's education level, husband's education level, religion, settlement type (urban/rural), total number of children and an indicator whether the respondent currently works or not. To test whether the probability of the last born child being a male in completed families is higher in conflict-affected districts, I estimate a model similar to the first one, using the sample of completed families:

$$y_{idt} = \lambda_d + \eta_t + \delta exposure_{dt} + X\gamma + \epsilon_{idt} \quad i \in completed\ families$$

in which y_{idt} is an indicator of the last born child to be a boy.

Another, more important, way gender preferences might translate into behaviour is parents' investment in their children. To test whether and how conflict-driven increased son preference translates into investment behaviour, I examine the vaccination patterns received by children of different gender and the level of conflict exposure. I construct and estimate the following model:

$$y_{idt} = \lambda_d + \eta_t + \delta_1 exposure_{dt} + \delta_2 boy_{idt} + \beta_1[exposure \times boy_{idt}] + X\gamma + \epsilon_{idt}$$

in which y_{ict} is an indicator that the child received one of the following vaccinations: polio, measles, and BCG (tuberculosis); *boy* is an indicator whether the child is a boy; and the remaining variables are similar to previous specifications. Polio vaccination is recommended to be given to children in four doses: at the age of 2, 4, 6 through 18 months; and 4 through 6 years old. The DHS survey records all the doses, and thus in my analysis I have polio 0, polio 1, polio 2 and polio 3 variables indicating the administration of each of the four doses, respectively.

2.6.2 Results

Table 2.1 below presents the results for the desired share of sons. The first two specifications use the total number of all events that occurred in a district seven years preceding each round of DHS survey in Nigeria. The third and fourth columns further disaggregate conflict events into two types: violence against civilians and other conflict events.

Table 2.1: Estimation Results for Desired Share of Sons

	Desired share	Desired share	Desired share	Desired share
# events	-0.000154	-0.000513		
	(0.00219)	(0.00219)		
# other conflict events			0.0347***	0.0372***
			(0.0133)	(0.0132)
# violence against civilians			-0.0408***	-0.0446***
			(0.0146)	(0.0145)
controls	No	Yes	No	Yes
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	118718	118411	118718	118411
Districts	680	680	680	680

Note: In all specifications, the outcome variable is the desired share of sons, constructed as the number of desired sons divided by the number of desired children multiplied by 100. The main explanatory variable in the first two columns is the total number of all conflict events seven years preceding each round of NDHS interview. In the last two columns, the main explanatory variables are the number of violent events against civilians and other conflict events, which include state-based and non-state events. The list of controls includes age, wealth, education level, husband's education level, religion, and the type of settlement (urban/rural). Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results show that the average effect of all the conflict events on the desired share of sons is 0. However, once I examine types of conflicts separately, I find that while the other types of conflict events increase the share of desired sons, violence against civilians has the opposite effect. Interestingly, the magnitudes of these effects are comparable and cancel each other out when examining all conflict events as one treatment variable.

To explain these differential effects in the results, I look at one of the key differences between these types of conflict events. In particular, while one-sided violence (violence against civilians) is characterized by high level of civilian death, other conflict events (state-based and non-state conflict) involve fewer casualties among civilians (see Figure 2.A1 in the Appendix 2.A). Therefore, to verify that the negative effect of violence against civilians is connected to the occurrence of civilian death, I further decompose all conflict events into two types - events with civilian death and without - and I estimate a district fixed-effects model with these variables. The results are presented in Table 2.2 and are consistent with those from Table 2.1. In particular, conflict events with no civilian deaths have a significant positive effect on preferences, while events with civilian deaths have a significant negative effect on preferences. To delve deeper, Table 2.B2 explores two interaction terms. The first examines the interaction between other conflict events and an indicator of whether these events involved civilian deaths. Additionally, it explores the interaction between violence against civilians and an indicator of whether these events involved civilian deaths. The positive coefficients for both types of conflict events and a negative coefficient for the interaction term involving violence against civilians solidify the notion that civilian casualties drive the negative impact of such violence.

Table 2.2: Estimation Results According to Occurrence of Civilian Deaths

	desired share of sons
# events with no civilian deaths	0.0276*
	(0.0158)
# events with civilian deaths	-0.0362*
	(0.0190)
Controls	Yes
District FE	Yes
Year FE	Yes
Observations	118411
Districts	680

Note: The outcome variable is the desired share of sons, constructed as the number of desired sons divided by the number of desired children multiplied by 100. The main explanatory variables are the number of all conflict events seven years preceding each round of NDHS interview with no occurrence of civilian death and with occurrence of civilian death. The list of controls includes age, wealth, education level, husband's education level, religion, and the type of settlement (urban/rural). Standard errors are clustered at the district level.

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

Thus, the significant negative effect of violence against civilians is explained by the high number of civilian deaths associated with these events. The conclusion that can be drawn from these results is that exposure to conflicts has a differential effect on stated preferences based on their type and the occurrence of civilian deaths. One of the explanations for these results might lie in individual versus societal survival threats. Other conflict events (state-based and non-state conflict) are conflicts between states, between a state and an armed group, or between two armed groups, which, from civilians' point of view, cause distortions in the economy, and fear and uncertainty about future individual or family survival. As discussed in the mechanisms section, all of these can affect preferences for sons in a positive direction. There can be several potential mechanisms here, which require further analysis to be identified, but, importantly, all of them work in the same direction. On the other hand, violence against civilians (or one-sided violence) is directly targeted at civilians and involves a much larger number of civilian deaths, causing societal or group survival threats, especially in an ethnically divided society such as Nigeria. Therefore, the concerns and need for reproduction becomes a stronger factor in this case and leads to a negative effect on the preference for sons.

The next step in the analysis is to test whether these preferences translate into behaviour expressed via sex-selective abortions. For this, I perform a similar analysis using the actual share of sons in families as the outcome variable. Table 2.3 displays the results from these regressions. The first two columns use all conflict events and the last two columns use disaggregated events. The first and third columns of the table use the full sample. Coefficient estimates are insignificant, suggesting that the preferences do not translate into behaviour using sex-selective abortions and/or there is no gender differential survival rate among children. In the second and fourth columns, I restrict the sample to completed families, i.e. respondents who stated that they do not want to have any more children. Had families used sex-selective abortions, the consequences of these (e.g. higher share of sons) would have been more visible in completed families rather than in the full sample. However, the results display no evidence of that with the restricted sample as well.

Table 2.3: Estimation Results for Actual Share of Sons

	full sample actual share	completed families actual share	full sample actual share	full sample actual share
# events	0.00199	0.0137		
	(0.00598)	(0.0153)		
# of other conflict events			-0.0422	0.0828
			(0.0483)	(0.0608)
# violence against civilians			0.0540	-0.0685
			(0.0515)	(0.0729)
controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	87720	24030	87720	24030
Districts	680	680	680	680

Note: In all specifications, the dependent variable is the actual share of sons, constructed as the number of living boys divided by the number of living children multiplied by 100. The main explanatory variable in the first two columns is the total number of all conflict events seven years preceding each round of NDHS interview. In the last two columns, the main explanatory variables are the number of violent events against civilians and other conflict events, which include state-based and non-state events. The list of controls includes age, wealth, education level, husband's education level, religion, and settlement type (urban/rural). The sample of completed families includes women who stated that they do not want to have any more children. Standard errors are clustered at the district level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As an additional check, in Table 2.B5 in the Appendix 2.B, I also restrict the sample to completed families with a recent newborn, i.e. respondents whose most recent child was born at most two years prior to each round of the DHS interview. The rationale behind this is connected to the measure of conflict exposure. Since the measure is defined as the cumulative number of events seven years preceding each round of survey, families who stopped having children, for instance five years ago, might not be affected by this measure. The results of these estimations are similar to those obtained using the full sample. These findings imply that while exposure to conflict affects women's stated preferences, it might not necessarily translate into actually having more sons than daughters. One possible reason for this could be the fact that sex-selective abortions are prohibited in Nigeria.

Table 2.4 presents the results for the stopping rule behaviour. The first column uses the full sample and tests whether women from districts affected by conflicts and whose most recent born child is a female have higher probability to want another child. The coefficient estimate of the interaction term of conflict events with the indicator of last born child being a girl is positive and significant, suggesting evidence for exacerbation of the stopping rule in areas more exposed to conflicts. Column two uses interactions with dissagregated conflict types and, in line with Table 2.1, the interaction term with violence against civilians is negative, while positive with other conflicts. The third and fourth columns show the probability of stopping after a boy. Here the analysis does not produce strong significant results. The last two columns examine the number of siblings a child has in a family. Column 5 uses the full sample and displays that girls from districts more affected by conflict have more siblings than boys. Column 6 displays the interaction with the dissagregated conflict types and the results are in line with Table 2.1. Overall, this table suggests that the stopping rule is being practiced in Nigerian families, and long-run exposure to conflicts further strengthens this practice.

Table 2.5 presents the results of the effects of conflict exposure on the probability of receiving a certain type of vaccination by gender. In the case of vaccinations, I observe that the effect of the conflict is not conditional on its type. Using the specification with all conflict events produces a significant positive coefficient estimate on the interaction term of all conflict events and an indicator for a child being a boy. This implies that in districts more exposed to all types of conflict, parents invest more in the health of their boys. These results suggest that, despite the difference in the effects of different types of conflict on preferences before birth, once the child is born, the conflict induces parents to invest more in the health of their boys. This is in line with the findings that, in son favoring societies, parents invest more in the health of their male offspring (Jayachandran & Kuziemko, 2011; Jayachandran & Pande, 2017; Barcellos et al., 2014). To check the robustness of these results, I repeat the analysis of Table 2.5 using the data from the Armed Conflict Location and Event Data Project (ACLED). The results are presented in Table 2.B6 in the Appendix 2.B and are comparable to Table 2.5.

Table 2.4: Estimation Results for the Stopping Rule

	(full sample) want more	(full sample) want more	(completed families) last birth boy	(full sample) last birth boy	(full sample) siblings	(completed families) siblings
last birth girl × # events	0.000161*				0.00629*	
	(0.0000881)				(0.00364)	
# events	0.00212**		-0.000488		-0.00906	
	(0.000825)		(0.000318)		(0.00611)	
last birth girl	0.0546***	0.0561***			0.00681	0.00756
	(0.00377)	(0.00379)			(0.0116	(0.0116)
last birth girl × # other events		0.00182**				0.00724**
		(0.000920)				(0.00364)
# other events		-0.00177**		0.00129		-0.0105*
		(0.000893)		(0.00135)		(0.00618)
last birth girl × # violence against civilians		-0.00178**				-0.00213***
		(0.000795)				(0.000696)
# violence against civilians		0.00277***		-0.00269*		0.00399***
		(0.000818)		(0.00157)		(0.00106)
controls	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	71450	71450	14909	14909	81829	81829
Districts	680	680	663	663	680	680

Note: In the first and second columns, the dependent variable is the desire to have another child. In the third and fourth columns, the dependent variable is the gender of the last born child, and in the last two columns, the dependent variable is the number of siblings. The main explanatory variables are the interaction of the indicator for last born girl and the number of total events or number of violent events against civilians and other events, and the number of total events or violence against civilians and other events. In all specifications, the list of controls includes age, wealth, education level, husband's education level, religion, and type of settlement (urban/rural). The sample of completed families includes women who stated that they do not want to have any more children. Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.5: Estimation Results for Postnatal Health Investment

	(1) polio 0	(2) polio 1	(3) polio 2	(4) polio 3	(5) measles	(6) BCG (TB)
# events × boy child	0.000482***	0.000674***	0.000726***	0.000529***	0.000553***	0.000238
	(0.000120)	(0.000261)	(0.000217)	(0.000164)	(0.000122)	(0.000193)
# events	0.00191	-0.00310	-0.00217	-0.00466**	-0.000396	0.00133
	(0.00205)	(0.00206)	(0.00229)	(0.00210)	(0.00103)	(0.00170)
boy child	-0.00252	-0.00412	-0.00514	-0.00340	-0.000238	-0.00244
	(0.00285)	(0.00314)	(0.00331)	(0.00357)	(0.00321)	(0.00281)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	74128	80710	79835	79827	80262	81671
Districts	675	675	675	675	675	675

Note: The dependent variables are indicators whether the child received polio 0-3, measles and BCG (tuberculosis) vaccination. The main independent variable is the interaction term of the number of events with the indicator of child being a boy. In all specifications, the list of controls includes age, wealth, education level, husband's education level, religion, and type of settlement (urban/rural). Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Overall, the results underline the importance of studying both the behavioural and attitudinal measures of gender preferences. This is because behavioural measures, such as sex ratios, shares of sons, and the measures used to detect the stopping rule, may sometimes fail to reveal any significant change in behaviour, even though there is a change.

2.7 Robustness

2.7.1 Respondents with No Children

A valid concern for using stated preferences for children is that mothers might be biased towards their realised gender composition, i.e. their stated preferences might be largely affected by the gender of the actual children that they have. To address this concern in the baseline specification I directly control for the actual number of sons and daughters. In addition, in the robustness checks I restrict the sample to the respondents with no children. These are women in reproductive age who still have not had children and their preferences could not have been affected by the gender composition of their actual children. The results are presented in column 2 of Table 2.B6 in the Appendix 2.B. I observe a significant positive effect of other types of conflict and a significant negative effect of violence against civilians on the desired share of sons even with the restricted sample. Furthermore, similar to the full sample, here as well the average effect of all the conflict types is 0.

2.7.2 Addressing Migration Concerns

Another concern to address is the migration behaviour of parents. If people with less conservative views are also those who migrate to non-conflict areas, then this might bias the results. The DHS data allows me to test this concern. One of the questions posed to the respondents is how long they reside in the current place of residence. Exploiting this question, I restrict the sample to women who stated that they have always been living in the current place of residence. The results are shown in the 3rd column of Table 2.B6 in the Appendix 2.B. The coefficients are more significant and larger in magnitude than in the baseline specification, implying that the effect of conflicts is stronger for the stayers.

2.7.3 Total Number of Desired Children

I define the desired share of sons as the ratio of desired sons to desired children. This ratio might increase either due to an increase in the desired number of sons or a decrease in the desired number of children. To ensure that the results I obtain are not driven by the fact that respondents in conflict areas state that they want fewer children of both gender, I repeat the analysis using the number of desired and actual children. The results are presented in Table 2.B7 in the Appendix 2.B and indicate that neither the total number of all events nor the number of disaggregated events has any significant effect on the desired number of children. However, the total number of actual children in the families that stopped having children is positively affected by the total number all conflict events. Column 4 of Table 2.B7 shows that this effect is mostly driven by violence against civilians. This further supports the explanation of the societal survival threat connected with violence against civilians.

2.8 Conclusion

Exploiting temporal and spatial variations in conflicts in Nigeria, this study establishes skewed gender preferences as another long-lasting legacy of armed conflicts. I combine two sources of data to perform the analysis: the Uppsala Conflict Data Program and the Demographic and Health Surveys Program. The results show that long-run exposure to violent conflicts has a differential effect on stated preferences (attitudes) for boys depending on the type of the conflict and occurrence of civilian deaths. The explanation for these results might lie in individual (or family) versus group (societal) survival threats. I find no evidence of translating these preferences into behaviour via sex-selective abortions or evidence of gender differential survival rate. Instead, evidence shows that parents use the stopping rule to achieve their desired gender composition of children. Further, my analysis also indicates that, in the districts affected by conflict, parents have a positive bias towards boys in terms of their postnatal health investment.

The study contributes to the literature on skewed gender preferences by simultaneously looking at both attitudinal and behavioural measures of gender preferences and testing whether and how the preferences translate into behaviour. It emphasises the importance of differentiating the impact of conflicts by their types. Finally, the results also contribute to the literature on the origins of gender gaps by revealing another mechanism that leads to skewed investment in the health of children in early childhood, raising questions about gender gaps in future human capital development.

2.A Appendix: Figures

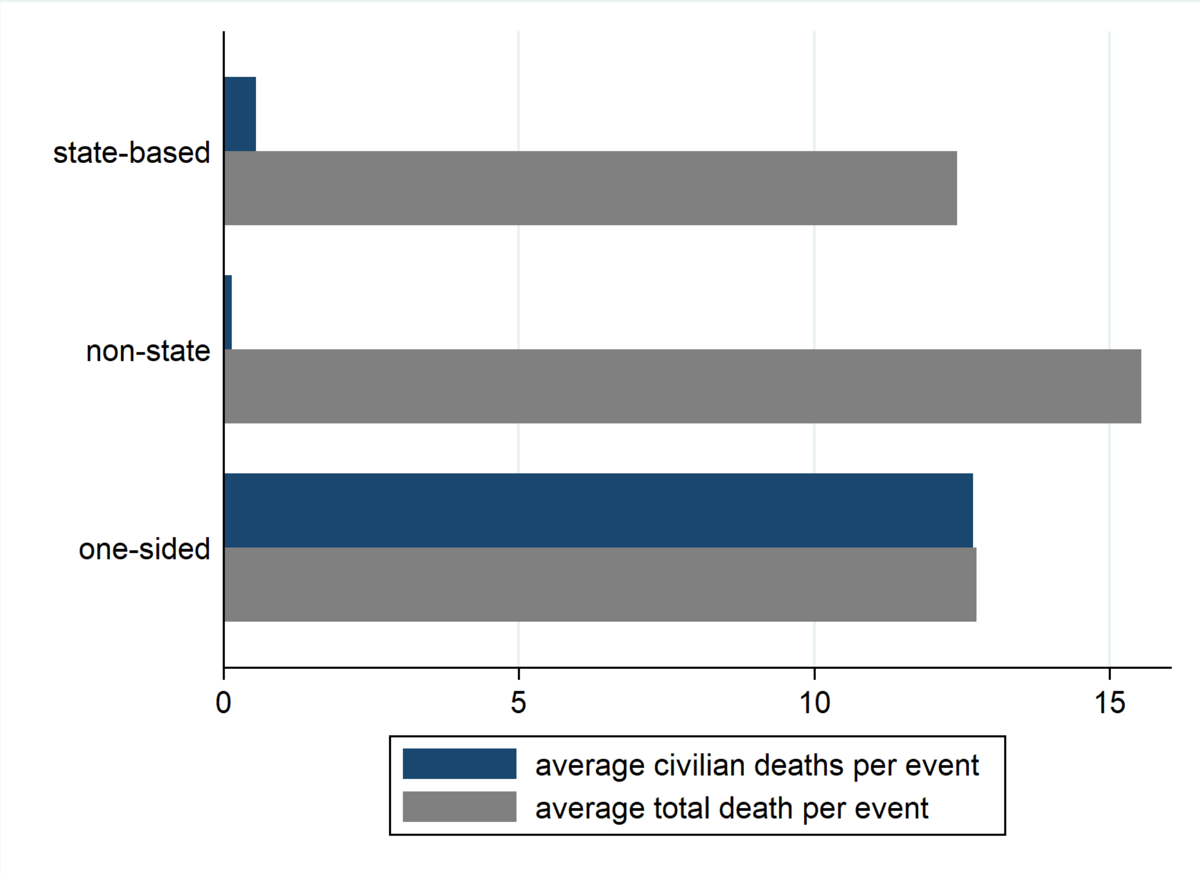


Figure 2.A1: Average Deaths by Type of Conflict
Source: Author's calculations based on data from the Uppsala Conflict Data Program (UCDP)

2.B Appendix: Tables

Table 2.B1: Mean Difference Test for Conflict Exposed and Non-exposed Districts

	non-exposed districts	conflict exposed districts	b
average ideal_ratio	51.90894	51.82097	.0879679
average of sons	1.231996	1.2732	-.0412038
average of daughters	1.219347	1.172902	.0464456
share no religion	.012161	.0051814	.0069796
share muslim	.442744	.4752755	-.0325315
share christian	.5287261	.4928153	.0359108
share other	.0163689	.0267279	-.010359
share poorest	.2188467	.1711315	.0477152
share poorer	.2003887	.183689	.0166997
share middle	.1862998	.1654123	.0208875
share richer	.1938507	.224476	-.0306253
share richest	.200614	.2552911	-.0546771
share no education	.4369059	.4494642	-.0125584
share primary education	.2370565	.2318725	.0051841
share secondary education	.2811597	.2642732	.0168866
share higher education	.0448779	.0543901	-.0095123
share Ekoi	.0020745	0	.0020745
share Fulani	.0357885	.0689157	-.0331272*
share Hausa	.2413576	.1723237	.069034
share Ibibio	.0100247	.0099451	.0000796
share Igala	.009579	.0311176	-.0215386
share Igbo	.2252784	.1433707	.0819077*
share Ijaw/Izon	.010234	.0097309	.0005031
share Kanuri/Beriberi	.0125692	.048428	-.0358588**
share Tiv	.0160862	.028652	-.0125658
share Yoruba	.2176256	.1246244	.0930012**
share Other	.2193822	.3628919	-.1435097***
Observations	428		

Table 2.B2: Mean Difference Test Between Districts Exposed to State/Non-State Conflict and Non-Exposed Districts

	non-exposed districts	conflict exposed districts	b
average ideal_ratio	51.91121	51.80863	.1025845
average of sons	1.227945	1.284352	-.0564069
average of daughters	1.212675	1.18074	.0319346
share no religion	.0127384	.00349	.0092485
share muslim	.4312848	.4990793	-.0677945
share christian	.5372684	.4739966	.0632718
share other	.0187084	.0234341	-.0047257
share poorest	.2114681	.1801348	.0313333
share poorer	.195906	.1902907	.0056153
share middle	.1882991	.1598582	.0284409
share richer	.1972311	.2211586	-.0239275
share richest	.2070957	.2485578	-.041462
share no education	.4261316	.4701847	-.0440531
share primary education	.2392326	.2274437	.0117889
share secondary education	.2875597	.2510968	.036463
share higher education	.0470761	.0512749	-.0041988
share Ekoi	.0019693	0	.0019693
share Fulani	.0344457	.0744051	-.0399593**
share Hausa	.2322445	.1825129	.0497316
share Ibibio	.011069	.0080416	.0030274
share Igala	.0124376	.0279108	-.0154733
share Igbo	.2407166	.107794	.1329226***
share Ijaw/Izon	.0097149	.0106272	-.0009122
share Kanuri/Beriberi	.0119316	.0528884	-.0409568***
share Tiv	.0152703	.031291	-.0160207
share Yoruba	.2134512	.1236383	.089813*
share Other	.2167493	.3808908	-.1641415***
Observations	428		

Table 2.B3: Mean Difference Test Between Districts Exposed to Violence Against Civilians and Non-Exposed Districts

	non-exposed districts	conflict exposed districts	b
average ideal_ratio	51.94591	51.4904	.4555024
average of sons	1.247259	1.251917	-.0046577
average of daughters	1.205248	1.179863	.0253844
share no religion	.0099653	.0066491	.0033162
share muslim	.4415863	.5309157	-.0893294
share christian	.5280305	.4422203	.0858102
share other	.020418	.0202149	.000203
share poorest	.2146899	.1216351	.0930549**
share poorer	.2029301	.1444476	.0584825*
share middle	.1847683	.1421646	.0426037
share richer	.1926311	.2775675	-.0849365**
share richest	.2049806	.3141852	-.1092046**
share no education	.4430314	.4348943	.0081371
share primary education	.2386366	.2153514	.0232853
share secondary education	.2738259	.2789126	-.0050867
share higher education	.0445061	.0708417	-.0263356*
share Ekoi	.0015015	0	.0015015
share Fulani	.0452536	.0671934	-.0219397
share Hausa	.2207625	.1806881	.0400743
share Ibibio	.0078271	.0218781	-.014051
share Igala	.0162087	.0273889	-.0111802
share Igbo	.1983041	.1672182	.0310859
share Ijaw/Izon	.0106367	.0067599	.0038768
share Kanuri/Beriberi	.0155761	.0862672	-.0706911***
share Tiv	.0211086	.020144	.0009647
share Yoruba	.2025905	.0661787	.1364118**
share Other	.2602306	.3562836	-.096053
Observations	428		

Table 2.B4: Estimation Results According to Occurrence of Civilian Deaths

	desired share of sons
# other conflict events	0.033**
	(0.016)
# other conflict events $\times CD$	0.009
	(0.018)
# violence against civilians	0.475*
	(0.245)
# violence against civilians $\times CD$	-0.524**
	(0.244)
Controls	Yes
District FE	Yes
Year FE	Yes
Observations	118411
Districts	680

Note: The outcome variable is the desired share of sons, constructed as the number of desired sons divided by the number of desired children multiplied by 100. The main explanatory variables are the number of violent events against civilians and other conflict events (including state-based and non-state events) and the interaction terms of these variables with an indicator of whether these events involve civilian deaths denoted by *CD*. The list of controls includes age, wealth, education level, husband's education level, religion, and the type of settlement (urban/rural). Standard errors are clustered at the district level.

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

Table 2.B5: Effect of Conflicts on Actual Share of Sons for Families with Recent Newborn

	(1) actual share of sons	(2) actual share of sons
# events	0.0400	
	(0.0269)	
# other conflict events		0.0426
		(0.113)
# violence against civilians		0.0371
		(0.143)
controls	Yes	Yes
District FE	Yes	Yes
Year FE	Yes	Yes
Observations	6979	6979
Districts	652	652

Note: In both specifications, the dependent variable is the actual share of sons, constructed as the number of living boys divided by the number of living children multiplied by 100. The main explanatory variable in the first column is the total number of all conflict events seven years preceding each round of NDHS interview. In column 2, the main explanatory variables are the number of violent events against civilians and other conflict events, which include state-based and non-state events. The list of controls includes age, wealth, education level, husband's education level, religion, and settlement type (urban/rural). The analyses are performed with the sample of completed families, whose most recent birth was at most two years before each round of NDHS interview. Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.B6: Effect of Conflicts on Investment Behaviour Using Data from ACLED

	(1) polio 0	(2) polio 1	(3) polio 2	(4) polio 3	(5) measles	(6) BCG (TB)
# events × Boy child	0.000161	0.000505***	0.000563***	0.000379**	0.000740***	0.000362**
	(0.000136)	(0.000128)	(0.000160)	(0.000184)	(0.000179)	(0.000149)
# events	0.000442**	-0.000303	-0.000132	-0.000143	-0.000351*	-0.000363
	(0.000214)	(0.000258)	(0.000265)	(0.000219)	(0.000210)	(0.000280)
Boy child	-0.00208	-0.00453	-0.00565*	-0.00369	-0.00165	-0.00315
	(0.00291)	(0.00312)	(0.00331)	(0.00357)	(0.00320)	(0.00278)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	74128	80710	79835	79827	80262	81671
Districts	675	675	675	675	675	675

Note: The dependent variables are indicators whether the child received polio 0-3, measles and BCG (tuberculosis) vaccinations. The main independent variable is the interaction term of the number of events with the indicator of child being a boy. In all specifications, the list of controls includes age, wealth, education level, husband's education level, religion, and type of settlement (urban/rural). Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.B7: Robustness Check: 0 Children and Never Moved Samples

	(full sample) desired share	(0 children) desired share	(never moved) desired share
# other conflict events	0.0372***	0.0350**	0.0628***
	(0.0132)	(0.0169)	(0.0198)
# violence against civilians	-0.0446***	-0.0315*	-0.0747***
	(0.0145)	(0.0186)	(0.0216)
total sons alive	0.546***		0.470***
	(0.0291)		(0.0404)
total daughters alive	-0.681***		-0.482***
	(0.0346)		(0.0447)
Controls	Yes	Yes	Yes
District FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	118411	39082	42278
Districts	680	680	677

Note: In all specifications, the outcome variable is the desired share of sons, constructed as the number of desired sons divided by the number of desired children multiplied by 100. The main explanatory variables are the number of violent events against civilians and other conflict events, which include state-based and non-state events. The first column uses the full sample, the second column uses the sample of women with no children, and the third column includes the sample of respondents who stated that they have always lived in the current place of residence. The list of controls includes age, wealth, education level, husband's education level, religion, and the type of settlement (urban/rural). Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.B8: Effect of Conflicts on Total Number of Children - Desired and Actual

	(full sample) desired # of tot. children	(full sample) desired # of tot. children	(completed families) tot. children alive	(completed families) tot. children alive
# events	0.000470		0.00363***	
	(0.00259)		(0.000800)	
# other conflict events		-0.0153		-0.00471
		(0.0165)		(0.00677)
# violence against civilians		0.0189		0.0136*
		(0.0191)		(0.00759)
controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	113175	113175	21405	21405
Districts	680	680	677	677

Note: In columns 1 and 2, the outcome variable is the total number of desired children. In columns 3 and 4, the outcome variable is the total number of living children. The main explanatory variable in columns 1 and 3 is the total number of all conflict events seven years preceding each round of DHS survey in Nigeria; in columns 2 and 4 - the number of violent events against civilians and other conflict events, which include state-based and non-state events. The list of controls includes age, wealth, education level, husband's education level, religion, and the type of settlement (urban/rural). The sample of completed families includes women who stated that they do not want to have any more children. Standard errors are clustered at the district level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Chapter 3

Activated Memory of Natural Disasters and Child Gender Preferences: The Case of Armenia

3.1 Introduction

Despite the recent enhancement of women's rights, parental preferences and gender differential attitudes still overwhelmingly lead to "missing" females and shape the role of women in many developing countries. Many quantitative and qualitative studies note that the preference for sons over daughters is a conspicuous feature of many Asian and African countries (Gupta, 2005; World Bank, 2012). Therefore, the introduction and spread of gender-diagnostic technologies in these regions have increased the possibility of sex-selective abortions, resulting in higher male-to-female ratios at birth (Lin et al., 2014; Chen et al., 2013; Bhalotra & Cochrane, 2010). This, alomg with biased resource allocation (for nutrition, health care, and education, among others) favoring sons within households (Jayachandran & Kuziemko, 2011; Jayachandran & Pande, 2017; Barcellos et al., 2014), has generated skewed male-to-female ratios in many developing countries and has given rise to the concept of "missing women" coined by Amartya Sen in 1990. According to his estimates, the differences in mortality rates have left the developing world with approximately 100 million "missing females".

The literature relates son preference to a variety of social and economic factors that interact to make females less valuable to their families. Existing views suggest that the reasons behind this differential treatment could be attributed to the belief that productive assets move through the male line within the family. In particular, some of the reasons are differential labor force opportunities (Qian, 2008; Carranza, 2014), laws related to inheritance and the family (Bhalotra et al., 2018), expectations about old age support (Ebenstein & Leung, 2010), expectations about dowries to be paid for daughters (Bhalotra et al., 2019; Bloch & Rao, 2002), religious beliefs about sons' role during rituals (Jayachandran, 2015), social pressure, among others.

One might expect that with the recent enhancement of women's rights and an increasing number of public policies designed to achieve gender equity and to equalize the value of sons and daughters to their parents, the effect of some of the above reasons would be diminished (Chung & Gupta, 2007; Gupta et al., 2009). However, many countries are still characterized by skewed male-to-female ratios at birth. In particular, Armenia is among the countries with a remarkably high rate of male-to-female ratio at birth. The proportion of male births per 100 female births surged after the country gained independence in 1991 as opposed to the vast majority of other post-Soviet countries, where the ratio fluctuates around the biological norm[1]. This places Armenia among the countries with the highest birth masculinity globally, trailing behind only China and Azerbaijan in 2021 (United Nations, World Population Prospects (2022)).

Concurrently, natural disasters have been shown to affect and alter the perceptions and preferences of individuals (Cameron & Shah, 2015; Brown et al., 2018; Cassar et al., 2017b). Therefore, one can expect that they can significantly impact parents' preferences for the gender of their children by altering or strengthening their beliefs and priorities (Becker et al., 2020). In regions prone to frequent natural calamities such as earthquakes, floods, or droughts, there may emerge a shift towards desiring children of a particular gender based on perceived societal roles and responsibilities. For instance, in areas where survival skills or physical strength are deemed crucial for navigating post-disaster challenges, parents might lean towards preferring male children.

This study proposes a novel explanation behind the high sex ratio at birth by exploring the long-run effect of the 1988 Armenian Earthquake. Specifically, I investigate how the activated memory of the devastating earthquake affects women's stated preferences for the gender of their children. I use four rounds of Demographic and Health Surveys (DHS) in

[1] According to the World Health Organization (WHO) the biological norm for "expected sex ratio at birth" fluctuates around 103 to 107 boys born per 100 girls. The "expected sex ratio at birth" means that there is no gender discrimination or interference.

Armenia and exploit plausibly exogenous differences in the timing of the DHS interviews. This approach is similar to that of Depetris-Chauvin et al. (2020). Specifically, I compare women's self-reported preference for boys between individuals interviewed on or near the day of the commemoration of the victims of the 1988 Armenian Earthquake with women interviewed on all other days. December 7 marks the commemoration of the earthquake victims. While not designated as a public holiday in Armenia, all Armenian TV channels broadcast special episodes recalling the events of the devastating earthquake that occurred on December 7, 1988[2]. The proposed mechanism posits that the reactivated memory of the profound loss and the potential recurrence of similar events in the future compel women toward a stronger (higher) preference for boys.

The findings indicate that women interviewed on or near December 7 exhibit a higher preference for boys. This result is particularly pronounced among those hailing from the Shirak region, as that region hosts the city, Gyumri, most severely affected by the disaster, witnessing the highest number of casualties and physical devastation. In further heterogeneity analyses, I show that this result is mostly driven by women who already have at least one child, and the fact that women lost children does not play a significant role. In a placebo test, I vary the treatment to September 7, October 7, and November 7 and I do not find significant differences in the stated preference for boys in any of these cases.

This research makes significant contributions to two main fields of literature. Firstly, it adds to the discourse on the imbalanced male-to-female ratio at birth by offering a novel perspective on the underlying factors driving the heightened preference for boys. Secondly, it advances our understanding of the lasting impacts of natural disasters by identifying skewed gender preferences in childbearing as one of their long-lasting consequences.

The remainder of this paper is organized as follows: Section 2 provides the background, Section 3 discusses the data, Section 4 describes the identification strategy and results, and Section 5 concludes.

[2]Figures 3.B1, 3.B2 and 3.B3 in Appendix 3.B show pictures similar to what is broadcasted on the TV every year on December 7.

3.2 Background

3.2.1 Sex Ratio at Birth

Since achieving independence, Armenia has exhibited a distinctive pattern characterized by a consistently high male-to-female ratio at birth. This trend stands in contrast to the majority of other post-Soviet countries (excluding Azerbaijan), where such imbalances are not as pronounced. Figure 3.1 depicts the long-run trend in the sex ratios at birth for all post-Soviet countries.

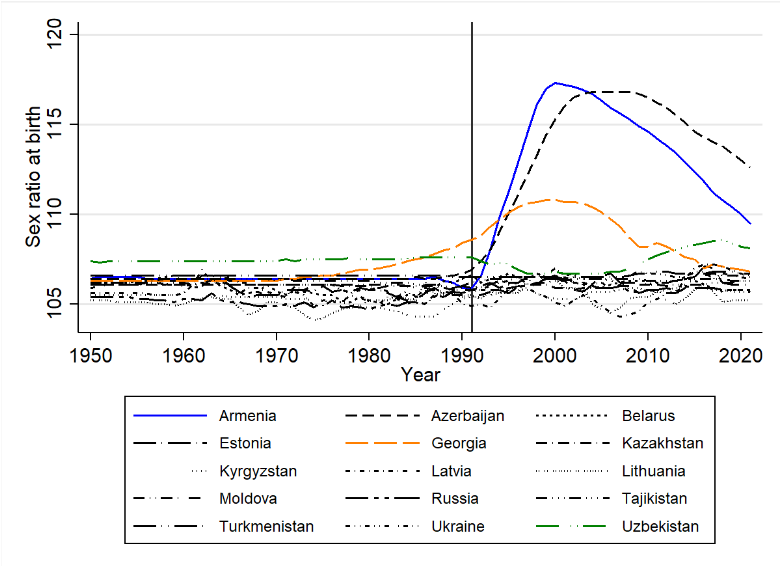


Figure 3.1: Sex ratio at birth in all post-Soviet countries, 1950-2021
Note: This figure depicts the evolution of sex ratios at birth in 15 post-Soviet countries. It shows the spike in the ratio in Armenia after independence in 1991 and contrasts its persistent high rate with other countries, where the ratio fluctuates around the biological norm of 105-106.
Source: Author's calculations using data from OurWorldInData.org.

On one hand, the prevalence of traditional kinship systems, which traditionally prioritize the role of sons, may offer insight into this pattern. On the other hand, in light of over 70 years of Soviet efforts to promote gender equality through various means such as education, labor force participation, political representation, and legislative reforms related to inheritance and family dynamics, one would expect these initiatives to have potentially mitigated deviations from the biological norm in the male-to-female birth ratio. Despite efforts to understand and address this phenomenon, including studies examining cultural preferences for male offspring or the potential impacts of societal changes, the elevated male-to-female ratio persists as a defining feature of Armenia's demographic makeup.

Comparisons with other post-Soviet countries shed light on the distinctiveness of

Armenia's demographic dynamics. While some nations in the region have witnessed fluctuations in their sex ratio at birth, none have displayed the sustained elevation seen in Armenia. This suggests that factors specific to Armenia, such as cultural norms and historical legacies, may play a significant role in shaping preferences for male children.

Moreover, a striking parallel can be drawn between Armenia and China regarding shifts in the sex ratio at birth (Figure 3.2). In China, the implementation of the one-child policy in the late 1970s led to a notable increase in the male-to-female ratio as families favored male heirs under the policy's restrictions. While there were no such reforms implemented in Armenia, the events that happened shortly before and after the collapse of the Soviet Union might have played a crucial role in determining the pattern of the sex ratio at birth, specifically the 1988 Armenian Earthquake and the First Nagorno-Karabakh War that lasted from 1988 to 1994. This study aims to establish the potential impact of the lasting effects of the earthquake in the child gender preferences of women. Figure 3.2 depicts the sex ratios at birth for Armenia and China, two countries with the highest sex ratios at birth during the last several decades.

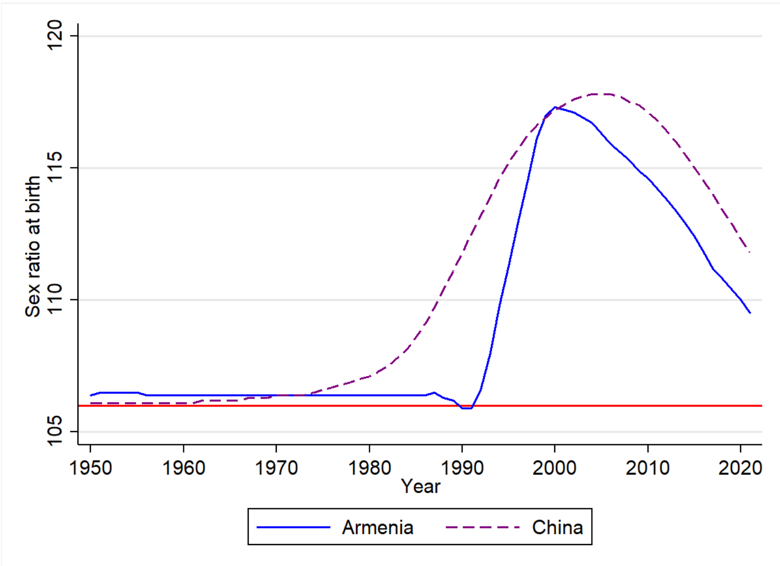


Figure 3.2: Sex ratio at birth in Armenia and China, 1950-2021
Note: This figure depicts the evolution of sex ratios at birth in Armenia and China, the countries with the highest male-to-female ratio at birth during the last three decades. The red horizontal line shows the biological norm for the sex ratio.
Source: Author's calculations using data from OurWorldInData.org.

In light of these observations, further research is needed to elucidate the underlying factors contributing to Armenia's elevated male-to-female ratio at birth and to explore potential implications for the country's demographic future. Understanding these dynamics is essential for informing policies and interventions aimed at addressing gender imbalances and promoting more equitable demographic outcomes in Armenia and beyond.

3.2.2 The 1988 Armenian Earthquake

The devastating 1988 Armenian Earthquake, with a surface wave magnitude of 6.8 and a maximum MSK intensity of X[3], stands as one of the most tragic events in the nation's history, leaving a profound impact on both its people and landscape. Striking on December 7th, this seismic catastrophe exacted a heavy toll, resulting in a significant loss of lives and widespread destruction. With casualties numbering in the tens of thousands and extensive physical devastation, the earthquake left scars that endure to this day. The official death toll was estimated to be between 25,000 and 50,000, with up to 130,000 injured, and 500,000 left homeless.[4]

The seismic event took place in Armenia's northern area, known for its susceptibility to significant and devastating earthquakes. This region forms part of an extensive active seismic zone that extends from the Alps to the Himalayas. The fault rupture impacted three nearby cities the most - Gyumri (with a population of 290,000), Spitak (with a population of 20,000), and Vanadzor (with a population of 170,000)[5] - each experiencing distinct levels of destruction. Despite similar proximity to the seismic center from Gyumri and Vanadzor, Gyumri was affected the most. This discrepancy could be attributed to the presence of a sedimentary layer, approximately 300-400 meters deep, underlying the city. Comparative analyses by the Earthquake Engineering Research Institute revealed that stone buildings of four stories or fewer buildings were affected similarly in both cities. However, taller frame-stone buildings suffered disproportionately, with Gyumri witnessing a 62% destruction rate, contrasting sharply with Vanadzor's 23% collapse rate. Furthermore, 95% of the precast frame buildings were destroyed in Gyumri as opposed to none in Vanadzor. The uneven distribution of seismic energy likely contributed to these

[3]The Medvedev-Sponheuer-Karnik (MSK) scale is a macroseismic intensity scale used to evaluate the severity of ground shaking on the basis of observed effects in an area where an earthquake transpires. It has 12 intensity degrees expressed in Roman numerals. Degree X - devastating - is characterized as: masonry buildings destroyed, infrastructure crippled; massive landslides; water bodies may be overtopped, causing flooding of the surrounding areas and formation of new water bodies.

[4]Sources: Noji et al. (1990) and Wikipedia.

[5]Gyumri and Vanadzor were called Leninakan and Kirovakan prior to independence in 1991, respectively.

variations, amplifying the disparities in damage observed[6]. Figure 3.3 shows the location of the epicenter and the main three cities that were affected by the earthquake.

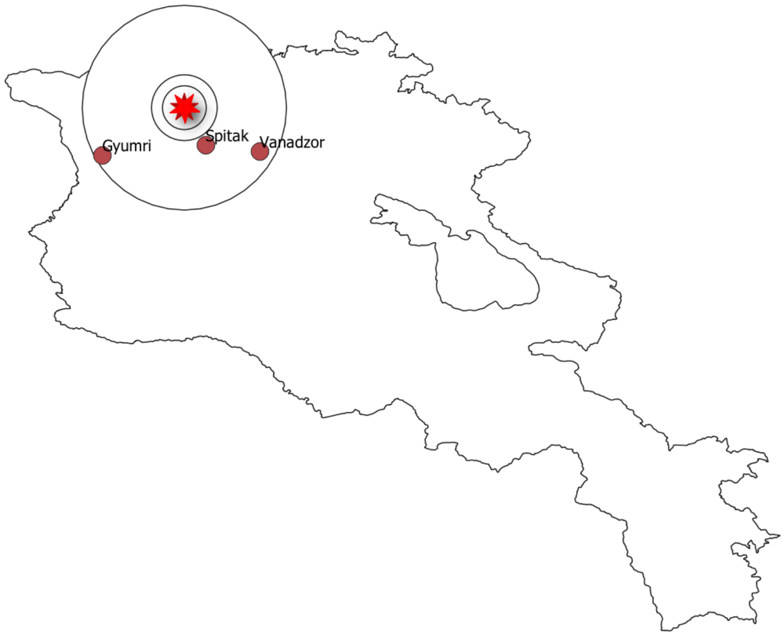


Figure 3.3: The epicenter of the 1988 Armenian Earthquake
Note: This map shows the location of the epicenter (red star) of the 1988 Armenian Earthquake and the location of the three main cities (Gyumri, Spitak, and Vanadzor) that were affected by it.

As per the World Bank's assessment in 2017[7], the direct material losses from the earthquake reached a staggering $15-$20 billion, a substantial sum for a small country like Armenia. The earthquake effectively obliterated or severely impaired Armenia's economic infrastructure, resulting in the destruction of 157 industrial establishments, which employed 82,000 people. Additionally, the earthquake inflicted damage on 17% of Armenia's residential properties, further exacerbating the scale of devastation.

Many years after the earthquake, displaced households had to live in temporary houses often constructed on their own. This is a possible example of the mechanisms through which activation of memory about the earthquake could lead to increased preference for sons; physical strength proved to be essential in the recovery stage post-disaster.

December 7 is the Day of Remembrance of the 1988 earthquake victims. While it is not designated as a public holiday in Armenia, every year, all Armenian TV channels

[6]The information in this paragraph relies on Wood et al. (1993)

[7]`https://documents1.worldbank.org/curated/en/316831526641378244/pdf/Armenia-Disaster-Risk-Finance-Country-Note.pdf`

broadcast special episodes recalling the events of the devastating earthquake that occurred on that day in 1988. In addition to that, even after 35 years, people individually or in organized groups (often arranged by the organizations they work for) visit dedicated places for remembrance ceremonies of the victims and lay flowers (see an example in Figure 3.B4 in Appendix 3.B).

3.3 Data

For the main analysis, I use data from four rounds of the Demographic and Health Surveys (DHS) conducted in Armenia in 2000, 2005, 2010, and 2015-2016. DHS collects representative individual and household-level data on population, health, HIV, and nutrition in more than 90 developing countries. I use information from a nationally representative sample of ever-married women in the reproductive age groups of 15-49. The samples were structured to yield estimates for various health indicators, including information about the fertility rates and gender preferences of women for Armenia as a whole, as well as for three distinct residential classifications (Yerevan, other urban areas, and rural areas), and each of the ten administrative regions (*marz*).

The surveys undertake a two-stage, stratified, random sample design. The first stage involves creating sampling strata by dividing each administrative region into urban and rural areas and selecting sample points (clusters) with probability proportional to size approach. The second stage selected households in which all women 15-49 were eligible to be interviewed. The final dataset consists of more than 25,000 observations.

To construct a variable that measures the preference for male children (the primary dependent variable), I utilized data concerning women's ideal family size. This data was collected through a series of questions posed to the respondents during the DHS surveys. Those without children were asked, "If you could choose exactly the number of children to have in your whole life, how many would that be?" For respondents with children, the inquiry was tailored slightly: "If you could go back to the time when you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?". Furthermore, respondents were prompted to specify the desired gender distribution among their children, indicating how many they wished to be boys and how many girls. I construct the preference variable denoted by the ideal ratio as follows:

$$ideal\ ratio = \frac{ideal\ number\ of\ boys * 100}{ideal\ number\ of\ children}$$

Figure 3.A1 maps the average values of the ideal ratio by the second administrative division levels of Armenia. Overall, all regions have a value of above 50% with the strongest preference in the Armavir, Gegharkunik, and Syunik regions. Table 3.A1 further decomposes the descriptive statistics for the ideal ratio by age group and highest education level. From this decomposition, it is cleat that the groups with the strongest preference for sons are 20-24 and 40-44 year old women with no education, as well as 25-44 year old women with basic education. Age overall does not seem to play a major role in the preference for sons.

The main treatment variable exploits the plausible exogenous variation in the timing of the interviews. Therefore, I create an indicator variable *Treatment* that takes value 1 if a woman was interviewed on December 6, 7, or 8, i.e. on and near the day of remembrance of the earthquake victims[8]. Table 3.A2 shows the timing of the interviews for different rounds of DHS surveys. Only rounds 2010 and 2015-2016 include December 7. In the baseline analysis, I use all the rounds given. However, in further robustness checks, I restrict the sample only to the women interviewed in the last two rounds, which include December 7.

Table 3.A3 presents summary statistics of the main variables used in the analysis, offering insights into the demographic and socioeconomic characteristics of the sample. The average age of women in the study cohort is 31 years. Approximately 45% of women have completed secondary education, which indicates a moderate level of educational achievement among participants. Interestingly, a higher proportion of partners, approximately 65%, have also attained secondary education.

Family dynamics are revealed through the average number of children reported by women with children, with an average of 1.18 sons and 1.07 daughters. Employment status is another important facet, with approximately 31% of respondents reporting current employment, underscoring the workforce participation within the sample.

Economic status, as measured by the combined wealth index, portrays a diverse landscape, with around 18% classified as belonging to the poorest households and a similar proportion, 17%, categorized as the wealthiest. 62.51% of respondents reside in urban areas.

Lastly, television viewing habits show that nearly 47% of respondents watch television almost daily, emphasizing the widespread prevalence of this form of entertainment and

[8]In one of the robustness checks I also report results where the indicator variable takes value 1 if women were interviewed on December 7 only.

information dissemination among study participants. The high rate of television viewing holds significant importance in this study, as it serves as a reminder of the devastating earthquake that struck on that date. The broadcast of TV programs on this anniversary plays a crucial role in activating the collective memory of the seismic catastrophe, allowing individuals to reflect on the profound impact it had on their lives and communities. Although visual narratives, documentaries, and commemorative events aired on television are provided with a view for honoring the memory of the lives lost, acknowledging the resilience of survivors, and reaffirming the commitment to rebuilding efforts, they might also trigger the fear of a recurrence of similar events and possible struggles they might face.

The proportion of women interviewed on December 6, 7, and 8 within the entire sample is only 1%. Initially, my baseline analysis utilizes this full sample. Subsequently, to ensure the robustness of our findings, I conduct additional checks using data from the 2010 and 2015-16 rounds of the DHS survey. In the 2010 dataset, approximately 4% of women were classified as treated individuals, i.e. interviewed on or near December 7 and therefore exposed to the documentaries and news commemorating the earthquake.

3.4 Identification Strategy and Results

3.4.1 Baseline Analyses

The main identification strategy in this study relies on the quasi-random nature of the day of the DHS interviews. In the baseline analyses, women who were interviewed on December 6, 7, and 8, are in the treatment group, while the control group includes women interviewed on all other days from all 4 rounds of DHS surveys. Every year December 7 marks the commemoration of the earthquake victims. Although December 7 is not officially recognized as a public holiday in Armenia, thus permitting interviews to take place on this day, all Armenian TV channels air special episodes commemorating the events of the devastating earthquake that struck on December 7, 1988. The proposed mechanism posits that the reactivated memory of the profound loss and fear of the potential recurrence of similar events in the future affect women's preferences for the gender of their children.

To assess the validity of the identification strategy, I conduct a balance test for several respondents' characteristics that may potentially correlate with the timing of the interview and the outcome of interest. These include the number of total sons, the number of total daughters, age, education, working status, husband's/partner's education level whether the respondent lives in a rural area, and the household's wealth index. Specifically, I compare individuals interviewed on or around December 7 with women interviewed on all other dates. To ensure a valid comparison, I regress each variable on the treatment status, cluster fixed effects, and I cluster standard errors at the same level.

The results are reported in Table 3.1. First, one can see that individual characteristics are mostly balanced between respondents interviewed on or around December 7 and all other days. The only exceptions are women's education, location of residence, and frequency of watching TV. Regarding women's education, the marginally significant differences between the treatment and control groups are very small: on average, individuals interviewed on or around December 7 have only 0.6 years of more education than women interviewed on all other days. Furthermore, the potential bias from this imbalance is likely to operate in the opposite direction, since less educated women generally tend to display a higher preference for sons.

Table 3.1: Balance Table in Covariates

	N	Estimate	Std. errors
Total number of sons	25034	-0.032	0.068
Total number of daughters	25034	-0.009	0.045
Age	25034	0.289	0.457
Education	25034	0.615***	0.266
Working Status	0.084	0.534	0.054
Husband's/partner's education	16937	0.352	0.236
Location of residence	25034	-0.153**	0.074
Region	25034	-0.071	0.527
Wealth index	18604	0.359*	0.186
Frequency of watching TV	25019	-0.596***	0.068

Note: This table reports OLS regression results of each covariate on the treatment variable - an indicator that takes the value of 1 if women were interviewed on December 6, 7, or 8. To ensure a valid comparison, cluster fixed effects are included in all specifications and the standard errors are clustered at the same level.
$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Regarding location of residence, the comparison indicates that individuals in urban areas are somewhat more likely to be interviewed on or around December 7. As with education, this imbalance should work against finding a positive effect of activated memory of the earthquake on the preference for boys, since people in rural areas are generally more likely to prefer more boys. Lastly, women interviewed on or around December 7 reported that they watch TV less frequently than women in the control group. This bias also works against finding a positive effect of the treatment on son preference, since if the programs broadcasted on TV are one of the mechanisms behind activated memory, women interviewed on December 7 have a lower probability of watching these programs. In any case, in the regressions presented subsequently, I incorporate controls for the full range of individual characteristics of women depicted in the balance table.

Furthermore, to alleviate concerns regarding a potential reluctance or absence of women for interviews on December 7, Figure 3.4 depicts the distribution of interviews across different days during the 2010 round of the DHS surveys. The dark purple column represents the number of interviews conducted on December 7. As illustrated in the figure, there is no discernible decrease in the number of interviews conducted on that specific day.

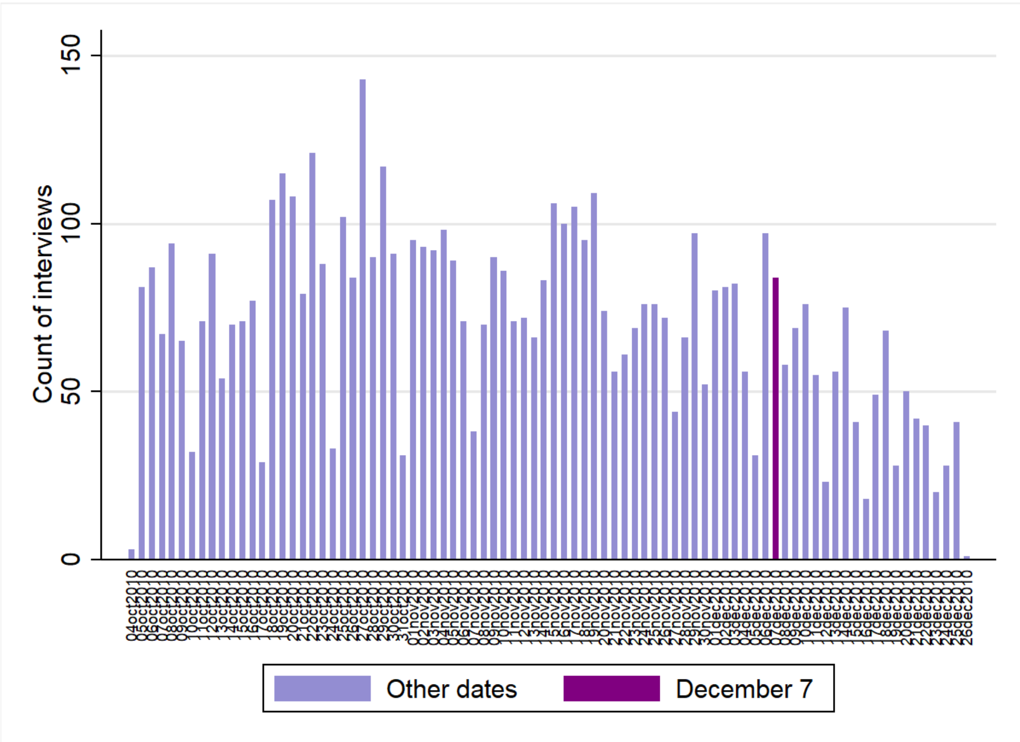


Figure 3.4: The distribution of DHS interviews by dates, 2010
Note: This figure displays the distribution of interviews conducted during the 2010 round of DHS surveys by dates. December 7 is highlighted in dark purple, while all other dates are indicated in lavender. The figure demonstrates that there is no reduction in the number of interviews conducted on December 7.

Additionally, to address the concern that the same or a limited number of locations were consistently interviewed on December 7 – which could suggest that differences in preferences are due to location rather than the interview date – Figure 3.A2 shows the location of DHS clusters of households interviewed on December 7.

The baseline specification estimates the following model:

$$Ideal\, ratio_{ict} = \alpha + \beta Treatment_{ict} + X_{itc}\gamma + \lambda_c + \eta_t + \epsilon_{ict}$$

where $Ideal\, ratio_{ict}$ is the ideal ratio for male children stated by women i from cluster c interviewed in year t; $Treatment$ is an indicator variable which takes the value 1 if a woman was interviewed on December 6, 7, or 8 and 0 otherwise; X_{itc} is a vector of control variables, including the total number of sons, the total number of daughters, age of the women, highest education level of women, husband's/partners education level, husband's/partner's occupation group, an indicator of whether the respondent is currently working, number of sons who have died, number of daughters who have died, location of residence (urban/rural), region of residence, frequency of watching television, and household's wealth index; λ_c is the cluster fixed effect; η_t is the year (interview round) fixed effect. In the most restrictive specification, I also control for the interviewer's fixed effects. I cluster the standard errors at the sampling cluster level.

The results of the baseline analysis are reported in Table 3.2. The first three columns of the table include specifications with different fixed effects controls. In the third column – the most restrictive specification – in addition to cluster and year, I control for the interviewer fixed effects. The fourth column includes the sample of women from 2010 and 2015-16 rounds of the DHS surveys, i.e. the two rounds that include December 7 in the timing of the interviews. The results of the baseline analysis show that women who were interviewed on or around December 7[9] have, on average, a three percentage point higher preference for male children. As expected, the actual number of children strongly affects the preference for boys. The effect of being interviewed on or around December 7 is comparable in magnitude to the effect of the total number of sons that the women have.

[9] I report results from a similar analysis comparing women interviewed only on December 7 with women interviewed on all other days in Table 3.A4 in Appendix 3.A. These findings exhibit comparable magnitudes to those of the baseline analysis, but the estimates are less precise due to the smaller size of the treatment group.

Table 3.2: Results from Baseline Specification

	Ideal Ratio			
Treatment	3.715***	3.067***	2.186*	2.472**
	(0.835)	(0.855)	(1.113)	(1.050)
Total number of sons	3.978***	3.977***	4.216***	4.182***
	(0.231)	(0.231)	(0.281)	(0.284)
Total number of daughters	-3.534***	-3.533***	-3.706***	-3.718***
	(0.211)	(0.211)	(0.252)	(0.256)
Constant	52.14***	52.60***	27.80	51.38***
	(1.727)	(1.804)	(17.12)	(2.426)
Controls	✓	✓	✓	✓
Cluster FE	✓	✓	✓	✓
Year FE		✓	✓	✓
Interviewer FE			✓	
Observations	12200	12200	7792	7800
Clusters	313	313	313	313

Note: This table compares the difference in the preference for boys among 15-49-year-old women interviewed on or around December 7 (the day commemorating the victims of the 1988 Armenian earthquake) and women interviewed on all other days, using data from four rounds of DHS surveys. *Treatment* variable takes value 1 if women were interviewed on December 6, 7, or 8. The first three columns include the full sample of women, while the last column restricts the sample to the last two rounds of DHS surveys (2010 and 2015-16). The vector of controls includes the age of the women, highest education level of women, husband's/partner's education level, husband's/partner's occupation group, an indicator of whether the respondent is currently working, number of sons who have died, number of daughters who have died, location of residence (urban/rural), region of residence, frequency of watching television, and household's wealth index Standard errors are clustered at the cluster level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

To depict how the stated preference for sons evolves around the days before and after Devember 7, in Figure 3.5 I plot the estimated coefficients and 95% confidence intervals for dummies indicating 3-day windows around December 7. The coefficients are estimated through a regression similar to the baseline specification, where, in addition to the Treatment variable, I include 3-day dummies for the periods around December 6, 7, and 8.

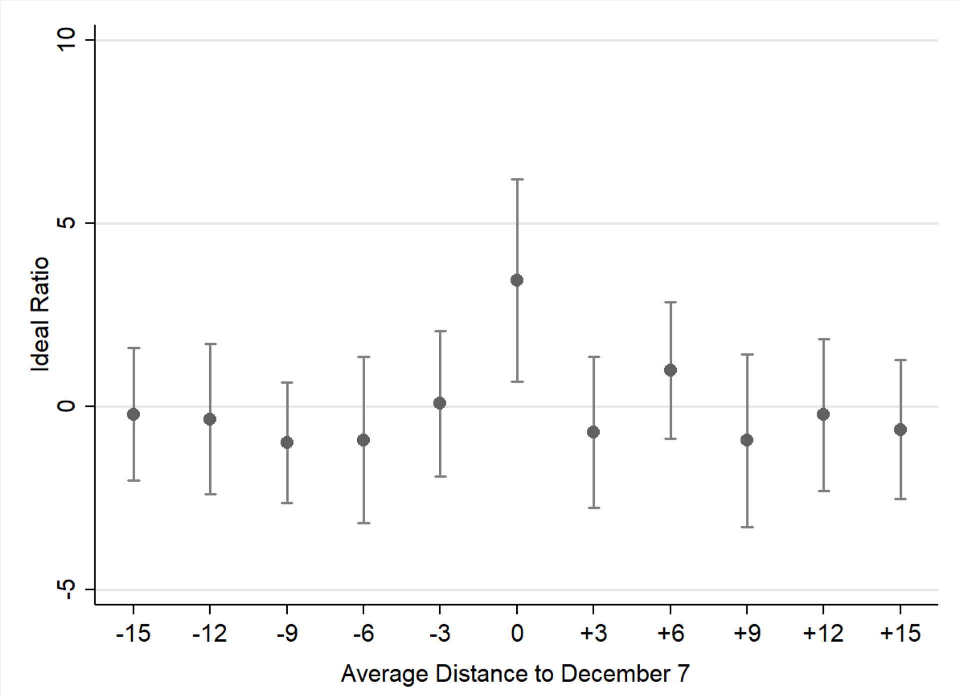


Figure 3.5: Stated preference for sons before and after December 7
Note: The figure plots the coefficient estimates and the 95% confidence intervals from a regression of ideal ratio on 11 dummies, each indicating a 3-day window around December 7 and a treatment dummy (indicated with 0) which takes value of one if women were interviewed on December 6, 7, or 8. The specification controls for individual characteristics of women, it includes cluster fixed effects, and standard errors are clustered at the same level.

The figure confirms that women state a stronger preference for sons on and around December 7, while on other days before and following December 7, the stated preferences do not seem to be significantly different from other days.

3.4.2 Heterogeneity Analyses

In what follows, I decompose the effect of being interviewed on or around December 7 based on different characteristics.

To understand whether the effect of activated memory is stronger for women from the regions that were most affected by the earthquake, namely the Shirak region, which includes Gyumri (the most affected city), and the Lori region, which includes Spitak and Vanadzor, I construct and estimate the following model:

$$Ideal\ ratio_{ict} = \alpha + \beta Treatment_{ict} + \delta_1 Treatment_{ict} \times Shirak +$$

$$+\delta_2 Treatment_{ict} \times Lori + X_{itc}\gamma + \lambda_c + \eta_t + \epsilon_{ict}$$

where all the variables are the same as in the baseline specification, $Shirak$ is an indicator variable which takes the value of 1 if women reside in the Shirak region and 0 otherwise; and $Lori$ takes the value of 1 if women reside in the Lori region.

The results of this analysis are presented in Table 3.2. As in Table 3.3, the first two columns include specifications with different fixed effects controls. The third column includes the sample of women from 2010 and 2015-16 rounds of the DHS surveys, i.e. the two rounds that include December 7 in the timing of the interviews. First, the results of this analysis reveal that women in Shirak have a smaller preference for male children than in other regions. However, the interaction term of the treatment variable with Shirak is large in magnitude and statistically significant in all the specifications, suggesting that women interviewed on or around December 7 in the Shirak region express a much higher preference for boys. Being from the Shirak region further increases the preference for sons by roughly 12 percentage points. This provides further confirmation of the suggested mechanism. Since Gyumri was the most affected city by the earthquake and the city is located in the Shirak region, women from there are more sensitive to the reactivation of the memory of the devastating events of December 7, 1988. In contrast to the Shirak region, the results do not reveal any significant differences in the preferences of women from the Lori region.

Table 3.3: Results for Shirak and Lori Regions

	Ideal Ratio		
Treatment	3.073***	2.517***	1.733*
	(0.888)	(0.882)	(1.041)
Shirak	-2.450***	-2.218**	-3.015***
	(0.869)	(0.874)	(0.977)
Treatment x Shirak	11.84***	12.01***	13.18***
	(1.848)	(2.022)	(1.153)
Lori	0.711	0.534	0.0989
	(0.772)	(0.725)	(0.938)
Treatment x Lori	-0.575	-1.007	-1.614
	(1.014)	(0.980)	(1.439)
Constant	52.23***	52.43***	50.58***
	(1.679)	(1.753)	(2.364)
Controls	✓	✓	✓
Cluster FE	✓	✓	✓
Year FE		✓	✓
Observations	12200	12200	7800
Clusters	313	313	313

Note: This table examines the disparity in the preference for boys among 15-49-year-old women interviewed on or around December 7 (the day commemorating the victims of the 1988 Armenian earthquake) compared to those interviewed on all other days. Additionally, it contrasts women from the Shirak and Lori regions interviewed on December 7 with those from all other regions. *Treatment* variable takes value 1 if women were interviewed on December 6, 7, or 8. *Shirak* takes the value of 1 if a woman resides in the Shirak region, and *Lori* is an indicator for women residing in the Lori region. The first two columns include the full sample of women, while the last column restricts the sample to the last two rounds of DHS surveys (2010 and 2015-16). The vector of controls includes the age of the women, highest education level of women, husband's/partner's education level, husband's/partner's occupation group, an indicator of whether the respondent is currently working, number of sons who have died, number of daughters who have died, location of residence (urban/rural), frequency of watching television, and household's wealth index. Standard errors are clustered at the cluster level.

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

Next, I check how this effect differs for women with and without children. To do this, I estimate the baseline specification for two different groups: women with no children and women with at least one child. To have a sufficient number of observations, I drop the husband/partner related controls from the specification for women without children. The results of this analysis are presented in Table 3.4.

Table 3.4: Results for Women with and without Children

	Ideal Ratio			
Treatment	-3.542**	-1.902	2.912***	3.488***
	(1.484)	(1.841)	(0.811)	(0.856)
Total number of sons			4.320***	4.516***
			(0.250)	(0.302)
Total number of daughters			-3.309***	-3.456***
			(0.231)	(0.273)
Constant	49.35***	52.23***	50.26***	48.60***
	(2.830)	(3.468)	(1.669)	(2.368)
Controls	✓	✓	✓	✓
Cluster FE	✓	✓	✓	✓
Year FE	✓		✓	
Observations	6254	3995	12000	7778
Clusters	313	312	313	313

Note: This table decomposes the effect of being interviewed on or around December 7 on stated preference for sons for women with and without children. The first two columns include the sample of women without any children from all four rounds and only the 2010 round of the DHS interviews, respectively. The second two columns include women with at least one child from all four rounds and only the 2010 round of the DHS interviews, respectively. *Treatment* variable takes value 1 if women were interviewed on December 6, 7, or 8. The vector of controls includes the age of the women, highest education level of women, husband's/partner's education level, husband's/partner's occupation group, an indicator of whether the respondent is currently working, number of sons who have died, number of daughters who have died, location of residence (urban/rural), frequency of watching television, and household's wealth index. To have enough observations, the first two columns do not include husband/partner related controls. In all specifications, standard errors are clustered at the cluster level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Finally, I also attempt to understand whether the women who have lost any children react differently to the reactivation of memories about the earthquake. To do so. I construct and estimate the following specification:

$$Ideal\, ratio_{ict} = \alpha + \beta Treatment_{ict} + \delta_1 Treatment_{ict} \times Children\ died +$$

$$+\delta_2 Treatment_{ict} \times Lori + X_{itc}\gamma + \lambda_c + \eta_t + \epsilon_{ict}$$

where all the variables are the same as in the baseline specification, with the addition of *Children died*, which is an indicator taking the value of 1 if a woman has at least one son who died, at least one daughter who died, or at least one child who died. The results from the estimation of all three specifications are presented in Table 3.5. According to the findings, women who lost children of any gender do not have significantly different preferences if they were interviewed on or around December 7. The only marginal difference is that women who have lost at least one son in general have a stronger preference for boys.

Table 3.5: Results for Women Who Lost Children

	Ideal Ratio		
	Sons died	Daughters died	Children died
Treatment	3.018***	3.238***	3.147***
	(0.858)	(0.904)	(0.913)
Children died	4.052*	-1.258	1.630
	(2.307)	(3.077)	(1.883)
Treatment x Children died	1.713	-4.536	-1.352
	(4.087)	(3.786)	(3.139)
Total number of sons	3.985***	3.977***	3.982***
	(0.229)	(0.231)	(0.229)
Total number of daughters	-3.531***	-3.533***	-3.531***
	(0.210)	(0.211)	(0.210)
Constant	52.61***	52.59***	52.60***
	(1.802)	(1.805)	(1.804)
Controls	✓	✓	✓
Cluster FE	✓	✓	✓
Year FE	✓	✓	✓
Observations	12200	12200	12200
Clusters	313	313	313

Note: This table examines the disparity in the preference for boys among 15-49-year-old women interviewed on or around December 7 (the day commemorating the victims of the 1988 Armenian earthquake) compared to those interviewed on all other days. Additionally, it contrasts women who have ever lost children with women who have not. *Treatment* variable takes value 1 if women were interviewed on December 6, 7, or 8. *Childrendied* takes the value of 1 if a woman has at least one son who died, at least one daughter who died, or at least one child who died. The vector of controls includes the age of the women, highest education level of women, husband's/partner's education level, husband's/partner's occupation group, an indicator of whether the respondent is currently working, location of residence (urban/rural), frequency of watching television, and household's wealth index. Standard errors are clustered at the cluster level.

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

3.4.3 Placebo Test

The identification strategy in this study relies heavily on the exogeneity in the timing of the interviews. In section 4.1, I presented a balance table to ensure that the treatment and control groups are balanced in terms of observable characteristics. As a further check for the exogeneity in the dates of the interviews, I conduct a placebo test, in which I vary the treatment variable by changing the date to September 7, October 7, and November 7. January, February, and March 7 are not included in this test since there are very few observations on or around these days. January 7 is the second day of Christmas in Armenia and March 7 is just before the holiday of International Women's Day. The idea behind the test is that if there is something systematic about the seventh day of the month that makes women state that they want more boys, I will capture it by the estimates of placebo treatment variables. Otherwise, there is no reason why the stated preference for sons should be different on these dates.

The results of the test are presented in Table 3.6. In the first column, the treatment group includes women interviewed on or around September 7, in the second column it includes women interviewed on or around October 7, in the third column on or around November 7, and in the last column, the treatment group includes women interviewed on or around December 7. All specifications control for the age of the women, highest education level of women, husband's/partner's education level, husband's/partner's occupation group, an indicator of whether the respondent is currently working, number of sons who have died, number of daughters who have died, location of residence (urban/rural), region of residence, frequency of watching television, household's wealth index, and cluster fixed effects, with the standard errors clustered at the same level. The results confirm that there is nothing systematic happening on the seventh day of each month that affects women's stated preference for boys. In none of the specifications, except the last one with December 7, is the treatment variable statistically significant or large in magnitude. This further confirms the finding that the activated memory of the devastating event of December 7, 1988 affects women's preferences for boys, resulting in them stating a higher preference for sons on or around December 7 even more than 25 years after the earthquake.

Table 3.6: Results from Placebo Test

	Ideal Ratio			
	September 7	October 7	November 7	December 7
Treatment	-1.030	1.302	0.336	3.067***
	(1.096)	(1.053)	(0.866)	(0.855)
Total number of sons	3.981***	3.977***	3.982***	3.977***
	(0.231)	(0.231)	(0.231)	(0.231)
Total number of daughters	-3.524***	-3.524***	-3.523***	-3.533***
	(0.212)	(0.211)	(0.212)	(0.211)
Constant	52.74***	52.68***	52.70***	52.60***
	(1.802)	(1.801)	(1.802)	(1.804)
Controls	✓	✓	✓	✓
Cluster FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Observations	12200	12200	12200	12200
Clusters	313	313	313	313

Note: This table compares the difference in the preference for boys among 15-49-year-old women interviewed on or around September 7, October 7, November 7, and December 7 and women interviewed on all other days, using data from four rounds of DHS surveys. *Treatment* variable takes value 1 if women were interviewed on September 6, 7, or 8 in the first column, on October 6, 7, or 8 in the second column, on November 6, 7, or 8 in the third column, and on December 6, 7, or 8 in the last column. The vector of controls in all specifications includes the age of the women, highest education level of women, husband's/partner's education level, husband's/partner's occupation group, an indicator of whether the respondent is currently working, number of sons who have died, number of daughters who have died, location of residence (urban/rural), region of residence, frequency of watching television, and household's wealth index. Standard errors are clustered at the cluster level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

3.5 Conclusion

Despite advancements in women's rights, skewed sex ratios at birth persist in many developing countries, reflecting a pronounced preference for sons, a concept underscored by Amartya Sen's "missing" women paradigm.

Among countries exhibiting a strong son preference and imbalanced male-to-female birth ratios, Armenia emerges as a salient example. Since gaining independence in 1991, Armenia has witnessed an unusually high rate of male births per 100 female births, surpassing many post-Soviet counterparts.

In an attempt to delve into the roots of Armenia's high rate of sex ratio at birth and robust son preference, this study explores a novel mechanism, suggesting that natural disasters, such as earthquakes, can exert long-lasting impacts on women's child gender preferences. By examining data from four rounds of Demographic and Health Surveys in Armenia and exploiting the plausible exogeneity of interview timing, this research reveals a significant impact of the reactivated memory of the 1988 Armenian Earthquake on women's stated preferences for male children. Specifically, women interviewed on or around December 7 – the day marking the earthquake victims' commemoration – express a three percentage point higher preference for sons. This heightened preference is attributed to the earthquake's commemoration serving as a striking reminder of personal and physical loss, along with the looming possibility of recurrence. Further analysis indicates that women from the most affected region, Shirak, exhibit an even stronger preference for boys. Notably, these effects are predominantly observed among women who are already mothers. I check the exogeneity in the timing of the interviews through a balance table on observable characteristics and a placebo test, in which I vary the treatment to different months to rule out that there is anything systematic occuring on the seventh day of every month.

The main finding of the paper highlights an important insight: Given that the activated memory of the disaster that struck Armenia appears to have an effect on the preference for boys even after more than 25 years, the potential effect of the earthquake in the short and medium run could have been much stronger and crucial in setting the son preference and therefore the sex ratio at birth in Armenia.

3.A Appendix: Figures and Tables

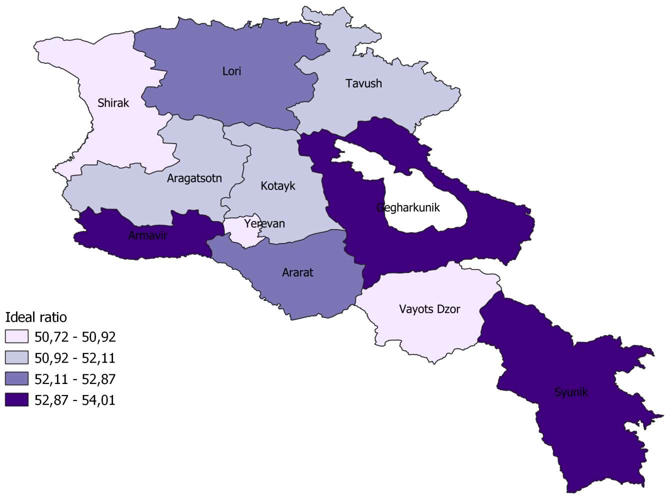


Figure 3.A1: Ideal Ratio by Regions of Armenia
Note: The map illustrates the average ideal ratio by the second administrative division levels of Armenia. Darker color indicates a higher ideal ratio for males, which is calculated by dividing the ideal number of boys multiplied by 100 on the ideal number of total children

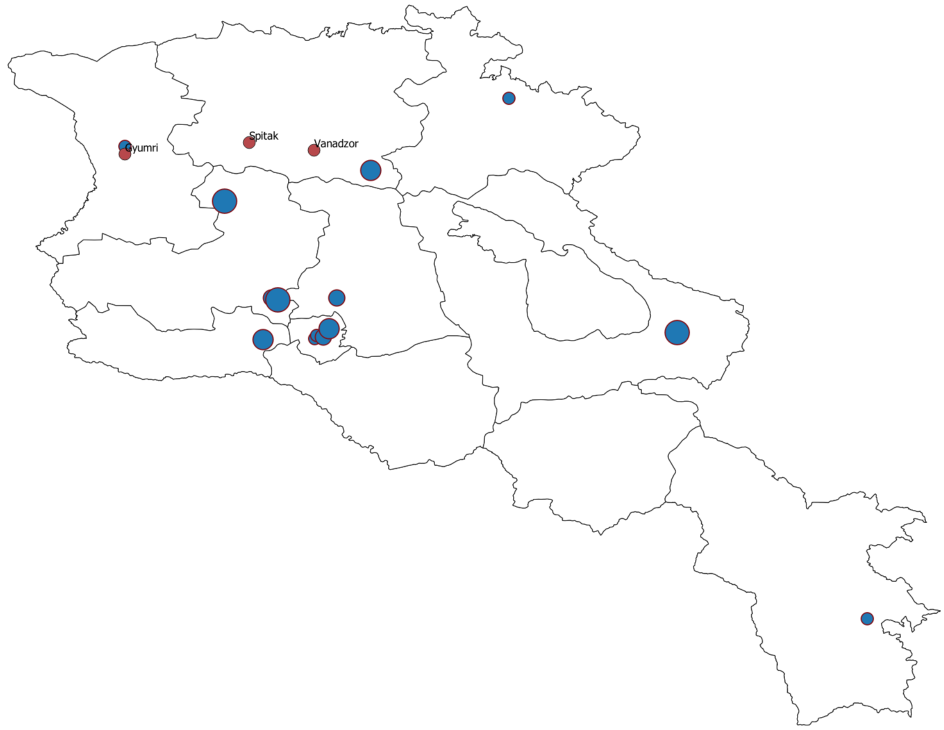


Figure 3.A2: Location of DHS Clusters
This map shows the location of DHS clusters of households interviewed on December 7. Larger blue circles illustrate larger numbers of interviews conducted.

Table 3.A1: Average Ideal Ratio by Age and Education Group

	highest educational level				
age in 5-year groups	no education	basic	secondary	higher	Total
15-19 (15%)	50.0	51.4	51.7	51.1	51.5
20-24 (16%)	55.6	51.1	52.5	51.2	51.9
25-29 (14%)	50.0	55.0	51.9	52.3	52.2
30-34 (13%)	50.0	52.4	52.1	51.8	52.0
35-39 (12%)	50.0	54.0	51.9	51.8	51.9
40-44 (14%)	58.3	53.9	52.6	50.8	52.1
45-49 (13%)	50.0	52.0	52.3	52.3	52.3
Total (100%)	53.7	52.5	52.1	51.6	52.0

Table 3.A2: Timing of the DHS Rounds

DHS survey rounds	Duration
2000	02 October - 03 December
2005	03 September - 29 November
2010	04 October - 26 December
2015-2016	07 December - 31 March

Table 3.A3: Summary Statistics of Main Variables

	mean	sd	min	max	count
Ideal ratio	51.98	16.50	0.00	100.00	23414
Treatment	0.01	0.10	0.00	1.00	25034
2010	0.04	0.20	0.00	1.00	5922
2015-16	0.01	0.08	0.00	1.00	6116
Total # of sons	0.77	0.85	0.00	6.00	25034
Total # of daughters	0.71	0.89	0.00	10.00	25034
Highest educational level	4.15	0.75	0.00	5.00	25034
No education	0.08%	NA	NA	NA	21
Incomplete primary	0.23%	NA	NA	NA	57
Complete primary	0.05%	NA	NA	NA	12
Incomplete secondary	19.33%	NA	NA	NA	4838
Complete secondary	44.60%	NA	NA	NA	11164
Higher	35.72 %	NA	NA	NA	8942
Husband/partner's education level	2.26	0.54	0.00	3.00	17248
No education	0.17%	NA	NA	NA	30
Primary	4.41%	NA	NA	NA	761
Secondary	64.56 %	NA	NA	NA	11136
Secondary special	30.85%	NA	NA	NA	5321
Respondent currently working	0.31	0.46	0.00	1.00	25022
Wealth index combined	2.97	1.35	1.00	5.00	18604
Poorest	17.94%	NA	NA	NA	3338
Poorer	21.88%	NA	NA	NA	4071
Middle	22.03%	NA	NA	NA	4098
Richer	21.44%	NA	NA	NA	3988
Richest	16.71%	NA	NA	NA	3109
# of sons who have died	0.04	0.22	0.00	4.00	25034
# of daughters who have died	0.03	0.19	0.00	6.00	25034
Location of residence	1.37	0.48	1.00	2.00	25034
Urban	62.51%	NA	NA	NA	15648
Rural	37.49%	NA	NA	NA	9386
Age	31.38	10.20	15.00	49.00	25034
Frequency of watching television	2.38	0.67	0.00	3.00	25019
Not at all	2.10%	NA	NA	NA	525
Less than once a week	4.70%	NA	NA	NA	1176
At least once a week	46.28 %	NA	NA	NA	11580
Almost every day	46.92 %	NA	NA	NA	11738
Observations	25034				

Table 3.A4: Results for Women Interviewed on December 7

	Ideal ratio		
Treatment	3.324*	3.217*	1.558
	(1.794)	(1.777)	(1.910)
Total number of sons	3.985***	4.005***	4.186***
	(0.231)	(0.236)	(0.289)
Total number of daughters	-3.526***	-3.527***	-3.732***
	(0.212)	(0.213)	(0.253)
Constant	52.32***	57.58***	7.594
	(1.724)	(2.814)	(21.82)
Controls	✓	✓	✓
Cluster FE	✓	✓	✓
Year FE		✓	✓
Interviewer FE			✓
Observations	12200	12200	7791
Clusters	313	313	313

Note: This table compares the difference in the preference for boys among 15-49-year-old women interviewed on December 7 (the day commemorating the victims of the 1988 Armenian Earthquake) and women interviewed on all other days, using data from four rounds of DHS surveys. *Treatment* variable takes the value 1 if women were interviewed on December 7. The vector of controls includes the age of the women, highest education level of women, husband's/partner's education level, husband's/partner's occupation group, an indicator of whether the respondent is currently working, number of sons who have died, number of daughters who have died, location of residence (urban/rural), region of residence, frequency of watching television, and household's wealth index Standard errors are clustered at the cluster level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

3.B Appendix: Pictures

Figure 3.B1: Note: This picture illustrates episodes from the 1988 Armenian Earthquake.
Source: https://news.am/arm/news/796536.html

Figure 3.B2: Note: This picture illustrates episodes from the 1988 Armenian Earthquake.
Source: https://www.rferl.org/a/armenias-catastrophic-earthquake-of-1988/29634413.html

Figure 3.B3: Note: This picture illustrates episodes from the 1988 Armenian Earthquake.
Source: `https://www.bbc.com/news/in-pictures-25262363`

Figure 3.B4: Note: This picture is taken on December 7, 2023 in Gyumri and depicts how officials and civilians lay flowers to commemorate the 1988 Armenian Earthquake victims.
Source: `https://news.am/arm/news/796536.html`

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