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Sex Ratio and the Intergenerational Impact of Conflict on Human Development: Evidence from Cambodia's Genocide

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Abstract:
We use geographical variation in the intensity of the genocide, which disproportionately killed prime-age males during the Khmer Rouge (KR) regime in Cambodia, to study the effect of violent conflict on the educational and health outcomes of children born years after the conflict ended. We show that the adverse effects of violent conflict are transmitted from one generation to the next through its effect on the sex ratio and marriage outcomes of those who survived the conflict. We find that mortality rates under the KR predict a lower likelihood of normal grade progression and lower height-for-age Z-scores for children born to parents who were of prime marriage age (14–29) during the time that the KR was in power. Using mortality rates during the KR regime as an instrumental variable for the sex ratio, we find that for every one standard deviation decrease in the sex ratio for the parents' generation, the likelihood of children exhibiting normal grade progression reduces by 6.8–7.4 percentage points and the height-for-age Z-score decreases by 1.5 standard deviations

Keywords: Civil conflict, sex ratio, marriage, education, health, intergenerational effects.
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1. Introduction

Armed conflicts tend to result in the deaths of large numbers of young males and reduce the sex ratio, the number of men for each woman, which, in turn, affects the marriage outcomes of survivors in post-conflict societies. The effects of an imbalanced sex ratio on marital outcomes have been documented in France after World War I (Abramitzky et al., 2011), in Bavaria after World War II (Bethmann & Kvasnicka, 2013, 2014), and in Tajikistan after the Tajik civil war (Shemyakina, 2013). Given the effects of armed conflicts on the sex ratio and marriage outcomes, they might also have negative intergenerational impacts as outcomes of parents and children are closely linked.

This paper examines the role of the sex ratio in perpetuating the negative impact of civil conflict on human development through intergenerational transmission. To do so, we exploit arguably exogenous geographical variation in the intensity of the Cambodian genocide, which disproportionately killed prime-age males under the Khmer Rouge (KR) regime (1975-1979), as a natural experiment. We show that in districts with high mortality rates during the KR regime, children born to parents who were of prime age for marriage (14–29) during the 1970s and 1980s have lower educational and health outcomes. Our results indicate that adverse educational and health outcomes of these children channel through the imbalanced sex ratio of their parents' generation.

We are the first to provide evidence on the intergenerational impact of civil conflict. Previous studies typically have examined the effects of exposure to civil conflict in early life, either *in utero* or infancy, and adolescence on health status (e.g., Bundervoet et al., 2009; Akresh et al., 2012, 2012a; Minoiu & Shemyakina, 2014, 2012; Grimard & Laszlo, 2014) and educational attainment (e.g., Akresh & de Walque, 2008; Chamarbagwala & Morán, 2011; Islam et al., 2015; Leon, 2012; Shemyakina, 2011). We provide evidence that the Cambodian genocide had negative impacts on the health and educational outcomes of children born years after it ended, and the impacts channel through the imbalanced sex ratio that existed in the parents' generation. Thus, we bridge the literature on the adverse impacts of armed conflicts and the literature on the direct consequences of gender imbalance on marriage and labor market outcomes (Abramitzky et al., 2011; Angrist, 2002; Brainerd, 2008; Shemyakina, 2013; Bethmann & Kvasnicka, 2013, 2014).

We find that mortality rates under the KR predict the likelihood of lower normal grade progression rates and height-for-age Z-scores among children born to parents who were marrying age in the 1970s and 1980s. Each additional percentage point increase in KR mortality rates reduces the probability of children displaying normal grade progression by 7.5 percentage points and decreases children's height-for-age Z-scores by 1.4–1.5 standard deviations. We also find that in districts with high mortality during the KR regime, the sex ratio is lower in the parents' generation. Using KR mortality as an instrumental variable (IV) for the sex ratio, the likelihood of children exhibiting normal grade progression decreases by 6.8–7.4 percentage points and height-for-age Z-scores fall by 1.5 standard deviations for every 1 standard deviation decrease in the sex ratio in the parents' generation. Our findings are robust to alternative measures of mortality rates, alternative cohort ranges that define the sex ratio of the parents' generation, and the possibility of sibling effects.

We examine other channels that could potentially bias the effects of the sex ratio on children's educational and health outcomes. Specifically, we focus on three major channels closely linked to children's education and health outcomes: parental educational attainment, income and health status. First, we find that geographical variations in mortality rates during the KR regime do not influence parents' educational attainment. Second, we find that parents' monthly earnings and household earnings are not associated with mortality rates during the KR regime. Third, we find that a wide range of parents' health measures are not correlated with mortality rates during the KR regime. While it is difficult to conclusively rule out all possible channels, the evidence is suggestive that the intergenerational impact of conflict is most likely mediated by changes in the sex ratio.

We also seek to understand whether changes in the sex ratio of the parents' generation capture the impact of genocide on their marital outcomes. We find that a low sex ratio leads to a higher likelihood of women marrying younger husbands and narrower spousal age and education gaps. Additionally, the lower sex ratio has no effect on children ever born, but does lead to higher mother's age at childbirth and at first marriage.

Finally, we supplement our main results for children's outcomes, by adding parents' age and education, as well as mother's age at marriage and first birth, as additional controls to allow for the direct effects of these variables. The intergenerational effect of the genocide on children's education decreases moderately when including both parents' educational attainment. We show that age of the mother at childbirth is unlikely to explain why height-for-age is lower in districts which had higher mortality rates under the KR. Therefore, we conclude that, although one cannot completely rule out alternative channels through which civil conflict could have adverse intergenerational outcomes, the effect of the genocide on the sex ratio, and the ensuing disruption to the marriage market in the parents' generation, most likely play crucial roles in perpetuating the intergenerational effects of the conflict.

2. Background of the Cambodian Genocide

The KR regime held power in Cambodia between April 1975 and January 1979 and this period coincided with one of the worst genocides in world history. The KR sought to transform Cambodia into a new society. The urban population was evacuated from cities throughout the country and forced to engage in agricultural labor in the countryside. The KR killed suspected political opponents, educated individuals, those enrolled in school and those who did not share their vision for a new Cambodia. Indentured labor, food shortages and the absence of modern medicine were responsible for large numbers of deaths.

According to estimates by the Cambodian Genocide Program at Yale University, approximately 1.7 million people, making up 21% of the total population, lost their lives during the KR regime. Adult males were the demographic group most likely to die under the KR regime (de Walque, 2006). A simulation study by Neupert and Prum (2005) found that mortality rates during the KR regime exhibited a high gender imbalance, with males accounting for approximately two-thirds of all deaths.

Marriage rates were very low under the regime, but rebounded immediately after its collapse (de Walque, 2006; Heuveline & Poch, 2007). The marriage boom after the KR was likely due to the delay in marriage by women who, based on their age, would otherwise have married for the first time during the KR regime (de Walque, 2006).

3. Data

The data for the main results in this study are drawn from four sources: the 10% micro sample of the 1998 General Population Census of Cambodia (Census 1998), the 2004 Cambodia Socio-Economic Survey (CSES), the Cambodian Genocide Database (CGD), and the 1962 Cambodian Population Census (Census 1962). In robustness checks we also draw on the Demography and Health Survey (DHS) 2000.

The 10% micro sample of Census 1998 provides the earliest post-KR nation-wide information related to marital status, educational attainment and other socio-demographic characteristics of individuals and households. We use this data to construct the sex ratio for our selected cohorts who were exposed to the KR regime during prime age for marriage. The large sample size allows more precise estimation of the effects of mortality under the KR regime and the imbalanced sex ratio. We limit the Census 1998 sample to individuals born in Cambodia, who make up 99.4% of the total sample, in order to exclude individuals who were not in Cambodia while the KR was in power. The main limitations of Census 1998 include the absence of information on educational expenditure, children's height and weight, health status and earnings profile. Thus, we use CSES 2004 to examine the effects of mortality during the KR regime and the resulting imbalanced sex ratio on children's educational and health outcomes, as well as the influence of parental health and income.

3.1. Child Sample and Measures of Children's Educational and Health Outcomes

We study children who were born after 1980 and whose parents were of prime age for marriage during the 1970s and 1980s. We use both Census 1998 and CSES 2004 to examine children's educational outcomes and CSES 2004 to examine children's health outcomes.

We use two indicators to evaluate educational outcomes of children aged 6 to 17: 1) whether children exhibit a normal grade progression; and 2) total spending on children's education. We use Census 1998 to code whether a child exhibits normal progression in school. This binary variable equals 1 if a child attends a grade level equal to, or higher than, the standard grade level for the child's age. We use CSES to construct total spending on children's education by summing school tuition fees, textbook and school supply costs, transportation and pocket money, as well as other school related expenses.

For children's health outcomes, we use a sample of children aged 0 to 5 years old in CSES 2004 because it contains information on height and weight only for children younger than 5 years old, while Census 1998 does not contain any of this information. We use height-for-age and weight-for-age Z-scores as measures of children's health outcomes. Height for age is a useful indicator of parents' investment in their children as it depends on accumulated investment in nutrition and healthcare throughout childhood, whereas weight for age provides information on children's current malnutrition and health status (Duflo, 2000). We code children as stunted if their height-for-age Z-scores are lower than −2 (below minus 2 standard deviations from the average of the reference population), and underweight if their weight-for-age Z-scores are below the same threshold.

3.2. Sex Ratios of the Parents' Generation

We use data from Census 1998 to construct the district-level sex ratios of individuals who were in the prime age for marriage in the 1970s and 1980s. These women and men were born between 1950 and 1965. The sex ratio for each district is defined as the ratio of men to women born between 1950 and 1965 who lived in that district in 1998.

There are two reasons for restricting our analysis to individuals born between 1950 and 1965. First, the lives of these individuals were the most affected by the KR regime. We use Census 1998 to plot the sex ratio of individuals by birth year (1940–2000 birth cohorts) at the national level. As shown in Figure 1, the sex ratio starts to abruptly drop for cohorts born in 1950 onwards and reaches a low point with the 1954–1956 birth cohorts. Although the sex ratio increases slightly for younger cohorts, it remains considerably less than 1. Only for cohorts born after the KR regime ended does the sex ratio come close to the normal level (approximately 1.06). Overall, sex ratios are fairly low for cohorts born between 1950 and 1965. The low sex ratios imply a shortage of men relative to women in local marriage markets. Second, these birth cohorts were of prime marriage age during and after the KR regime. Approximately 98% of all women in CSES 2004 and 97% of women born between 1950 and 1965 were married for the first time between the ages of 15 and 30.

[Figure 1]

3.3 Khmer Rouge Mortality Rates

We use geographic variation in KR mortality rates across districts to examine the impact of the genocide on children's outcomes and the mediating role played by the conflict-driven gender imbalance. We construct KR mortality rates using information sourced from the CGD and Census 1998. The CGD includes a district identifier of each KR mass gravesite and the estimated number of bodies at each mass grave.[1] Some graves have minimum and maximum estimates of bodies and, in such situations, we use the average of the two estimates to construct district-level KR mortality rates. Specifically, we divide the estimated deaths under the KR in a district (based on information in the CGD) by the sum of the estimated deaths under the KR and the number of individuals born in each district before 1980 who were still living in 1998 (based on Census 1998 data). As we do not have information on the number of individuals who survived the KR regime, but died between 1980 and 1998 at the district level, the estimated KR mortality rates are noisy. Districts in five provinces (Kaoh Kong, Preah Vihear, Otdar Mean Chey, Krong Kaeb, and Krong Pailin) are excluded from the analysis because no information on the estimated deaths under the KR regime is available in the CGD. In a robustness section, we find that the main results are robust to alternative ways of constructing mortality rates.

Figure 2 plots changes in the sex ratios of the 1950–1965 birth cohorts against KR mortality rates. There is a strong negative relationship between the sex ratio and the KR mortality rate at the district level. The association is statistically different from zero at the 1% level. When the KR mortality rate increases by 1 percentage point, the sex ratio decreases by 0.013–0.018 standard deviations.

[1] The CGD was initially developed by Yale University and has been updated by the Documentation Center of Cambodia (DC-Cam). We use data from both sources.
See http://www.yale.edu/cgp/ and http://www.d.dccam.org/Database/Index1.htm for details on the Cambodian Genocide Program and DC-Cam database.

[Figure 2]

We argue that the geographical variation in KR mortality rates at the district level provides exogenous variation in the sex ratio of individuals born from 1950 to 1965. Table 1 shows no statistically significant association between KR mortality rates and various measures that are potential correlates of outcomes or economic activities: the 1) pre-KR sex ratio; 2) pre-KR population density; 3) geographical distance of a district to an urban center; and 4) geographical distance of a district to a neighboring country. Census 1962 allows us to test whether the variation in KR mortality rates is orthogonal to the pre-KR sex ratio and population density.[2] The sex ratios in 1962 are unrelated to the KR mortality rates at the district level (column 1). The KR mortality rates are also not correlated with various measures of population density in 1962 (columns 2–4). Similarly, district mortality rates under the KR are not correlated with distance to the provincial capital, the nearest Thai border district or the nearest Vietnamese border district. Thus, geographical variation in KR mortality is likely exogenous.

[Table 1]

3.4 Summary statistics

Summary statistics for the samples are presented in Table A1 in the appendix. The upper panel (A) shows statistics for observations from Census 1998, and the lower panel (B) observations from CSES 2004.

In Panel A of Table A1, only 11.3% of children aged 6–17 in the mother sample exhibit normal grade progression, while about 12% in the father sample do. For both mother

[2] The General Population Census 1962 provides data on commune-level population by gender. First, we match the commune codes in Census 1962 with the district codes in Census 1998. Next, we match the commune-level population with the district-level population based on the district codes in Census 1998. To merge Census 1962 with the CGD, we replaced the sex ratio and population density with the neighboring district's sex ratio and population density for district codes that were not available in Census 1962.

and father samples, about 51% of the children aged 6–17 are boys. The average mother's age at childbirth is about 28 and ranges from 16 to 42 years old. The average mother's age at first marriage is about 23.

Approximately 79% of women born between 1950 and 1965 are married in 1998, while 96% of men born during the same period are married. The mean years of schooling are only about 2.6 years for women and 4.5 years for men. The mean sex ratios for both the male and female samples are lower than 1, meaning that more women than men are in the 1950–1965 birth cohorts. The standard deviation of the female sex ratio is 0.107, while that of the male sex ratio is 0.122. In the female sample, approximately 23% of women have younger husbands and 18% of men are younger than their wives in the male sample. The mean age gap of spouses is approximately 2.7 years in both the male and female samples. The average spousal education gap in the female sample is about 1.7 years of schooling, compared to 1.5 years in the male sample. On average, about 15% of women in the female sample have less-educated husbands and about 16% of the men in the male sample have less education than their wives. The average number of children ever born and the average number of children surviving in the female sample are 5.4 and 4.7, respectively.

In Panel B of Table A1, average expenditure on children's education is slightly higher in the female sample than the male sample. Nearly 46% of children younger than 5 in the mother sample and 43% of children younger than 5 in the father sample are stunted. Approximately 30% of children younger than 5 in the mother sample and 28% of children younger than 5 in the father sample are underweight. The mean height-for-age and weight-for-age Z-scores are -1.05 and -0.80, respectively, in the mother sample. In the father sample, they are -0.85 and -0.53, respectively. The mean mother's age at childbirth and mother's age at first marriage in CSES 2004 is approximately 39 and 21, respectively.

The demographic characteristics of the parents' generation in the CSES 2004 sample are similar to those in the Census 1998 sample, except that all women and men born between 1950 and 1965 were married in the CSES 2004 sample.

4. Effects of KR Mortality on Children's Education and Health

We employ the following reduced-form specification to estimate the effects of KR mortality rates on educational and health outcomes of children born after the genocide ended:

$$Chltoutcome_{ij} = \gamma_0 + \gamma_1 DR_j + \gamma_2 \mathbf{C}_{ij} + \varepsilon_{ij} \qquad (1)$$

where $Chltoutcome_{ij}$ represents the educational or health outcome of child i in district j. Children's education variables are the likelihood of the children exhibiting normal grade progression and expenditure on children's education. Children's health outcomes are the height-for-age and weight-for-age Z-scores. DR_j denotes the mortality rate during the KR regime in district j. We expect $\gamma_1 < 0$, implying that KR mortality rates negatively affect children's outcomes. $\mathbf{C}_{ij}$ is a vector of the characteristics of the child i (age and gender) living in district j, and ε_{ij} is the error term. We cluster standard errors at the district level and include sampling weights.

We report the reduced-form estimates of the effects of civil conflict on children's educational and health outcomes in Table 2. Panel A reports the results for the sample of children whose mothers belong to the 1950–1965 cohorts and Panel B presents the results for the sample of children whose fathers belong to the 1950–1965 cohorts.

The results in columns 1 and 2 of Table 2 indicate that the likelihood of children experiencing normal grade progression is lower in high mortality districts for both the mother and father samples. The effects in the mother sample are statistically significant at the

10% level. In the mother sample, each additional percentage point in KR mortality rate reduces the likelihood of children experiencing normal grade progression by 7.5 percentage points. However, the results for the father sample are statistically insignificant.

Columns 3 and 4 of Table 2 show that expenditure on children's education are negatively associated with variation in KR mortality rates in both the mother and father samples, but the relationship is not statistically significant in either sample. Regarding children's health outcomes, the reduced-form results shown in columns 5 and 6 of Table 2 suggest that, in districts with high KR mortality rates, children's height-for-age and weight-for-age Z-scores are smaller in both the mother and father samples. However, the effects are statistically significant only for the height-for-age Z-scores. A 1 percentage point increase in KR mortality rates reduces a child's height-for-age Z-score by 1.5 standard deviations in the mother sample and 1.4 standard deviations in the father sample.

Overall, the genocide in Cambodia under the KR regime negatively affected the likelihood of normal grade progression and height of children born after 1980.

[Table 2]

5. Effects of KR Mortality on the Education, Income and Health of the Parents' Generation

We show in section 3.3 that the district-level mortality rates under the KR regime negatively affect the district-level sex ratios of individuals born between 1950 and 1965, whose children are the subjects of the empirical analysis in section 4. Therefore, the sex ratio of the parents' generation is likely to be one of the channels through which the genocide has intergenerational impacts on children's outcomes. However, the intergenerational impact of the genocide on children might also channel through its impact on parental education, earnings, and health, as earlier studies have shown that parents' education, earnings, and health affect their ability to invest in children's education and health (e.g., see Black et al., 2005; Oreopoulos et al., 2006; Case et al., 2002; Thomas, 1994).

Using equation (1), we investigate whether geographical variation in KR mortality rates influences geographical variation in parental education, income, and health status. We use four sets of observations for our analysis: 1) mothers born between 1950 and 1965 who have children aged 0-17; 2) the husbands of these mothers; 3) fathers born between 1950 and 1965 who have children aged 0-17; and 4) the wives of these fathers.

[Table 3]

Panel A in Table 3 shows no evidence that geographical variation in KR mortality rates influence parents' completed years of schooling. Therefore, parental education is unlikely to be the channel through which the genocide influences children's educational and health outcomes. Similarly, panel B in Table 3 shows no evidence that mortality under the KR directly affects parents' monthly earnings or household income.

Panel C in Table 3 presents the effects of KR mortality on parental health measures, including if the individual had experienced injury or illness during the past 30 days, was disabled, had experienced difficulties with physical movement or had experienced psychological difficulties. In the sample of mothers born between 1950 and 1965 and the sample of fathers married to mothers born between 1950 and 1965, there is no statistically significant relationship between KR mortality rates and any of the health measures examined (columns 1 and 2). In the father sample, the KR mortality rate does not have a statistically significant correlation with the majority of health indicators. The exceptions are difficulty moving (column 3), which is statistically positive at the 10% level, and difficulty speaking (columns 2 and 3), which is statistically negative at the 5% level.[3] The majority of health indicators are not correlated with KR mortality rates, and those coefficients that are significant are small or have the wrong sign; therefore, the evidence that genocide affects children's outcomes through its influence on parental health is weak at best.

These findings imply that the estimated effects of the genocide on children's outcomes are unlikely to have come through its effects on parental education, income and health. The lack of effects of KR mortality on parental education, income, and health and the strong effect of KR mortality on the sex ratio of the parents' generation suggest that the intergenerational impacts of violent conflicts are mediated primarily through the sex ratio.

6. Effects of the Sex Ratio on Children's Education and Health

We provide evidence that the geographical variation in KR mortality rates is exogenous to the historical sex ratio, historical population density, distance to various centers of economic activities, completed years of schooling and later-life income and health measures of individuals born between 1950 and 1965. We also show that mortality under the KR regime is a major source of variation in gender imbalances across districts among individuals who were of prime age for marriage in the 1970s and 1980s. Most importantly, KR mortality rates affect the educational and health outcomes of children born years after the KR regime ended. These results imply that mortality under the KR regime during the 1970s influences the outcomes of children in the late 1990s and early 2000s through its impact on gender imbalance in the parents' generation.

[3] The estimated effect of the sex ratio on children's health is not sensitive to adding difficulty moving as a control variable.

We use variation in KR mortality rates as an IV for the sex ratio of the parents' generation to further examine the effects of the parental sex ratio on children's educational and health outcomes. Our second-stage (IV) specification is as follows:

$$Chltoutcome_{ij} = \delta_0 + \delta_1 \widetilde{Sexratio}_j + \delta_2 \mathbf{C}_{ij} + \upsilon_{ij} \qquad (2)$$

where $Sexratio_j$ is the sex ratio in district j. $\mathbf{C}_{ij}$ is a vector of the child's characteristics i (age and gender) living in district j, and υ_{ij} is the error term. We expect $\delta_1 > 0$. When δ_1 is positive, it implies that the higher the sex ratio (more men), the better the outcomes for children. That is, the more imbalanced the sex ratio is, the worse the outcomes for children.

Panel A in Table 4 presents the effects in the mother sample and Panel B displays the effects in the father sample. We also report the first-stage F-statistics. Columns 1 and 2 of Table 4 present the IV results for the effects of the sex ratio on the likelihood of normal grade progression for children aged 6–17 years old. The sex ratio of the parents' generation has a positive effect on the children's educational outcomes. A 1 standard deviation decrease in the sex ratio, which is roughly 0.11 in the mother sample, lowers the likelihood of normal grade progression by 6.8 percentage points (columns 1 and 2, Panel A). This finding amounts to a 60.4% decrease in the likelihood of normal grade progression from the mean of 11.3%. For the father sample, a 1 standard deviation decline in the sex ratio, which is approximately 0.12, reduces the likelihood of children's normal grade progression by 7.4 percentage points (columns 1 and 2, Panel B), which represents a 62.3% decrease from the mean of 11.9%.

Parents might favor sons over daughters or vice versa (e.g., Dahl & Moretti, 2008), and if so, it is possible that parents would engage in gender-biased investment in children's health or education. When we control for children's gender (column 2), the estimated effects remain unchanged, indicating that gender-biased investment in children's health or education is unlikely to play any role in this setting. Columns 3 and 4 of Table 4 show that the sex ratio of the parents' generation has a positive association with educational expenditure on children in both the mother and father samples, but the association is statistically insignificant. Children's gender also has no effect on parents' spending on children's education.

Columns 5 and 6 of Table 4 present the results for the effects of the sex ratio on children's health based on observations in the mother and father samples. The sex ratio is positively associated with height-for-age and weight-for-age Z-scores in both samples, but only the effects on height-for-age Z-scores are statistically significant (column 5). A 1 standard deviation decrease in the sex ratio decreases children's height-for-age Z-scores by approximately 1.5 standard deviations in both the mother and father samples.

[Table 4]

We also test whether the estimated effects of the gender imbalance in the parents' generation on children's outcomes in the father sample are sensitive to controlling for difficulty moving, as this health measure is correlated with KR mortality (Table A2, appendix). As it is available only in CSES 2004, we could not include it as a control variable in the estimation of the effects of the sex ratio on the likelihood of children's normal grade progression, which is a variable in Census 1998. The estimated effects of the sex ratio on children's educational expenditure (column 1 of Table A2), height-for-age Z-scores (column 2) and weight-for-age Z-scores (column 3) are all close to the main results.

7. Effects of the Sex Ratio on Marriage and Fertility Outcomes

We establish that the effects of KR mortality on the outcomes of children born years after the genocide are most likely mediated through the genocide's impact on the gender imbalance in the parents' generation. In this section, we examine whether the genocide-driven gender imbalance affects measures of marriage outcomes of individuals born between 1950 and 1965, given that previous studies (e.g., Abramitzky et al., 2011; Angrist, 2002) have found that gender imbalances worsen marriage outcomes for the gender that has a surplus.

Due to the limited information in the available datasets, we focus on measures of marital outcomes that can be constructed based on basic demographic and education characteristics and information about the interrelationships of household members in the datasets. We estimate the effects of the imbalanced sex ratio on marriage outcomes using IV regression. The second-stage IV regression is as follows:

$$Y_{ij} = \beta_0 + \beta_1 \widetilde{Sexratio}_j + \beta_2 \mathbf{Z}_{ij} + \omega_{ij} \qquad (3)$$

The outcome variable, Y_{ij}, of individual i in district j includes the likelihood of being married at the time of the survey, the likelihood that a woman marries a younger man (or that a man is a younger husband), the spousal age gap, the likelihood that a woman marries a less-educated man (or that a man is a less-educated husband), the spousal education gap, the number of children ever born, the number of children surviving and the mother's age at childbirth and at first marriage. $\mathbf{Z}_{ij}$ is a vector of the individual's characteristics i (age and education) living in district j, and ω_{ij} is the error term.

Table 5 reports the IV estimates for the effects of the sex ratio on the likelihood of getting married and spousal differences in the female sample (Panel A) and the male sample (Panel B). In the female sample, a higher sex ratio increases the likelihood of being married, but the effect is not statistically significant (column 1). Therefore, despite the shortage of men of similar ages, the probability of women being married remains largely unchanged, consistent with the findings of de Walque (2006) and Heuveline and Poch (2007). Our results imply that many of the affected women ended up marrying men outside their age range, perhaps reflecting that their eagerness to get married after the KR regime fell. Indeed, our estimates in Panel A confirm that women are more likely to marry a younger spouse, and the spousal age and education gaps are reduced, when there is a decrease in the sex ratio (more women than men). The estimates are mostly statistically significant at the conventional levels, except for the likelihood of marrying a less-educated husband.

A 1 standard deviation decrease in the sex ratio increases the probability of a woman marrying a younger man by 4.4 percentage points (column 2), which represents a 19.3% increase from the mean of 23%. A 1 standard deviation decrease in the sex ratio reduces the spousal age difference by 0.6 years, a 23.3% decrease from the mean (column 3). The median spousal age difference is approximately 4 years for individuals born before 1940, who most likely married before the KR regime, but falls to 2 years for the 1950–1965 birth cohorts (Figure 3). This result is consistent with the findings of Abramitzky et al. (2011) from post-World War I France. The lower sex ratio also reduces the spousal education gap (column 5). For every 1 standard deviation decrease in the sex ratio, the spousal education gap falls by 0.3 years, or a 18.4% decrease from the mean. In a traditional society like Cambodia, there is a strong stigma against women who never get married, so parents with unmarried daughters are less demanding of potential sons-in-law (Heuveline & Poch, 2006). The smaller spousal age and educational gaps might indicate poorer marital match quality.

[Figure 3 & Tables 5 & 6]

Similar effects from the sex ratio on marriage outcomes also appear in the male sample. There is a strong negative and statistically significant relationship between the sex ratio and the likelihood of a man being younger than his wife in the male sample (column 2, Panel B). Similarly, spousal age and education gaps also decrease as the sex ratio falls (columns 3 and 5, Panel B). In particular, the effect of the sex ratio on the spousal age gap is much larger in the male sample than in the female sample.

Columns 6–9 of Table 5 show that the sex ratio does not affect the fertility of the 1950–1965 birth cohorts. There is no statistically significant relationship between the sex ratio and the number of children ever born or the number of surviving children across different specifications. However, the results in columns 1–3 of Table 6 show that there is a significant negative relationship between the sex ratio and the mother's age at the birth of the children whose outcomes we examine.[4] A 1 standard deviation decrease in the sex ratio increases the age at which the mother gives birth to a child 6–17 years old in Census 1998 by 0.4-0.5 years. This is a 1.6%–1.7% increase from the mean mother's age at childbirth.

These results imply that women delay their age of marriage in response to the shortage of men. As shown in columns 4–6 of Table 6, there is a significant negative correlation between the sex ratio and the age at first marriage for the mothers of children aged 6-17. We have no information on mother's age at first marriage in Census 1998, but it is available in CSES 2004. Thus, we use a proxy variable for mother's age at first marriage in Census 1998, which is the age of the mother minus the age of the oldest child in the household minus 1. This variable assumes that the oldest child living in the household is the oldest child of the mother as we do not have information on children living outside the household. Every 1 standard deviation decrease in the sex ratio increases the age at first marriage for mothers of children aged 6–17 by 0.4–0.5 years, representing a 1.9%-2.0% increase from the mean. These estimates indicate that women delay marriage as a result of the shortage of men resulting from the genocide.

[4] Mother's age at childbirth is a proxy variable equal to the mother's age minus the child's age because we do not have information for this variable in both Census 1998 and CSES 2004.

Our findings so far suggest several possible channels through which the gender imbalance in the parents' generation could lead to negative outcomes for children. The shortage of men in the 1950–1965 birth cohorts led women to marry younger, less educated men and to enter their first marriage at a later age than they would have otherwise, while marriage rates remain unchanged in equilibrium. This means that the combined educational attainment of parents decreased with the lower sex ratio. If the father's educational attainment influences children's outcomes, then the lower combined educational attainment of the parents will also hinder the children's educational attainment. As illustrated in Table 7, we compare the main results for the likelihood of children's normal grade progression when including only the child's characteristics (age and gender) with the results when controlling for parents' characteristics (age and education). We re-report the main results in column 1 (Panel A for the mother sample and Panel B for the father sample). The estimated effects of the sex ratio on the likelihood of children's normal grade progression decrease by about 15%-25% when we include age and education of the mother or age and education of both father and mother (columns 2 and 3). However, these variables do not seem to have any influence on children's height-for-age Z-scores (column 8).

[Table 7]

When we include mother's age at childbirth as an additional control variable, the effect of the sex ratio on the height-for-age Z-scores is statistically insignificant in the mother sample, but mother's age at childbirth has a significant positive correlation with children's height-for-age Z-scores (column 9). The inclusion of this variable slightly increases the estimated coefficient on the sex ratio in the father sample. The estimated estimates are similar when controlling for mother's age both at childbirth and at first marriage (column 10). Thus, mother's age at childbirth is unlikely to explain why height-for-age is lower in districts with high KR mortality.

Another possibility is that the lower sex ratio implies that men might obtain a higher marriage surplus than women as the price of marriage adjusts in men's favor. This advantage could potentially give men greater household bargaining power. As some studies have shown, fathers tend to invest less in children than mothers; therefore, men's stronger bargaining position in the household might lead to poorer outcomes for children (Thomas, 1990, 1994; Duflo, 2000; Rangel, 2006; Qian, 2008). Unfortunately, the Census and CSES data lack suitable measures to capture the relationship between the imbalanced sex ratio and women's bargaining position in the household. However, we explored proxies for married women's bargaining position in the household using variables related to women's empowerment from the DHS 2000. Specifically, DHS 2000 asked childbearing-age married women (aged 15–49) whether they, or their husbands, have the final say on various individual and household decisions, including the money the wife earns, the wife's health care, large household purchases, household purchases for daily needs, visits to family, what food to cook, children's education and medical care for sick children. We find no relationship between KR mortality rates and these proxies of women's relative bargaining position in the household. However, because the sample is fairly small (roughly 4,000 women) and cannot be directly linked to our outcome measures, we cannot completely rule out the possibility that the intergenerational effects of the genocide on children's health outcomes channel through women's bargaining position in the household.

8. Robustness Checks

We check whether the key findings are robust to alternative measures of mortality rates and the age range of cohorts used to construct of the sex ratio for the parents' generation. We also restrict the children's sample to the oldest children born to parents in the 1950–1965 cohorts to examine whether the intergenerational effects of civil conflict on children born years after the genocide channel through a sibling effect.

8.1.Alternative Mortality Estimates

We re-estimate equations (1), (2), and (3) using an alternative measure of KR mortality rates constructed based on the population currently residing in various districts (KR mortality rates–current districts). To do so, we divide the estimated number of deaths in a district by the sum of the estimated deaths under the KR and the number of individuals born before 1980, but currently residing in each district (instead of the district in which they were born). The major shortcomings of this alternative measure are that it includes individuals who moved from other districts and is influenced by migration during, and after, the period when the KR was in power. This alternative measure gives us stronger first-stage F-statistics, while the magnitude, sign and significance of the estimated effects are comparable to the main results presented earlier (Tables A3 and A4).[5]

8.2.Alternative Birth Cohorts Used to Construct the Sex Ratio

We examine the sensitivity of our main results to three alternative ranges of birth cohorts used to construct the sex ratio of the parents' generation: 1) the 1954–1965 birth cohorts (excluding the 1950–1953 birth cohorts); 2) the 1950–1960 birth cohorts (eliminating the 1961–1965 birth cohorts); and 3) the 1960–1965 birth cohorts. We selected the first two alternative ranges because Figure 1 shows that the sex ratio drops sharply, reaching its lowest level with those born in 1954 and then stabilizing with those born in 1961 and later. We select the third group because excluding the pre-1960 birth cohorts, who might have

[5] Our results are also robust when using the maximum KR mortality rates and the absolute average number of deaths (without dividing by population). The results are available upon request.

already married before or during the KR regime, allows one to test whether the results are confounded by other non-marriage market channels.

We run separate regressions for each alternative birth cohort. The reduced-form and IV results have the same signs and statistical significance as the main findings for the effects on the likelihood of children's normal grade progression (columns 1 and 2 of Table A5). In addition, the precision of the coefficient for height-for-age Z-scores in the IV estimates decrease, mainly due to the smaller sample size (columns 5 and 6 of Table A5). The estimated effects on children's health outcomes become noisier, but the magnitudes are comparable to the main results, except for the 1950–1960 birth cohorts whose sample size is less than half that used to estimate the main results.

Table A6 shows that the estimated effects of the sex ratio on marriage outcomes remain statistically significant across the samples, although the magnitudes are slightly smaller (Panel A). The estimated effects of the sex ratio on the number of children ever born and the number of children surviving remain statistically insignificant, as in the main results (Panel B). The statistically significant results for the effects of the sex ratio on mother's age at childbirth for the 1954–1965 and 1950–1960 birth cohorts are marginally lower than the main results (columns 1 and 2, Panel C). The coefficients become statistically insignificant for the younger birth cohorts (column 3, Panel C). The effects of the sex ratio on mother's age at first marriage are statistically insignificant for all alternative birth cohorts.

8.3. Sibling Effect

The intergenerational effects of the civil conflict on children born well after the conflict ended may potentially channel through a sibling effect. For instance, the health of older siblings born before, or during, the conflict could have been affected by direct exposure to conflict. If this is the case, parents might devote greater resources to older siblings, and this intra-household allocation of resources could affect younger siblings. To explore this issue, we restrict our sample to the oldest children born to the 1950–1965 cohorts. We have no information about children not living in the household, so we assume that the oldest child living in the household is the oldest child of the mother or father.

The reduced-form and IV estimates of the likelihood of children's normal grade progression are larger in this restricted sample than in the main sample (Table A7).[6] Thus, our main findings are robust to the possibility of a sibling effect.

9. Conclusion

This paper examines the effects of the genocide that occurred in Cambodia during the KR regime from 1975 to 1979 on the health and educational outcomes of children born years after the regime fell. We demonstrate that genocide-induced mortality exogenously lowers sex ratios for the 1950–1965 birth cohorts across districts in Cambodia and leads to lower normal grade progression rates and height-for-age Z scores among children born to these cohorts. Since the geographical variation in mortality rates under the KR regime is not correlated with various determinants of children's educational and health outcomes, such as parental educational attainment, earnings, and health, our results suggest that the intergenerational effects of the genocide are primarily mediated through its gender-differentiated mortality effect on the parents' generation.

Although it is difficult to pin down precisely what aspects of the sex ratio channel drive the intergenerational effects, we further explore the role of the disruption to the marriage market during the parents' generation. We show that a lower sex ratio increases the likelihood of marriages of women to younger men, lower spousal age and education gaps,

[6] We do not report the estimates for children's educational expenses and health outcomes because the CSES 2004 samples become too small for any meaningful analysis when we restrict the sample to the oldest child.

increase mother's age at birth (of the children studied) and mother's age at first marriage. The lower sex ratio, though, has no effect on completed fertility. Once we control for the educational attainment of both parents, the intergenerational effects of the genocide weakens, suggesting that the marriage market serves as an important channel. However, the ages at which the mother gives birth and first marries are unlikely to be the channel through which the genocide affects children's outcomes. One possible policy suggestion stemming from our results is to provide greater public education and health support to children growing up in areas in which the sex ratio of the parents' generation is relatively unbalanced. It is important to note that our results are informed by variation in sex ratio significantly below the normal level. Though it is unclear if our findings are applicable to situations in which sex ratios are considerably above the normal level, our findings are relevant for conflicts affected regions where males are typically the ones that suffer excess mortality.

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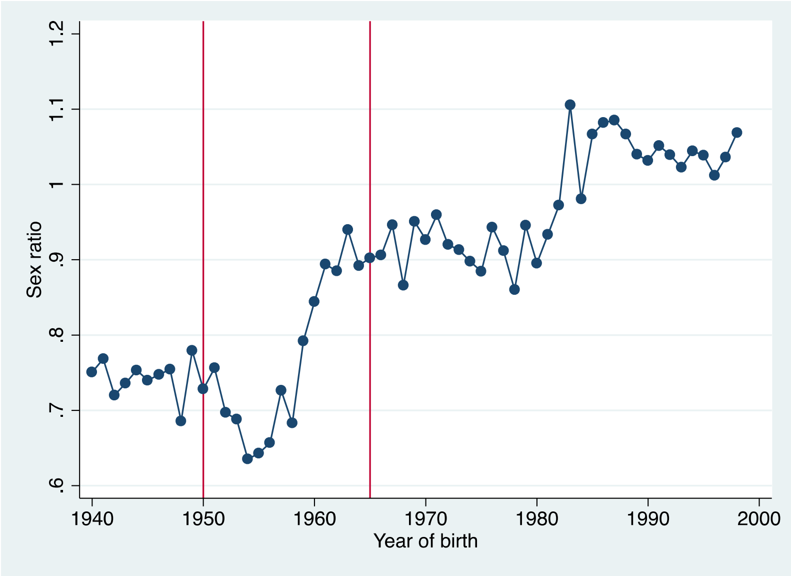


Figure 1: Sex ratio by year of birth (Census 1998)

Notes: The first vertical line indicates the cohort born in 1950 and the second vertical line indicates the cohort born in 1965.

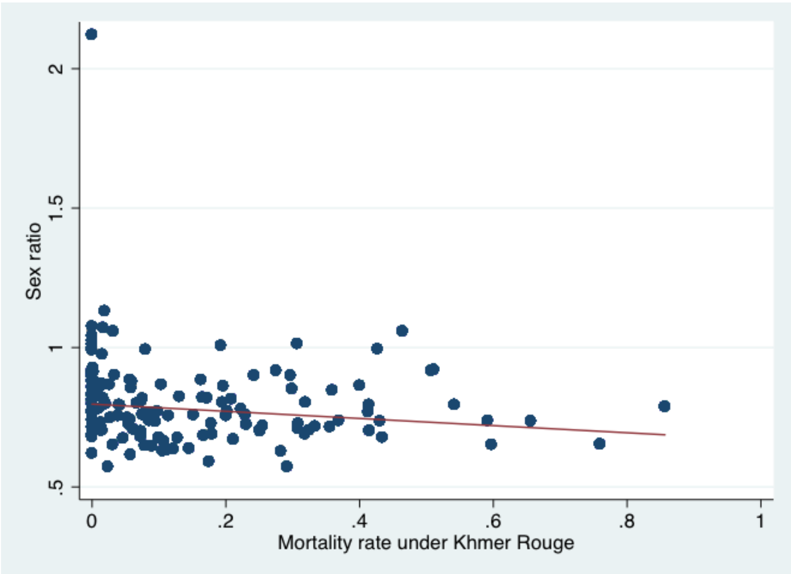
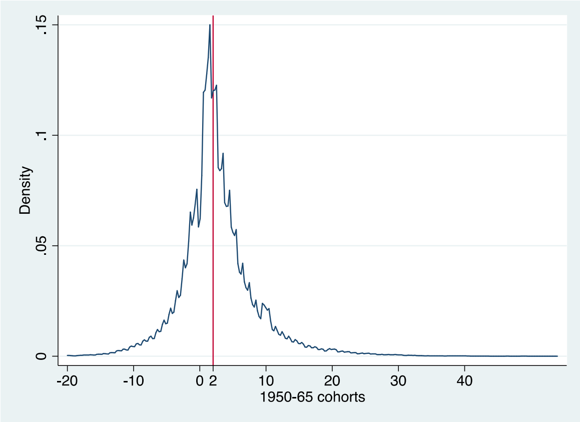
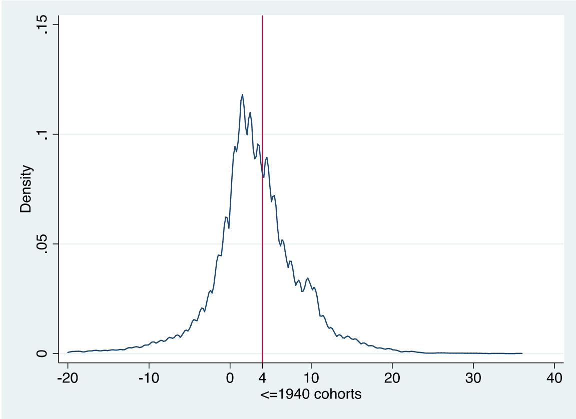


Figure 2: Sex ratio of the 1950–1965 birth cohorts against the Khmer Rouge mortality rates (Census 1998 and CGD).

Note: The negative correlation between variation in KR mortality rates and sex ratio is statistically significantly different from zero at the 1% level.



(A)



(B)

(A): Figure indicates husband age – wife age for individuals born between 1950 and 1965.
(B): Figure indicates husband age – wife age for individuals born before 1940.
Vertical line is the median.

Figure 3: Distribution of the husband and wife age gap.

Table 1: Exogeneity of mortality rates under the Khmer Rouge regime

	Sex ratio in 1962	Density in 1962	Density— Men in 1962	Density — Women in 1962	Distance to capital district	Distance to nearest Thai border district	Distance to nearest Vietnamese border district
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
KR mortality rates	-0.022	-819.500	-419.917	-399.583	4.191	3.719	7.428
	(0.017)	(659.871)	(334.296)	(325.630)	(9.542)	(32.113)	(48.342)
Constant	1.010***	541.307***	274.367***	266.940***	28.919***	198.946***	139.267***
	(0.005)	(205.022)	(104.262)	(100.772)	(2.223)	(9.127)	(13.214)
R-squared	0.008	0.008	0.008	0.008	0.001	0.0001	0.0001
Observations	145	145	145	145	145	145	145

Note: Each observation is a district. The values for the dependent variables in columns 1–4 are from Census 1962. Robust standard errors are in parentheses. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 2: Estimates of effects of mortality rates under the Khmer Rouge regime on children's educational and health outcomes

	Census 1998		**CSES 2004**			
	Children's normal grade progression likelihood		Children's school expenditure		Height-for-age Z-score	Weight-for-age Z-score
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Children of mothers born in 1950–1965 sample						
KR mortality rates	-0.075*	-0.075*	-86.227	-86.652	-1.499**	-0.668
	(0.044)	(0.044)	(58.211)	(57.980)	(0.696)	(0.441)
Age	-0.016***	-0.016***	16.451***	16.470***		
	(0.001)	(0.001)	(2.716)	(2.718)		
Male		0.0005		-5.854		
		(0.002)		(4.982)		
R-squared	0.030	0.030	0.038	0.038	0.005	0.002
Observations	193288	193288	7168	7168	1267	1267
Panel B: Children of fathers born in 1950–1965 sample						
KR mortality rates	-0.073	-0.073	-85.948	-86.265	-1.354*	-0.357
	(0.045)	(0.045)	(66.634)	(66.513)	(0.733)	(0.498)
Age	-0.018***	-0.018***	14.934***	14.953***		
	(0.001)	(0.001)	(2.427)	(2.429)		
Male		-0.000		-5.840		
		(0.002)		(4.296)		
R-squared	0.033	0.033	0.033	0.033	0.003	0.000
Observations	177877	177877	7767	7767	1717	1717

Note: All specifications include sampling weights. The samples in columns 1 and 2 include children aged 6–17 in 1998 with a parent born between 1950 and 1965. The samples in columns 3 and 4 are children aged 6–17 in 2004 with a parent born between 1950 and 1965. The samples in columns 5 and 6 are children younger than 5 in 2004 with a parent born between 1950 and 1965. Robust standard errors clustered by district (145 districts) in parentheses. See note to Table 1 for statistical significance.

Table 3 Estimated effects of mortality rates under the Khmer Rouge (KR) regime on parents' education, income, and health

	Mother born 1950–1965 with children aged 0–17 (1)	Her spouse (2)	Father born 1950-1965 with children aged 0–17 (3)	His spouse (4)
Panel A: Effects on Parents' Education (Census 1998)				
Dependent Variable:				
Years of schooling	-0.691	-1.033	-1.121	-0.783
	(0.542)	(0.656)	(0.747)	(0.622)
Observations	66284	66284	65643	65643
Panel B: Effects on Parents' Income (CSES 2004)				
Dependent Variable:				
Monthly earnings	-0.263	-0.079	-0.417	-0.353
	(0.825)	(0.324)	(0.390)	(0.680)
Observations	301	961	1102	350
Monthly household income	-0.470	-0.470	-0.373	-0.373
	(0.322)	(0.322)	(0.344)	(0.344)
Observations	3732	3732	3852	3852
Panel C: Effects on Parents' Health (CSES 2004)				
Dependent Variable:				
Illness/injury during the past 30 days	0.025	0.077	0.100	0.021
	(0.078)	(0.062)	(0.067)	(0.073)
Disabled	0.058	0.043	0.049	0.028
	(0.054)	(0.045)	(0.046)	(0.045)
Difficulty seeing	0.008	0.010	0.009	0.011
	(0.023)	(0.027)	(0.018)	(0.017)
Difficulty hearing	-0.001	0.009	0.014	-0.0003
	(0.008)	(0.011)	(0.010)	(0.007)
Difficulty speaking	-0.005	-0.007**	-0.007**	-0.004
	(0.005)	(0.003)	(0.003)	(0.004)
Difficulty moving	0.044	0.037	0.047*	0.020
	(0.028)	(0.023)	(0.024)	(0.020)
Difficulty sensing	0.004	0.003	-0.007	0.001
	(0.011)	(0.011)	(0.010)	(0.011)
Psychological or behavioral difficulties	0.007	-0.0001	-0.005	0.003
	(0.013)	(0.007)	(0.008)	(0.009)
Observations	3736	3736	3855	3855

Note: We report the coefficient for KR mortality rates. All specifications include sampling weights. In the mother sample, when we include either the mother's own age (specification 1) or the father's own age (specification 2), the estimated coefficients for KR mortality rates remain similar. In the father sample, the estimated coefficients for KR mortality rates are similar when we include either the father's own age (specification 3) or the mother's own age (specification 4). Robust standard errors clustered by district in parentheses. See note to Table 1 for statistical significance.

Table 4: Estimated effects of the sex ratio on children's educational and health outcomes

	Census 1998		CSES 2004			
	Children's normal grade progression likelihood		Children's educational expenditure		Height-for-age Z-score	Weight-for-age Z-score
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Children of mothers born in 1950–1965 sample						
Sex ratio	0.638*	0.638*	865.499	868.581	13.963*	6.227
	(0.370)	(0.370)	(543.333)	(541.715)	(8.321)	(4.544)
Age	-0.016***	-0.016***	16.152***	16.165***		
	(0.001)	(0.001)	(2.371)	(2.370)		
Male		0.001		-4.223		
		(0.002)		(4.587)		
First-stage *F-statistic*	7.337***	7.337***	4.439**	4.452**	5.442**	5.442**
R-squared	0.014	0.014	0.044	0.044	-0.113	-0.035
Observations	193288	193288	7168	7168	1267	1267
Panel B: Children of fathers born in 1950–1965 sample						
Sex ratio	0.608*	0.608*	844.546	847.115	12.653*	3.332
	(0.362)	(0.362)	(591.498)	(590.562)	(7.345)	(4.400)
Age	-0.017***	-0.017***	15.545***	15.562***		
	(0.001)	(0.001)	(2.215)	(2.213)		
Male		-0.001		-4.815		
		(0.002)		(3.992)		
First-stage *F-statistic*	7.536***	7.535***	4.422**	4.427**	5.936**	5.936**
R-squared	0.018	0.018	0.046	0.046	-0.079	-0.005
Observations	177877	177877	7767	7767	1717	1717

Note: All specifications include sampling weights. Robust standard errors clustered by district (145 districts) in parentheses. See note to Table 1 for statistical significance. The age composition of children in each column is the same as Table 2.

Table 5: Estimated effects of the sex ratio on marriage and fertility outcomes

	Census 1998								
	Married	Husband's age < Wife's age	Spousal age gap	Husband's education < Wife's education	Spousal education gap	Number of children ever born		Number of children surviving	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Mother born in 1950–1965 sample									
Sex ratio	0.138	-0.415**	5.974***	-0.108	2.891**	-2.833	-2.074	-1.630	-1.168
	(0.165)	(0.176)	(2.076)	(0.125)	(1.415)	(2.601)	(2.168)	(1.856)	(1.632)
Age	-0.007***	-0.008***	0.176***	0.0001	0.034***	0.177***	0.181***	0.122***	0.125***
	(0.0003)	(0.001)	(0.007)	(0.0003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)
Education							-0.130***		-0.080***
							(0.010)		(0.008)
First-stage *F-statistic*	7.899***	7.968***	7.968***	7.968***	7.968***	7.968***	7.839***	7.893***	7.765***
R-squared	0.007	0.004	0.015	-0.001	-0.005	0.097	0.123	0.080	0.093
Observations	97812	69185	69185	69185	69185	69185	69185	68123	68123
Panel B: Father born in 1950–1965 sample									
Sex ratio	0.0001	-0.490***	7.392***	-0.172	2.662**				
	(0.067)	(0.140)	(1.805)	(0.132)	(1.279)				
Age	0.002***	-0.009***	0.143***	-0.002***	0.077***				
	(0.0003)	(0.00004)	(0.004)	(0.0003)	(0.003)				
First-stage *F-statistic*	8.614***	8.376***	8.376***	8.376***	8.376***				
R-squared	0.002	0.007	0.026	-0.002	0.007				
Observations	75683	68462	68462	68462	68462				

Note: All specifications include sampling weights. Robust standard errors clustered by district (145 districts) in parentheses. See notes to Table 1 for statistical significance.

Table 6: Estimated effects of the sex ratio on mother's age at childbirth and at first marriage

	Census 1998: Children aged 6-17						CSES 2004: Children under 5					
	Mother's age at childbirth			Mother's age at first marriage			Mother's age at childbirth			Mother's age at first marriage		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Sex ratio	-4.155**	-4.446**	-4.301***	-4.075*	-4.407*	-4.170**	9.098	9.547	8.257	2.735	0.133	3.409
	(1.742)	(1.787)	(1.410)	(2.254)	(2.251)	(2.109)	(6.834)	(7.002)	(5.682)	(9.283)	(8.511)	(9.291)
Mother's education		0.058***			0.067***			-0.067*			0.269***	
		(0.009)			(0.009)			(0.040)			(0.058)	
Father's age			0.343***			0.158***			0.262***			-0.118***
			(0.004)			(0.004)			(0.022)			(0.033)
Father's education			-0.016**			-0.004			-0.071*			0.107**
			(0.007)			(0.007)			(0.037)			(0.047)
First-stage *F-statistic*	7.338***	7.247***	7.217***	7.349***	7.258***	7.229***	5.442**	5.350**	5.443**	4.442**	4.328**	4.424**
R-squared	-0.005	-0.004	0.229	-0.011	-0.010	0.067	-0.044	-0.047	0.186	-0.005	0.030	0.027
Observations	193288	193288	193288	192711	192711	192711	1267	1267	1267	1213	1213	1213

Note: All specifications include sampling weights. The samples in columns 1–6 are children aged 6–17 in 1998 with a mother born between 1950 and 1965. The samples in columns 7–12 are children under 5 in 2004 with a mother born between 1950 and 1965. Mother's age at childbirth in both Census 1998 and CSES 2004 is a proxy variable which is equal to the mother's age minus the child's age. Mother's age at first marriage in Census 1998 is a proxy variable which is equal to the mother's age minus the age of the oldest child in the household minus 1. We assume that the oldest child living in the household is her oldest child because we have no information about the children living outside the household. Robust standard errors clustered by district in parentheses. For statistical significance see notes to Table 1.

Table 7: Estimated effects of the sex ratio on children's normal grade progression and height-for-age Z-scores

	Census 1998: Children's normal grade progression likelihood					CSES 2004: Children's height-for-age Z-scores				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Children of mothers born in 1950–1965 sample										
Sex ratio	0.638*	0.522*	0.439*	0.439*	0.436*	13.963*	13.887*	13.935*	11.126	12.316
	(0.370)	(0.281)	(0.246)	(0.246)	(0.245)	(8.321)	(8.375)	(8.358)	(7.513)	(8.655)
Age	-0.016***	-0.017***	-0.018***	-0.018***	-0.018***					
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)					
Male	0.001	0.0003	0.0001	0.0001	-0.0001					
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)					
Mother's age		0.001***	-0.00003				-0.030	-0.020		
		(0.0003)	(0.0004)				(0.037)	(0.041)		
Mother's education		0.024***	0.016***	0.016***	0.016***		0.031	0.025	0.028	0.027
		(0.002)	(0.001)	(0.001)	(0.001)		(0.040)	(0.045)	(0.044)	(0.045)
Father's age			0.0001	0.0001	0.0003			-0.010	-0.101***	-0.111***
			(0.0003)	(0.0003)	(0.0003)			(0.022)	(0.022)	(0.025)
Father's education			0.015***	0.015***	0.015***			0.012	0.036	0.047
			(0.001)	(0.001)	(0.001)			(0.039)	(0.036)	(0.038)
Mother's age at childbirth				-0.00003	-0.001				0.329***	0.382***
				(0.0004)	(0.001)				(0.042)	(0.046)
Mother's age at first marriage					0.001***					-0.028
					(0.0004)					(0.028)
First-stage *F-statistic*	7.337***	7.225***	7.150***	7.150***	7.172***	5.442**	5.294**	5.382**	5.332**	4.313**
R-squared	0.014	0.072	0.097	0.097	0.097	-0.113	-0.111	-0.111	0.003	-0.005
Observations	193288	193288	193288	193288	192711	1267	1267	1267	1267	1213
Panel B: Children of fathers born in 1950–1965 sample										
Sex ratio	0.608*	0.445*	0.415*	0.415*	0.417*	12.653*	12.799*	12.853*	12.918*	14.632*
	(0.362)	(0.261)	(0.234)	(0.234)	(0.236)	(7.345)	(7.376)	(7.467)	(7.366)	(8.202)
Age	-0.017***	-0.018***	-0.018***	-0.018***	-0.019***					
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)					
Male	-0.001	-0.001	-0.001	-0.001	-0.001					
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)					
Mother's age			-0.00001					-0.059**		
			(0.001)					(0.027)		
Mother's education			0.017***	0.017***	0.017***			-0.022	0.012	0.020
			(0.001)	(0.001)	(0.001)			(0.040)	(0.039)	(0.040)
Father's age		0.001**	0.001*	0.001*	0.001**		0.008	0.045	-0.053*	-0.059*
		(0.0003)	(0.001)	(0.001)	(0.001)		(0.025)	(0.033)	(0.032)	(0.035)
Father's education		0.023***	0.016***	0.016***	0.015***		0.042	0.030	0.071**	0.070*
		(0.002)	(0.001)	(0.001)	(0.001)		(0.031)	(0.033)	(0.034)	(0.036)
Mother's age at childbirth				-0.00001	-0.001				0.101***	0.114***
				(0.001)	(0.001)				(0.026)	(0.030)
Mother's age at first marriage					0.002***					-0.042
					(0.001)					(0.027)
First-stage *F-statistic*	7.535***	7.424***	7.363***	7.363***	7.335***	5.936**	6.036**	6.076**	6.064**	5.717**
R-squared	0.018	0.084	0.103	0.103	0.103	-0.079	-0.080	-0.075	-0.067	-0.091
Observations	177877	177877	177877	177876	176409	1717	1717	1717	1717	1676

Note: All specifications include sampling weights. The samples in columns 1-5 are children aged 6–17 in 1998 with a parent born between 1950 and 1965. The samples in columns 6–10 are children under 5 in 2004 with a parent born between 1950 and 1965. Robust standard errors clustered by district are in parentheses. For statistical significance, see notes to Table 1.

Appendix

Table A1: Summary statistics of main variables

	Mother born in 1950–1965 sample					Father born in 1950–1965 sample				
	N	Mean	SD	Min.	Max.	N	Mean	SD	Min.	Max.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Census 1998										
Children aged 6–17										
Age	193288	11.307	3.312	6	17	177877	10.986	3.291	6	17
Years of schooling	193288	2.319	2.542	0	13	177877	2.158	2.457	0	13
Male	193288	0.510	0.500	0	1	177877	0.511	0.500	0	1
Children’s normal grade progression likelihood	193288	0.113	0.317	0	1	177877	0.119	0.324	0	1
Mother’s age at childbirth	193288	28.436	4.979	16	42					
Mother’s age at first marriage	192711	22.453	3.960	11	41					
Individuals born 1950–1965										
Sex ratio *(men born 1950-1965 / women born 1950-1965)*	97812	0.777	0.107	0.573	2.122	75683	0.792	0.122	0.573	2.122
KR mortality rates	97812	0.146	0.160	0	0.857	75683	0.142	0.159	0	0.857
Age	97812	39.719	4.542	33	48	75683	39.226	4.548	33	48
Married	97812	0.789	0.408	0	1	75683	0.961	0.194	0	1
Years of schooling	97716	2.595	2.996	0	13	75549	4.457	3.483	0	13
Spouse’s age	69185	42.242	7.839	15	91	68462	36.540	5.849	12	66
Younger husband	69185	0.230	0.421	0	1	68462	0.178	0.382	0	1
Spouse’s education	69185	4.319	3.401	0	13	68462	2.875	3.060	0	13
Less-educated husband	69185	0.146	0.353	0	1	68462	0.156	0.362	0	1
Spouse age gap *(husband’s age to wife’s age)*	69185	2.738	5.862	-20	54	68462	2.741	4.402	-20	33
Spouse education gap *(husband’s education to. wife’s education)*	69185	1.684	3.271	-13	13	68462	1.541	3.205	-13	13
Number of children ever born	69185	5.385	2.547	0	20					
Number of children surviving	68123	4.690	2.017	0	16					
Panel B: CSES 2004										
Children aged 6–17										
Age	7168	12.186	2.958	6	17	7767	11.912	2.984	6	17
Years of schooling	7168	3.705	2.586	0	12	7767	3.557	2.539	0	12
Male	7168	0.524	0.499	0	1	7767	0.516	0.500	0	1
Children’s educational expenditure (in thousand Cambodian riels)	7168	90.543	293.424	0	12220	7767	91.039	285.059	0	12220
Children aged under 5										
Age	1267	3.154	1.641	0	5	1717	3.000	1.680	0	5
Male	1267	0.526	0.500	0	1	1717	0.507	0.500	0	1
Height-for-age Z-score	1267	-1.052	3.714	-9.12	19.61	1717	-0.847	3.903	-9.37	19.61
Weight-for-age Z-score	1267	-0.795	2.692	-7.05	16.36	1717	-0.531	2.910	-7.05	16.36
Mother’s age at childbirth	1267	38.860	3.429	33	54					
Mother’s age at first marriage	1213	21.271	4.195	15	40					
Individuals born 1950–1965										
Age	5876	45.543	4.591	37	55	4442	45.169	4.598	37	55
Married	5876	0.738	0.440	0	1	4442	0.962	0.191	0	1
Years of schooling	5820	2.837	3.108	0	22	4379	4.854	3.610	0	22
Spouse’s age	4159	48.032	7.566	23	88	4186	42.081	6.142	18	70
Younger husband	4159	0.221	0.415	0	1	4186	0.171	0.377	0	1
Spouse’s education	4159	4.751	3.536	0	22	4186	3.248	3.185	0	22
Less-educated husband	4159	0.155	0.362	0	1	4186	0.163	0.369	0	1
Spouse age gap	4159	2.830	5.610	-20	38	4186	3.065	4.670	-20	31
Spouse education gap	4159	1.773	3.365	-18	16	4186	1.604	3.263	-11	18

Note: Mother’s age at childbirth is a proxy variable equal to the mother’s age minus the child’s age because we do not have information for this variable in either Census 1998 or CSES 2004. Mother’s age at first marriage in Census 1998 is a proxy variable equal to the mother’s age minus the age of the oldest child in the household minus 1. We assume that the oldest child living in the household is her oldest child because we have no information about children living outside the household. There are some missing values, so some variables used in the analysis do not have the same sample size.

Table A2: Estimated effects of the sex ratio on children's outcomes after controlling for fathers having difficulty moving

	CSES 2004: Children of fathers born 1950-1965 sample		
	Children's educational expenditure	Height-for-age Z-score	Weight-for-age Z-score
	(1)	(2)	(3)
Explanatory variables:			
Sex ratio	831.656	12.129*	3.211
	(592.912)	(7.158)	(4.321)
Father having difficulty moving	-31.045*	-0.817	-0.189
	(17.105)	(0.560)	(0.516)
Age	15.560***		
	(2.216)		
Male	-4.748		
	(3.975)		
First-stage *F-statistic*	4.404**	6.053**	6.053**
R-squared	0.048	-0.071	-0.004
Observations	7767	1717	1717

Note: All specifications include sampling weights. Column 1 includes children aged 6–17 in 2004 with a father born between 1950 and 1965. Columns 2 and 3 include children under 5 in 2004 with a father born between 1950 and 1965. Robust standard errors clustered by district in parentheses. For statistical significance, see notes to Table 1.

Table A3: Robustness of estimated effects on children's educational and health outcomes to alternative mortality estimates

	Children of mothers born in 1950–1965 sample						Children of fathers born in 1950–1965 sample					
	Children's normal grade progression likelihood		Children's educational expenditure		Height-for-age Z-score		Children's normal grade progression likelihood		Children's educational expenditure		Height-for-age Z-score	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Reduced-form estimates												
KR mortality rates—current district	-0.105***	-0.071***	-131.853**	-113.631***	-1.498**	-1.478**	-0.105**	-0.068***	-135.516**	-115.387**	-1.561**	-1.523**
	(0.040)	(0.025)	(51.064)	(42.911)	(0.666)	(0.662)	(0.040)	(0.025)	(58.355)	(47.436)	(0.725)	(0.697)
Own age and gender	Yes	Yes	Yes	Yes	-	-	Yes	Yes	Yes	Yes	-	-
Parental age and education	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.032	0.104	0.042	0.088	0.005	0.007	0.035	0.110	0.038	0.088	0.005	0.018
Observations	193288	193288	7168	7168	1267	1267	177877	177877	7767	7767	1717	1717
IV estimates												
Sex ratio	0.535***	0.364***	747.064***	655.598***	9.234**	9.145**	0.523**	0.346***	728.523**	631.611**	9.082**	8.927**
	(0.207)	(0.132)	(274.903)	(238.921)	(4.499)	(4.501)	(0.205)	(0.127)	(293.879)	(248.913)	(4.039)	(4.013)
Own age and gender	Yes	Yes	Yes	Yes	-	-	Yes	Yes	Yes	Yes	-	-
Parental age and education	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
First-stage *F-statistic*	24.142***	23.824***	18.509***	18.007***	14.717***	14.428***	24.495***	24.162***	20.693***	20.975 ***	17.219***	17.543***
R-squared	0.022	0.101	0.055	0.096	-0.046	-0.043	0.025	0.107	0.055	0.099	-0.037	-0.028
Observations	193288	193288	7168	7168	1267	1267	177877	177877	7767	7767	1717	1717

Note: All specifications include sampling weights. KR mortality rates–current district measure the mortality rates under the KR regime based on the estimated deaths in the CGD and the number of individuals born before 1980 but currently residing in the district. The samples in columns 1, 2, 7 and 8 are children aged 6–17 in 1998 with a parent born between 1950 and 1965. Normal grade progression likelihood takes the value of 1 if a child attends the expected grade level or higher and 0 otherwise. The samples in columns 3, 4, 9 and 10 are children aged 6–17 in 2004 with a parent born between 1950 and 1965. The samples in columns 5, 6, 11 and 12 are children under 5 in 2004 with a parent born between 1950 and 1965. Robust standard errors clustered by district are in parentheses. For statistical significance, see notes to Table 1.

Table A4: Robustness of estimated effects on marriage and fertility outcomes to alternative mortality estimates

	Census 1998								
	Married (1)	Husband's age < Wife's age (2)	Spousal age gap (3)	Husband's education < Wife's education (4)	Spousal education gap (5)	Number of children ever born (6)	Number of children surviving (7)	Mother's age at childbirth (8)	Mother's age at first marriage (9)
Panel A: Mother born in 1950–1965 sample									
Sex ratio	0.132	-0.314***	4.597***	-0.058	2.448***	-2.537*	-1.737		
	(0.096)	(0.106)	(1.121)	(0.069)	(0.814)	(1.472)	(1.075)		
Age	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
First-stage *F-statistic*	26.509***	26.568***	26.568***	26.568***	26.568***	26.568***	26.379***		
R-squared	0.007	0.006	0.017	-0.0004	-0.003	0.099	0.080		
Observations	97812	69185	69185	69185	69185	69185	68123		
Panel B: Father born in 1950–1965 sample									
Sex ratio	-0.023	-0.378***	6.452***	-0.095	2.370***				
	(0.039)	(0.076)	(0.955)	(0.070)	(0.761)				
Age	Yes	Yes	Yes	Yes	Yes				
First-stage *F-statistic*	27.090***	28.224***	28.224***	28.224***	28.224***				
R-squared	0.002	0.012	0.029	-0.0000	0.008				
Observations	75683	68462	68462	68462	68462				
Panel C: Children aged 6–17 with a mother born in 1950–1965 sample									
Sex ratio								-3.197***	-2.578**
								(0.901)	(1.254)
Mother's education								Yes	Yes
First-stage *F-statistic*								23.955***	23.917***
R-squared								-0.001	-0.002
Observations								193288	192711

Note: All specifications include sampling weights. KR mortality rates–current district measure the mortality rates under the KR regime based on the estimated deaths in the CGD and the number of individuals born before 1980 but currently residing in the district. In Panel A, the samples are mothers born between 1950 and 1965. In Panel B, the samples are fathers born between 1950 and 1965. In Panel C, the samples are children aged 6–17 in 1998 with a parent born between 1950 and 1965. Robust standard errors clustered by district are in parentheses. For statistical significance, see notes to Table 1.

Table A5: Robustness of estimated effects on children's educational and health outcomes to alternative birth cohorts used in constructing sex ratio of the parents' generation

	Mother Sample						**Father Sample**					
	Children's normal grade progression likelihood		**Children's educational expenditure**		**Height-for-age Z-score**		**Children's normal grade progression likelihood**		**Children's educational expenditure**		**Height-for-age Z-score**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Born 1954–65												
RF: KR-mortality rates	-0.078*	-0.053*	-76.137	-68.921	-1.466**	-1.464**	-0.075*	-0.051*	-76.286	-69.181	-1.257*	-1.304*
	(0.045)	(0.028)	(53.446)	(45.015)	(0.714)	(0.706)	(0.044)	(0.027)	(60.936)	(49.765)	(0.726)	(0.686)
IV: Sex ratio	0.658*	0.457*	894.192	818.937	14.109	14.169	0.629*	0.434*	817.654	742.742	12.537	13.064*
	(0.376)	(0.248)	(617.814)	(555.414)	(8.783)	(8.856)	(0.362)	(0.237)	(608.781)	(528.397)	(7.793)	(7.939)
First-stage *F-statistic*	7.374***	7.221***	3.216*	3.240*	5.052**	4.996**	7.328***	7.159***	3.674*	3.965**	5.141**	5.338**
Observations	158303	158303	6235	6235	1241	1241	140025	140025	6608	6608	1602	1602
Born 1950–1960												
RF: KR-mortality rates	-0.076*	-0.050	-99.100	-91.514	-1.285	-1.319	-0.080	-0.052	-105.946	-107.463	-1.022	-0.941
	(0.045)	(0.030)	(74.226)	(62.378)	(1.228)	(1.219)	(0.049)	(0.031)	(84.825)	(69.062)	(0.847)	(0.836)
IV: Sex ratio	0.665*	0.439*	827.491	771.607	7.268	7.433	0.658*	0.439*	1010.771	1003.079	10.266	9.527
	(0.391)	(0.262)	(545.063)	(477.043)	(6.836)	(6.752)	(0.387)	(0.253)	(721.928)	(622.750)	(9.695)	(9.550)
First-stage *F-statistic*	7.103***	6.902***	6.170**	6.272**	10.967***	10.579***	7.508***	7.271***	4.556**	5.266**	4.333**	4.358**
Observations	124274	124274	3985	3985	411	411	116966	116966	4438	4438	693	693
Born 1960–1965												
RF: KR-mortality rates	-0.072*	-0.050*	-64.919	-58.173	-1.392*	-1.354*	-0.067*	-0.047*	-60.083	-54.449	-1.636*	-1.689**
	(0.043)	(0.027)	(48.893)	(42.431)	(0.717)	(0.709)	(0.038)	(0.024)	(46.049)	(38.806)	(0.872)	(0.851)
IV: Sex ratio	0.610*	0.427*	790.499	731.830	14.919	14.746	0.556*	0.396*	548.681	498.440	13.924*	14.405*
	(0.359)	(0.242)	(615.550)	(582.469)	(10.147)	(10.214)	(0.325)	(0.223)	(406.481)	(357.996)	(7.311)	(7.502)
First-stage *F-statistic*	7.196***	7.077***	2.959*	2.857*	3.799 *	3.701*	7.606***	7.386***	4.969**	5.287**	6.597**	7.109***
Observations	85336	85336	3755	3755	980	980	76287	76287	4008	4008	1182	1182
Control variables:												
Own age and gender	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental age and education	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Note: All specifications include sampling weights. The samples in columns 1, 2, 7, and 8 are children aged 6–17 in 1998. The samples in columns 3, 4, 9, and 10 are children aged 6–17 in 2004. The samples in columns 5, 6, 11, and 12 are children under 5 in 2004. Robust standard errors clustered by district are in parentheses. For statistical significance, see notes to Table 1.

Table A6: Robustness of estimated effects on marriage and fertility outcomes to alternative birth cohorts used in constructing sex ratio of the parents' generation

	Census 1998					
	Mother Sample			**Father Sample**		
	Born 1954–1965	**Born 1950–1960**	**Born 1960–1965**	**Born 1954–1965**	**Born 1950–1960**	**Born 1960–1965**
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Effects of the Sex Ratio on the Marriage Outcomes						
Dependent variables:						
Married	0.163	0.129	0.175	0.005	0.007	0.001
	(0.130)	(0.173)	(0.142)	(0.073)	(0.051)	(0.077)
Husband's age < Wife's age	-0.381**	-0.413**	-0.363**	-0.448***	-0.432***	-0.410***
	(0.172)	(0.187)	(0.160)	(0.143)	(0.128)	(0.145)
Spousal age gap	4.641**	6.767**	3.803**	6.687***	6.980***	6.292***
	(1.860)	(2.769)	(1.911)	(1.741)	(1.894)	(1.686)
Husband's education < Wife's education	-0.052	-0.030	-0.077	-0.159	-0.083	-0.203*
	(0.109)	(0.137)	(0.110)	(0.126)	(0.139)	(0.113)
Spousal education gap	2.069	2.736*	1.934	2.201*	2.816**	2.083*
	(1.258)	(1.405)	(1.379)	(1.261)	(1.340)	(1.107)
Observations	56543	42081	32574	55775	39369	34776
Panel B: Effects of the Sex Ratio on the Number of Children						
Dependent variables:						
Number of children ever born	-2.604	-3.430	-2.301			
	(2.567)	(2.945)	(2.347)			
Observations	56543	42081	32574			
Number of children surviving	-1.628	-2.304	-0.919			
	(1.828)	(2.142)	(1.640)			
Observations	55650	41529	31976			
Panel C: Effects of the Sex Ratio on Mother's Age at Childbirth and at First Marriage						
Dependent variables:						
Mother's age at childbirth	-2.652*	-3.535**	-1.321			
	(1.366)	(1.444)	(0.996)			
Observations	158303	124274	85336			
Mother's age at first marriage	-3.408	-3.565	-2.668			
	(2.226)	(2.241)	(2.217)			
Observations	157869	123900	85098			

Note: We report the estimated coefficient for the sex ratio. All specifications include sampling weights. In Panel A and B, regressions controlled for individual's own age. In Panel C, the samples are children aged 6–17 in 1998 and regressions controlled for mother's education. Robust standard errors clustered by district are in parentheses. For statistical significance, see notes to Table 1.

Table A7: Robustness: Reduced-form and instrumental variable estimates of normal grade progression likelihood of the oldest children born after 1980

	Census 1998							
	The oldest children of mothers born in 1950–1965 sample				The oldest children of fathers born in 1950–1965 sample			
	Reduced-Form (1)	Reduced-Form (2)	Instrumental Variable (3)	Instrumental Variable (4)	Reduced-Form (5)	Reduced-Form (6)	Instrumental Variable (7)	Instrumental Variable (8)
KR mortality rates	-0.091**	-0.063**			-0.098**	-0.069**		
	(0.044)	(0.027)			(0.048)	(0.028)		
Sex ratio			0.729**	0.516**			0.763**	0.550**
			(0.371)	(0.242)			(0.379)	(0.238)
First-stage F stat.			8.090***	7.856***			8.372***	8.134***
R-squared	0.024	0.123	-0.012	0.107	0.037	0.142	-0.001	0.123
Observations	42903	42903	42903	42903	46519	46519	46519	46519

Note: All specifications include sampling weights. The samples are the oldest children aged 6–17 in 1998 with a parent born between 1950 and 1965. Robust standard errors clustered by district in parentheses. For statistical significance, see notes to Table 1.