Birth Spacing in the Presence of Son Preference and Sex-Selective Abortions: India's Experience over Four Decades*

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Abstract

Strong son preference is typically associated with shorter birth spacing in the absence of sons, but access to sex selection has the potential to reverse this pattern because each abortion extends spacing by six to twelve months. I introduce a statistical method that simultaneously accounts for how sex selection increases the spacing between births and the likelihood of a son. Using four rounds of India's National Family and Health Surveys, I show that, except for first births, the spacing between births increased substantially over the last four decades, with the most substantial increases among women most likely to use sex selection. Specifically, well-educated women with no boys now exhibit significantly longer spacing and more male-biased sex ratios than similar women with boys. Women with no education still follow the standard pattern of short spacing when they have girls and little evidence of sex selection, with medium-educated women showing mixed results. Finally, sex ratios are more likely to decline within spells at lower parities, where there is less pressure to ensure a son, and more likely to increase or remain consistently high for higher-order spells, where the pressure to provide a son is high.

JEL: J1, O12, I1 Keywords: India, prenatal sex determination, censoring, competing risk

1 Introduction

Parents' spacing of births has long served as a measure of son preference (Leung, 1988). Before prenatal sex determination became available, the only recourse for parents who wanted a son—but did not yet have one—was to have the next birth sooner. Son preference is therefore often associated with shorter spacing after the births of girls than boys (Das, 1987; Rahman and DaVanzo, 1993; Pong, 1994; Haughton and Haughton, 1996; Arnold, 1997; van Soest and Saha, 2012; Rossi and Rouanet, 2015). Shorter spacing is, in turn, associated with worse health outcomes for girls and mothers (Arnold, Choe and Roy, 1998; Conde-Agudelo and Belizán, 2000; Whitworth and Stephenson, 2002; Razzaque, Vanzo, Rahman, Gausia, Hale, Khan and Mustafa, 2005; Rutstein, 2005; Conde-Agudelo, Rosas-Bermúdez and Kafury-Goeta, 2006).[1]

However, the introduction of prenatal sex determination fundamentally changed the relationship between son preference and birth spacing. Couples, who had shorter birth spacing before because of son preference, now have access to prenatal sex determination and sex-selective abortions, and each abortion increases birth spacing by six months to a year. The increase consists of three parts. First, starting from the time of the abortion, the uterus needs at least two menstrual cycles to recover; otherwise, the likelihood of spontaneous abortion increases substantially (Zhou, Olsen, Nielsen and Sabroe, 2000). The second part is the waiting time to conception, which is between one and six months (Wang, Chen, Wang, Chen, Guang and French, 2003). Finally, sex determination tests are reliable only from three months of gestation onwards.

As a result, we now have a situation where we may observer *longer* spacing for families with daughters than for families with sons, precisely because strong son preference leads them to use sex selection. Working in the opposite direction, couples with strong son preference will likely still try to conceive earlier in the absence of sons. They may even

[1] Parents are also more likely to cease childbearing after the birth of a son than after a daughter (Repetto, 1972; Ben-Porath and Welch, 1976; Das, 1987; Arnold, 1997; Arnold et al., 1998; Clark, 2000; Dreze and Murthi, 2001; Filmer, Friedman and Schady, 2009; Basu and De Jong, 2010; Altindag, 2016).

shorten the time until conception, knowing that they might have to go through multiple pregnancies and abortions before they conceive a son. To further complicate matters, we can still observe shorter birth spacing after the births of daughters as a representation of son preference for families who—for one reason or another—do not use prenatal sex selection.

Spacing, by itself, can therefore no longer be used as a direct measure of son preference, but understanding birth spacing remains a critical undertaking. First, birth spacing is still useful in understanding son preference, if combined with the likelihood of observing a boy or a girl. Second, the duration between births may be an important factor in parents' decisions, either for preference or economic reasons. It is, for example, possible that even parents with strong son preference may reverse their decision to use prenatal sex determination—and carry the next pregnancy to term whether male or female—as the duration from the previous birth becomes sufficiently long.

At a broader level, we know less about what determines spacing behavior in developing countries than in developed countries.[2] With increasing numbers of women entering the labor force in developing countries, understanding how couples make timing decisions will be necessary for the design of suitable policies (Pörtner, 2018a). Furthermore, if spacing does affect health outcomes for mother and children, it is essential to understand what drives changes in spacing. We know, for example, that health outcomes for girls appear to improve in the presence of sex selection (Lin, Liu and Qian, 2014; Hu and Schlosser, 2015). It is possible that these improvements are an unintended side-effect of

[2] Even the effects of access to contraceptive on spacing are uncertain. On the one hand, access to contraceptives allows women to avoid too short spacing between birth, which would increase birth spacing. On the other hand, increased reliability of access and effectiveness of contraceptives can lead to shorter spacing between births (Keyfitz, 1971; Heckman and Willis, 1976). With less reliable contraception parents choose a higher level of contraception, which results in longer spacing, to avoid having too many children by accident. But, as contraception becomes more effective parents can more easily avoid future births, allowing them to reduce the spacing between births without having to worry about overshooting their preferred number of children. This idea may explain why better-educated women have shorter spacing than less educated women in some instances (Tulasidhar, 1993; Whitworth and Stephenson, 2002). These two counteracting effects may explain why finding statistically significant effects of contraception use on birth spacing is difficult (Yeakey, Muntifering, Ramachandran, Myint, Creanga and Tsui, 2009).

the longer spacing that arises from sex-selective abortions, rather than because the smaller number of girls makes them more valued as is often assumed.

In this paper, I introduce and apply a novel empirical method that directly incorporates the effects of sex-selective abortions on the duration between births *and* the likelihood of a son. The method can be used to analyze both situations with and without prenatal sex selection. My proposed method allows for the time since the previous birth to affect the decision on sex selection. By examining under what circumstances sex selection decisions change with spacing, we can draw a more nuanced picture of the degree of son preference.

I apply the method to birth histories of Hindu women, using data from India's National Family and Health Surveys (NFHS), covering the period 1972 to 2016. India is a particularly compelling case. On the one hand, India has seen dramatic increases in the males-to-females ratio at birth over the last three decades as access to prenatal sex determination expanded (Das Gupta and Bhat, 1997; Sudha and Rajan, 1999; Arnold, Kishor and Roy, 2002; Retherford and Roy, 2003; Jha, Kumar, Vasa, Dhingra, Thiruchelvam and Moineddin, 2006).[3] On the other hand, research suggests that son preference in India, when measured as ideally having more boys than girls, is decreasing over time and with higher education (Bhat and Zavier, 2003; Pande and Astone, 2007).

There have also been substantial changes in access and legality of prenatal sex determination in India over the period covered. Abortion has been legal in India since 1971 and still is. The first reports of sex determination appeared around 1982–83 (Sudha and Rajan, 1999; Bhat, 2006; Grover and Vijayvergiya, 2006). The number of clinics quickly increased, and knowledge about sex selection became widespread after a senior government official's wife aborted a fetus that turned out to be male (Sudha and Rajan, 1999, p. 598). In 1994, the Central Government passed the Prenatal Diagnostic Techniques (PNDT) Act, making determining and communicating the sex of a fetus illegal.[4]

[3] India is not alone; both China and South Korea saw significant changes in the sex ratio at birth over the same period (Yi, Ping, Baochang, Yi, Bohua and Yongpiing, 1993; Park and Cho, 1995).

[4] Details about the act are at http://pndt.gov.in/. The number of convictions has been low. It took until January 2008 for the first state, Haryana, to reach five convictions. Hence, private clinics apparently operate

There are four main results. First, there has been a general increase in the length of spacing between births over the four decades covered by the data. The exception is for first births, where the median duration has either remained the same or slightly declined, although this hides a significant compression of the variation in spell length. Second, the most substantial increase in spacing is for the women who are most likely to use sex selection. Specifically, among the best-educated women, those with no boys now has significantly longer spacing—and a more male-biased sex ratio—than similar women with boys. Third, women with no education still follow the standard pattern of short spacing when they have girls and little evidence of the use of sex selection. In other words, these women adhere to a strategy where they achieve a son through higher fertility rather than the use of sex selection. Finally, sex ratios are the most likely to decline within spells at lower-order spells, where the pressure to provide a son is smaller, and are more likely to increase or remain consistently high for higher-order spells, where the pressure to ensure a son is high.

2 Estimation Strategy

The unit of analysis is a spell, the period from one birth, or marriage for the first spell, to the next. For some spells, the duration is censored, for example, because the survey took place before the birth that would end the spell or because the couple has finished childbearing. The standard approach to address the censoring of spells, which I follow here, is to use a hazard model. To capture the effects of sex selection, I extend the standard hazard model to allow for multiple exit states and a non-proportional hazard specification.

First, I use a competing risk framework with two possible exit states, either a boy or a girl is born, because access to prenatal sex determination means that parents can choose the sex of children born. Prior research on birth spacing, in contrast, relied on single exit

with little risk of legal action (Sudha and Rajan, 1999). Furthermore, there is little evidence that bans like this significantly affect sex ratios (Das Gupta, 2016).

state hazard models.[5] Having only one exit state works when there is no sex selection—making the sex of the child a random event—but not here since at least some couples use sex selection.

Second, I use a non-proportional hazard specification because sex composition and the use of sex selection are likely to affect the shape of the hazard functions across groups. The use of a non-proportional specification also mitigates any potential effects of unobserved heterogeneity when used in conjunction with a flexible baseline hazard (Dolton and von der Klaauw, 1995). Proportional hazard models, where covariates have a multiplicative effect on the hazard rate, are more efficient than non-proportional models, but only provided that the proportionality assumption hold. If the proportionality assumption does not hold, the estimates are biased.

It is unlikely—even in the absence of prenatal sex determination—that the effect of, for example, the sex composition of previous births have the same effect throughout the entire spell. Assuming that the effect of sex composition is the same throughout a spell is especially problematic for higher-order spells where different sex composition of previous births can lead to substantial differences both in the likelihood of progressing to the next birth and how soon couples want their next child if they are going to have one.

The introduction of prenatal sex determination is likely to exacerbate any bias from the proportionality assumption. First, sex-selective abortions affect birth spacing, and use varies across groups. Second, the use of sex selection may vary within a spell, which means that the effects of covariates vary within the spell as well.

In summary, my proposed model is a discrete time, non-proportional, competing risk hazard model with two exit states: either a boy or a girl is born. For each woman, $i = 1, \dots, n$, the starting point for a spell is time $t = 1$, and the spell continues until time t_i, when either a birth occurs or the spell is censored.[6] There are two exit states: the birth of

[5] Merli and Raftery (2000) used a discrete hazard model to examine whether there were under-reporting of births in rural China, although they estimated separate waiting time regressions for boys and girls.

[6] The time of censoring is assumed independent of the hazard rate, as is standard in the literature.

a boy, $j = 1$, or the birth of a girl, $j = 2$, and J_i is a random variable indicating which event took place. The discrete time hazard rate h_{ijt} is

$$h_{ijt} = \Pr(T_i = t, J_i = j \mid T_i \geq t; \mathbf{Z}_{it}, \mathbf{X}_i), \tag{1}$$

where T_i is a discrete random variable that captures when woman i's birth occurs. To ease presentation the indicator for spell number is suppressed. The explanatory variable vectors, $\mathbf{Z}_{it}$ and $\mathbf{X}_i$, include individual, household, and community characteristics discussed below.

The hazard rate is specified as

$$h_{ijt} = \frac{\exp(D_j(t) + \alpha'_{jt}\mathbf{Z}_{it} + \beta'_j\mathbf{X}_i)}{1 + \sum_{l=1}^{2} \exp(D_j(t) + \alpha'_{lt}\mathbf{Z}_{it} + \beta'_l\mathbf{X}_i)} \quad j = 1, 2 \tag{2}$$

where $D_j(t)$ is the piece-wise linear baseline hazard for outcome j, captured by dummies and the associated coefficients,

$$D_j(t) = \gamma_{j1}D_1 + \gamma_{j2}D_2 + ... + \gamma_{jT}D_T, \tag{3}$$

where $D_m = 1$ if $t = m$ and zero otherwise. This approach to modeling the baseline hazard is flexible and does not place overly strong restrictions on the baseline hazard.

The explanatory variables in $\mathbf{Z}$ and the interactions between them are the non-proportional part of the model, which means that they are interacted with the baseline hazard:

$$\mathbf{Z}_{it} = D_j(t) \times (\mathbf{Z}_1 + Z_2 + \mathbf{Z}_1 \times Z_2), \tag{4}$$

where $D_j(t)$ is the piece-wise linear baseline hazard and $\mathbf{Z}_1$ captures sex composition of previous children, if any, and Z_2 captures area of residence. The non-proportionality allows the effects of the main explanatory variables on the probabilities of having a boy, a girl, or no birth to vary over time within a spell. The remaining explanatory variables, $\mathbf{X}$, enter proportionally, but to further minimize any potential bias from assuming proportionality, estimations are done separately for different levels of mothers' education and for different time periods.

Equation (2) is equivalent to the logistic hazard model and has the same likelihood function as the multinomial logit model (Allison, 1982; Jenkins, 1995). Hence, transforming the data, so each observation is an interval—here equal to three months—the model can be estimated using a standard multinomial logit model.[7] In the reorganized data the outcome variable is 0 if the woman does not have a child in a given interval (the base outcome), 1 if she gives birth to a son in that interval, and 2 if she gives birth to a daughter in that interval.

The main downside of this set-up is that interpretation of the estimated coefficients is challenging; the coefficients show the change in hazards relative to the base outcome, here no birth, rather than the hazard of an event. Hence, a positive coefficient does not necessarily imply that the associated exit state becomes more likely as the explanatory variable increases because the probability of the other exit state may increase even more (Thomas, 1996).

It is, however, straightforward to calculate the predicted probabilities of having a boy and of having a girl for each t within a spell, conditional on a set of explanatory variables and not having had a child before that period. The predicted probability of having a boy in period t for a given set of explanatory variable values, $\mathbf{Z}_k$ and $\mathbf{X}_k$, is

$$P(b_t|\mathbf{X}_k, \mathbf{Z}_{kt}, t) = \frac{\exp(D_j(t) + \alpha'_{1t}\mathbf{Z}_{kt} + \beta'_1\mathbf{X}_k)}{1 + \sum_{l=1}^{2} \exp(D_j(t) + \alpha'_{lt}\mathbf{Z}_{kt} + \beta'_l\mathbf{X}_k)}, \tag{5}$$

[7] A potential issue is that the multinomial model assumes that alternative exit states are stochastically independent, also known as the Independence of Irrelevant Alternatives (IIA) assumption. This assumption rules out any individual-specific unmeasured or unobservable factors that affect both the hazard of having a girl and the hazard of having a boy. I, therefore, include a proxy for fecundity discussed in Section 3. Also, the multivariate probit model can be used as an alternative to the multinomial logit because the IIA is not imposed (Han and Hausman, 1990). The results are substantially identical between these two models and available upon request.

and the predicted probability of having a girl is

$$P(g_t|\mathbf{X}_k, \mathbf{Z}_{kt}, t) = \frac{\exp(D_j(t) + \alpha'_{2t}\mathbf{Z}_{kt} + \beta'_2\mathbf{X}_k)}{1 + \sum_{l=2}^{2}\exp(D_j(t) + \alpha'_{lt}\mathbf{Z}_{kt} + \beta'_l\mathbf{X}_k)}. \tag{6}$$

Within each period the probability of not having a birth in period t is $1 - P(b_t) - P(g_t)$.

The distribution of spacing is captured by the survival curve, which shows the probability of not having had a birth yet by spell duration, for a given set of explanatory variables. The survival curve at time t is

$$S_t = \prod_{d=1}^{t}\left(1 - \left(P(b_d|\mathbf{X}_k, \mathbf{Z}_{kd}, d) + P(g_d|\mathbf{X}_k, \mathbf{Z}_{kd}, d)\right)\right), \tag{7}$$

or equivalently

$$S_t = \prod_{d=1}^{t}\left(\frac{1}{1 + \sum_{l=2}^{2}\exp(D_j(t) + \alpha'_{ld}\mathbf{Z}_{kd} + \beta'_l\mathbf{X}_k)}\right). \tag{8}$$

An important issue is that the probability of ever having a next birth varies across groups. For example, as the parity progression literature shows, couples with stronger son preference are less likely, for a given number of prior births, to ever have a next birth if they already have one or more sons. Direct comparison of standard survival curves, therefore, tells us little about how the spread of sex selection affects birth spacing across groups.

To overcome this problem, I condition on the predicted likelihood of parity progression when examining birth spacing measures, such as the median duration to a birth. How well this approach works depends on whether the spell length covered is sufficiently long that few women are likely to give birth after the spell cut-off. I discuss the choice of spell length below. It is important to note that the approach is not the same as merely calculating the birth spacing measures for women who already have a given parity child in the survey because that number does not take into account the censoring of spells that will eventually lead to a birth. In addition to calculating conditional birth spacing measures for different percentages, I also present graphs of both standard survival curves and survival curves conditional on parity progression (which therefore begin at 100% and end at 0%).

Finally, given the predicted probabilities of having a boy and of having a girl for each t within a spell, is it easy to calculate the estimated percentage of children born that are boys, $\hat{Y}$, at each t

$$\hat{Y}_t = \frac{P(b_t|\mathbf{X}_k, \mathbf{Z}_{kt}, t)}{P(b_t|\mathbf{X}_k, \mathbf{Z}_{kt}, t) + P(g_t|\mathbf{X}_k, \mathbf{Z}_{kt}, t)} \times 100. \tag{9}$$

Combining the percentage boys and the likelihood of exiting the spell across all t gives the predicted percent boys born over the entire spell. In addition to the predicted percent boys over the entire spell, I also present graphs of how the percentage boys born vary across time within a spell, together with the associated confidence interval for given values of explanatory variables calculated using the Delta method.

3 Data

The data come from the four rounds of the National Family Health Survey (NFHS-1, NFHS-2, NFHS-3, and NFHS-4), collected in 1992–1993, 1998–1999, 2005–2006, and 2015–2016.[8] The surveys are large: NFHS-1 covered 89,777 ever-married women aged 13–49 from 88,562 households; NFHS-2 covered 90,303 ever-married women aged 15–49 from 92,486 households; NFHS-3 covered 124,385 never-married and ever-married women aged 15–49 from 109,041 households; and NFHS-4 covered 699,686 never-married and ever-married women aged 15–49 from 601,509 households surveyed.

I exclude visitors to the household, as well as women who have been married more than once, divorced, or who are not living with their husband, women with inconsistent age at marriage, and those with missing information on education. Women interviewed in NFHS-3 or NFHS-4 who were never married or where Gauna had not yet been performed were also dropped. The same goes for women who had at least one multiple

[8] A delay in the survey for Tripura means that NFHS-2 has some observation collected in 2000.

births, reported having a birth before age 12, had a birth before marriage, or duration between births of less than nine months. Women who reported less than nine months between marriage and first birth remain in the sample—unless they are dropped for another reason—because 8.5% fall into this category across the four surveys. Although it is possible that some of these births are premature, the high number of women who report a birth less than six months after their marriage indicates that for a majority conception likely occurred before marriage.

Finally, I restrict the sample to Hindus, who constitute about 80% of India's population. If the use of sex selection differ between Hindu and other religions, such as Sikhs, assuming that the baseline hazard is the same would lead to bias. The other groups are each so small relative to Hindus that it is not possible to estimate different baseline hazards for each group. Furthermore, the other groups are so different in background and son preference that combining them into one group would not make sense.

There are four advantages to using the NFHS. First, surveys enumerators pay careful attention to spacing between births and probe for "missed" births. Second, no other surveys cover as extended a period in the same amount of detail. The four NFHS rounds allow me to show how spacing and sex ratio changed from before sex-selective abortions were available until 2016. Third, NFHS has birth histories for a large number of women. Finally, even if probing for missing births does not eliminate recall error, the overlap in cohorts covered and the large sample size makes it possible to establish where recall error remains a problem.

Recall error arises mainly from child mortality when respondents are reluctant to discuss deceased children. Systematic recall error, where the likelihood of reporting a deceased child depends on the sex of the child, is especially problematic because it biases both spacing and sex ratios. Probing catches many missed births, but systematic recall error is still a potentially substantial problem.

Three factors contribute to the problem here. First, girls have significantly higher mortality risk than boys. Second, son preference may increase the probability that parents recall boys more readily than girls. Finally, in NFHS-1 and NFHS-2 enumerators probed only for a missed birth if the initially reported birth interval was four calendar years or more, but, given short durations between births, especially after the birth of a girl, that procedure is unlikely to pick up all missed children.

Recall error is heavily dependent on how long ago a woman was married (Pörtner, 2018b). I, therefore, drop women married 22 years or more for NFHS-1, with the corresponding cut-off points 23 years for NFHS-2, and 25 years for NFHS-3 and NFHS-4. The final sample consists of 427,813 women, with 909,558 parity one through four births.

3.1 Spell Definition

As mentioned above, 8.5% of women gave birth less than nine months after they were married, and the first spell, therefore, begins at the month of marriage. The exception is for women married very young, where I use the month they turned 12. The second and subsequent spells begin nine months after the previous birth because that is the earliest we should expect to observe a new birth. A few women report births that occurred less than nine months after the previous birth; I drop those women from the sample as mentioned above.

All spells continue until either a child is born or censoring occurs. Censoring can happen for three reasons: the survey takes place; sterilization of the woman or her husband; or too few births are observed for the method to work. For the first spell I set censoring because of too few births to 108 months (nine years) after marriage, while for the second, third, and fourth spells censoring is at 96 months (eight years) after a birth can occur. With these cut-offs, less than one percent of observed births occur after the spell cut-off.[9]

[9] The cut-offs are determined not by the total number of births, but by how many that occur in each three months period. If there are too few births, the multinomial logit estimations will not converge. For spell 1, 0.74%, or 2,814 births, of a total of 378,726 births are observed after 120 months from the month of marriage, with the highest observed duration 280 months. For spell 2, 0.93%, or 2,751 births, of a total of 295,924 births are observed after 105 months from the first birth, with the highest observed duration 259 months. For spell

I group spells into four periods based on the year of marriage or year of the previous birth: 1972–1984, 1985–1994, 1995–2004, and 2005–2016. The periods follow the main changes in availability and legality of prenatal sex determination discussed in the Introduction. The allocation into periods is determined by when conception and therefore decisions on sex selection can begin, even if we do not observe any births until nine months later.

The allocation into periods means that some spells cover two periods. A couple may, for example, be married in 1984, but not have their first child until 1986. That couple's first spell will be in the 1972–1984 period, even though most of the interval falls in the 1985–1994 period. Hence, prenatal sex determination was likely available when some children from spells that began in the 1972–1984 period were conceived, which could result in evidence of sex-selective abortions even for this period. Similarly, a spell that started in the 1985–1994 period may have been partly or mostly under the PDNT act. The effect is a downward bias in the differences between the periods.

3.2 Explanatory Variables

I divide the explanatory variables into two groups. The first group consists of variables expected to affect the shape of the hazard function (the **Z** variables): mother's education, sex composition of previous children, and area of residence. I chose these variables because the prior literature shows that they affect spacing choices and correlate with sex selection. Increasing the number of variables interacted with the baseline hazard would further lower the risk of bias but at the cost of requiring more data to precisely estimate.

I divide women into three groups based on education attainment: no education, one to seven years of education, and eight and more years of education. The models are es-

3, 0.72%, or 1,154 births, of a total of 159,586 births are observed after 105 months from the second birth, with the highest observed duration 236 months. For spell 4, 0.52%, or 392 births, of a total of 75,322 births are observed after 105 months from the third birth, with the highest observed duration 197 months. Recall also that these numbers are totals across all 36 separate regressions.

timated separately for each education level to reduce the potential problem of including other variables as proportional. Increasing education of mothers correlates closely with lower fertility (Schultz, 1997), and we should expect lower fertility to lead to more use of sex selection.[10]

I capture sex composition with dummy variables for the possible combinations for the specific spell, ignoring the ordering of births. As an example, for the third spell, three groups are used: Two boys, one girl and one boy, and two girls. It is, in principle, possible to estimate the model taking into account the ordering of children, but this would further lower the power of the test, by adding one additional group for the third spell and four additional groups for the fourth spell. As discussed, the sex composition of previous children affects both the timing of births and the use of sex-selective abortions.

Area of residence is a dummy variable for the household living in an urban area. The cost of children is higher in urban areas than in rural areas, and there is easier access to prenatal sex determination in urban areas. Both factors are likely to lead to higher use of sex-selective abortions in urban than in rural areas.

The second group of variables consists of those expected to have an approximately proportional effect on the hazard. These include the length of the first spell (for the second and higher-order spells to capture fecundity), the age of the mother at the beginning of the spell, whether the household owns any land, and whether the household belongs to a scheduled tribe or caste. We cannot observe fecundity directly, but the time from marriage until first birth is a suitable proxy because most Indian women do not use contraception before the first birth and there is pressure to show that a newly married woman can conceive (Dyson and Moore, 1983; Sethuraman, Gujjarappa, Kapadia-Kundu, Naved, Barua, Khoche and Parveen, 2007; Dommaraju, 2009). The absence of contraception before the first birth is confirmed below by the very short spells between marriage and first birth,

[10] Fathers' education has two opposite predicted effects: the associated higher income should increase fertility and therefore lower the pressure to use sex selection, but the higher income also makes the use of sex selection cheaper. In practice, fathers' education had little effect on the hazards and the use of sex-selective abortions, and I, therefore, do not include it.

even among the most educated. Hence, a long spell between marriage and first birth is likely due to low fecundity. For both duration from marriage to first birth and the age of the mother at the beginning of the spell, I also include their squares. The remaining variables are dummies for household ownership of land and membership of a scheduled caste or tribe.

3.3 Descriptive Statistics

Appendix Table A.1 presents descriptive statistics for the spells by education level and period they began. There is a substantial number of censored observations. As an example, for highly educated women who had their first child in the 2005–2016 period, more than 40% did not have their second child by the time of the survey. Censoring becomes even more important for the third and fourth spells, with around 70% of the observations censored. The level of censoring also increases with parity and time, which reflects a combination of factors: timing of the surveys relative to the periods of interest, later beginning of childbearing, falling fertility, and the increase in spell lengths from sex-selective abortions.

The share of urban women in the sample has fallen slightly over the periods, even though India's population has become progressively more urbanized. For the first and second periods, over 32% of the women entering the first spell lived in urban areas, falling to 30% for the third period and 26% in the last period. The most likely explanation is that the age of marriage has increased faster in urban areas than in rural areas. Hence, there are relatively more urban women, but fewer show up in the sample because they are not yet married.

The population has become substantially better educated over time. Women with no education constituted almost 60% in the first period, but less than twenty percent in the last period. Correspondingly, in the first period just over twenty percent had eight or more years of education, whereas in the last period more than 60% did. These changes are an underestimate of the increase in female education overall because many of the younger women with more education have not yet married than therefore are not in the sample.[11]

Age at marriage increased over time across all three education groups. The most substantial increase was for women without any education, where the average went from below 16 years of age to 18.5. The smallest change is for the most educated women where the average age at marriage went up by less than a year—from 19.6 to 20.4—across the four periods.

4 Results

The overall hypothesis is that spacing patterns significantly changed as prenatal sex determination became available. To address this, I examine three questions in order of importance.

First, did the spacing after girls increase relative to the spacing after boys? The underlying hypothesis is that in the absence of sex selection son preference leads to shorter spacing after the birth of a girl than after the birth of a boy, whereas son preference increases the spacing after the birth of a girl relative to after the birth of a boy when prenatal sex selection is available. I still expect parents to *try* to conceive earlier after the birth of a girl than after a boy, but the abortions will increase the duration between births, and may even lead to longer spacing after the birth of girls than after boys.

Second, have the shapes of the survival curves changed? The shapes of the survival curves provide information both on general changes in birth spacing and whether parents are still trying to conceive earlier after girls than boys. I expect this to be the case if there is still a strong preference for boys, and, as discussed above, this behavior may even become more pronounced with access to sex selection.

[11] Women with eight or more years of education accounted for 65.9% of unmarried women in NFHS-3 and 82.8% of unmarried women in NFHS-4. See International Institute for Population Sciences (IIPS) and Macro International (2007, p 56) and International Institute for Population Sciences (IIPS) and ICF (2017, p 61) for more information.

Finally, does the sex ratio change within a spell? There are two reasons why this is interesting. First, if the sex ratio changes within a spell, relying on the observed sex ratio at birth—as is standard practice in the literature—will not provide correct estimates of the use of sex selection or the sex ratio at the conclusion of childbearing. Second, any changes in the sex ratio within a spell provides clues to parents' preferences over the ideal spacing between births and the distribution of son preference in the sample.

Tables 1, 2, and 3 show the predicted median duration and sex ratios by period, spell, and sex composition for the three education levels separated by area of residence.[12] For each subsample, I first estimate the model described in Section 2 and then use the estimated coefficients to predict median duration and sex ratio. For the standard errors, I use bootstrapping for both measures, where the model is repeatedly estimated using resampling with replacement.

The predicted median duration is the weighted average over the women in the subsample, using the individual probabilities of giving birth as weights. For each woman in a sample, I calculate her probability of ending the spell with a birth, and her contribution to median spacing is how long it will take from the beginning of the spell to where she is predicted to reach half of that probability. For example, if a woman has an 80% probability of having a birth by the end of the spell, her median duration is the number of months it takes to reach 40% probability of having exited with a birth. The 40% is equivalent to the 60% point on a standard survival curve because that captures how many have not yet exited.

For the second through the fourth spell, I show whether durations for sex composition other than only girls are statistically significantly different from the duration with only girls. To calculate the level of statistical significance, I bootstrap the difference in spacing.

The cleanest test is comparing durations after only boys with durations after only girls, but the number of births to women with only sons becomes small in the later periods.

[12] Appendix Tables B.1, B.2, and B.3 show 25th and 75th percentiles durations.

Hence, it is possible to have substantial differences in spacing that are not statistically significant because of low power, especially for the third and fourth spell.

The predicted sex ratio is the weighted average over the women in the sample's individual predicted sex ratios, using the individual probabilities of having given birth by the end of the spell as weights. Each woman's predicted sex ratio is the weighted average of the predicted percentage boys over the months in the spell calculated using equation (9) and the probability of giving birth in each month as weights.[13] The predicted sex ratio captures the percent boys that will have been born to women in the sample when childbearing for that spell is over.

Each predicted percent boys is tested against the natural percentage boys using the bootstrapped standard errors. The natural sex ratio is approximately 105 boys to 100 girls or 51.2% (Ben-Porath and Welch, 1976; Jacobsen, Moller and Mouritsen, 1999; Pörtner, 2015). The predicted percentage boys may differ from the natural rate because of natural variation, any remaining recall error not corrected for, or sex selection.

4.1 No Education Women

Women with no education follow a pattern consistent with son preference with shorter spacing when they have only girls compared to when they have one or more sons, and the differences are often statistically significant as shown in Table 1. Most of the women without education live in rural areas, whereas there are relatively few urban women with no education. There are especially very few urban women to based the third and fourth spell results on, and I therefore focus on rural women.

Predicted median duration has increased over time within each sex composition. The exception is for the first spell, where there is little change, and possibly even a small de-

[13] Imagine a spell has two periods and that the estimated percentage boys for a woman are 54% and 66% and that the likelihood of having a birth is 20% and 40%. The likelihood of having a birth is the change in the survival curve; in other words, there is 40% chance that she will not have given birth by the end of this spell. This woman's percentage boys is then $\frac{54*0.2+66*0.4}{0.2+0.4} = 62$.

Table 1: Estimated Median Duration and Sex Ratio for Women with No Education

Spell	Composition of Prior Children	1972–1984 Duration[a] (Months)	1972–1984 Percent[b] Boys	1985–1994 Duration[a] (Months)	1985–1994 Percent[b] Boys	1995–2004 Duration[a] (Months)	1995–2004 Percent[b] Boys	2005–2016 Duration[a] (Months)	2005–2016 Percent[b] Boys
				Urban					
1		23.3	52.3*	21.7	53.2***	23.0	52.6**	21.9	53.2**
		(0.3)	(0.7)	(0.2)	(0.6)	(0.2)	(0.6)	(0.3)	(0.9)
2	One girl	17.9	52.4	18.5	53.0*	18.9	51.9	19.7	56.0***
		(0.3)	(1.3)	(0.3)	(1.0)	(0.3)	(0.9)	(0.6)	(1.5)
	One boy	18.9**	52.6	20.1***	50.9	19.7**	52.0	20.0	50.1
		(0.3)	(1.2)	(0.3)	(0.9)	(0.3)	(0.9)	(0.4)	(1.3)
3	Two girls	18.8	52.0	18.4	51.4	20.1	53.4	22.2	52.5
		(0.7)	(2.3)	(0.4)	(1.6)	(0.5)	(1.5)	(0.7)	(2.0)
	One boy / one girl	18.4	55.3***	20.0***	51.8	20.2	52.5	20.2**	53.6
		(0.4)	(1.5)	(0.4)	(1.1)	(0.3)	(1.0)	(0.4)	(1.7)
	Two boys	18.7	49.1	21.2***	49.8	21.4*	47.9**	22.8	52.0
		(0.7)	(2.0)	(0.6)	(1.4)	(0.6)	(1.4)	(1.1)	(2.2)
4	Three girls	18.0	55.5	19.8	51.1	20.4	53.2	23.7	56.4*
		(1.0)	(3.9)	(0.6)	(2.6)	(0.7)	(2.3)	(1.2)	(2.9)
	One boy / two girls	18.6	54.3	20.3	53.3	21.0	54.2**	23.6	49.6
		(0.5)	(2.4)	(0.4)	(1.5)	(0.4)	(1.5)	(0.7)	(2.2)
	Two boys / one girl	20.1*	54.7	22.9***	50.8	22.6**	51.3	24.1	53.9
		(0.6)	(2.9)	(0.6)	(1.8)	(0.6)	(1.8)	(0.9)	(2.9)
	Three boys	21.2*	59.3*	23.3***	54.8	20.5	51.2	23.7	46.9
		(1.3)	(4.6)	(1.0)	(3.1)	(0.7)	(3.1)	(1.3)	(4.6)
				Rural					
1		26.2	52.1***	24.5	52.5***	25.9	51.8**	24.4	51.5
		(0.2)	(0.3)	(0.1)	(0.3)	(0.1)	(0.3)	(0.1)	(0.4)
2	One girl	18.5	51.1	19.2	52.1**	19.7	52.0**	19.7	51.8
		(0.2)	(0.6)	(0.1)	(0.5)	(0.1)	(0.3)	(0.2)	(0.5)
	One boy	19.6***	52.7**	20.1***	52.1*	19.9	51.3	20.1*	52.2*
		(0.2)	(0.6)	(0.1)	(0.5)	(0.1)	(0.3)	(0.2)	(0.5)
3	Two girls	17.9	49.4*	19.8	53.4***	19.8	54.0***	20.3	52.9**
		(0.2)	(1.0)	(0.2)	(0.7)	(0.2)	(0.5)	(0.2)	(0.7)
	One boy / one girl	19.1***	53.0**	19.7	51.9	20.2**	52.6***	21.1***	51.8
		(0.2)	(0.7)	(0.2)	(0.5)	(0.1)	(0.4)	(0.2)	(0.6)
	Two boys	19.1***	51.4	20.6**	51.1	20.8***	51.0	22.0***	50.9
		(0.3)	(1.0)	(0.3)	(0.7)	(0.2)	(0.6)	(0.3)	(0.9)
4	Three girls	18.9	53.7	20.1	50.2	19.6	53.6**	21.9	54.2**
		(0.4)	(1.8)	(0.3)	(1.3)	(0.2)	(1.0)	(0.3)	(1.2)
	One boy / two girls	19.3	52.6	21.4***	53.1**	21.1***	53.1***	22.9***	52.3
		(0.3)	(1.2)	(0.2)	(0.8)	(0.2)	(0.6)	(0.2)	(0.8)
	Two boys / one girl	19.3	53.7**	21.9***	50.3	22.2***	51.7	25.0***	50.5
		(0.2)	(1.2)	(0.2)	(0.8)	(0.2)	(0.7)	(0.3)	(1.0)
	Three boys	19.6	51.0	22.4***	51.0	22.1***	52.2	24.9***	51.9
		(0.5)	(1.9)	(0.4)	(1.4)	(0.4)	(1.2)	(0.6)	(1.7)

Note. The statistics for each spell/period combination are calculated based on the regression model for that combination as described in the main text, using bootstrapping to find the standard errors shown in parentheses. For bootstrapping, the original sample is resampled, the regression model run on the resampled data, and the statistics calculated. This process is repeated 250 times and the standard errors calculated.

[a] Median duration is calculated as follows. For each woman in a given spell/period combination sample, I calculate the time point at which there is a 50% chance that she will have given birth, conditional on the probability that she will eventually give birth in that spell. For example, if there is an 80% chance that a woman will give birth by the end of the spell, her median duration is the predicted number of months before she passes the 40% mark on her survival curve. The reported statistics is the average of this median duration across all women in a given sample using the individual predicted probabilities of having had a birth by the end of the spell as weights. Duration begins at marriage for spell 1 or at 9 months after the birth of the prior child for all other spells. For spells two and higher duration sex compositions other than all girls are tested against the duration for all girls, with *** indicating significantly different at the 1% level, ** at the 5% level, and * at the 10% level.

[b] Percent boys is calculated as follows. For each woman in a given spell/period combination sample, I calculate the predicted percent boys for each month and sum this across the length of the spell using the likelihood of having a child in each month as the weight. The percent boys is then averaged across all women in the given sample using the individual predicted probabilities of having had a birth by the end of the spell as weights. The result is the predicted percent boys that will be born to women in the sample once child bearing for that spell is over. The predicted percent boys is tested against the natural percentage boys, 105 boys per 100 girls, with *** indicating significantly different at the 1% level, ** at the 5% level, and * at 10% level.

cline.

The differences in duration across sex compositions increase with spell number. For the second spell, the difference in median duration between having a girl or a boy as the first-born are mostly between a half and one month. For the third spell, the difference in duration between only girls and only boys is, on average, slightly over one month and statistically significant in all periods. The differences for the fourth spell are between two and three months, except for the 1972–1984 period, which is also the only period where the difference is not statistically significant.

There are no clear time trends in the differences in median duration across sex compositions or the predicted sex ratios across the four periods. Despite that some sex ratios are statistically significantly higher than the natural sex ratio there is therefore little consistent evidence for the use of sex selection for women without education. There has, for example, been relatively little change in the length of spacing for rural women with two girls in the third spell and the predicted sex ratio was higher in the 1985–1994 period than in the 2005–2016 period. The possible exception is the fourth spell, where both duration and sex ratio has increased for women with three girls, although the *difference* across sex compositions has remained almost the same.

4.2 Middle Education Women

Women with one to seven years of education follow a pattern broadly similar to those with no education as Table 2 shows. The sample size is more evenly distributed across urban and rural for this education group than for the no education women. As a result, the only spells where there are few women to base results on are for the fourth spell for urban women and the first period of the fourth spell for rural women.

The spacing between births increased over the four decades. On average, the increase is approximately three to four months. The exception is again the first spell, where the time from marriage to first birth remained the same or fell slightly.

Table 2: Estimated Median Duration and Sex Ratio for Women with 1 to 7 Years of Education

Spell	Composition of Prior Children	1972–1984 Duration[a] (Months)	1972–1984 Percent[b] Boys	1985–1994 Duration[a] (Months)	1985–1994 Percent[b] Boys	1995–2004 Duration[a] (Months)	1995–2004 Percent[b] Boys	2005–2016 Duration[a] (Months)	2005–2016 Percent[b] Boys
				Urban					
1		20.4	52.6	19.3	52.6**	20.9	52.3*	19.4	51.4
		(0.4)	(0.9)	(0.2)	(0.6)	(0.2)	(0.6)	(0.2)	(0.8)
2	One girl	17.3	51.5	19.2	52.1	20.0	53.2**	21.3	52.9
		(0.3)	(1.5)	(0.4)	(1.1)	(0.3)	(0.9)	(0.4)	(1.3)
	One boy	18.4**	50.9	20.5***	50.7	20.5	49.9	22.4	51.3
		(0.4)	(1.3)	(0.4)	(1.0)	(0.3)	(0.9)	(0.5)	(1.2)
3	Two girls	17.8	56.5**	20.2	53.0	22.4	56.5***	23.7	56.2**
		(0.6)	(2.7)	(0.6)	(1.8)	(0.7)	(1.5)	(0.9)	(2.2)
	One boy / one girl	19.7**	53.4	20.5	53.3	20.8*	51.6	22.3	55.7**
		(0.6)	(1.9)	(0.5)	(1.4)	(0.5)	(1.3)	(0.7)	(1.9)
	Two boys	19.2	48.0	21.2	50.3	21.4	49.1	23.7	52.3
		(0.7)	(2.6)	(0.8)	(2.0)	(0.5)	(2.0)	(1.1)	(2.6)
4	Three girls	19.6	47.8	20.8	56.2	25.5	63.1***	24.0	56.8
		(1.4)	(5.5)	(1.0)	(3.3)	(1.3)	(3.2)	(1.2)	(3.5)
	One boy / two girls	19.4	53.7	21.9	53.3	21.8***	55.4*	21.9	52.2
		(0.7)	(2.9)	(0.7)	(2.2)	(0.6)	(2.3)	(0.7)	(2.7)
	Two boys / one girl	20.3	51.4	23.5*	54.1	23.4	54.0	27.2	49.4
		(0.9)	(3.4)	(1.0)	(2.9)	(0.9)	(2.7)	(1.8)	(4.4)
	Three boys	19.4	56.8	23.7*	40.4**	23.8	42.4*	28.1	58.0
		(1.7)	(7.6)	(1.4)	(4.2)	(1.5)	(4.9)	(3.4)	(6.9)
				Rural					
1		22.1	51.5	21.6	52.1*	23.0	52.2***	22.0	52.4***
		(0.3)	(0.6)	(0.2)	(0.5)	(0.1)	(0.4)	(0.1)	(0.4)
2	One girl	18.2	51.4	19.2	51.1	20.2	53.4***	20.5	52.9***
		(0.3)	(1.1)	(0.2)	(0.7)	(0.2)	(0.5)	(0.2)	(0.6)
	One boy	19.5***	50.2	20.0**	51.0	20.5	51.5	21.3**	50.4
		(0.3)	(1.0)	(0.2)	(0.7)	(0.2)	(0.5)	(0.2)	(0.5)
3	Two girls	18.1	50.5	19.4	54.1**	21.2	54.2***	22.3	55.6***
		(0.5)	(1.7)	(0.4)	(1.3)	(0.3)	(0.9)	(0.3)	(0.9)
	One boy / one girl	19.2*	52.1	20.3*	51.5	20.9	52.7**	22.3	53.5***
		(0.4)	(1.3)	(0.3)	(1.1)	(0.2)	(0.7)	(0.3)	(0.8)
	Two boys	20.9***	49.4	21.0***	51.0	21.3	49.7	23.2	49.4
		(0.6)	(2.1)	(0.5)	(1.5)	(0.4)	(1.0)	(0.5)	(1.4)
4	Three girls	19.2	50.5	21.1	55.2*	22.8	56.3***	24.4	57.7***
		(0.8)	(3.6)	(0.6)	(2.2)	(0.5)	(1.7)	(0.5)	(1.5)
	One boy / two girls	19.9	49.9	21.8	55.1**	22.0	53.1	23.9	51.8
		(0.5)	(2.1)	(0.4)	(1.6)	(0.3)	(1.2)	(0.4)	(1.3)
	Two boys / one girl	21.3**	45.7**	23.0**	52.0	22.9	50.4	26.3**	52.8
		(0.7)	(2.8)	(0.5)	(1.9)	(0.4)	(1.6)	(0.7)	(1.9)
	Three boys	19.7	51.9	22.2	55.6	22.9	47.8	25.3	45.5
		(1.0)	(4.3)	(1.1)	(3.4)	(0.8)	(2.9)	(1.2)	(3.7)

Note. The statistics for each spell/period combination are calculated based on the regression model for that combination as described in the main text, using bootstrapping to find the standard errors shown in parentheses. For bootstrapping, the original sample is resampled, the regression model run on the resampled data, and the statistics calculated. This process is repeated 250 times and the standard errors calculated.

[a] Median duration is calculated as follows. For each woman in a given spell/period combination sample, I calculate the time point at which there is a 50% chance that she will have given birth, conditional on the probability that she will eventually give birth in that spell. For example, if there is an 80% chance that a woman will give birth by the end of the spell, her median duration is the predicted number of months before she passes the 40% mark on her survival curve. The reported statistics is the average of this median duration across all women in a given sample using the individual predicted probabilities of having had a birth by the end of the spell as weights. Duration begins at marriage for spell 1 or at 9 months after the birth of the prior child for all other spells. For spells two and higher duration sex compositions other than all girls are tested against the duration for all girls, with *** indicating significantly different at the 1% level, ** at the 5% level, and * at the 10% level.

[b] Percent boys is calculated as follows. For each woman in a given spell/period combination sample, I calculate the predicted percent boys for each month and sum this across the length of the spell using the likelihood of having a child in each month as the weight. The percent boys is then averaged across all women in the given sample using the individual predicted probabilities of having had a birth by the end of the spell as weights. The result is the predicted percent boys that will be born to women in the sample once child bearing for that spell is over. The predicted percent boys is tested against the natural percentage boys, 105 boys per 100 girls, with *** indicating significantly different at the 1% level, ** at the 5% level, and * at 10% level.

In the period before sex selection became available, 1972–1985, the differences in spacing between only girls and only boys increase with between the second and third spell. For both urban and rural women, the difference in duration is just over a month for the second spell, but it is 1.4 and 2.8 months for urban and rural women, respectively, for the third spell. In the three later periods, there is no clear pattern in the differences across sex compositions.

The differences in duration between only girls and only boys appear to decrease over time. The exception is for the two later periods where the differences are slightly larger in the last period compared with the second-to-last period.

The decreases in differences are accompanied by increases in predicted sex ratios, some of which are statistically significantly different from the natural sex ratio. Hence, even though the evidence is not substantial, it does appear that women with one to seven years of education have begun to use sex selection at higher-order spells.

4.3 High Education Women

Women with eight or more year of education mostly followed the traditional spacing pattern before sex selection became available as shown in Table 3. Compared to the two other education groups there are, however, more situations where the pattern is less clear. Part of the problem may be that there are few women in this group for the 1972–1984 period, and, hence, only the results for the first and second spells in both urban and rural areas are likely reliable.

Birth spacing increases substantially over time, especially for urban women. The median duration for urban women increases between a half and a full year, whereas the increase for rural women is between a quarter and half a year. The spacing between marriage and the first birth is still the exception, and for this group of women, there is a decline of about a month for both urban and rural areas.

In urban areas, the increase in spacing with only girls is so substantial that women with

Table 3: Estimated Median Duration and Sex Ratio for Women with 8 or More Years of Education

		1972–1984		1985–1994		1995–2004		2005–2016	
Spell	Composition of Prior Children	Duration[a] (Months)	Percent[b] Boys	Duration[a] (Months)	Percent[b] Boys	Duration[a] (Months)	Percent[b] Boys	Duration[a] (Months)	Percent[b] Boys
				Urban					
1		20.0	51.1	19.2	52.7***	19.1	52.8***	18.8	52.7***
		(0.2)	(0.6)	(0.1)	(0.4)	(0.1)	(0.3)	(0.1)	(0.4)
2	One girl	19.8	52.1	24.6	55.6***	25.9	58.1***	29.0	56.1***
		(0.4)	(1.0)	(0.3)	(0.7)	(0.2)	(0.5)	(0.3)	(0.6)
	One boy	20.9**	51.8	24.7	52.1	25.6	50.1**	29.0	49.6**
		(0.4)	(1.0)	(0.3)	(0.7)	(0.2)	(0.5)	(0.4)	(0.6)
3	Two girls	21.5	54.9*	27.3	63.7***	28.6	65.8***	33.2	66.3***
		(0.8)	(2.1)	(0.8)	(1.4)	(0.6)	(1.2)	(0.9)	(1.5)
	One boy / one girl	20.7	54.8**	24.2***	54.1**	24.0***	53.5**	26.7***	55.6***
		(0.6)	(1.7)	(0.6)	(1.3)	(0.4)	(1.0)	(0.8)	(1.4)
	Two boys	21.8	49.5	25.6	52.2	24.2***	46.6***	28.2***	48.8
		(1.1)	(2.5)	(1.0)	(2.1)	(0.7)	(1.5)	(1.3)	(2.2)
4	Three girls	20.6	59.9*	30.5	67.9***	28.1	61.9***	34.2	63.6***
		(1.3)	(4.8)	(1.8)	(3.3)	(1.4)	(2.8)	(1.7)	(3.6)
	One boy / two girls	20.3	49.9	24.4***	52.8	24.8**	58.6***	26.9***	61.7***
		(1.0)	(3.5)	(0.9)	(2.6)	(0.8)	(2.3)	(1.3)	(3.0)
	Two boys / one girl	20.1	51.6	22.8***	46.9	25.0	50.8	25.1***	51.2
		(1.1)	(4.1)	(1.2)	(3.2)	(1.3)	(3.0)	(2.0)	(4.5)
	Three boys	21.1	56.4	24.3**	56.7	23.0**	44.7	28.9	56.4
		(2.2)	(7.3)	(2.3)	(5.8)	(1.8)	(5.2)	(5.0)	(8.2)
				Rural					
1		20.9	52.4	21.1	52.8***	20.5	51.7*	19.7	51.6
		(0.4)	(0.9)	(0.2)	(0.5)	(0.1)	(0.3)	(0.1)	(0.3)
2	One girl	20.4	52.3	21.7	52.7	22.2	55.3***	23.9	55.3***
		(0.5)	(1.6)	(0.3)	(0.9)	(0.2)	(0.5)	(0.2)	(0.5)
	One boy	19.8	48.8*	21.4	50.7	21.9	50.7	24.1	49.5***
		(0.5)	(1.4)	(0.3)	(0.7)	(0.2)	(0.5)	(0.2)	(0.5)
3	Two girls	20.7	54.5	23.7	57.4***	23.8	60.0***	27.4	60.2***
		(1.0)	(3.1)	(0.7)	(1.6)	(0.4)	(0.9)	(0.4)	(0.9)
	One boy / one girl	20.6	54.0	22.3*	54.3**	22.0***	54.3***	23.1***	53.6***
		(0.7)	(2.2)	(0.5)	(1.5)	(0.3)	(0.7)	(0.4)	(0.8)
	Two boys	22.0	46.8	22.8	49.5	21.7***	49.8	24.0***	49.3
		(1.1)	(3.3)	(0.7)	(2.1)	(0.5)	(1.2)	(0.6)	(1.4)
4	Three girls	19.7	48.8	26.6	62.4***	25.2	62.7***	27.2	60.4***
		(1.9)	(7.4)	(1.7)	(3.7)	(0.8)	(1.8)	(0.8)	(1.8)
	One boy / two girls	22.0	42.5**	23.8	50.5	22.5***	55.9***	25.9	55.0**
		(1.2)	(4.3)	(1.0)	(2.6)	(0.4)	(1.5)	(0.6)	(1.9)
	Two boys / one girl	24.1	49.9	26.6	53.0	24.2	51.6	28.9	50.1
		(1.8)	(5.1)	(1.9)	(3.4)	(0.6)	(2.1)	(1.6)	(2.6)
	Three boys	22.7	57.5	23.0	43.9	23.8	54.7	25.9	60.4**
		(3.1)	(8.7)	(2.2)	(6.1)	(1.0)	(3.7)	(1.7)	(4.2)

Note. The statistics for each spell/period combination are calculated based on the regression model for that combination as described in the main text, using bootstrapping to find the standard errors shown in parentheses. For bootstrapping, the original sample is resampled, the regression model run on the resampled data, and the statistics calculated. This process is repeated 250 times and the standard errors calculated.

[a] Median duration is calculated as follows. For each woman in a given spell/period combination sample, I calculate the time point at which there is a 50% chance that she will have given birth, conditional on the probability that she will eventually give birth in that spell. For example, if there is an 80% chance that a woman will give birth by the end of the spell, her median duration is the predicted number of months before she passes the 40% mark on her survival curve. The reported statistics is the average of this median duration across all women in a given sample using the individual predicted probabilities of having had a birth by the end of the spell as weights. Duration begins at marriage for spell 1 or at 9 months after the birth of the prior child for all other spells. For spells two and higher duration sex compositions other than all girls are tested against the duration for all girls, with *** indicating significantly different at the 1% level, ** at the 5% level, and * at the 10% level.

[b] Percent boys is calculated as follows. For each woman in a given spell/period combination sample, I calculate the predicted percent boys for each month and sum this across the length of the spell using the likelihood of having a child in each month as the weight. The percent boys is then averaged across all women in the given sample using the individual predicted probabilities of having had a birth by the end of the spell as weights. The result is the predicted percent boys that will be born to women in the sample once child bearing for that spell is over. The predicted percent boys is tested against the natural percentage boys, 105 boys per 100 girls, with *** indicating significantly different at the 1% level, ** at the 5% level, and * at 10% level.

only girls have longer spacing to the next birth than any of the other sex compositions from 1985 onward.[14] This reversal in the standard spacing pattern is substantial, especially for the third and fourth spells. For the latest period, the difference between only girls than the other sex compositions is between 4.8 and 9.1 months for the third and fourth spell. Furthermore, the differences are statistically significant, except for only boys for the fourth spell because few women have a fourth birth if they have three boys already.

Rural women also show a reversal of the typical spacing pattern, although the changes are less pronounced than for urban women. The third spell shows that spacing for women with only girls become increasing longer compared to the other two sex compositions. Most of the differences are statistically significant, although they are smaller than for urban women. For the second spell, there is little difference in spacing for women with one girl and women with one boy.

The predicted sex ratios at the end of the spells show that the reversal in spacing patterns is not the result of a declining son preference but instead corresponds to a substantially more male-biased sex ratio. For urban women, the predicted sex ratio with only girls is consistently above 60% boys for the third and fourth spells. For rural women, the predicted sex ratios are lower than for urban women but still substantial and statistically significant at close to 60%. The high predicted sex ratios are presumably the result of increased use of sex selection.

When trying to understand the strength of son preference, it is interesting that the sex ratio is also statistically significantly different from the natural rate in the case where women already have one son for the third and fourth spells. Again, the sex ratio in the presence of one son for the third and fourth spells are higher in urban areas than rural areas, although the difference is less than for women with only girls. Hence, it is possible that women are still willing to use sex selection even after giving birth to one, although this behavior may also be in response to either experienced or expected mortality of the

[14] The exception is the second spell for the 1985–1994 period, where women with one girl have 0.1 months shorter spacing the women with one boy.

first son born.

It also appears that there is a slightly elevated sex ratio among first-born for urban women. There is, however, no corresponding increase in spacing; instead, the median duration has fallen over time and is the lowest among the three education groups. Hence, unless duration between marriage and first birth has decreased substantially by itself, for example, because of improved health, it is not clear how much stock to place on the increased sex ratio among first-borns as evidence for sex selection among first-borns.

Both of the last two results are different from prior studies using NFHS data. There are two potential explanations. First, the NFHS-4 is substantially larger than the three prior surveys. Hence, it is possible that the effects have been there all along, but we did not have the power to detect them. Second, it is possible that at least the first-born results are an artifact of any recall error not captured by the data restrictions. Certain types of recall error would also explain why the sex ratio for the second spell and one boy is statistically significantly *below* the natural sex ratio (Pörtner, 2018b).

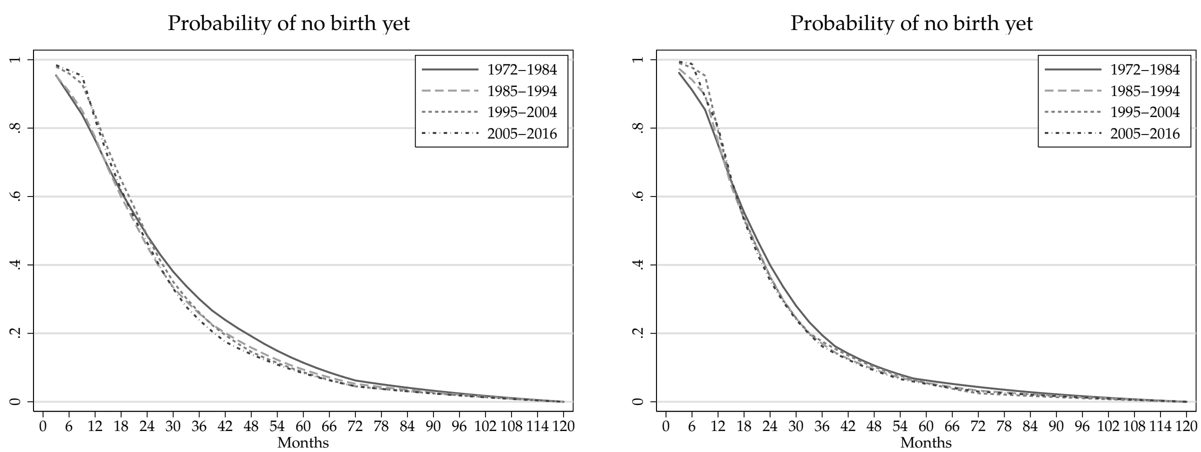
4.4 Distribution of Birth Spacing Across Sex Compositions and Time

Median spacing is a convenient way to understand the overall changes but may hide important differences in the distribution of spacing. This section, therefore, provides more detail on how spacing is distributed over time and sex compositions using a graphical approach.

I show survival curves conditional on predicted parity progression rather than standard survival curves. The advantage of this approach is that it is possible to directly compare the distribution of spacing to next birth across groups, independently of differences in how likely the next birth is. Because the conditional survival curves are independent of the likelihood of final parity progression, they all begin at 100% and end at 0%.

Instead of averaging across the entire sample, I calculate the conditional survival curves for an average woman using the method detailed in Section 2. For each combination of education and spell, I use values based on the average age at the start of the spell and, for the second and higher spells, the average duration of the first spell. Furthermore, I use the majority categories for the categorical explanatory variables, which means no ownership of land and not in a scheduled caste or tribe. The characteristics used do not change across period to ensure that composition effects do not drive the changes.

In the interest of brevity, I discuss only a select set of subsamples. Figure 1 shows spacing for the first spell across the four periods for rural women with no education and urban women with eight or more years of education. Figures 2 and 3 show spacing across sex compositions for the second, third, and fourth spells for the first period, 1972–1984, and the last period, 2005–2016, for rural women with no education and for urban women with eight or more years of education. The Appendix shows standard and conditional survival curves for all groups and time periods, and I discuss some examples of standard survival curves in the following section.[15]



(a) Rural Women with No Education

(b) Urban Women with 8 or More Years of Education

Figure 1: Survival curves conditional on progression to first birth; start point is month of marriage

The biased sex ratio for the first spell for the most educated women suggests that there might be sex selection on the first birth. I, therefore, begin by comparing in Figure 1 how

[15] To ease legibility of the graphs some three months intervals are combined into longer ones when there are few births available in the sample.

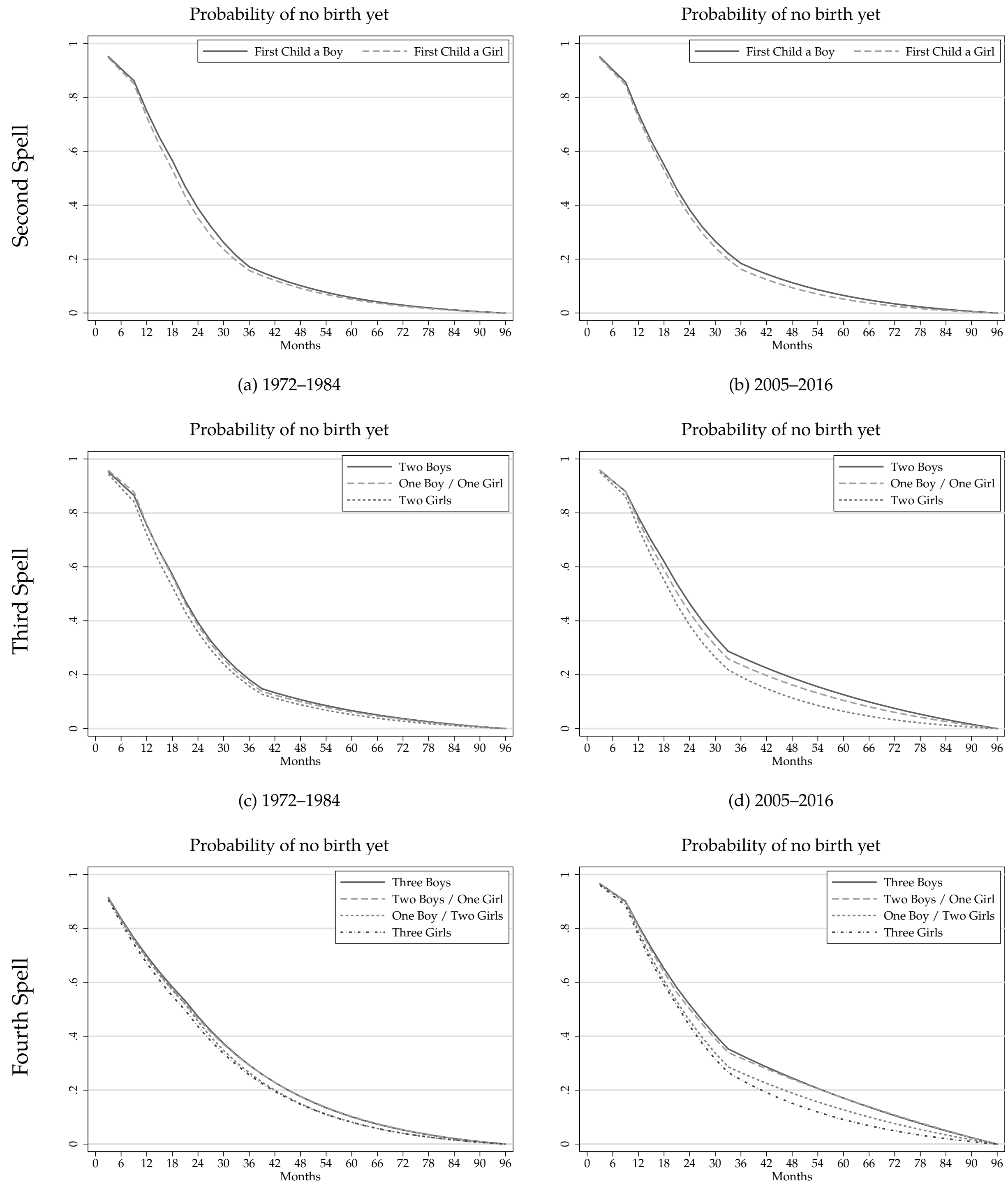
the distribution of spacing has changed over time for rural women with no education and urban women with eight or more years of education. What is most striking is how similar the distribution of spacing is across the two groups.

Both groups show little change in median spacing, but that masks a substantial compression of when most of the births occur. In the 1972–1984 period, the middle 80% of births for women with no education are predicted to occur between approximately 6 and 64 months, whereas in the 2005–2016 period it is between 12 and 54 months. Hence, the compression is equivalent to more than a full year. Women with eight or more years of education show a slightly smaller compression: in the 1972–1984 period, the middle 80% of births are predicted to occur between approximately 6 and 48 months, whereas in the 2005–2016 period it is between 12 and 46 months. Hence, the compression is eight months.

Women became less likely to conceive before marriage over time. In the first two periods there was a relatively smooth decline in the number of women without a birth starting at the time of marriage, but in the last two periods, there are few women who exit early after marriage and instead there is a substantial dip between 9 and 12 months after marriage.

It is likely that the compressed spacing, beginning at nine months after marriage in the later periods, is associated with better health and higher age at marriage. For example, women without education have seen an increase in the average age at marriage from below 16 to 18.5 from the first period to the last while women with the most education increased from 19.5 to 20.4.

For women with no education, Figure 2 shows that the median results above are consistent with the distribution of spacing within a spell with spacing after only girls consistently shorter than after only boys. There are slight variations in how strong this effect is across the three spells. On the one hand, for the second spell the difference in spacing between when the first child is a girl versus when the first child is a boy as first-born remains almost the same across the four decades. On the other hand, for the third spell the differences



(a) 1972–1984 (b) 2005–2016

(c) 1972–1984 (d) 2005–2016

(e) 1972–1984 (f) 2005–2016

Figure 2: Survival curves conditional on progression to next birth for rural women without education; start point for each spell is nine months after prior birth

between two girls and the other sex compositions become more pronounced over time, and especially the difference between two girls and two boys have become substantially larger. The fourth spell results are based on relatively few observations but do indicate that women with either only girls or two girls and one boy have shorter spacing than women with only boys or one girl and two boys. Although the evidence is not substantial, it does appear that there is a slight preference for two boys in the sense that spacing becomes longer once the couple has at least two boys than for the other sex compositions.

The distribution of spacing for the second spell is almost indistinguishable between urban women with eight or more years of education and rural women with no education for the 1972–1984 period, as shown in Figure 3. The small difference points to these two very different groups of women behaving similarly in response to son preference in a situation where there was little access to prenatal sex determination or little incentive to use it early even for those who might have had access.

Whereas the no education group show almost no change across the four decades, the high education women show a rightward shift if the spacing pattern when the first child is a girl. The result is that the spacing patterns are close to identical after first-born girls and after first-born boys. Given the elevated predicted percentage boys in Table 3, this change is consistent with the use of sex selection for women with a girl as their first child.

The hypothesized correlation between use of sex selection and reversal of the standard spacing pattern show up clearly in the 2005–2016 period for the third spell with spacing to the third child consistently longer with two girls than with either two girls or one boy and one girl. The rightward movement for only girls from the, mostly, standard pattern in the 1972–1984 period to the new pattern in the 2005–2016 period is substantial. There are also indications that the spacing distribution has moved rightward for women with one boy and one girl relatively to women with two boys, which provides some evidence for the use of sex selection for this group. The caveat is that the 1972–1985 period also had a biased sex ratio, which points to uncorrected recall error for this group.

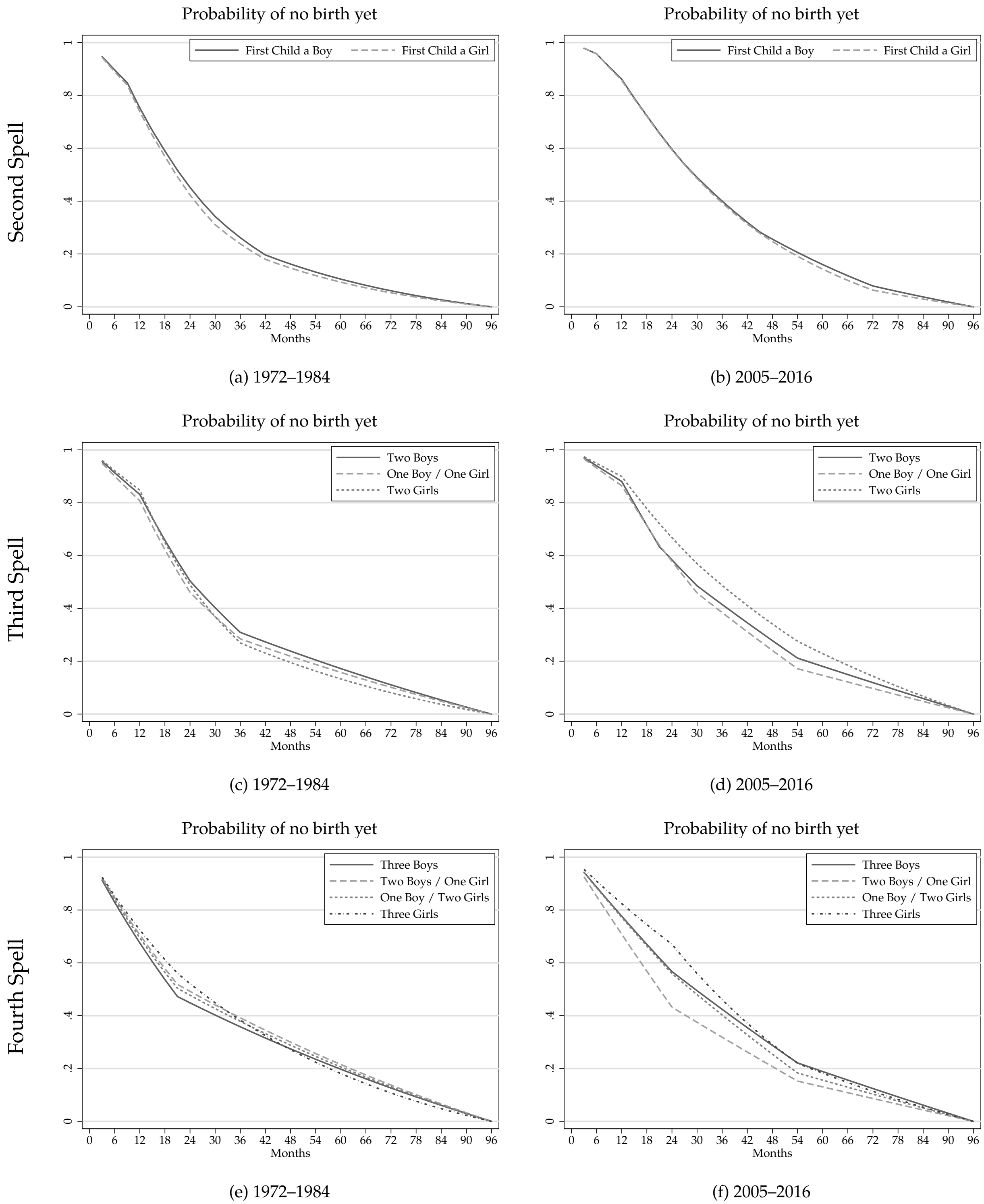


Figure 3: Survival curves conditional on progression to next birth for urban women with eight or more years of education; start point is nine months after prior birth

There is an even more pronounced rightward shift for spacing after only girls in the fourth spell for the first years of the spell. The caveat is that there are few births to base the results on, especially for women with two or more sons.[16] Furthermore, the differences are substantial across most of the distribution. Twelve months after the beginning of the spell there is a more than ten percentage points difference in the conditional survival curves for only girls and only boys. That is, of the women who are predicted to have a fourth child just over 30% of women with three boys have had their fourth child, while less than 20% of those with three girls have had theirs. Even at three years after the beginning of the spell, there is a more than five percentage points difference.

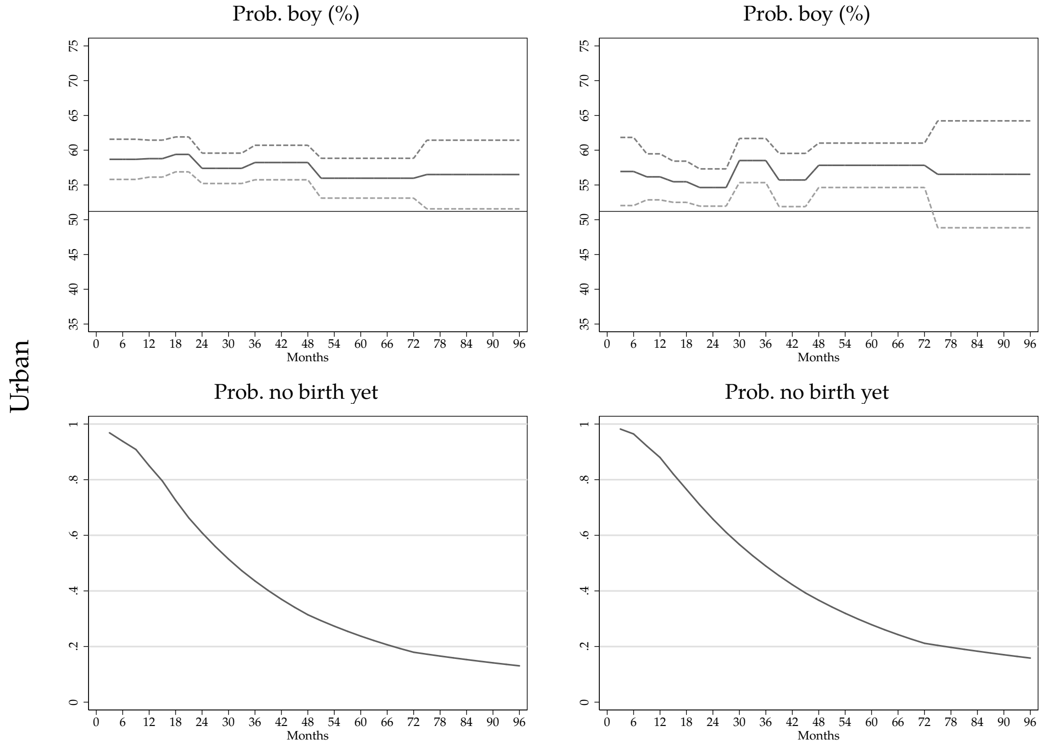
As discussed above there is some evidence of a two-son preference with the spacing pattern almost the same for women with three boys and with two boys and one girl. The conditional survival curve for women with one boy and two girls is consistently above those for women with two or more son, but below those with three girls. The pattern fit the predicted sex ratios shown above where the highest predicted sex ratio is for women with only girls, followed by those with one son and two girls, and those with two or more boys having almost the same sex ratio.

4.5 Does Sex Selection Change within Spells?

The above results show that length of birth spacing increased more for women with only girls than for other sex compositions as sex ratios became more male-biased, presumably because of increased use of sex selection. Neither the median spacing or the conditional survival curves, however, can tell us whether sex selection varies *within* a spell or provide any information about the likelihood of exiting a spell with a birth. To understand both, I now turn to the standard survival curves and predicted sex ratios by spell duration.

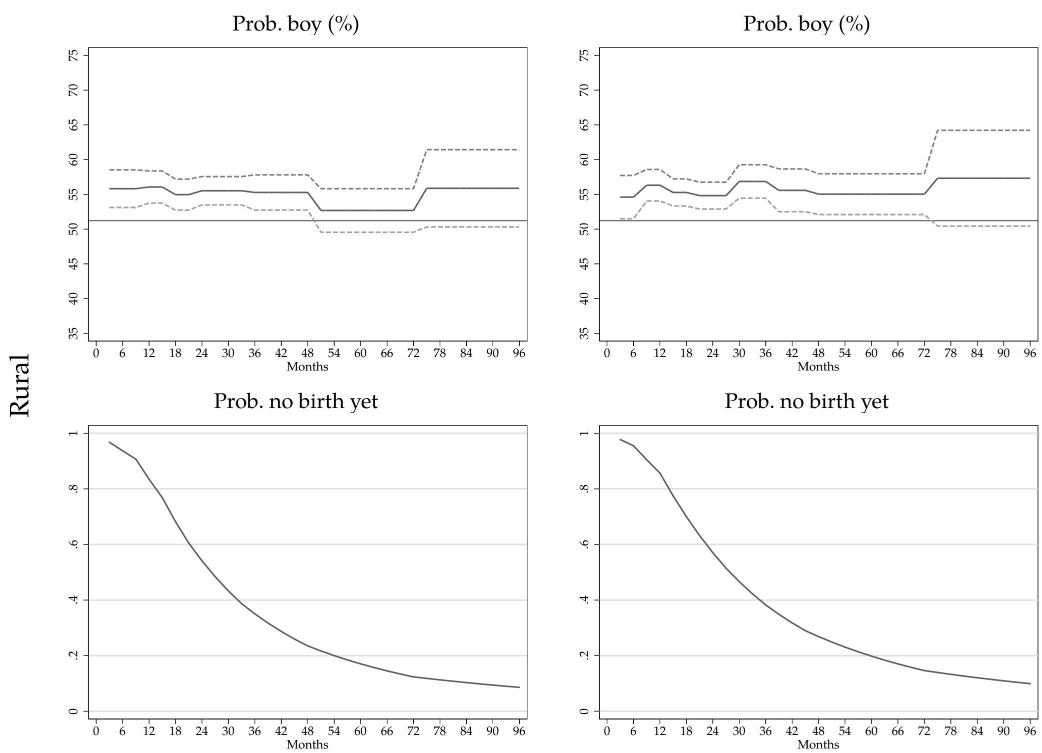
The predicted sex ratio may change within a spell for, at least, two reasons. First, par-

[16] As mentioned, it is possible that some women had access to sex selection even in the first period. I would expect well educated urban women with more children to be the most likely to know about and use this early access to prenatal sex determination.



(a) 1995–2004

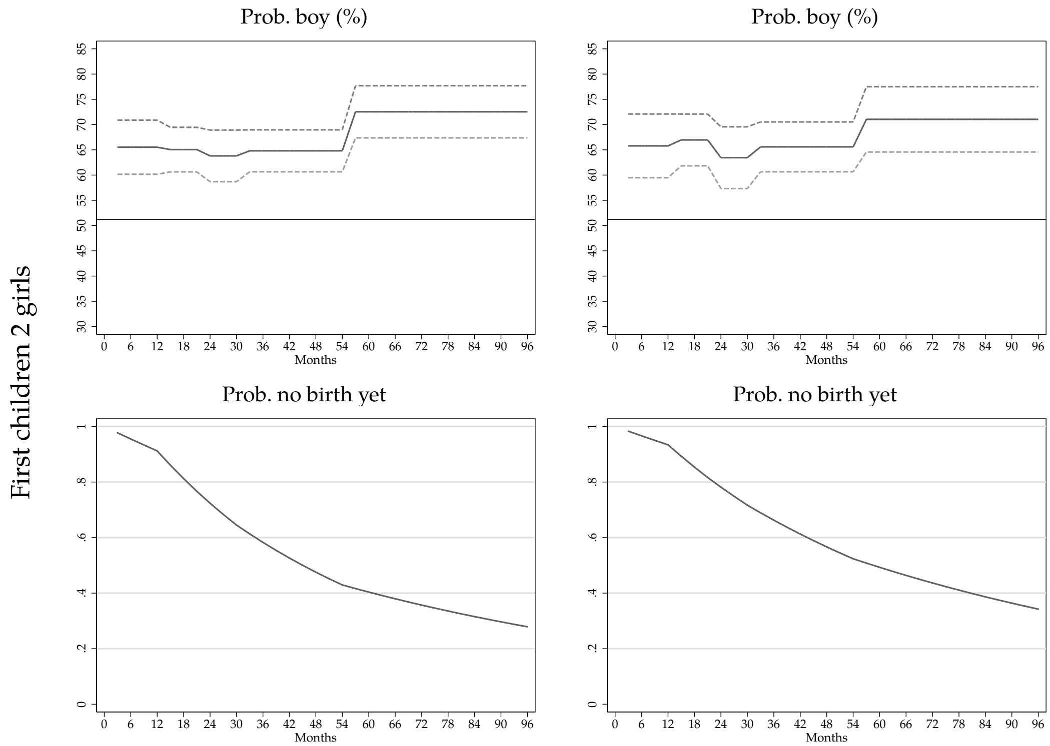
(b) 2005–2016



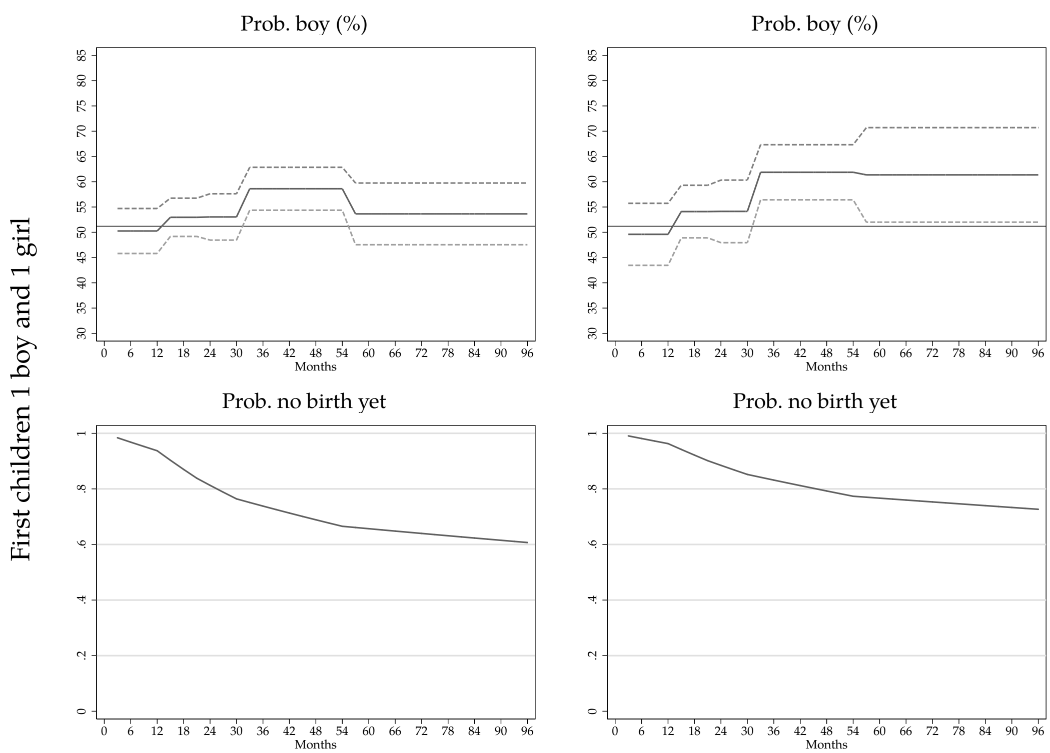
(c) 1995–2004

(d) 2005–2016

Figure 4: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for women with a girl as their first child and eight or more years of education for the 1995–2004 and 2005–2016 periods



(a) 1995–2004 (b) 2005–2016



(c) 1995–2004 (d) 2005–2016

Figure 5: Predicted probability of having a boy and probability of no birth yet from nine months after second birth for urban women with eight or more years of education for the 1995–2004 and 2005–2016 periods

ents may stop using prenatal sex determination within a spell once the duration from the previous birth becomes long enough. The desire for short spacing could, for example, arise from economies of scale in childbearing and rearing that parents lose if children are born too far apart (Schultz, 1997, p 374). In this case, we should observe the predicted sex ratio decline with spell length.

Second, if the degree of son preference varies across women within the sample, but their behavior is not affected by duration from the previous birth, we should observe an increasing share of births come from parents with stronger son preference as the duration from the previous birth increases. Whereas the early births are a combination of births to people with lower son preference and those with stronger son preference who conceived a son in the first or second pregnancy, births later in the spell are then predominately from those with stronger son preference who have not yet conceived a son. In this case, we should see an increase in the sex ratio as duration increases.

Figures 4 and 5 show examples of how sex ratio behave within spells. Both are for women with eight or more education since the results above indicate that they are the most likely to use sex selection or other means of achieving an unequal sex ratio. Figure 4 shows results for the second spell for the 1995–2004 and 2005–2016 periods for women with a girl as their first child by area of residence. Figure 5 shows results for the third spell for the same two periods for urban women with either two girls or one boy and one girl as their first two children.

Within the second spell, both urban and rural women show a declining sex ratio as duration increases for the 1995–2004 period, whereas there is little change, or possibly a small increase, with duration for the 2005–2016 period. These results are consistent with a situation where fertility is declining over time leaving less room for a change in the decision to use sex selection. Fertility decline is not immediately apparent from the second spell results, but the third spell shows that the likelihood of progressing from two to third children declines by approximately 15 percentage points if the woman has given birth to a boy.

The third spell figures show a very different situation with substantial increases in sex ratios. The high sex ratio for women with two girls is likely motivated by the combined desire to limit fertility and ensure a son; similarly to the situation for the second spell as shown in Figure 4 (b) and (d).

The increase in sex ratio with duration for women who already have given birth to a boy likely illustrates the case where there is a combination of degrees of son preference. Say that one group wants one son and after that will not use sex selection, whereas another group has a strong preference for two sons (or either have or expect to lose the boy they already have) and that the two groups conceive at the same rate. In that case, we should expect precisely the increasing sex ratios we observe, especially given the declining fertility over time.

5 Conclusion

The central question addressed here is the extent to which spacing patterns significantly changed as prenatal sex determination became available. Specifically, did the spacing after girls increase relative to the spacing after boys? The underlying idea is that in the absence of sex selection son preference leads to shorter spacing after the birth of a girl than after the birth of a boy, whereas son preference increases the spacing after the birth of a girl relative to after the birth of a boy when prenatal sex selection is available. I introduce a new method that simultaneously accounts for spacing between births and the potential use of sex selection. I apply the method to over four decades of data from India's NFHS. The results show two very different approaches to son preference.

At one extreme, women without education mostly follow the standard pattern of shorter spacing when a woman does not have the desired number of sons. There is also limited evidence of biased sex ratios and the increases in spacing that should follow from the use of sex selection. In the situations where there are elevated sex ratios for women without education, the spacing patterns are close to those with more regular sex ratios. Hence, it is difficult to conclude that the changes in sex ratios indicate sex selection rather than normal variation or problems with recall errors.

At the other extreme, women with eight or more years of education have experienced an almost complete reversal of the traditional spacing patterns. Rather than having the next birth sooner as they mostly did before sex selection became available, women with either no or one son now have substantially longer spacing than if they have two or more sons. As shown by the increasingly significant deviations in the sex ratio from the natural sex ratio, these changes are likely due to increased use of sex selection rather than changes in son preference. Banning prenatal sex determination has not been able to reverse the use, although it is possible that it has slowed the rate of increase.

Over the last 40 years, there has been a general increase in median spacing for all education groups, but especially for the most educated women. The exception is for the spacing between marriage and first birth where there are two counteracting forces: women have become less likely to conceive before marriage, and there has been a substantial compression in the variation of spacing. The result is that median spacing from marriage to first birth has changed little or even declined for the best-educated women. Both the decrease for the first spell and the increase for higher-order spells are consistent with increased access to contraceptives over time (Yeakey et al., 2009).

The empirical model allows for the effects of covariates to vary within the spell. Non-proportionality is essential because the use of sex selection may vary within a spell. The use of sex selection may change either because preferences for not too long spacing between births override the preference for sons or because of selection, where the women who remain in a spell are those with the strongest son preference who have been through multiple pregnancies because the fetuses were female. Because these move in opposite directions, I cannot directly establish the extent to which they affect the results. Both are, however, present, as can be seen from the cases where there is either a decline in sex ratio with spell duration or a substantial increase with spell duration. The first case is most likely at lower parities where there is still less pressure to ensure a son, which allows any preference for shorter spacing to play more of a role. The second is most likely for higher parities where the desire to limit further childbearing and ensure a son dominates any preferences for shorter spacing.

The potential for changes in sex ratio within a spell means that censoring is an important issue when trying to understand how the sex ratio changes over time, and especially when it comes to establishing whether the use of sex selection is increasing or decreasing. Take, for example, the case of women with eight or more years of education in the last period. If we look at women who started their third spell in either the 2005–2009 or the 2010–2014 periods and we treat end of 2015 as the cut-off point, then the observed sex ratio for the 2005–2009 women is 55.99% boys while it is 55.38% for women who started in the 2010–2014 period.[17] It would, therefore, appear that the use of sex selection for this spell is slightly decreasing over time. This interpretation, however, ignores the role of censoring. If we use the estimation results to predict final sex ratio once childbearing for the third spell is over, the predicted sex ratios are 56.10% boys and 56.08% boys for the 2005–2009 and the 2010–2015 starts, which indicates virtually no change over time. The reason for the difference is that while we would have observed 7,134 birth out of a predicted 7,451 total number of births for the 2005–2009 start, we would only have observed 3,348 births out of a predicted 8,842 for the 2010–2014 group.

Although it is not possible to directly observe whether sex selection causes the unequal sex ratio and longer spacing the results are consistent with a general increase in sex selection over time. The apparent increase in the use of sex selection is mainly found among women with more education and more so in urban than in rural areas, although

[17] The calculations combines urban and rural women; the basis result changes little if I split by area of residence. I chose the 2014 cut-off to ensure that both groups cover five years, even though NFHS-4 took place in 2015 and 2016.

the differences between urban and rural areas are relatively minor. Compared to previous research one result stands out. It appears that the use of sex selection is spreading to women with lower levels of education. Even women with one to seven years of education show unequal sex ratios and longer spacing for their higher-order spells.

The results here point to two important, interconnected, questions for future research: What is the connection between falling fertility and the use of sex selection and is the use of sex selection increasing or decreasing over time? It is clear that fertility has been declining over time in India, although it is important to note that the decline might be overstated precisely because of increased use of sex selection and the resulting longer spacing between births makes it less likely that we will observe births to women, even though they eventually will happen. The fact that biased sex ratio occurs at lower-order spells over time and is starting to show up for women with less education all indicate that lower fertility and use of sex selection are related, but a more detailed analysis is needed. Furthermore, although examining spells separately, as done here, is a useful first step in understanding how sex selection changes over time, it does not lend itself easily to examine the degree to which sex selection changes over time. For both, a combined model that incorporates the full fertility history of women would be more appropriate.

The results here also lead to a set of broader questions that future research should address. First, to what extent are the improvements in health for girls relative to boys the result of selection, the longer spacing between births, or changing son preference? There is some early evidence that sample selection can make it appear that girls are healthier, even though the underlying cause is a combination of sex selection and higher mortality together with recall error (Pörtner and Su, 2018). Understanding what role these factors play in better health for girls is especially important when evaluating policies that aim to directly limit the use of sex selection rather than changing preferences or incentives. If the better health outcomes for girls are, for example, an unintended side-effect of the longer spacing that arises from sex-selective abortions, then an effective ban on sex selection may, at least temporarily, worsen health outcomes for girls.

Second, we need to understand how female labor force participation interacts with the use of sex selection. Increased autonomy for women, arising, for example, from better opportunities for working outside the home, has been suggested as a way to increase women's status and thereby lower the use of sex selection (Das Gupta, 2016). This may, however, be a double-edged sword. On the one hand, it is a clear benefit to the women who gain bargaining power, and it increases the cost of repeated sex-selective abortions because the increased duration between births would cause a stronger disruption in labor market participation. On the other hand, it may further lower desired fertility, and that may, everything else equal, lead to higher use of sex selection. Understanding the trade-off between long-term benefits from improvements in women's labor force participation and short-term costs from potential increases in sex selection is of paramount importance.

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Appendices for Online Publication

These appendices are intended for online publication. They provide the descriptive statistics, additional estimated duration tables, and graphs for all education groups and spells.

A Descriptive Statistics

Table A.1: Descriptive Statistics by Education Level and Beginning of Spell

		No Education				1–7 Years of Education				8+ Years of Education			
		1972–1984	1985–1994	1995–2004	2005–2016	1972–1984	1985–1994	1995–2004	2005–2016	1972–1984	1985–1994	1995–2004	2005–2016
First Spell	Boy born	0.500	0.478	0.479	0.423	0.500	0.482	0.484	0.420	0.499	0.485	0.485	0.389
		(0.500)	(0.500)	(0.500)	(0.494)	(0.500)	(0.500)	(0.500)	(0.494)	(0.500)	(0.500)	(0.500)	(0.488)
	Girl born	0.460	0.431	0.443	0.395	0.464	0.441	0.443	0.386	0.470	0.434	0.443	0.360
		(0.498)	(0.495)	(0.497)	(0.489)	(0.499)	(0.497)	(0.497)	(0.487)	(0.499)	(0.496)	(0.497)	(0.480)
	Censored	0.040	0.091	0.077	0.182	0.036	0.077	0.073	0.194	0.031	0.081	0.072	0.251
		(0.196)	(0.288)	(0.267)	(0.386)	(0.186)	(0.266)	(0.259)	(0.395)	(0.174)	(0.274)	(0.259)	(0.433)
	Urban	0.177	0.166	0.148	0.123	0.361	0.307	0.245	0.190	0.688	0.561	0.467	0.332
		(0.382)	(0.372)	(0.355)	(0.328)	(0.480)	(0.461)	(0.430)	(0.392)	(0.463)	(0.496)	(0.499)	(0.471)
	Age	15.852	16.592	17.189	18.551	16.993	17.366	17.483	18.693	19.553	19.529	19.658	20.372
		(2.481)	(2.882)	(3.290)	(3.324)	(2.742)	(3.085)	(3.277)	(3.233)	(3.339)	(3.567)	(3.826)	(3.619)
	Owns land	0.592	0.565	0.507	0.483	0.503	0.494	0.475	0.470	0.321	0.399	0.426	0.489
		(0.506)	(0.501)	(0.500)	(0.500)	(0.500)	(0.500)	(0.499)	(0.499)	(0.467)	(0.490)	(0.495)	(0.500)
	Sched. caste/tribe	0.356	0.409	0.450	0.502	0.168	0.251	0.348	0.435	0.071	0.140	0.200	0.276
		(0.479)	(0.492)	(0.497)	(0.500)	(0.374)	(0.434)	(0.476)	(0.496)	(0.256)	(0.347)	(0.400)	(0.447)
	3 months periods	352,863	480,661	577,394	252,133	114,144	206,159	336,400	233,193	106,538	278,909	557,700	646,264
	Women	29,298	44,954	50,104	26,223	10,801	21,276	32,644	26,842	10,943	30,076	59,575	85,077
Second Spell	Boy born	0.504	0.465	0.471	0.413	0.493	0.456	0.464	0.380	0.478	0.433	0.430	0.301
		(0.500)	(0.499)	(0.499)	(0.492)	(0.500)	(0.498)	(0.499)	(0.485)	(0.500)	(0.496)	(0.495)	(0.459)
	Girl born	0.465	0.427	0.441	0.379	0.475	0.436	0.426	0.353	0.450	0.385	0.375	0.270
		(0.499)	(0.495)	(0.496)	(0.485)	(0.499)	(0.496)	(0.494)	(0.478)	(0.497)	(0.487)	(0.484)	(0.444)
	Censored	0.031	0.108	0.088	0.208	0.033	0.108	0.111	0.267	0.073	0.182	0.195	0.428
		(0.174)	(0.310)	(0.284)	(0.406)	(0.177)	(0.311)	(0.314)	(0.443)	(0.260)	(0.386)	(0.396)	(0.495)
	One boy	0.526	0.521	0.521	0.516	0.521	0.518	0.523	0.519	0.514	0.525	0.524	0.519
		(0.499)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.499)	(0.500)	(0.500)	(0.499)	(0.499)	(0.500)
	One girl	0.474	0.479	0.479	0.484	0.479	0.482	0.477	0.481	0.486	0.475	0.476	0.481
		(0.499)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.499)	(0.500)	(0.500)	(0.499)	(0.499)	(0.500)
	Urban	0.178	0.176	0.154	0.122	0.364	0.331	0.259	0.192	0.695	0.600	0.481	0.350
		(0.382)	(0.381)	(0.361)	(0.327)	(0.481)	(0.471)	(0.438)	(0.394)	(0.461)	(0.490)	(0.500)	(0.477)
	Age	17.772	18.456	19.582	20.786	18.623	19.144	19.583	20.547	21.017	21.310	21.462	21.978
		(2.747)	(3.068)	(3.446)	(3.581)	(2.880)	(3.171)	(3.324)	(3.307)	(3.387)	(3.537)	(3.719)	(3.657)
	First spell length	25.799	26.861	30.060	35.013	21.957	22.887	26.190	28.881	20.631	21.001	23.313	23.705
		(20.536)	(22.920)	(21.678)	(29.540)	(18.339)	(19.785)	(19.494)	(24.281)	(15.517)	(16.749)	(16.979)	(19.171)
	Owns land	0.594	0.564	0.517	0.482	0.501	0.489	0.475	0.467	0.314	0.377	0.419	0.476
		(0.509)	(0.502)	(0.500)	(0.500)	(0.500)	(0.500)	(0.499)	(0.499)	(0.464)	(0.485)	(0.493)	(0.499)
	Sched. caste/tribe	0.352	0.397	0.443	0.486	0.162	0.231	0.332	0.415	0.067	0.126	0.192	0.261
		(0.478)	(0.489)	(0.497)	(0.500)	(0.368)	(0.421)	(0.471)	(0.493)	(0.249)	(0.332)	(0.393)	(0.439)
	3 months periods	180,873	305,318	446,319	245,159	68,409	143,461	279,807	229,603	82,229	238,184	599,537	671,438
	Women	20,627	35,286	49,311	29,516	7,902	16,075	29,533	26,428	7,915	21,653	51,723	68,363

Note. Means without parentheses and standard deviation in parentheses. Interactions between variables, baseline hazard dummies and squares not shown.

Table A.1: (Continued) Descriptive Statistics by Education Level and Beginning of Spell

		No Education				1–7 Years of Education				8+ Years of Education			
		1972–1984	1985–1994	1995–2004	2005–2016	1972–1984	1985–1994	1995–2004	2005–2016	1972–1984	1985–1994	1995–2004	2005–2016
Third Spell	Boy born	0.491	0.435	0.430	0.340	0.466	0.401	0.366	0.272	0.376	0.285	0.271	0.169
		(0.500)	(0.496)	(0.495)	(0.474)	(0.499)	(0.490)	(0.482)	(0.445)	(0.484)	(0.451)	(0.444)	(0.374)
	Girl born	0.455	0.402	0.391	0.313	0.434	0.365	0.331	0.235	0.330	0.228	0.216	0.133
		(0.498)	(0.490)	(0.488)	(0.464)	(0.496)	(0.482)	(0.471)	(0.424)	(0.470)	(0.420)	(0.411)	(0.340)
	Censored	0.053	0.163	0.180	0.348	0.100	0.234	0.303	0.493	0.294	0.487	0.514	0.698
		(0.225)	(0.369)	(0.384)	(0.476)	(0.300)	(0.424)	(0.459)	(0.500)	(0.456)	(0.500)	(0.500)	(0.459)
	Two boys	0.276	0.258	0.257	0.249	0.247	0.246	0.245	0.239	0.268	0.243	0.244	0.226
		(0.447)	(0.437)	(0.437)	(0.433)	(0.432)	(0.431)	(0.430)	(0.426)	(0.443)	(0.429)	(0.430)	(0.419)
	One boy, one girl	0.489	0.501	0.503	0.499	0.510	0.502	0.504	0.506	0.486	0.510	0.523	0.522
		(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)	(0.500)
	Two girls	0.235	0.241	0.240	0.251	0.243	0.252	0.251	0.256	0.245	0.247	0.233	0.251
		(0.424)	(0.427)	(0.427)	(0.434)	(0.429)	(0.434)	(0.433)	(0.436)	(0.430)	(0.432)	(0.423)	(0.434)
	Urban	0.176	0.179	0.156	0.121	0.372	0.347	0.263	0.193	0.693	0.634	0.469	0.350
		(0.381)	(0.383)	(0.363)	(0.326)	(0.483)	(0.476)	(0.440)	(0.395)	(0.461)	(0.482)	(0.499)	(0.477)
	Age	19.993	20.638	21.885	23.148	20.820	21.378	21.885	22.875	23.005	23.692	23.673	24.423
		(2.900)	(3.181)	(3.534)	(3.761)	(2.958)	(3.233)	(3.414)	(3.506)	(3.418)	(3.751)	(3.782)	(3.976)
	First spell length	24.831	26.660	27.427	33.633	21.176	23.122	24.448	27.983	20.151	20.686	22.582	23.426
		(18.938)	(22.321)	(19.162)	(25.455)	(17.051)	(19.847)	(17.156)	(21.060)	(14.787)	(16.391)	(15.358)	(17.135)
	Owns land	0.604	0.573	0.533	0.490	0.507	0.503	0.494	0.474	0.321	0.373	0.448	0.485
		(0.506)	(0.497)	(0.499)	(0.500)	(0.500)	(0.500)	(0.500)	(0.499)	(0.467)	(0.484)	(0.497)	(0.500)
	Sched. caste/tribe	0.343	0.394	0.442	0.479	0.158	0.221	0.324	0.409	0.065	0.113	0.197	0.253
		(0.475)	(0.489)	(0.497)	(0.500)	(0.364)	(0.415)	(0.468)	(0.492)	(0.247)	(0.317)	(0.398)	(0.435)
	3 months periods	113,854	224,936	394,760	271,093	46,092	100,027	232,299	211,216	59,640	156,264	444,587	483,944
	Women	12,953	26,090	40,672	29,609	4,803	10,227	20,482	20,915	4,192	11,173	28,993	39,189
Fourth Spell	Boy born	0.482	0.396	0.372	0.285	0.410	0.362	0.304	0.222	0.323	0.240	0.239	0.154
		(0.500)	(0.489)	(0.483)	(0.451)	(0.492)	(0.480)	(0.460)	(0.415)	(0.468)	(0.427)	(0.426)	(0.361)
	Girl born	0.423	0.371	0.335	0.264	0.407	0.312	0.265	0.198	0.311	0.205	0.184	0.117
		(0.494)	(0.483)	(0.472)	(0.441)	(0.491)	(0.464)	(0.441)	(0.399)	(0.463)	(0.404)	(0.388)	(0.322)
	Censored	0.095	0.233	0.293	0.451	0.183	0.326	0.432	0.580	0.366	0.554	0.577	0.729
		(0.293)	(0.423)	(0.455)	(0.498)	(0.387)	(0.469)	(0.495)	(0.494)	(0.482)	(0.497)	(0.494)	(0.445)
	Three boys	0.135	0.124	0.118	0.106	0.107	0.105	0.101	0.087	0.106	0.102	0.090	0.073
		(0.341)	(0.329)	(0.322)	(0.307)	(0.310)	(0.306)	(0.302)	(0.282)	(0.307)	(0.302)	(0.287)	(0.261)
	Two boys, one girl	0.374	0.358	0.358	0.335	0.348	0.326	0.327	0.314	0.360	0.307	0.320	0.289
		(0.484)	(0.479)	(0.479)	(0.472)	(0.476)	(0.469)	(0.469)	(0.464)	(0.480)	(0.461)	(0.466)	(0.453)
	One boys, two girls	0.362	0.388	0.393	0.407	0.400	0.410	0.413	0.425	0.391	0.436	0.442	0.459
		(0.481)	(0.487)	(0.488)	(0.491)	(0.490)	(0.492)	(0.492)	(0.494)	(0.488)	(0.496)	(0.497)	(0.498)
	Three girls	0.129	0.130	0.132	0.152	0.145	0.159	0.158	0.175	0.143	0.155	0.148	0.178
		(0.336)	(0.337)	(0.338)	(0.359)	(0.352)	(0.366)	(0.365)	(0.380)	(0.350)	(0.362)	(0.355)	(0.383)
	Urban	0.169	0.177	0.155	0.114	0.360	0.340	0.254	0.190	0.671	0.596	0.402	0.288
		(0.375)	(0.382)	(0.361)	(0.318)	(0.480)	(0.474)	(0.435)	(0.392)	(0.470)	(0.491)	(0.490)	(0.453)
	Age	21.948	22.843	23.942	25.480	22.621	23.486	23.998	25.031	24.289	25.449	25.217	26.089
		(3.018)	(3.322)	(3.563)	(3.943)	(2.898)	(3.381)	(3.473)	(3.631)	(3.156)	(3.720)	(3.732)	(3.984)
	First spell length	23.432	26.402	25.837	32.577	20.561	22.924	24.033	27.965	19.203	20.656	22.869	24.701
		(17.482)	(21.523)	(18.114)	(23.187)	(15.554)	(19.132)	(16.672)	(19.517)	(14.009)	(16.122)	(14.797)	(17.196)
	Owns land	0.614	0.588	0.550	0.498	0.524	0.532	0.513	0.479	0.338	0.413	0.499	0.519
		(0.508)	(0.496)	(0.498)	(0.500)	(0.500)	(0.499)	(0.500)	(0.500)	(0.473)	(0.492)	(0.500)	(0.500)
	Sched. caste/tribe	0.337	0.402	0.451	0.481	0.153	0.222	0.330	0.413	0.085	0.112	0.224	0.282
		(0.473)	(0.490)	(0.498)	(0.500)	(0.360)	(0.416)	(0.470)	(0.492)	(0.278)	(0.316)	(0.417)	(0.450)
	3 months periods	59,829	159,387	248,583	226,843	21,887	53,967	111,372	114,216	18,621	51,866	132,379	149,651
	Women	6,813	18,082	24,832	23,067	2,189	5,410	9,232	10,804	1,336	3,825	8,613	12,055

Note. Means without parentheses and standard deviation in parentheses. Interactions between variables, baseline hazard dummies and squares not shown.

B Additional Duration Results

Table B.1: Estimated 25th and 75th Percentile Durations for Women with No Education

Spell	Composition of Prior Children	1972–1984 Duration (Months)[a] Percentile 25th	1972–1984 75th	1985–1994 Duration (Months)[a] Percentile 25th	1985–1994 75th	1995–2004 Duration (Months)[a] Percentile 25th	1995–2004 75th	2005–2016 Duration (Months)[a] Percentile 25th	2005–2016 75th
				Urban					
1		12.5	40.4	12.5	35.7	14.2	35.6	13.9	33.7
		(0.2)	(0.6)	(0.1)	(0.5)	(0.1)	(0.5)	(0.2)	(0.6)
2	One girl	11.9	28.5	11.6	29.8	12.1	30.8	12.4	31.6
		(0.4)	(0.5)	(0.3)	(0.5)	(0.2)	(0.5)	(0.4)	(0.8)
	One boy	12.6	29.1	12.7***	32.4***	12.4	32.4**	12.6	31.4
		(0.3)	(0.5)	(0.2)	(0.6)	(0.2)	(0.5)	(0.3)	(0.7)
3	Two girls	11.6	30.8	11.8	29.8	12.4	32.9	13.8	36.4
		(0.6)	(1.1)	(0.5)	(1.0)	(0.4)	(0.9)	(0.5)	(1.5)
	One boy / one girl	12.5	28.6*	13.1**	30.9	13.3*	32.0	12.9	33.2*
		(0.3)	(0.7)	(0.3)	(0.6)	(0.2)	(0.6)	(0.4)	(1.1)
	Two boys	12.8	30.5	13.5***	32.0*	13.5**	33.4	13.8	35.1
		(0.4)	(1.1)	(0.3)	(0.9)	(0.4)	(0.9)	(0.6)	(1.5)
4	Three girls	9.7	26.1	11.3	31.0	10.8	34.4	14.3	41.5
		(1.5)	(2.0)	(0.8)	(1.5)	(0.9)	(1.9)	(1.0)	(2.2)
	One boy / two girls	10.3	27.2	10.9	33.9	11.9	35.3	14.2	44.7
		(0.8)	(1.1)	(0.5)	(1.2)	(0.6)	(1.8)	(0.8)	(2.0)
	Two boys / one girl	11.7	31.6*	13.6**	40.5***	13.7***	41.3**	15.3	47.1
		(1.0)	(1.9)	(0.7)	(1.3)	(0.7)	(2.3)	(0.9)	(3.3)
	Three boys	12.3	34.9**	14.0**	41.1***	11.7	31.9	15.8	43.9
		(1.6)	(2.9)	(1.1)	(2.1)	(1.1)	(3.0)	(1.1)	(5.2)
				Rural					
1		14.3	43.4	13.8	39.5	15.8	40.3	15.7	36.6
		(0.1)	(0.3)	(0.1)	(0.2)	(0.1)	(0.2)	(0.1)	(0.2)
2	One girl	12.5	28.3	12.8	30.0	13.0	30.9	12.9	30.6
		(0.1)	(0.3)	(0.1)	(0.2)	(0.1)	(0.2)	(0.1)	(0.3)
	One boy	13.0***	29.7***	13.1***	31.1***	13.1	31.4*	13.2*	31.6**
		(0.1)	(0.2)	(0.1)	(0.2)	(0.1)	(0.2)	(0.1)	(0.3)
3	Two girls	12.0	27.5	13.0	30.5	13.2	30.9	13.5	31.9
		(0.3)	(0.4)	(0.2)	(0.4)	(0.1)	(0.3)	(0.1)	(0.4)
	One boy / one girl	13.0***	28.6**	13.0	30.7	13.5*	32.0***	14.0**	33.4***
		(0.1)	(0.3)	(0.1)	(0.3)	(0.1)	(0.2)	(0.1)	(0.4)
	Two boys	13.0***	29.0***	13.4*	32.0***	13.8***	32.2***	14.4***	34.7***
		(0.2)	(0.4)	(0.2)	(0.4)	(0.1)	(0.4)	(0.2)	(0.6)
4	Three girls	10.5	28.5	11.5	31.7	10.9	30.6	13.8	35.9
		(0.6)	(1.0)	(0.5)	(0.7)	(0.3)	(0.6)	(0.3)	(0.7)
	One boy / two girls	10.8	29.5	12.9***	34.9***	12.6***	35.0***	14.4	40.5***
		(0.4)	(0.7)	(0.3)	(0.5)	(0.2)	(0.6)	(0.2)	(0.6)
	Two boys / one girl	11.2	28.7	13.2***	37.3***	13.5***	39.7***	16.0***	48.5***
		(0.4)	(0.6)	(0.3)	(0.6)	(0.3)	(0.8)	(0.2)	(0.8)
	Three boys	10.7	31.0	14.2***	37.9***	13.1***	39.3***	15.6***	47.9***
		(0.7)	(1.3)	(0.4)	(1.0)	(0.5)	(1.3)	(0.5)	(1.2)

Note. The statistics for each spell/period combination are calculated based on the regression model for that combination as described in the main text, using bootstrapping to find the standard errors shown in parentheses. For bootstrapping, the original sample is resampled, the regression model run on the resampled data, and the statistics calculated. This process is repeated 250 times and the standard errors calculated.
[a] 25th and 75th percentile durations calculated as follows. For each woman in a given spell/period combination sample, I calculate the time point at which there is a 25% or 75% chance that she will have given birth, conditional on the probability that she will eventually give birth in that spell. For example, if there is an 80% chance that a woman will give birth by the end of the spell, her median duration is the predicted number of months before she passes the 20% or 60% mark on her survival curve. The reported statistics is the average of this median duration across all women in a given sample using the individual predicted probabilities of having had a birth by the end of the spell as weights. Duration begins at marriage for spell 1 or at 9 months after the birth of the prior child for all other spells. For spells 2 and higher duration sex compositions other than all girls are tested against the duration for all girls, with *** indicating significantly different at the 1% level, ** at the 5% level, and * at the 10% level.

Table B.2: Estimated 25th and 75th Percentile Durations for Women with 1 to 7 Years of Education

Spell	Composition of Prior Children	1972–1984 Duration (Months)[a] Percentile 25th	75th	1985–1994 Duration (Months)[a] Percentile 25th	75th	1995–2004 Duration (Months)[a] Percentile 25th	75th	2005–2016 Duration (Months)[a] Percentile 25th	75th
				Urban					
1		11.2	34.6	11.9	31.5	13.5	31.9	13.1	30.7
		(0.2)	(0.6)	(0.1)	(0.4)	(0.1)	(0.3)	(0.1)	(0.4)
2	One girl	10.7	26.3	12.1	31.0	12.2	33.2	13.1	34.3
		(0.4)	(0.5)	(0.3)	(0.6)	(0.2)	(0.5)	(0.3)	(0.9)
	One boy	12.1***	29.2***	12.5	31.5	12.9**	33.4	13.5	37.6**
		(0.3)	(0.5)	(0.3)	(0.5)	(0.2)	(0.6)	(0.3)	(1.0)
3	Two girls	11.4	27.6	13.0	32.7	14.2	37.1	15.4	39.6
		(0.6)	(1.3)	(0.4)	(1.1)	(0.4)	(1.3)	(0.4)	(2.2)
	One boy / one girl	13.0**	29.6	13.8	33.6	13.7	34.2*	14.4*	35.5
		(0.4)	(0.9)	(0.3)	(1.0)	(0.3)	(0.9)	(0.4)	(1.5)
	Two boys	13.1**	29.5	14.1*	36.1	14.5	34.4	15.0	39.5
		(0.6)	(1.2)	(0.4)	(1.8)	(0.4)	(1.4)	(0.6)	(2.0)
4	Three girls	10.5	31.3	11.4	35.2	15.6	45.7	14.7	43.7
		(1.7)	(3.3)	(1.2)	(2.5)	(0.9)	(2.2)	(1.1)	(2.9)
	One boy / two girls	10.8	29.3	12.3	39.8	12.3***	39.1*	13.5	36.6
		(1.0)	(2.1)	(0.8)	(2.3)	(0.8)	(2.9)	(1.0)	(4.0)
	Two boys / one girl	11.7	31.4	14.0*	44.5**	14.7	44.1	17.4**	55.4**
		(1.2)	(3.2)	(1.0)	(2.8)	(0.9)	(3.8)	(1.0)	(3.5)
	Three boys	10.4	28.6	15.1**	42.6*	15.9	43.7	16.8	56.3**
		(2.0)	(5.3)	(1.2)	(3.6)	(1.2)	(5.3)	(1.9)	(5.0)
				Rural					
1		12.1	36.8	12.9	34.6	14.3	35.1	14.3	33.4
		(0.2)	(0.4)	(0.1)	(0.3)	(0.1)	(0.2)	(0.1)	(0.2)
2	One girl	12.4	28.5	12.5	30.2	13.2	31.8	13.3	32.6
		(0.2)	(0.5)	(0.2)	(0.4)	(0.1)	(0.3)	(0.1)	(0.4)
	One boy	13.2**	30.1**	13.1**	31.1*	13.3	32.4	13.7***	34.3***
		(0.2)	(0.4)	(0.2)	(0.3)	(0.1)	(0.3)	(0.1)	(0.4)
3	Two girls	12.3	26.9	12.4	28.8	13.8	33.3	14.6	35.8
		(0.5)	(0.6)	(0.3)	(0.5)	(0.2)	(0.5)	(0.2)	(0.7)
	One boy / one girl	13.2	29.1***	13.4***	32.4***	14.0	32.5	14.5	36.0
		(0.3)	(0.6)	(0.2)	(0.5)	(0.2)	(0.4)	(0.2)	(0.6)
	Two boys	14.4***	31.7***	14.1***	32.4***	14.0	33.8	14.7	36.8
		(0.5)	(0.9)	(0.3)	(0.9)	(0.3)	(0.7)	(0.2)	(1.2)
4	Three girls	11.8	27.9	13.1	33.7	14.5	37.6	16.2	41.5
		(1.3)	(1.8)	(0.7)	(1.4)	(0.5)	(1.1)	(0.4)	(1.1)
	One boy / two girls	12.1	30.2	13.4	36.9	13.5	38.5	15.4*	45.0**
		(0.9)	(1.6)	(0.6)	(1.3)	(0.4)	(1.4)	(0.3)	(1.3)
	Two boys / one girl	13.7	34.5**	14.0	41.7***	14.6	41.6*	16.1	53.3***
		(0.9)	(2.4)	(0.6)	(1.5)	(0.5)	(2.2)	(0.5)	(1.5)
	Three boys	11.8	29.5	12.5	39.7**	13.2	43.6**	16.1	50.2**
		(1.5)	(2.6)	(1.1)	(2.5)	(1.0)	(2.8)	(0.8)	(3.7)

Note. The statistics for each spell/period combination are calculated based on the regression model for that combination as described in the main text, using bootstrapping to find the standard errors shown in parentheses. For bootstrapping, the original sample is resampled, the regression model run on the resampled data, and the statistics calculated. This process is repeated 250 times and the standard errors calculated.

[a] 25th and 75th percentile durations calculated as follows. For each woman in a given spell/period combination sample, I calculate the time point at which there is a 25% or 75% chance that she will have given birth, conditional on the probability that she will eventually give birth in that spell. For example, if there is an 80% chance that a woman will give birth by the end of the spell, her median duration is the predicted number of months before she passes the 20% or 60% mark on her survival curve. The reported statistics is the average of this median duration across all women in a given sample using the individual predicted probabilities of having had a birth by the end of the spell as weights. Duration begins at marriage for spell 1 or at 9 months after the birth of the prior child for all other spells. For spells 2 and higher duration sex compositions other than all girls are tested against the duration for all girls, with *** indicating significantly different at the 1% level, ** at the 5% level, and * at the 10% level.

Table B.3: Estimated 25th and 75th Percentile Durations for Women with 8 or More Years of Education

Spell	Composition of Prior Children	1972–1984 Duration (Months)[a] Percentile 25th	1972–1984 75th	1985–1994 Duration (Months)[a] Percentile 25th	1985–1994 75th	1995–2004 Duration (Months)[a] Percentile 25th	1995–2004 75th	2005–2016 Duration (Months)[a] Percentile 25th	2005–2016 75th
	Urban								
1		12.0	31.8	12.2	29.5	12.8	29.5	12.9	29.2
		(0.1)	(0.3)	(0.1)	(0.2)	(0.0)	(0.2)	(0.0)	(0.2)
2	One girl	12.0	33.0	13.9	40.5	15.2	43.0	16.7	47.0
		(0.3)	(0.6)	(0.2)	(0.5)	(0.2)	(0.4)	(0.2)	(0.5)
	One boy	12.3	35.2**	14.5**	40.5	15.1	42.6	16.7	47.5
		(0.3)	(0.6)	(0.2)	(0.5)	(0.1)	(0.4)	(0.2)	(0.6)
3	Two girls	13.6	33.6	16.0	45.9	16.8	46.5	18.7	54.0
		(0.4)	(1.3)	(0.5)	(1.3)	(0.4)	(1.0)	(0.5)	(1.3)
	One boy / one girl	12.7	35.9	14.5**	40.4***	14.7***	40.6***	16.0***	43.7***
		(0.4)	(1.4)	(0.3)	(1.0)	(0.3)	(0.9)	(0.4)	(1.7)
	Two boys	13.9	37.6	14.9	42.3	15.5**	39.3***	15.6***	48.5*
		(0.6)	(2.0)	(0.5)	(2.0)	(0.3)	(1.2)	(0.5)	(2.5)
4	Three girls	12.0	34.2	17.3	51.0	16.7	50.8	19.7	56.3
		(1.6)	(4.3)	(1.1)	(1.9)	(0.8)	(1.7)	(1.0)	(1.3)
	One boy / two girls	10.5	35.1	14.7*	48.2	14.5*	50.6	16.7**	55.7
		(1.1)	(4.2)	(0.9)	(2.8)	(0.8)	(2.3)	(0.8)	(2.9)
	Two boys / one girl	10.4	33.2	12.6***	44.6	13.3**	52.9	13.8***	53.2
		(1.2)	(4.5)	(1.2)	(4.6)	(1.2)	(3.1)	(1.6)	(5.3)
	Three boys	12.2	34.4	14.5	48.4	13.1*	44.3	16.8	59.3
		(2.2)	(7.3)	(1.9)	(6.7)	(1.8)	(6.9)	(2.5)	(6.0)
	Rural								
1		12.2	33.5	12.9	33.3	13.4	31.6	13.3	30.6
		(0.2)	(0.5)	(0.1)	(0.3)	(0.0)	(0.2)	(0.0)	(0.1)
2	One girl	12.2	30.6	13.5	34.8	13.9	35.7	14.6	39.2
		(0.4)	(0.6)	(0.2)	(0.5)	(0.1)	(0.3)	(0.1)	(0.3)
	One boy	12.4	31.7	13.5	34.5	13.9	35.8	14.6	39.8
		(0.3)	(1.0)	(0.2)	(0.6)	(0.1)	(0.3)	(0.1)	(0.4)
3	Two girls	14.4	31.8	15.1	37.4	14.9	38.5	16.9	44.5
		(0.7)	(1.6)	(0.4)	(1.1)	(0.2)	(0.7)	(0.2)	(0.8)
	One boy / one girl	13.9	31.2	14.1*	35.0	14.2***	35.7***	14.6***	38.2***
		(0.4)	(1.2)	(0.3)	(1.0)	(0.2)	(0.6)	(0.2)	(0.7)
	Two boys	14.1	32.2	14.2	35.1	14.2*	35.2***	15.3***	39.5***
		(0.7)	(1.8)	(0.6)	(1.6)	(0.3)	(0.9)	(0.4)	(1.3)
4	Three girls	10.9	31.1	15.3	45.5	15.6	44.2	16.8	47.6
		(2.0)	(3.6)	(1.2)	(2.1)	(0.6)	(1.3)	(0.5)	(0.9)
	One boy / two girls	14.8*	36.4	14.0	44.7	14.0**	40.3	15.8	52.5***
		(1.2)	(3.6)	(0.8)	(2.3)	(0.5)	(2.0)	(0.5)	(1.5)
	Two boys / one girl	15.3	44.8**	15.7	52.3**	15.6	46.7	16.9	59.0***
		(1.4)	(4.4)	(1.1)	(2.7)	(0.6)	(2.5)	(0.7)	(1.7)
	Three boys	13.3	41.2	14.3	42.3	15.8	44.1	16.3	52.6
		(2.6)	(6.6)	(1.8)	(7.1)	(0.9)	(4.4)	(1.2)	(4.3)

Note. The statistics for each spell/period combination are calculated based on the regression model for that combination as described in the main text, using bootstrapping to find the standard errors shown in parentheses. For bootstrapping, the original sample is resampled, the regression model run on the resampled data, and the statistics calculated. This process is repeated 250 times and the standard errors calculated.
[a] 25th and 75th percentile durations calculated as follows. For each woman in a given spell/period combination sample, I calculate the time point at which there is a 25% or 75% chance that she will have given birth, conditional on the probability that she will eventually give birth in that spell. For example, if there is an 80% chance that a woman will give birth by the end of the spell, her median duration is the predicted number of months before she passes the 20% or 60% mark on her survival curve. The reported statistics is the average of this median duration across all women in a given sample using the individual predicted probabilities of having had a birth by the end of the spell as weights. Duration begins at marriage for spell 1 or at 9 months after the birth of the prior child for all other spells. For spells 2 and higher duration sex compositions other than all girls are tested against the duration for all girls, with *** indicating significantly different at the 1% level, ** at the 5% level, and * at the 10% level.

C Graphs for All Education and Spell Groups

C.1 First Spell

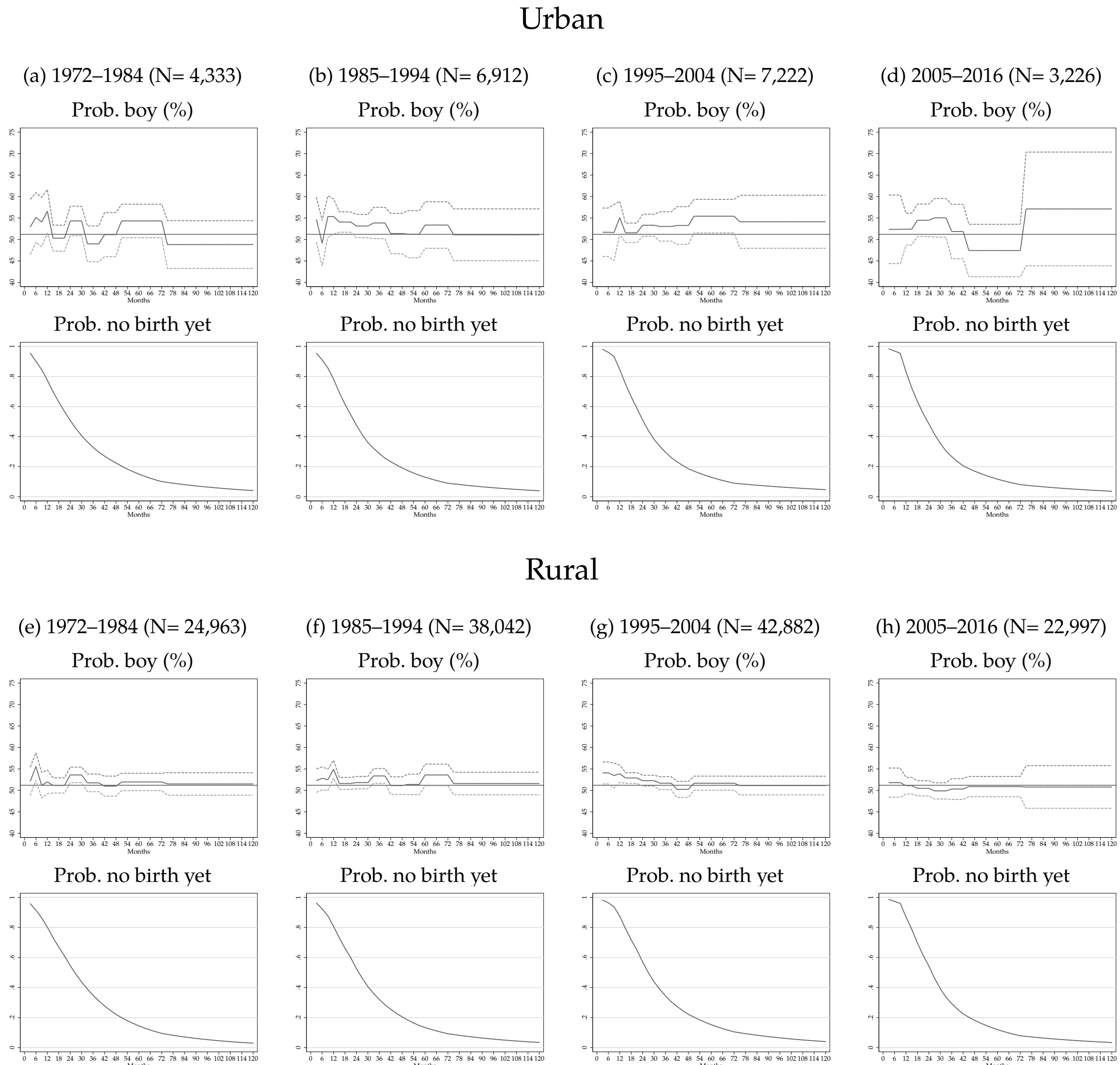


Figure C.1: Predicted probability of having a boy and probability of no birth yet from time of marriage for women with no education by month beginning at marriage. Predictions based on age 16 at marriage. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

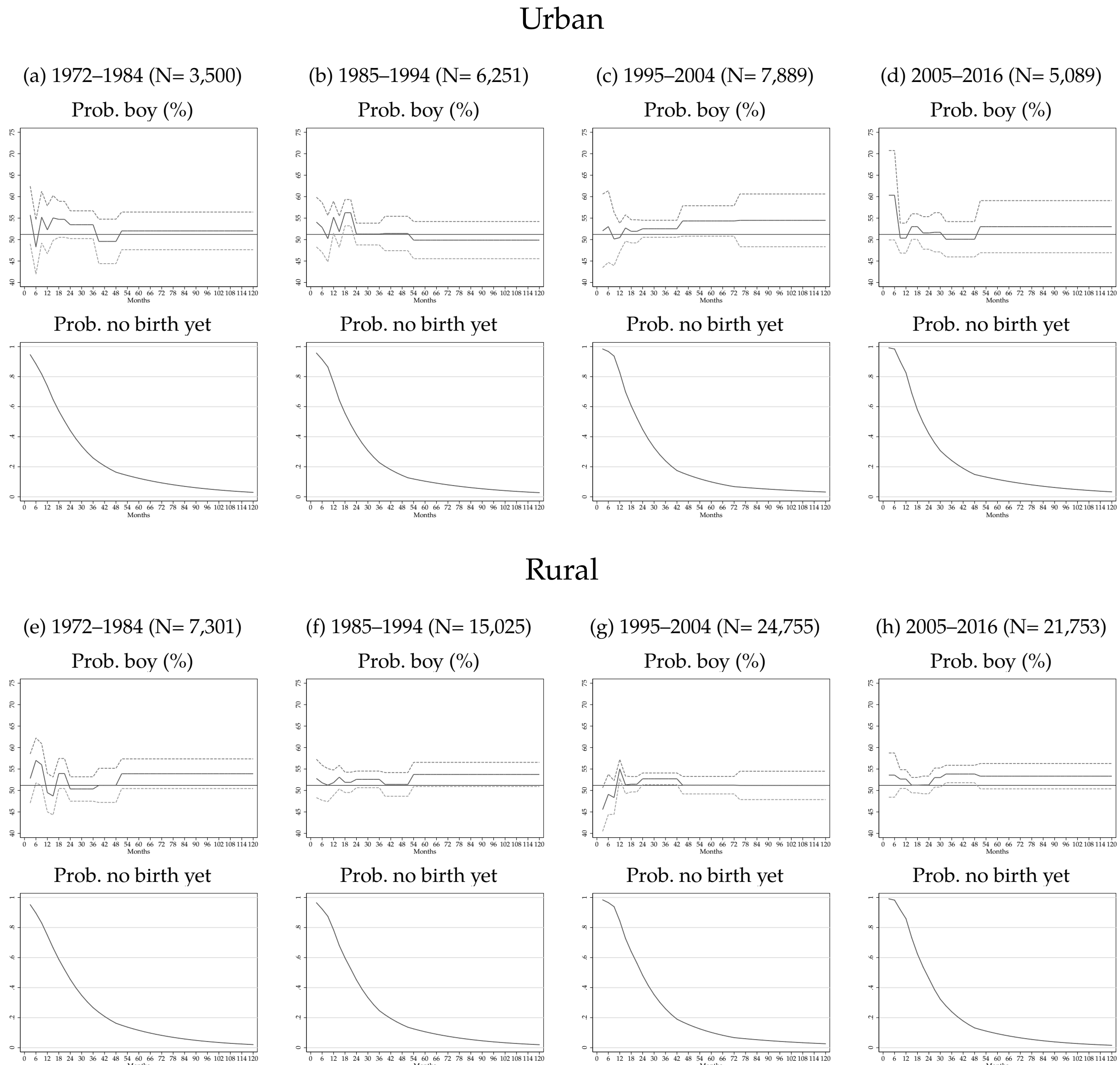


Figure C.2: Predicted probability of having a boy and probability of no birth yet from time of marriage for women with 1 to 7 years of education by month beginning at marriage. Predictions based on age 17 at marriage. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

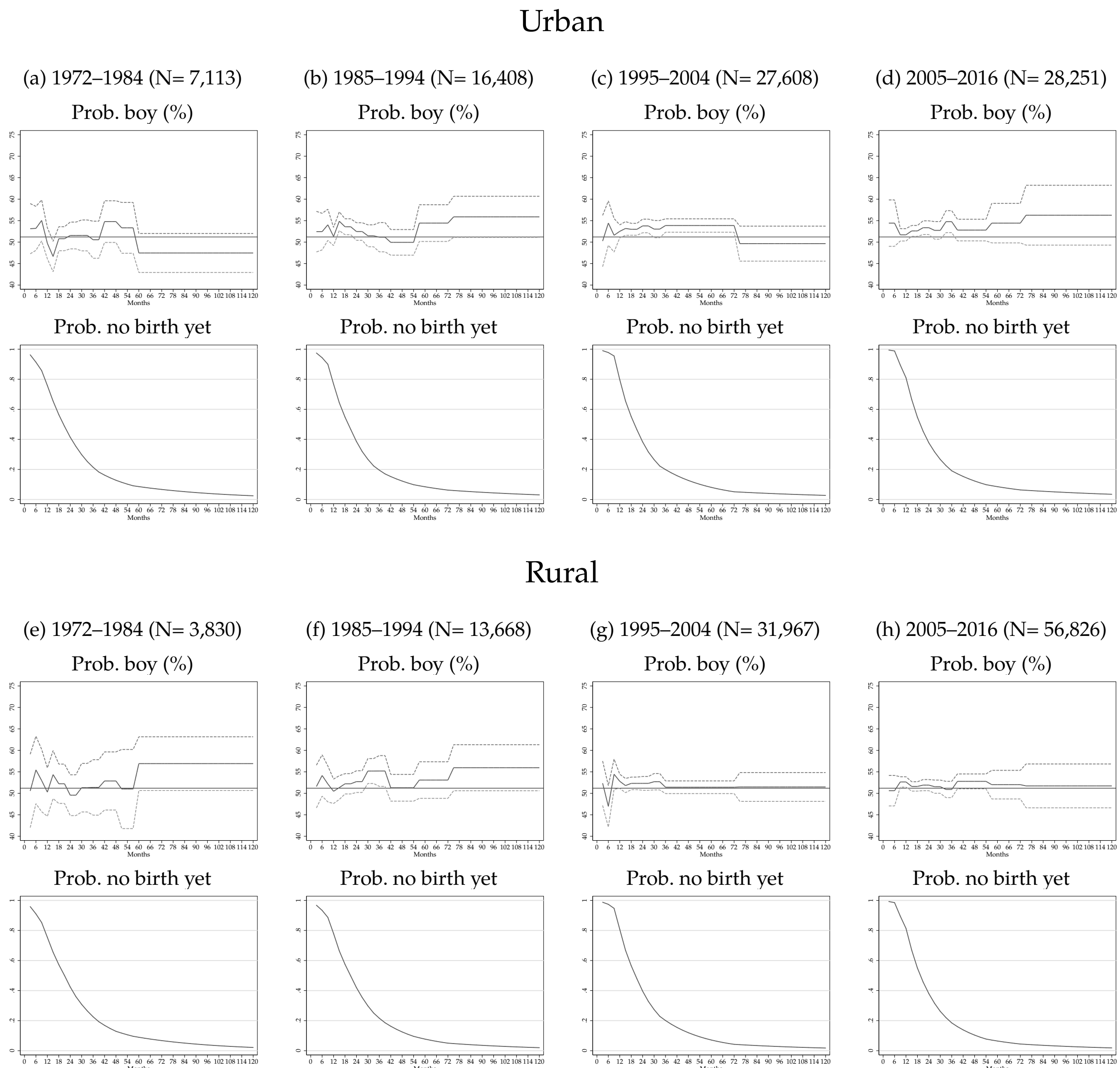
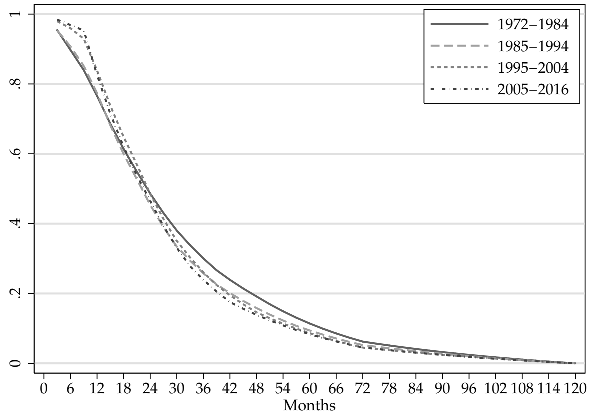


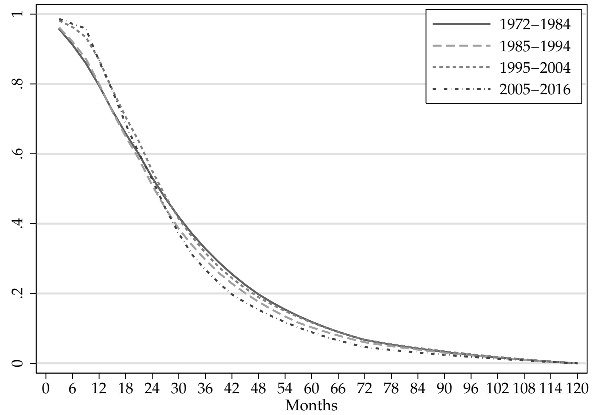
Figure C.3: Predicted probability of having a boy and probability of no birth yet from time of marriage for women with 8 or more years of education by month beginning at marriage. Predictions based on age 20 at marriage. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

No Education

(a) Urban

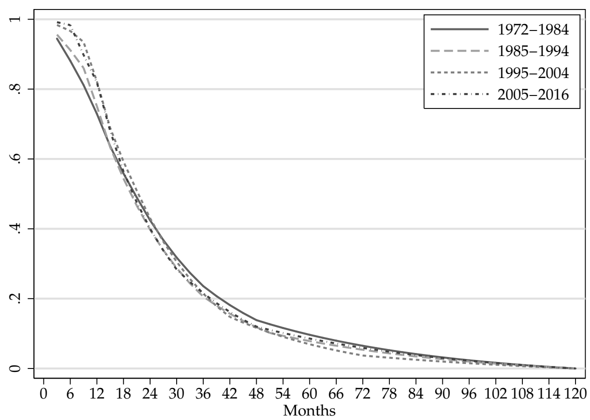


(b) Rural

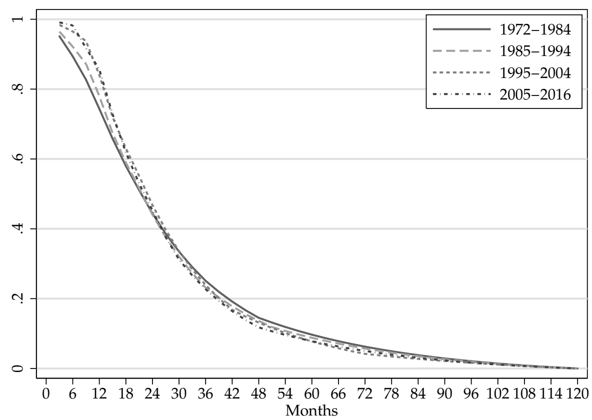


1-7 Years of Education

(c) Urban

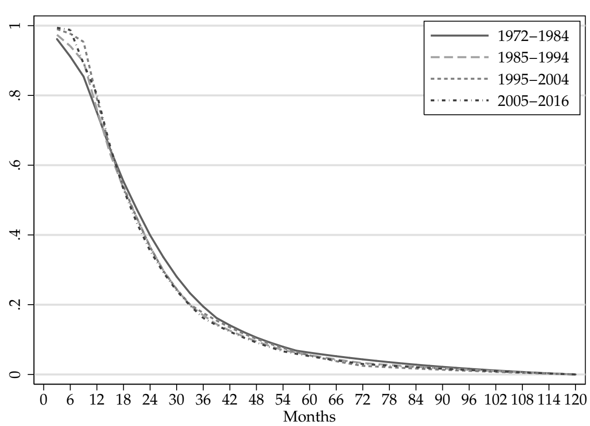


(d) Rural



8 or more Years of Education

(e) Urban



(f) Rural

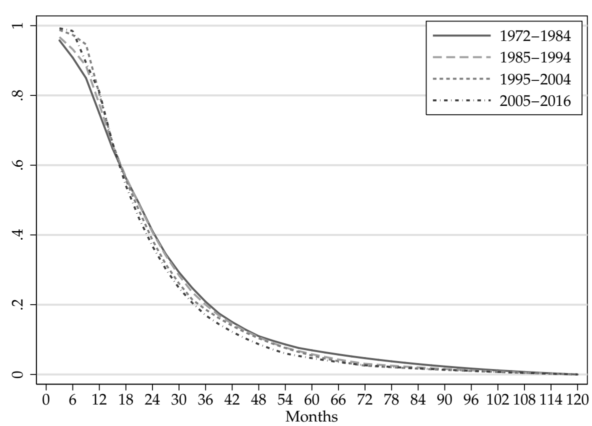


Figure C.4: Survival curves conditional on progression to first birth; start point is month of marriage

C.2 Second Spell

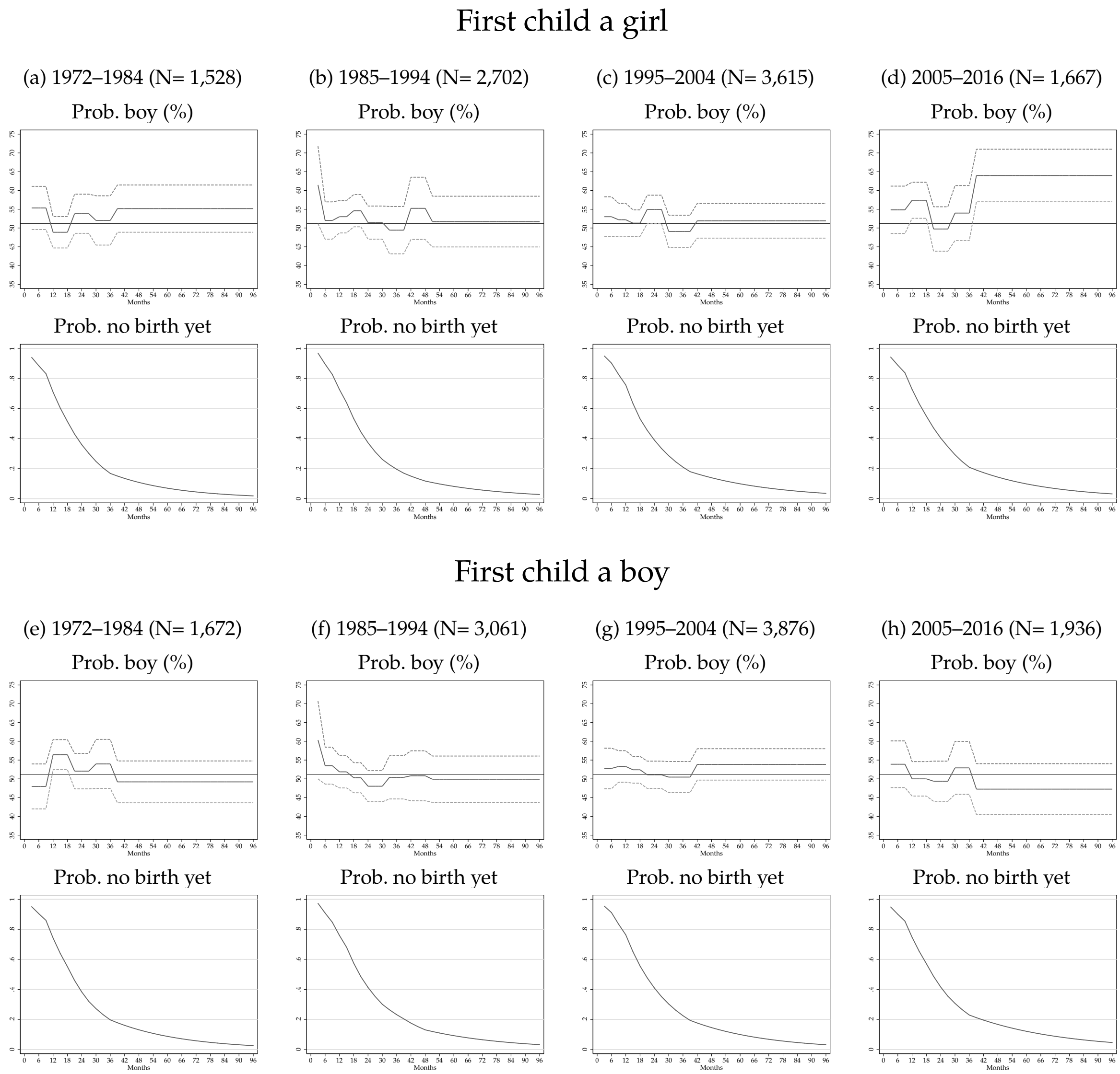


Figure C.5: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with no education by month beginning at 9 months after prior birth. Predictions based on age 18 at first birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

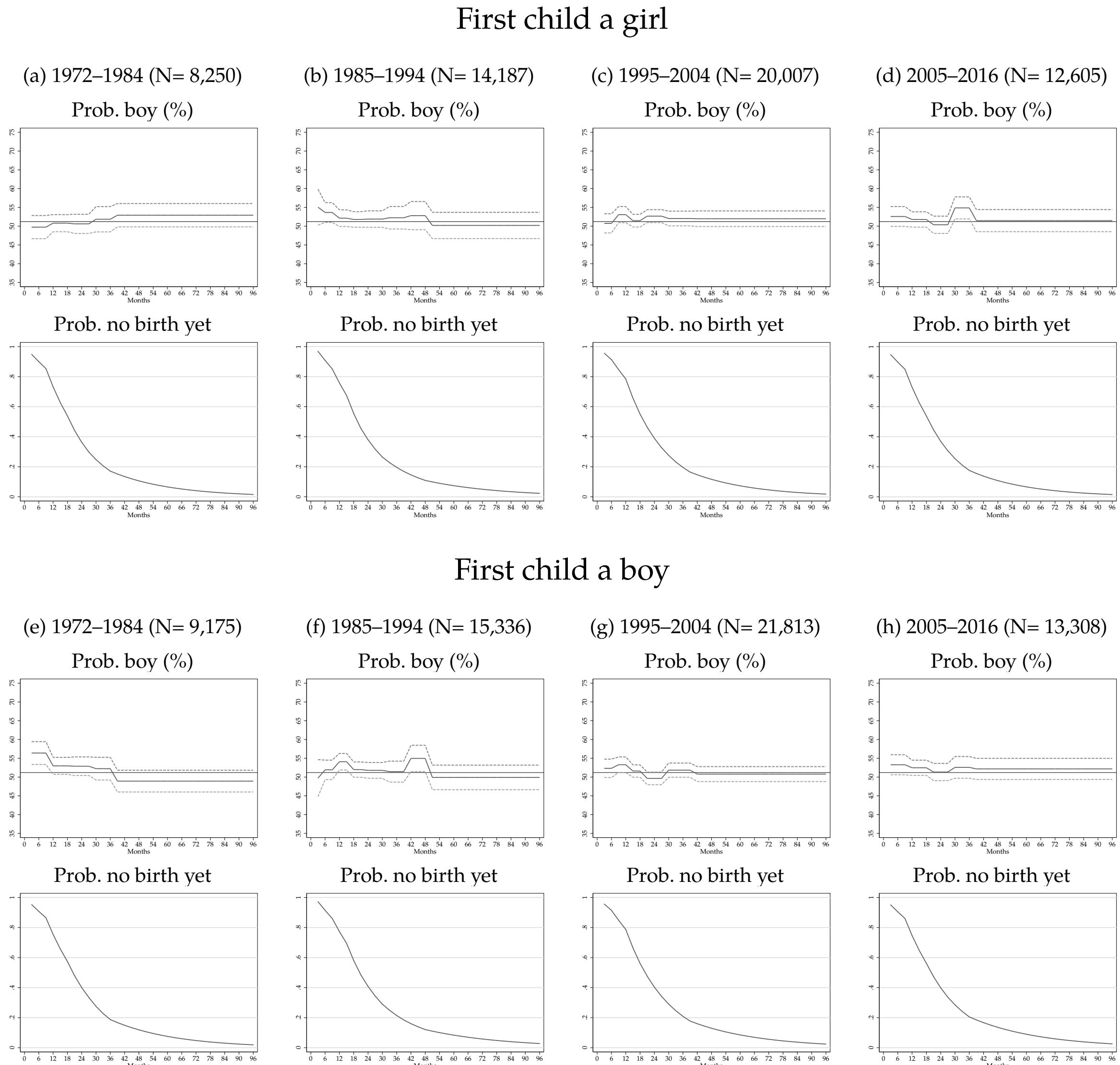


Figure C.6: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with no education by month beginning at 9 months after prior birth. Predictions based on age 18 at first birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

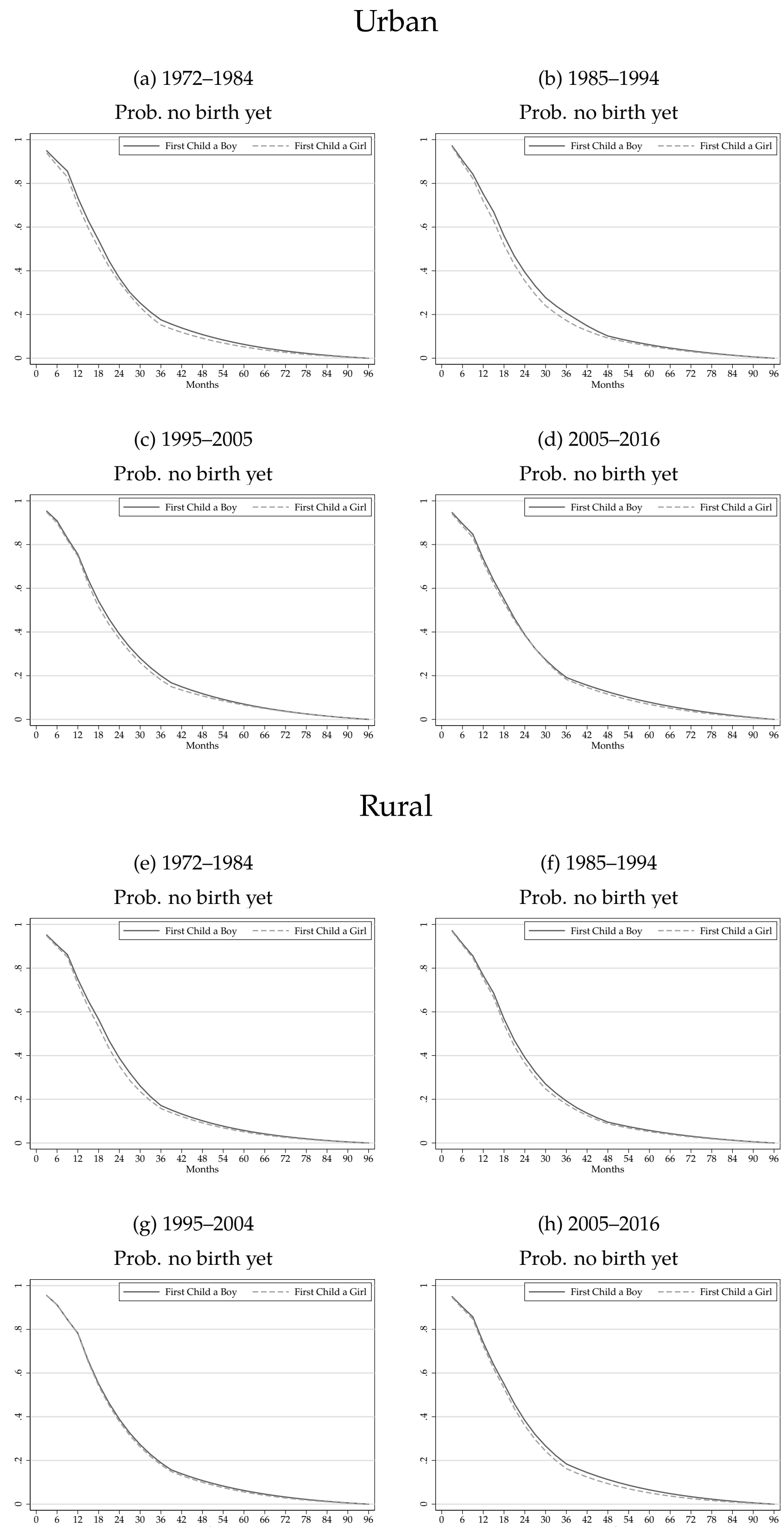


Figure C.7: Survival curves conditional on parity progression for women with no education by month beginning 9 months after prior birth.

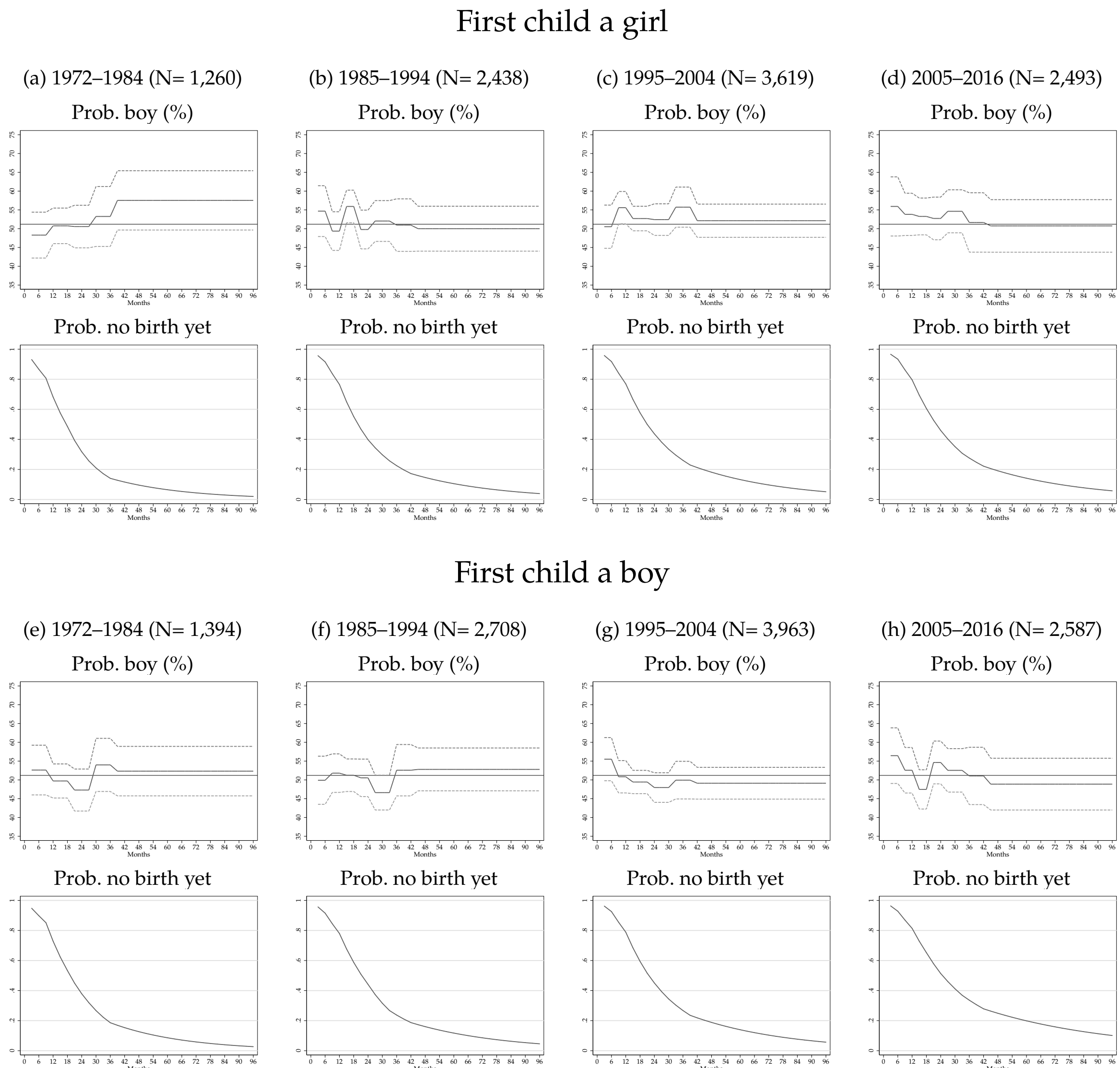


Figure C.8: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with 1 to 7 years of education by month beginning at 9 months after prior birth. Predictions based on age 19 at first birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

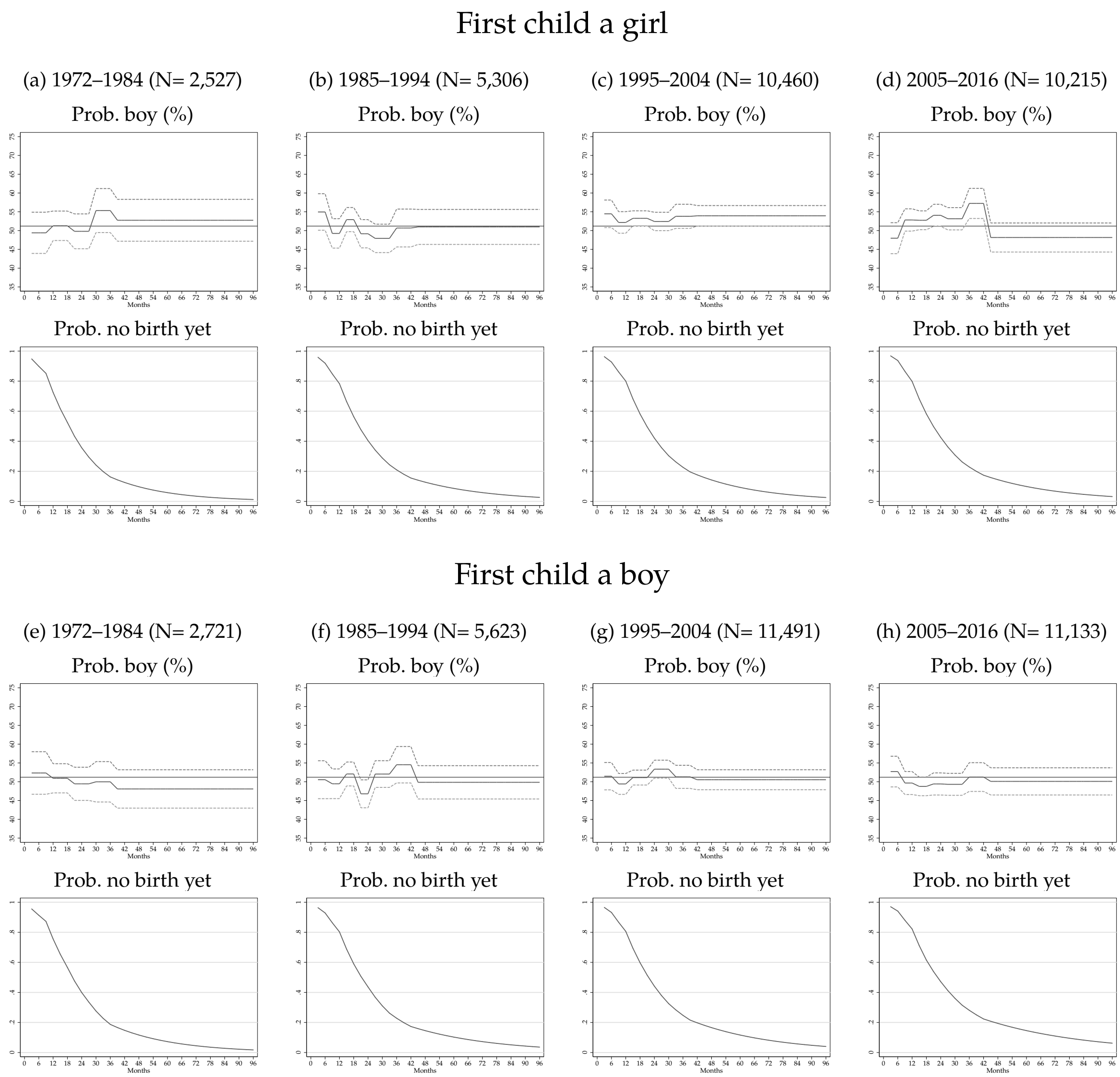
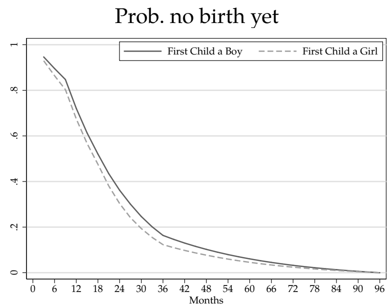


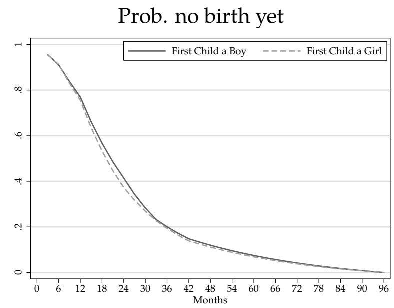
Figure C.9: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with 1 to 7 years of education by month beginning at 9 months after prior birth. Predictions based on age 19 at first birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

Urban

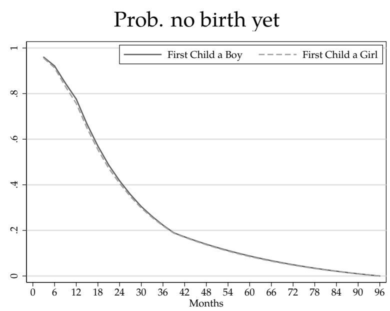
(a) 1972–1984



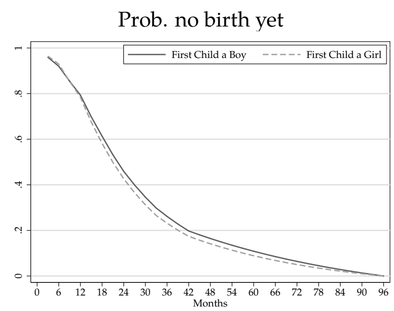
(b) 1985–1994



(c) 1995–2004

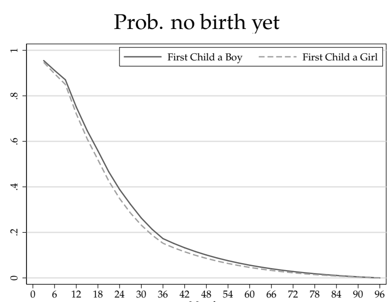


(d) 2005–2016



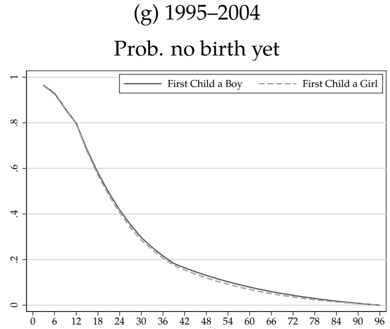
Rural

(e) 1972–1984



(f) 1985–1994

(g) 1995–2004



(h) 2005–2016

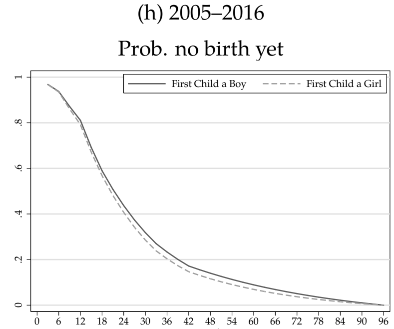


Figure C.10: Survival curves conditional on parity progression for women with 1-7 years of education by month beginning 9 months after prior birth.

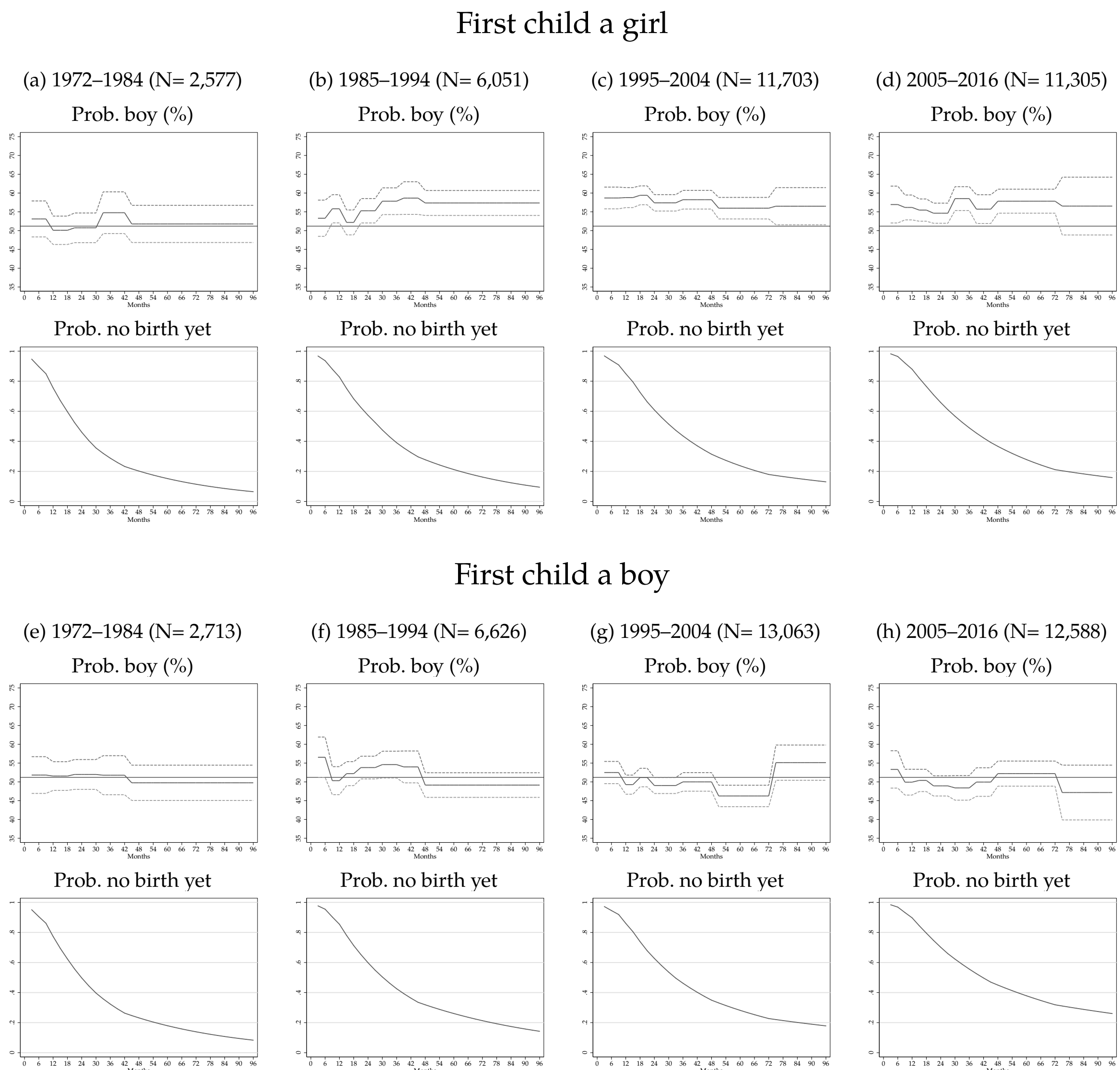


Figure C.11: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with 8 or more years of education by month beginning at 9 months after prior birth. Predictions based on age 22 at first birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

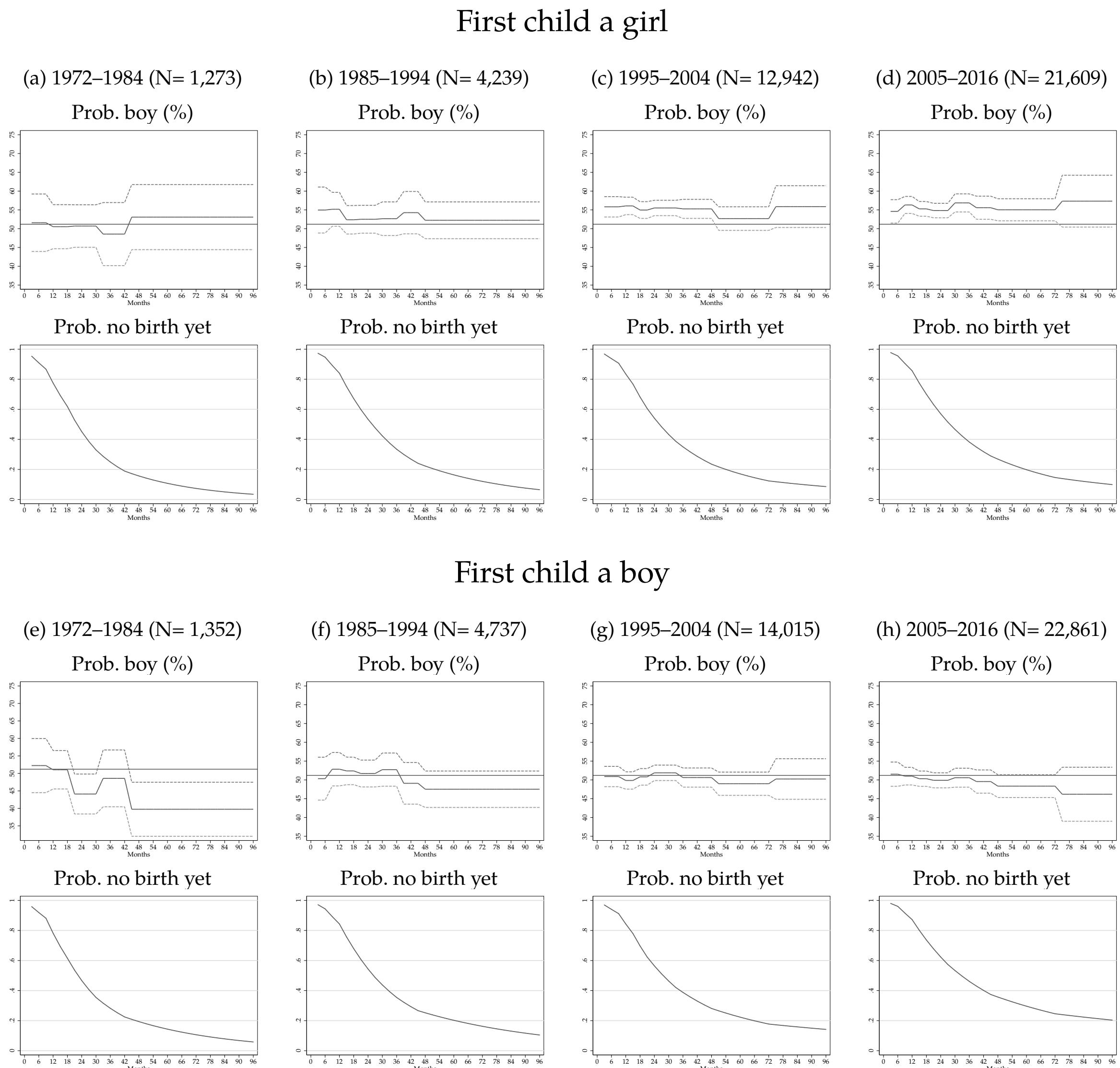
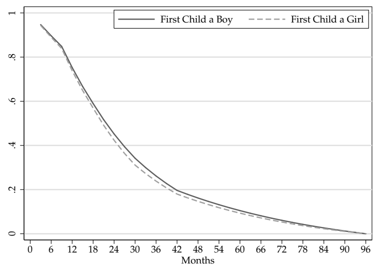


Figure C.12: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with 8 or more years of education by month beginning at 9 months after prior birth. Predictions based on age 22 at first birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

Urban

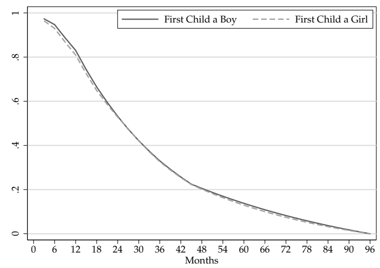
(a) 1972–1984

Prob. no birth yet



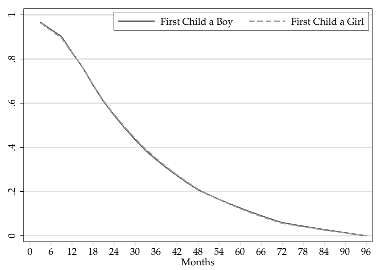
(b) 1985–1994

Prob. no birth yet



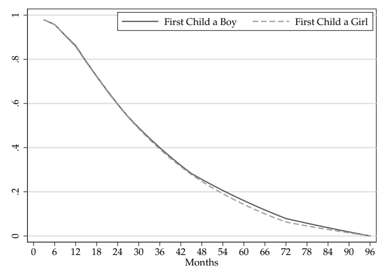
(c) 1995–2004

Prob. no birth yet



(d) 2005–2016

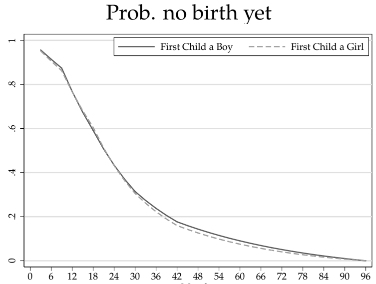
Prob. no birth yet



Rural

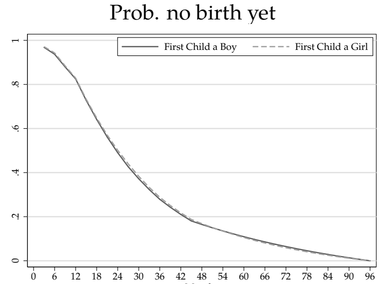
(e) 1972–1984

Prob. no birth yet



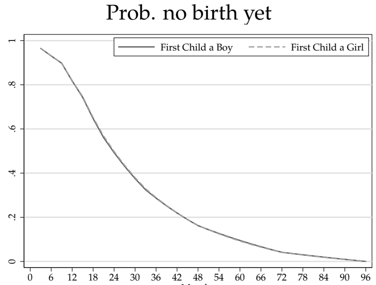
(f) 1985–1994

Prob. no birth yet



(g) 1995–2004

Prob. no birth yet



(h) 2005–2016

Prob. no birth yet

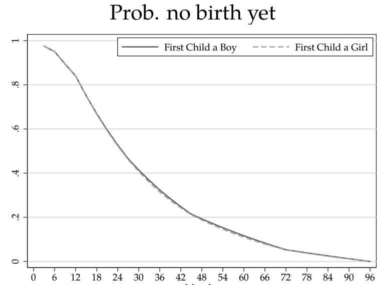


Figure C.13: Survival curves conditional on parity progression for women with 8 or more years of education by month beginning 9 months after prior birth.

C.3 Third Spell

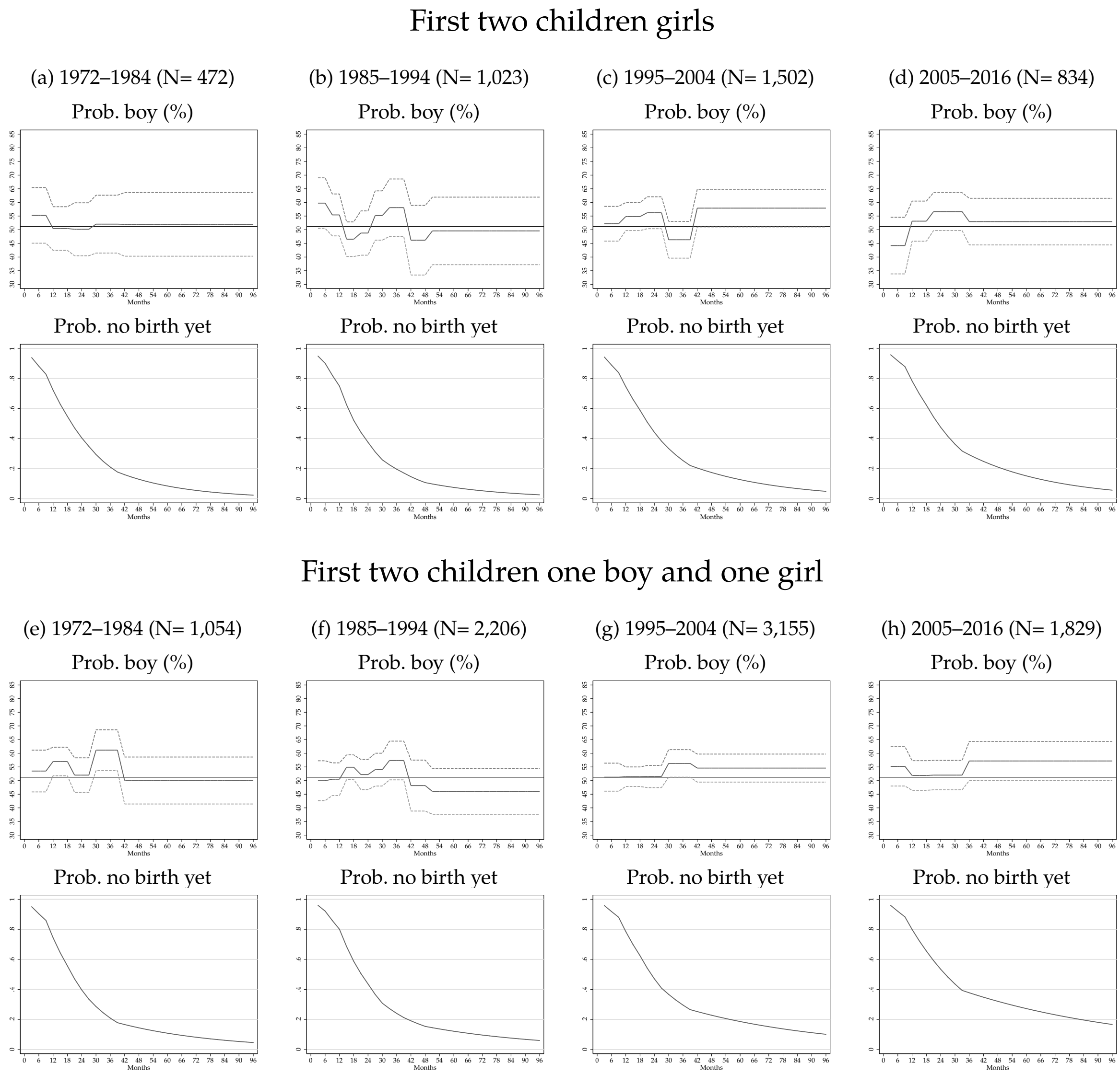


Figure C.14: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with no education by month beginning at 9 months after prior birth. Predictions based on age 20 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

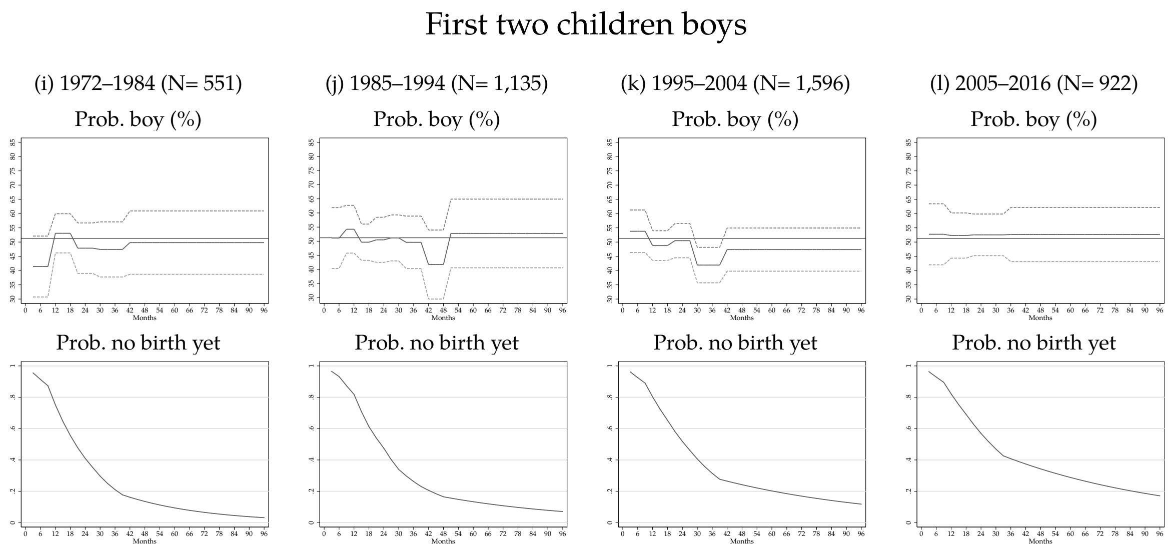


Figure C.14: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with no education by month beginning at 9 months after prior birth. Predictions based on age 20 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

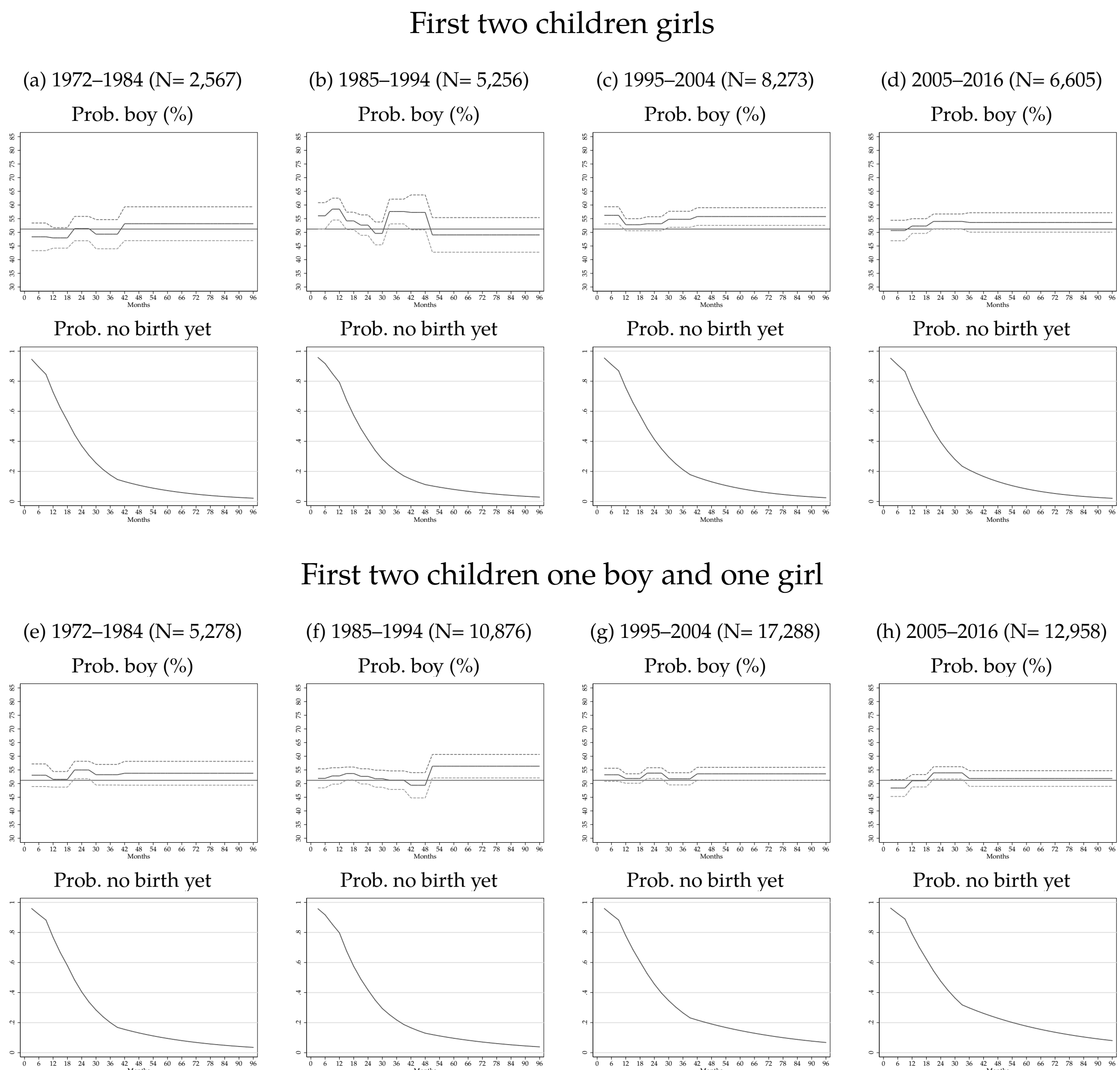


Figure C.15: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with no education by month beginning at 9 months after prior birth. Predictions based on age 20 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

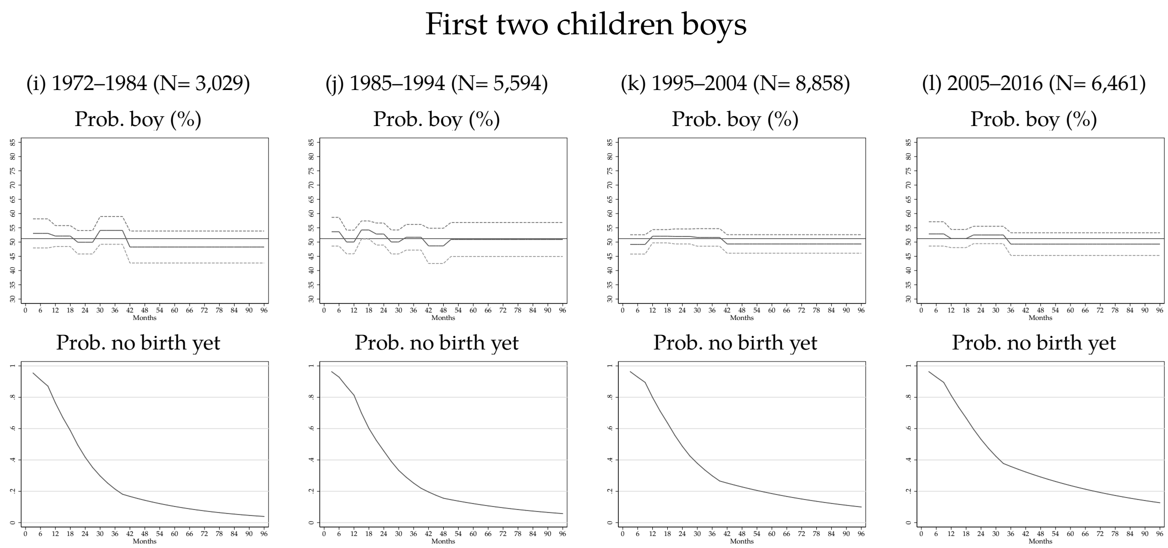


Figure C.15: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with no education by month beginning at 9 months after prior birth. Predictions based on age 20 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

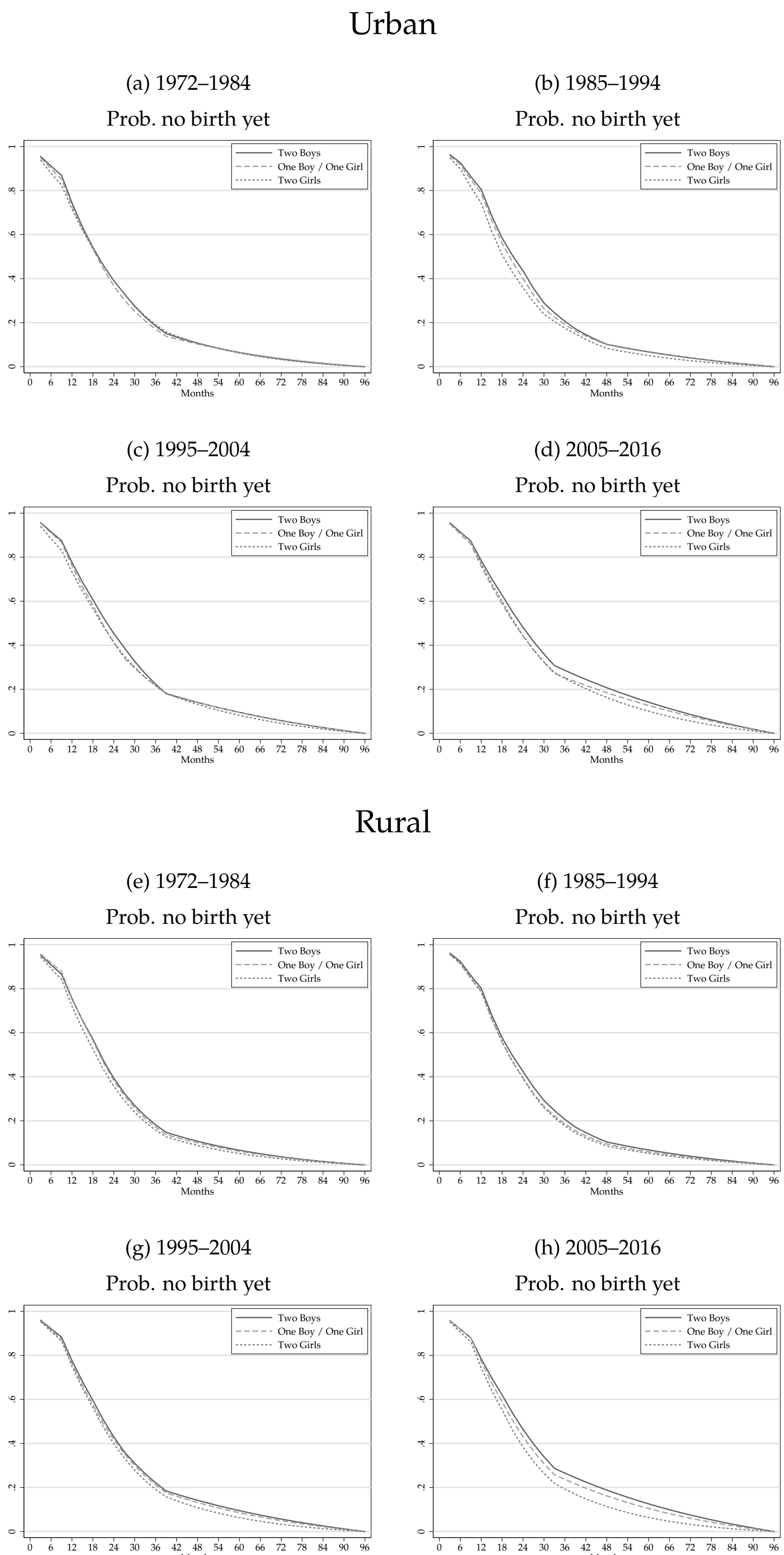


Figure C.16: Survival curves conditional on parity progression for women with no education by month beginning 9 months after prior birth.

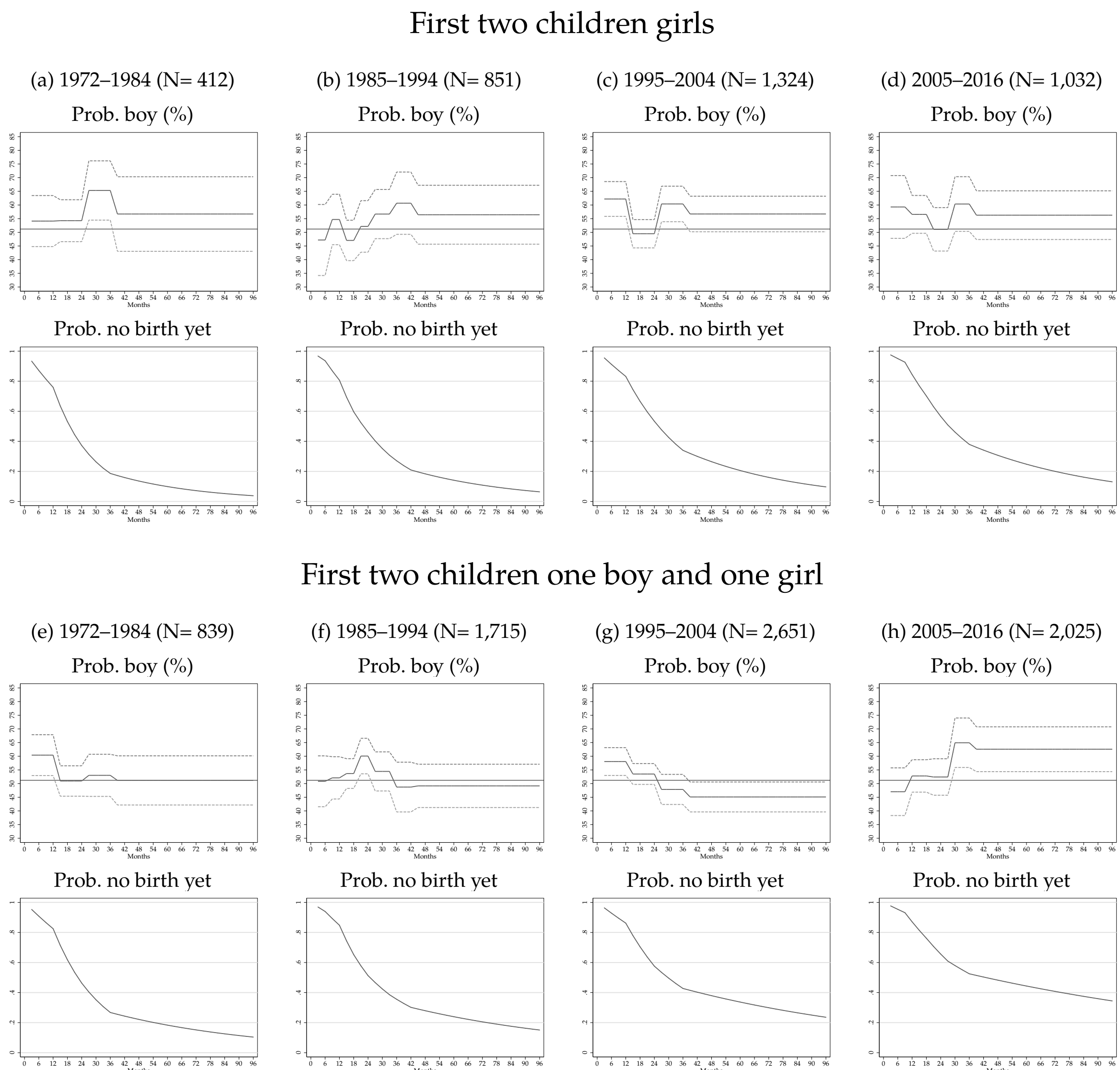


Figure C.17: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with 1 to 7 years of education by month beginning at 9 months after prior birth. Predictions based on age 21 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

First two children boys

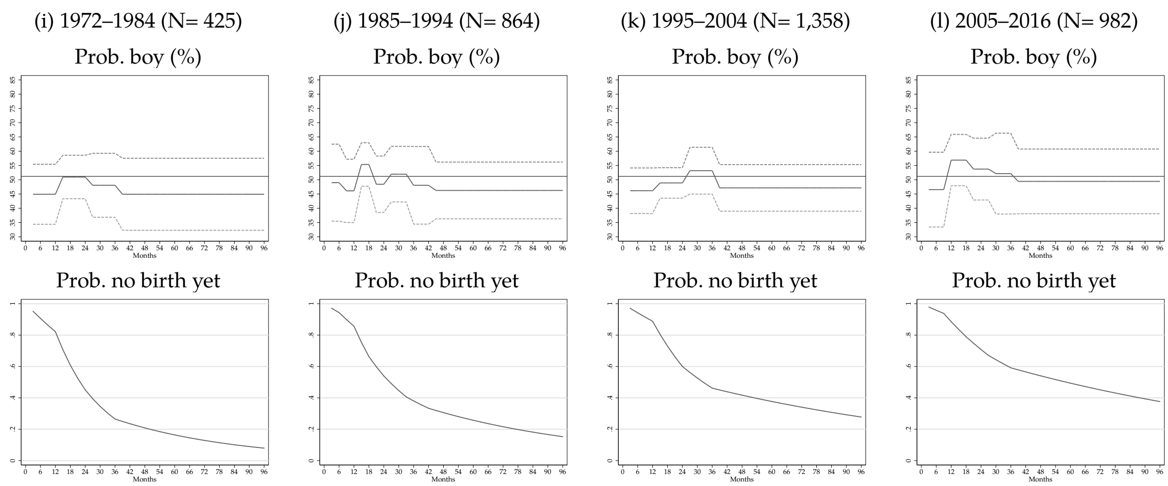


Figure C.17: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with 1 to 7 years of education by month beginning at 9 months after prior birth. Predictions based on age 21 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

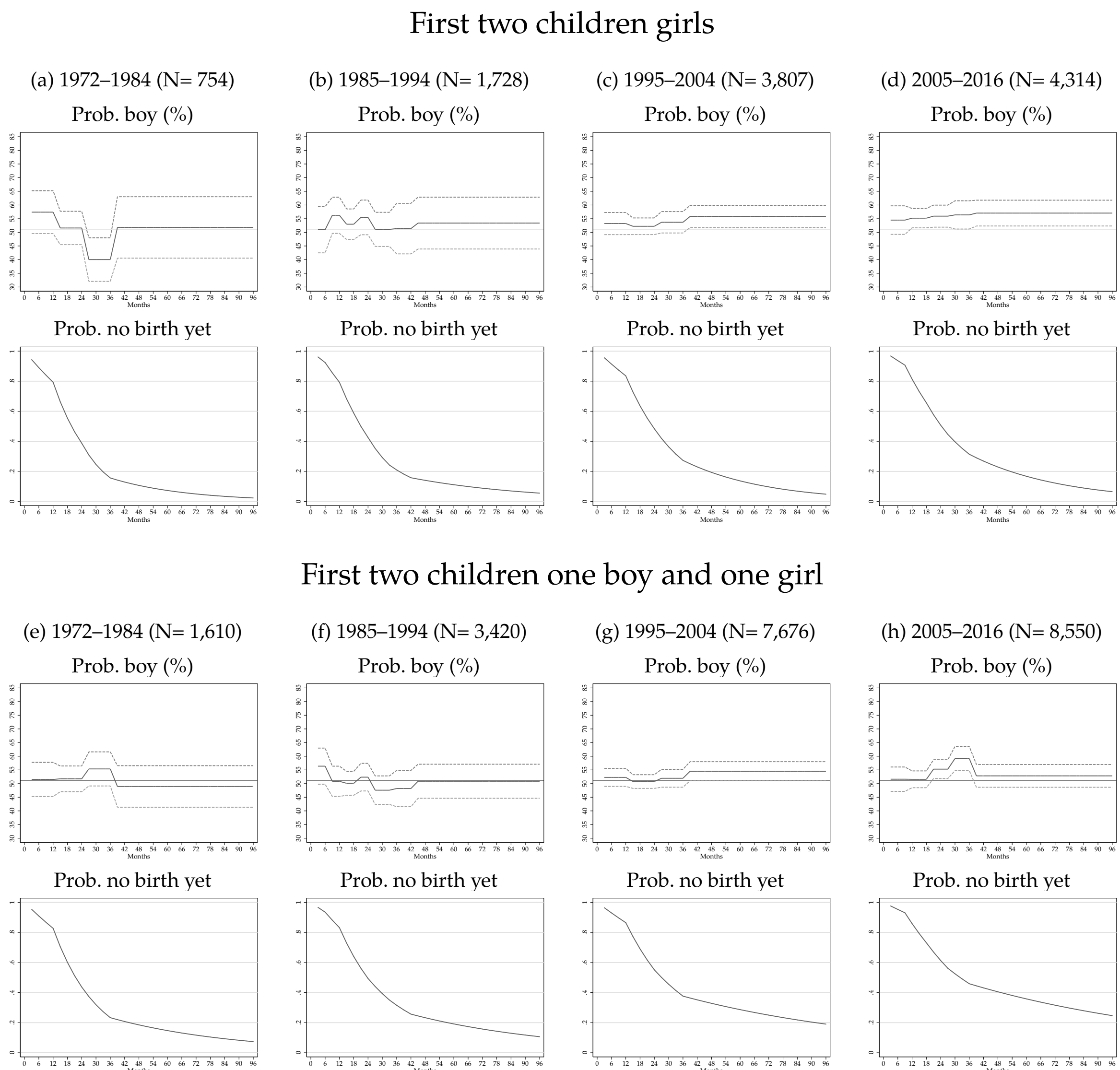


Figure C.18: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with 1 to 7 years of education by month beginning at 9 months after prior birth. Predictions based on age 21 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

First two children boys

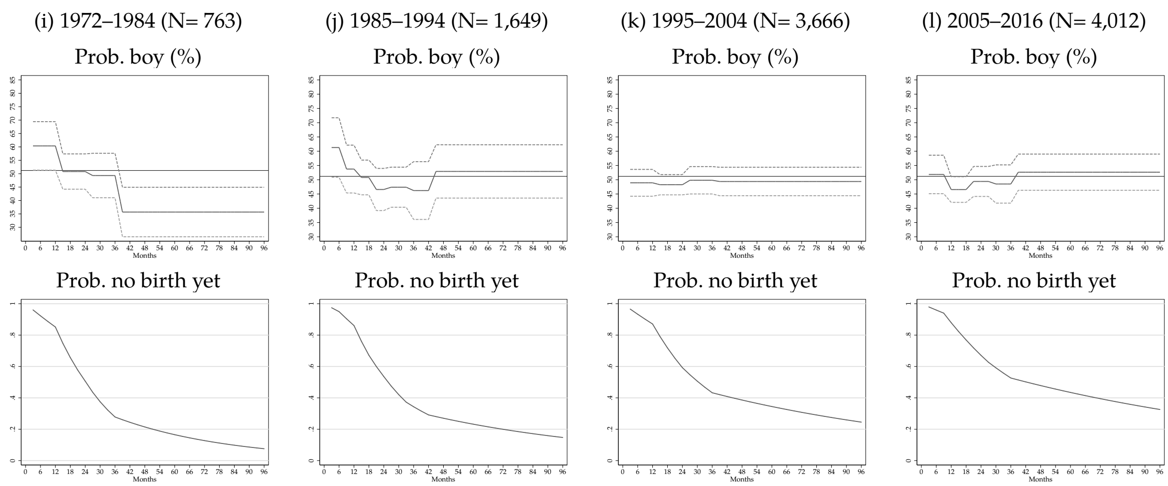
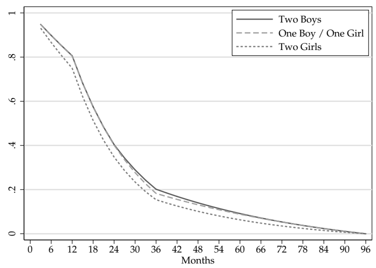


Figure C.18: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with 1 to 7 years of education by month beginning at 9 months after prior birth. Predictions based on age 21 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

Urban

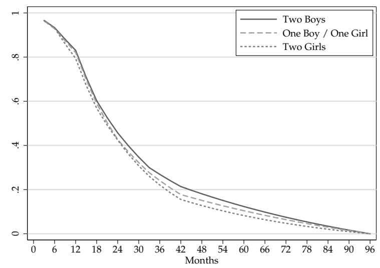
(a) 1972–1984

Prob. no birth yet



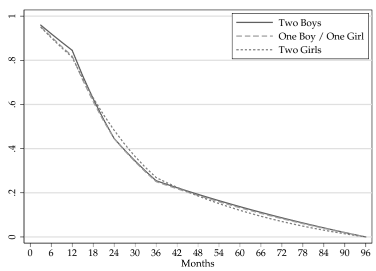
(b) 1985–1994

Prob. no birth yet



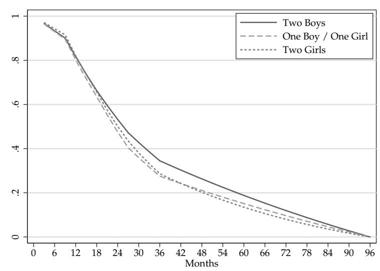
(c) 1995–2004

Prob. no birth yet



(d) 2005–2016

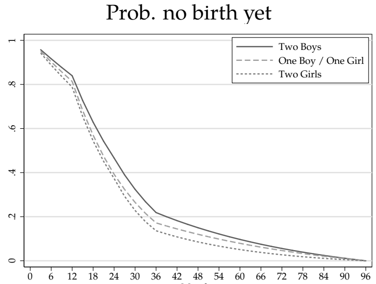
Prob. no birth yet



Rural

(e) 1972–1984

Prob. no birth yet



(f) 1985–1994

Prob. no birth yet

(g) 1995–2004

Prob. no birth yet

(h) 2005–2016

Prob. no birth yet

Figure C.19: Survival curves conditional on parity progression for women with 1 to 7 years of education by month beginning 9 months after prior birth.

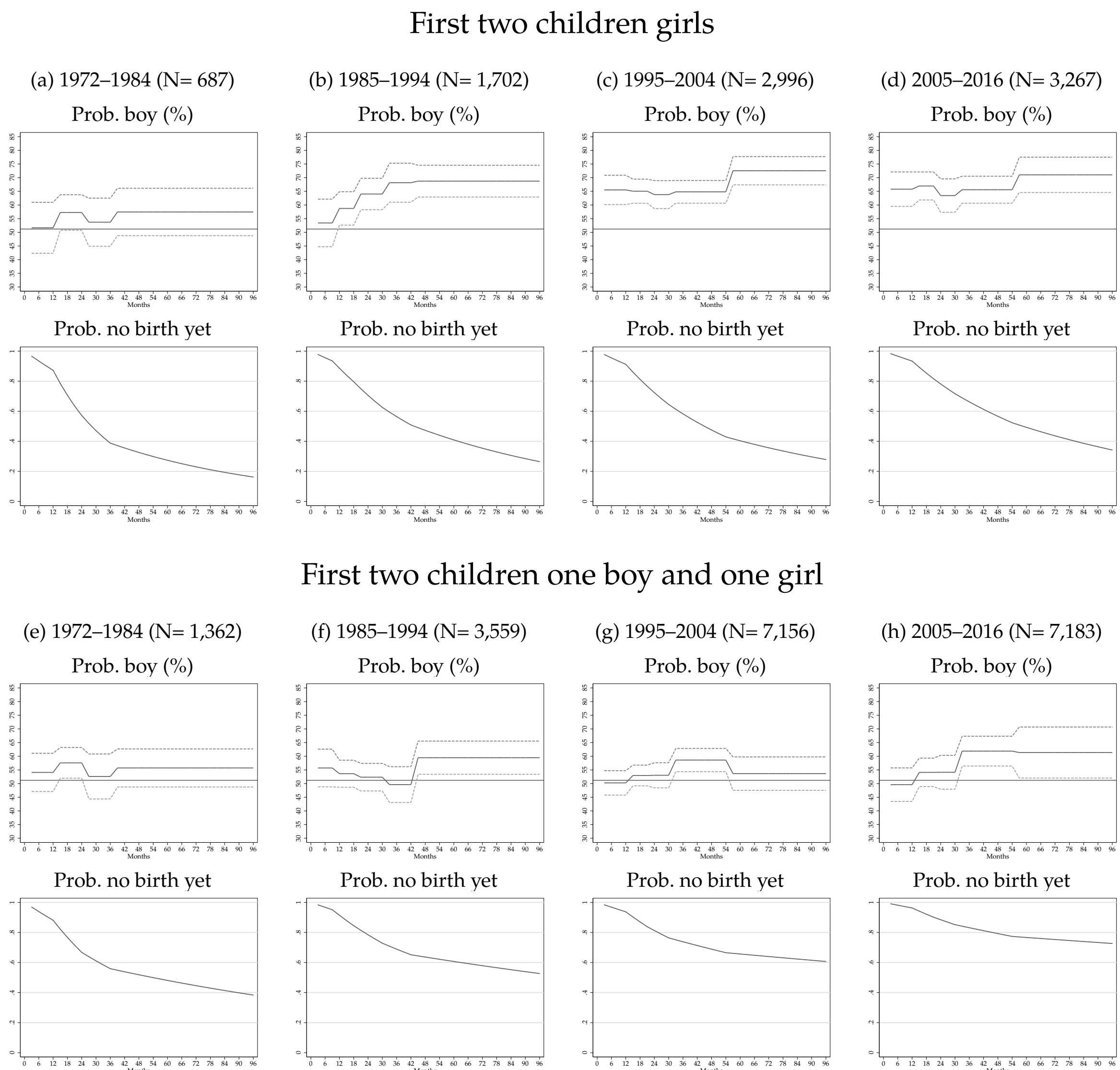


Figure C.20: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with 8 or more years of education by month beginning at 9 months after prior birth. Predictions based on age 24 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

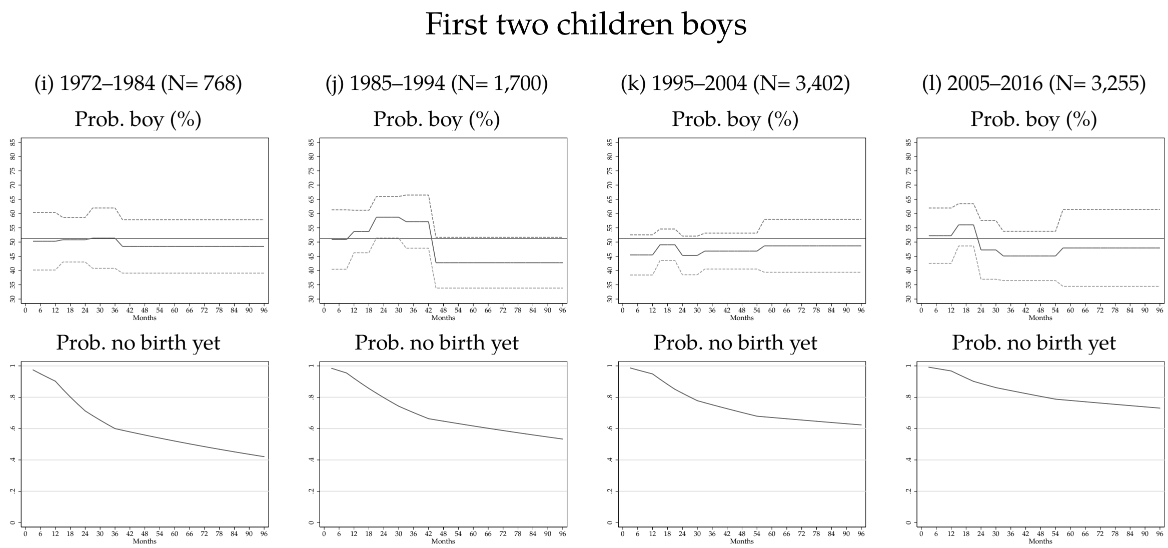


Figure C.20: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with 8 or more years of education by month beginning at 9 months after prior birth. Predictions based on age 24 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

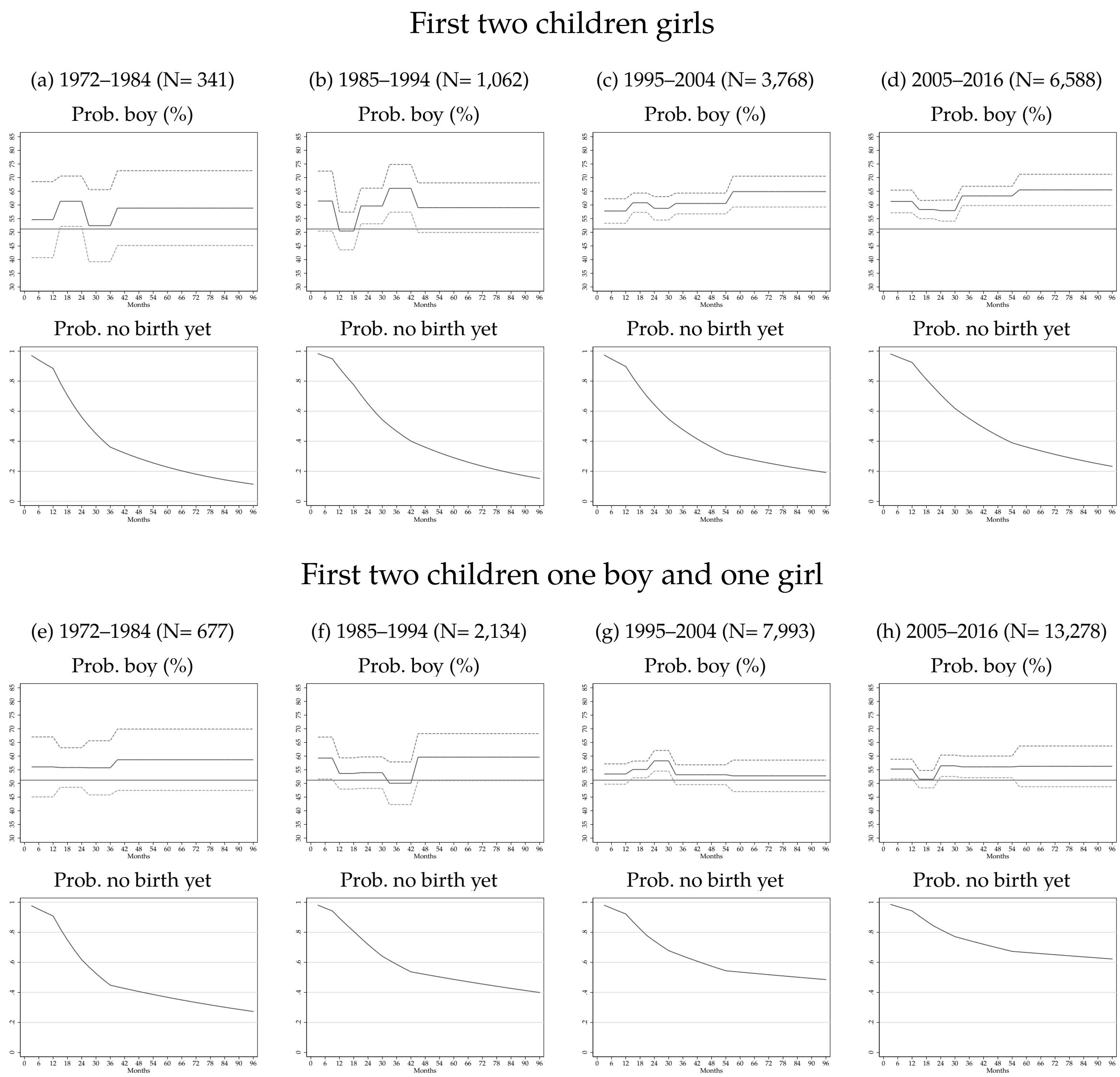


Figure C.21: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with 8 or more years of education by month beginning at 9 months after prior birth. Predictions based on age 24 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

First two children boys

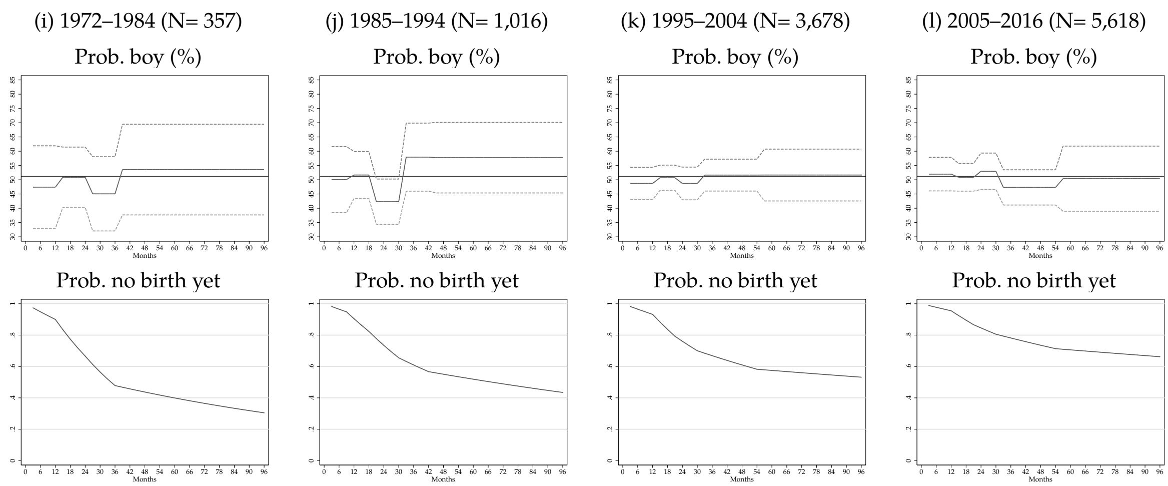
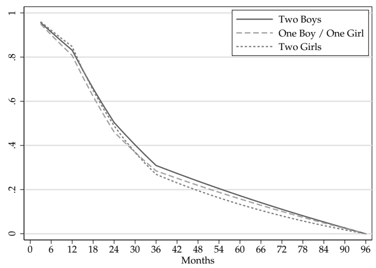


Figure C.21: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with 8 or more years of education by month beginning at 9 months after prior birth. Predictions based on age 24 at second birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

Urban

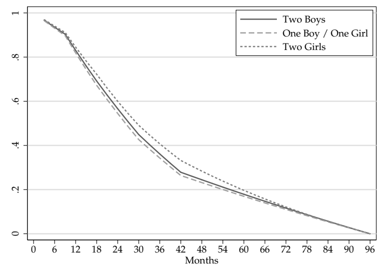
(a) 1972–1984

Prob. no birth yet



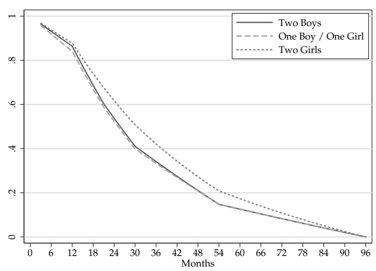
(b) 1985–1994

Prob. no birth yet



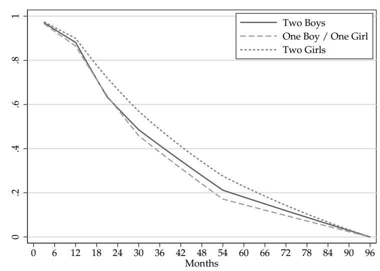
(c) 1995–2004

Prob. no birth yet



(d) 2005–2016

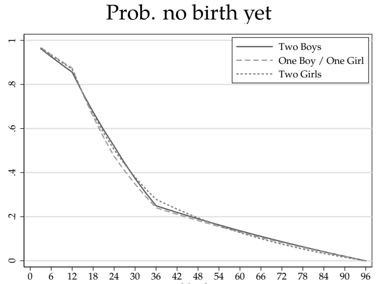
Prob. no birth yet



Rural

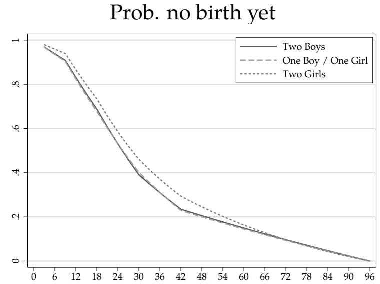
(e) 1972–1984

Prob. no birth yet



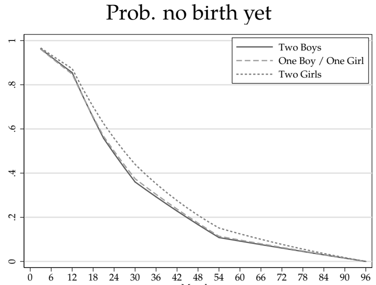
(f) 1985–1994

Prob. no birth yet



(g) 1995–2004

Prob. no birth yet



(h) 2005–2016

Prob. no birth yet

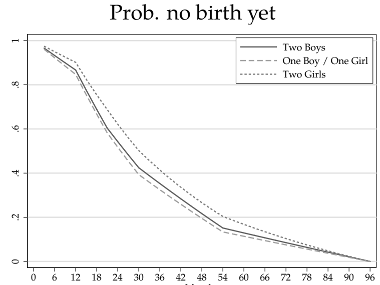


Figure C.22: Survival curves conditional on parity progression for women with 8 or more years of education by month beginning 9 months after prior birth.

C.4 Fourth Spell

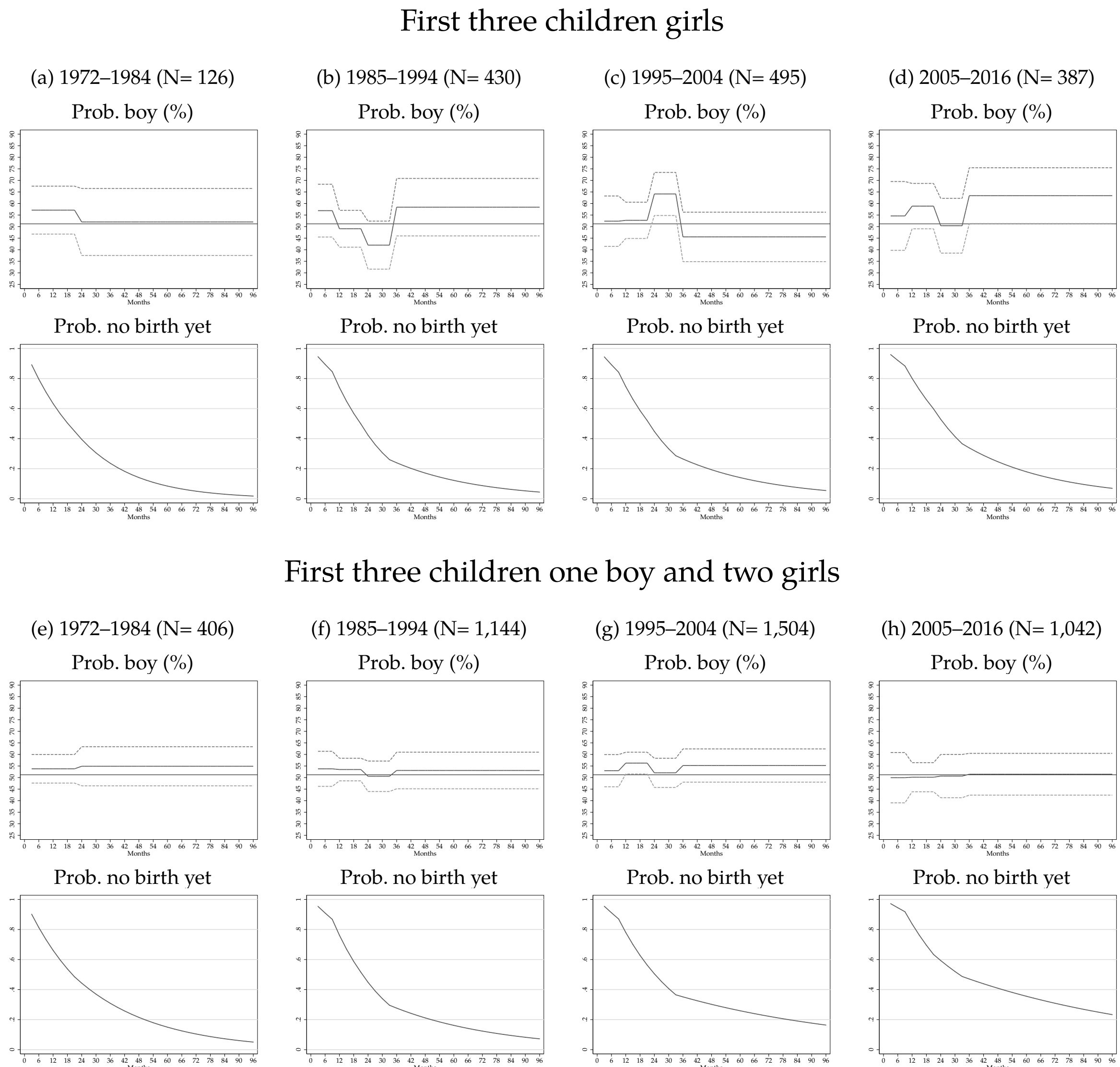
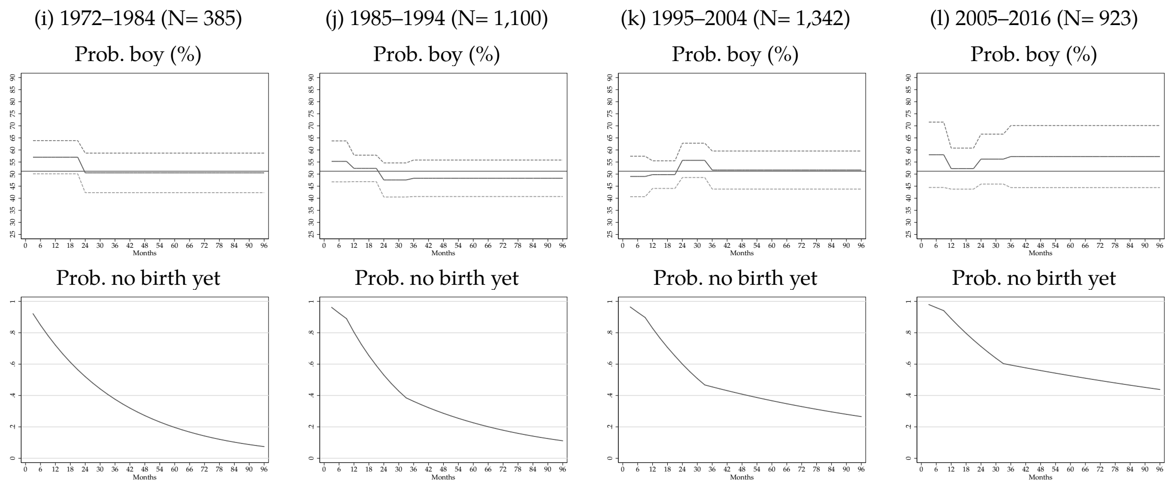


Figure C.23: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with no education by month beginning at 9 months after prior birth. Predictions based on age 23 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

First three children two boys and one girl



First three children boys

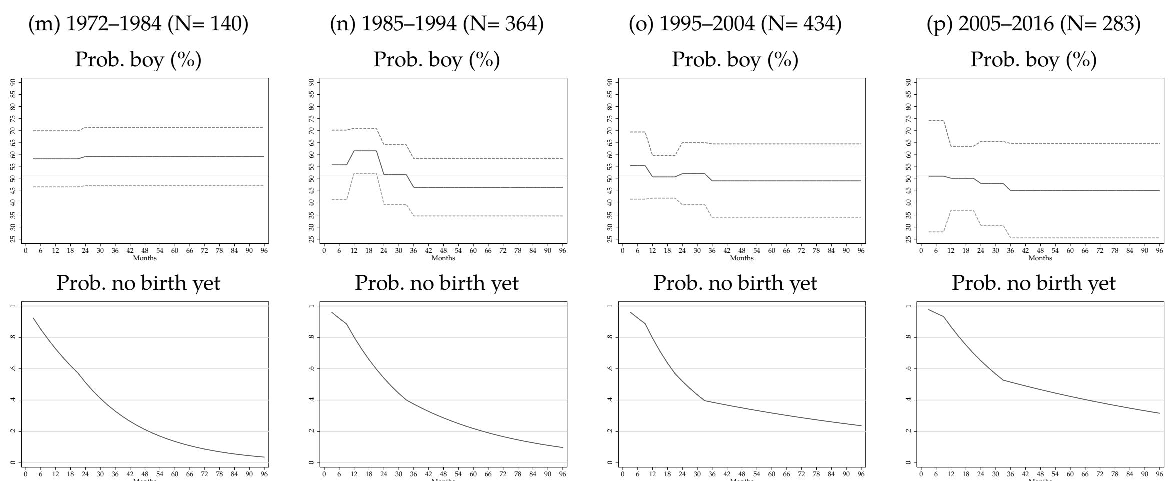


Figure C.23: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with no education by month beginning at 9 months after prior birth. Predictions based on age 23 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

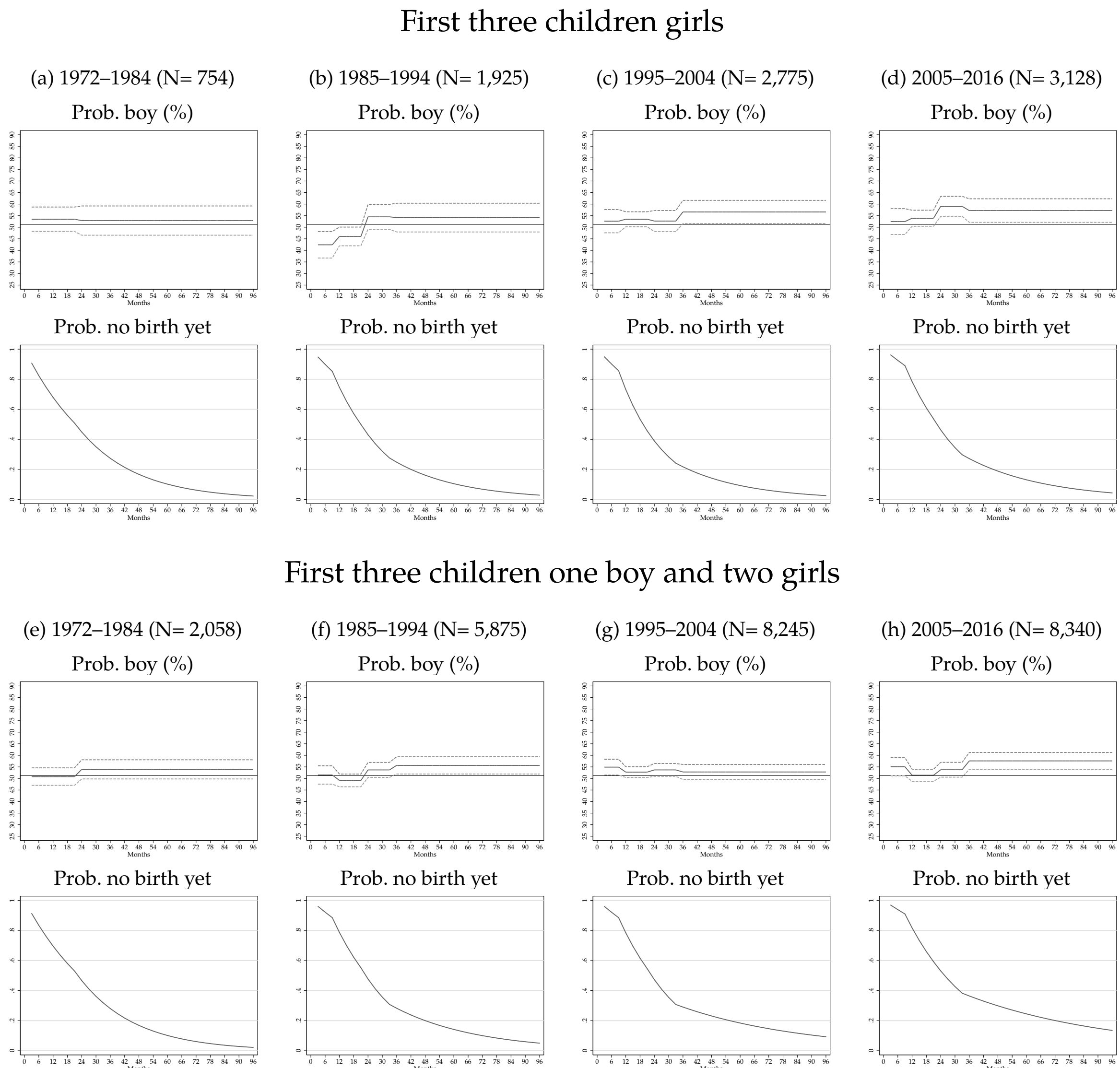
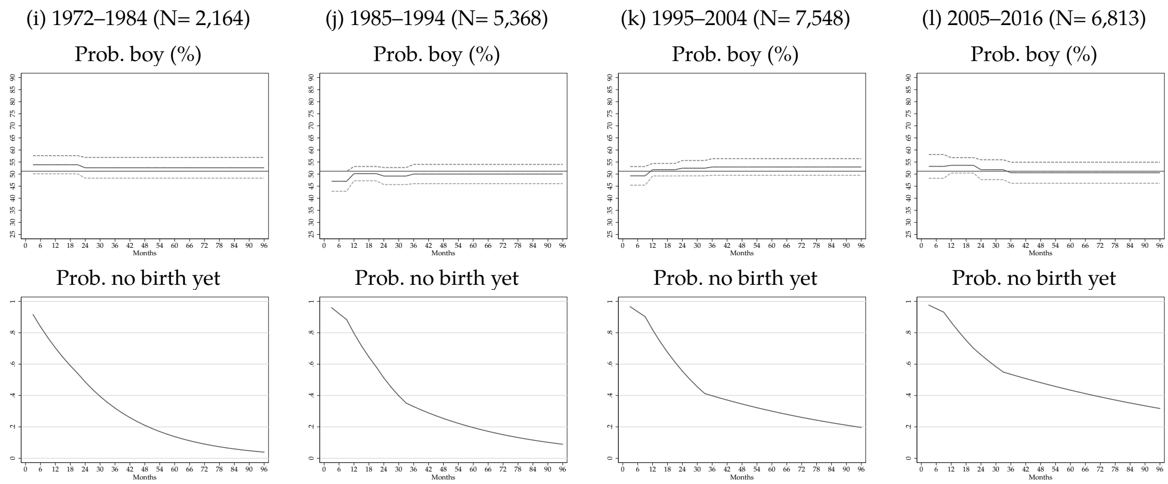


Figure C.24: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with no education by month beginning at 9 months after prior birth. Predictions based on age 23 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

First three children two boys and one girl



First three children boys

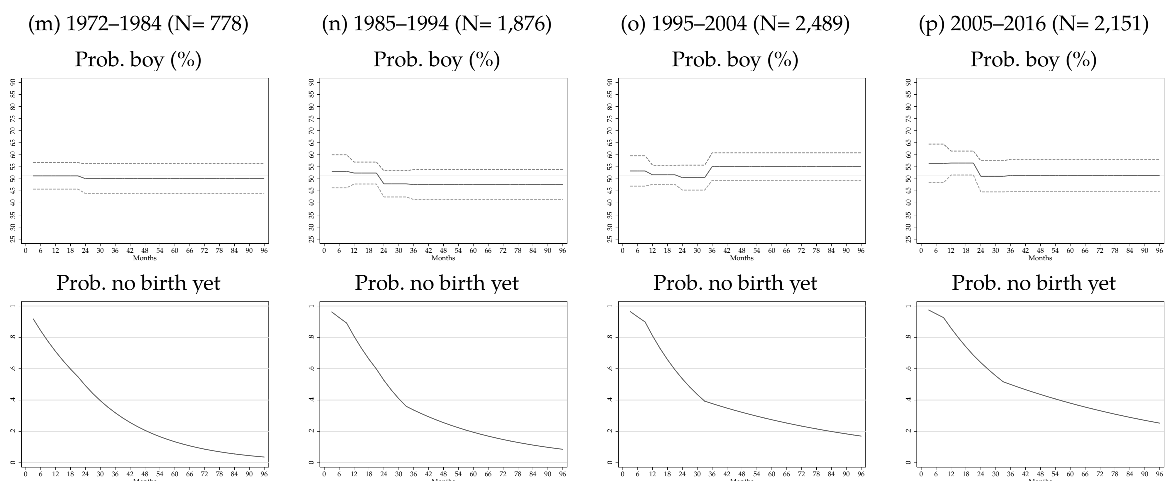
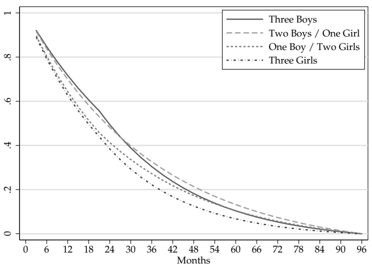


Figure C.24: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with no education by month beginning at 9 months after prior birth. Predictions based on age 23 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

Urban

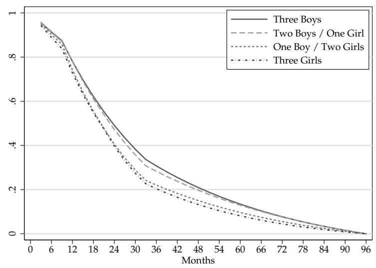
(a) 1972–1984

Prob. no birth yet



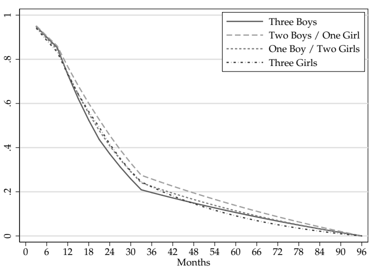
(b) 1985–1994

Prob. no birth yet



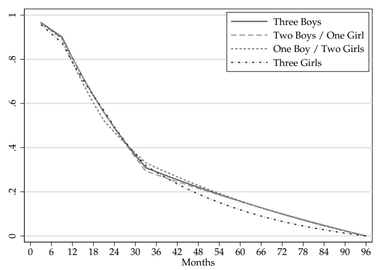
(c) 1995–2004

Prob. no birth yet



(d) 2005–2016

Prob. no birth yet



Rural

(e) 1972–1984

Prob. no birth yet

(f) 1985–1994

Prob. no birth yet

(g) 1995–2004

Prob. no birth yet

(h) 2005–2016

Prob. no birth yet

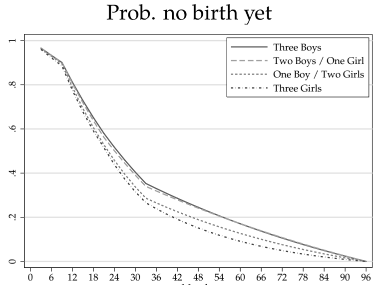


Figure C.25: Survival curves conditional on parity progression for women with no education by month beginning 9 months after prior birth.

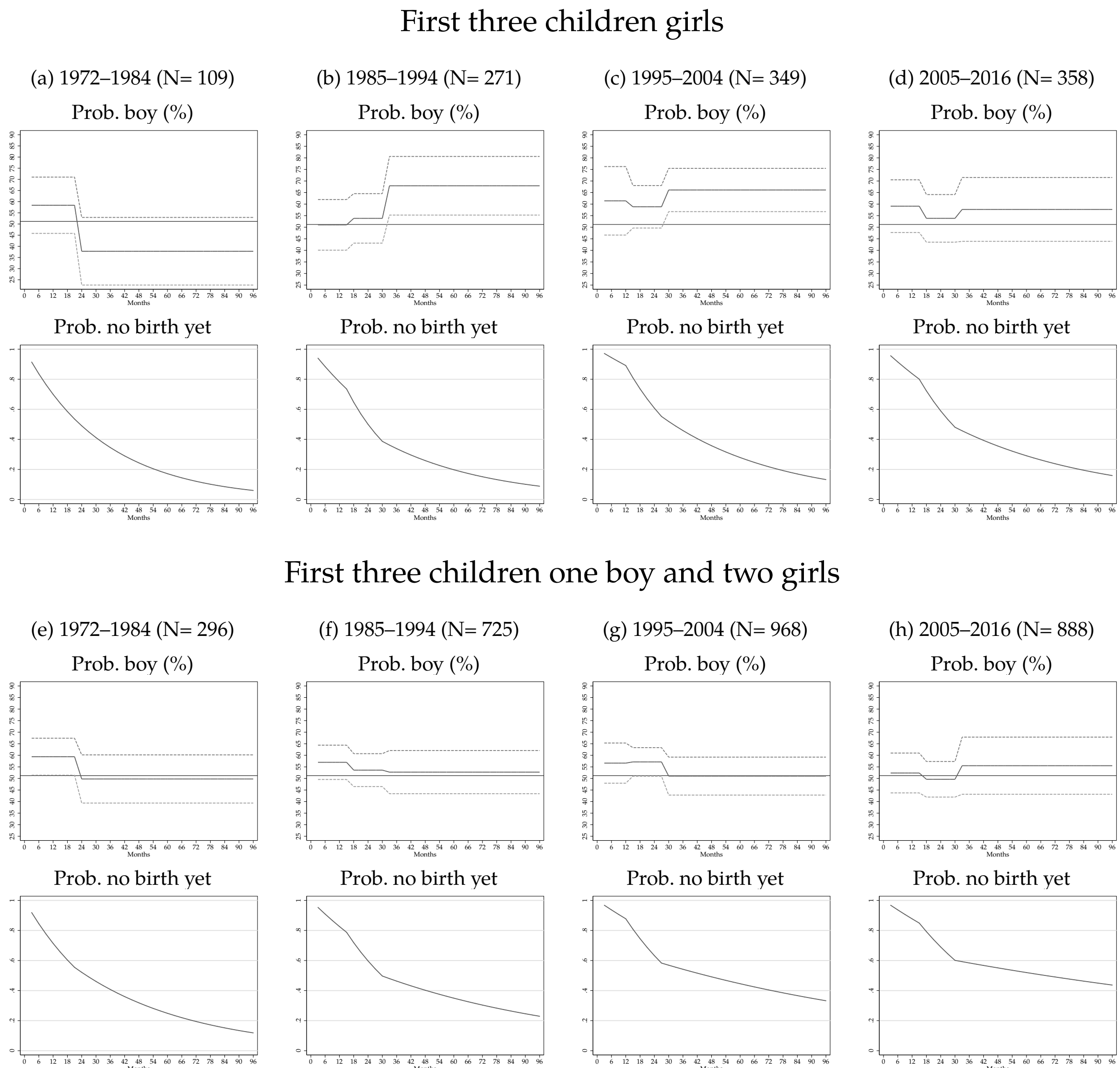


Figure C.26: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with 1 to 7 years of education by month beginning at 9 months after prior birth. Predictions based on age 24 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

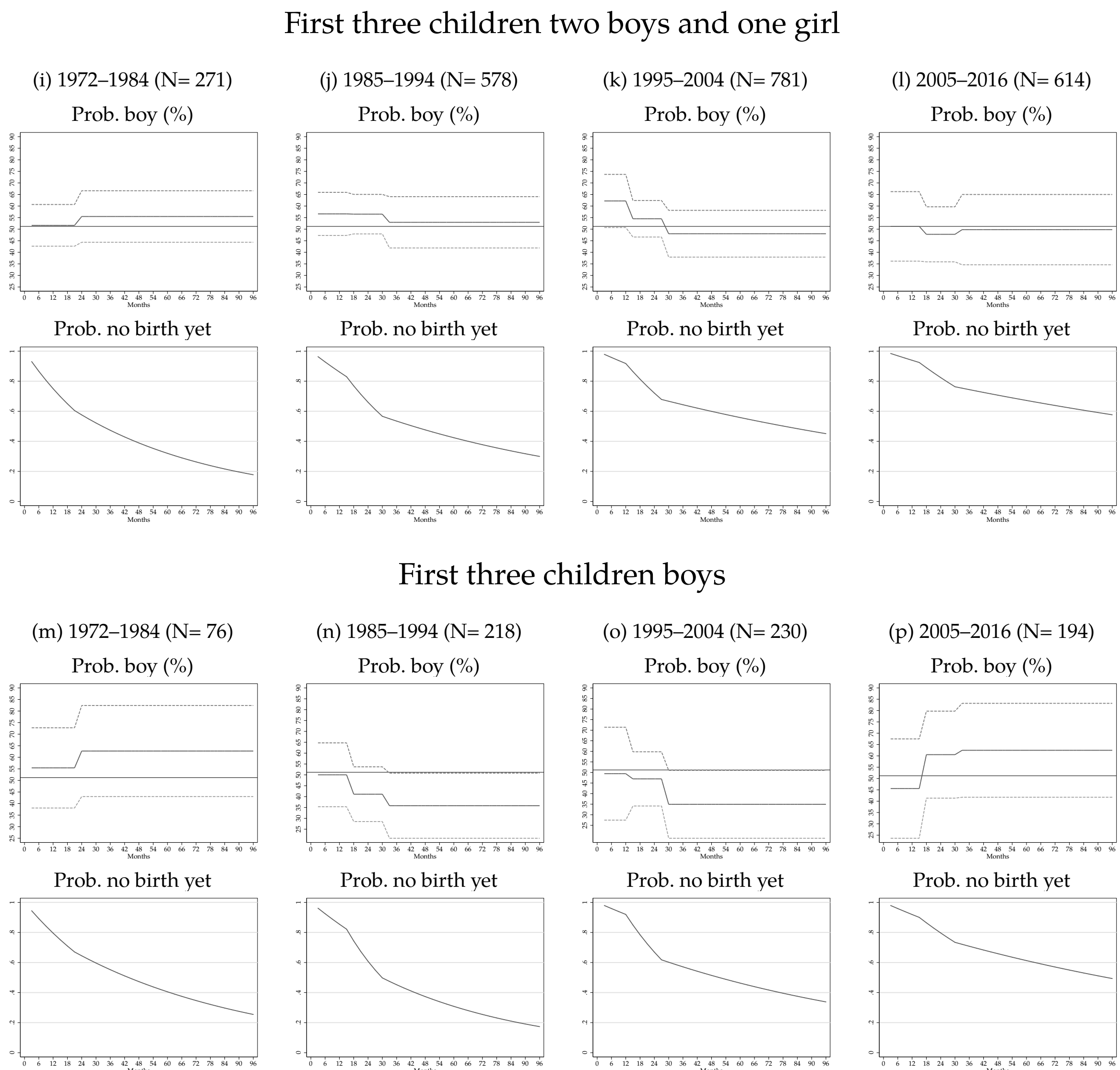


Figure C.26: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with 1 to 7 years of education by month beginning at 9 months after prior birth. Predictions based on age 24 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

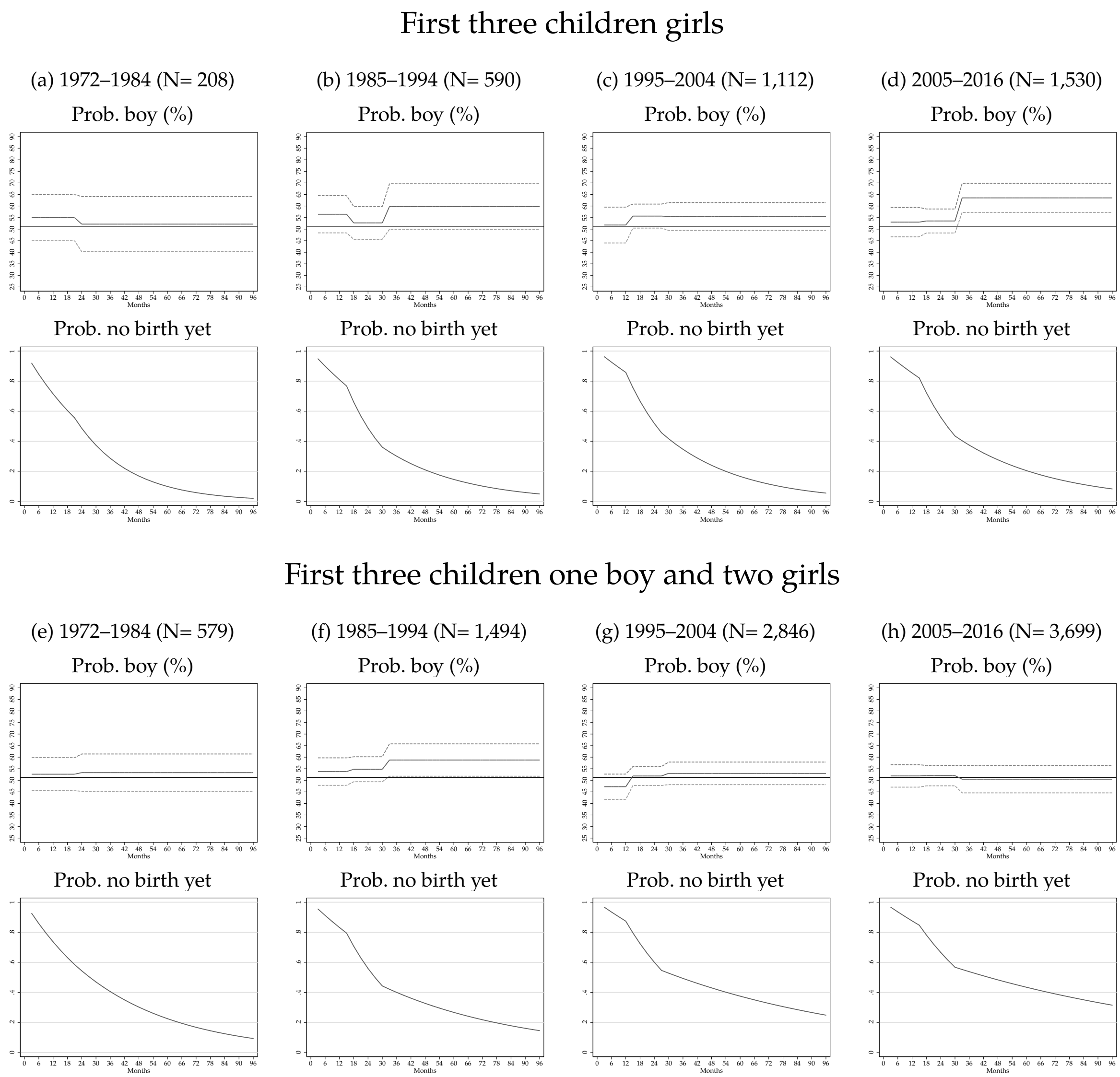
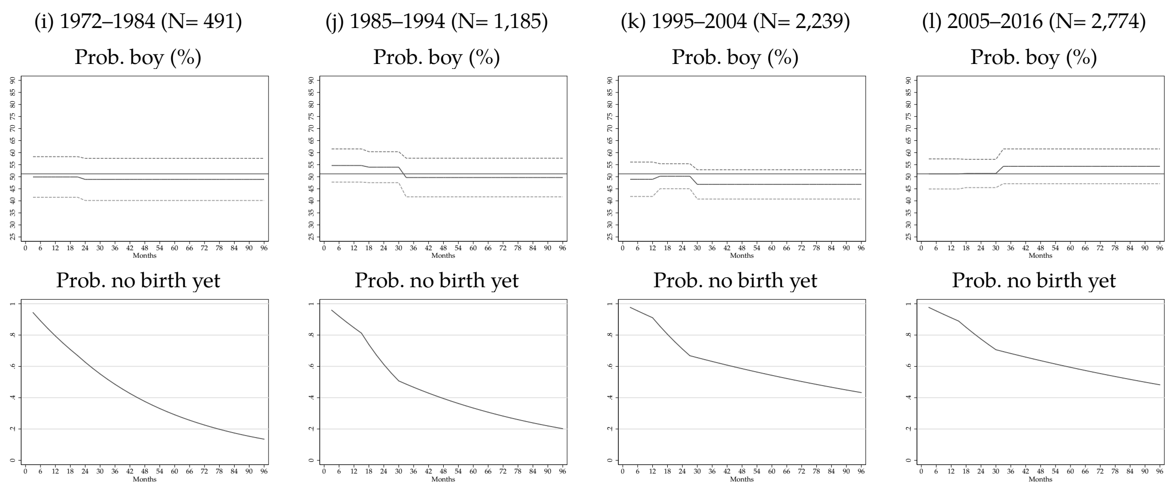


Figure C.27: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with 1 to 7 years of education by month beginning at 9 months after prior birth. Predictions based on age 24 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

First three children two boys and one girl



First three children boys

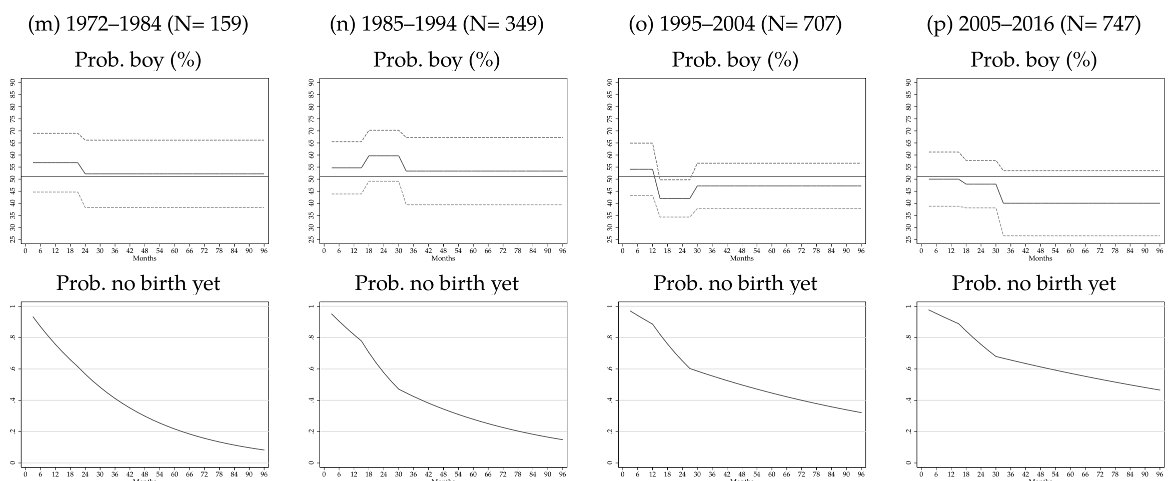
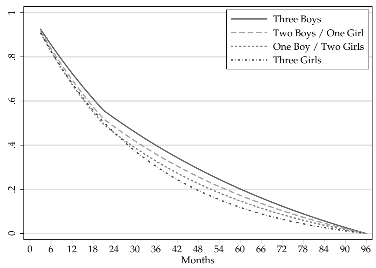


Figure C.27: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with 1 to 7 years of education by month beginning at 9 months after prior birth. Predictions based on age 24 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

Urban

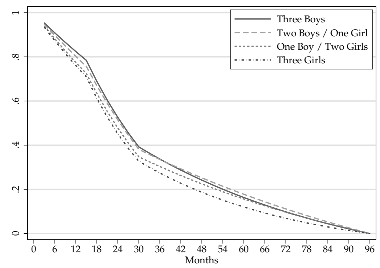
(a) 1972–1984

Prob. no birth yet



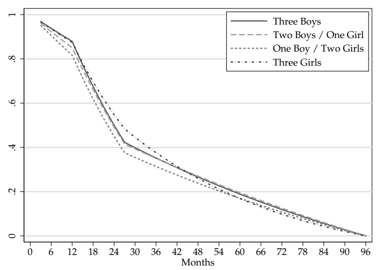
(b) 1985–1994

Prob. no birth yet



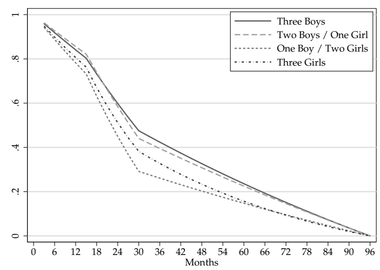
(c) 1995–2004

Prob. no birth yet



(d) 2005–2016

Prob. no birth yet



Rural

(e) 1972–1984

Prob. no birth yet

(f) 1985–1994

Prob. no birth yet

(g) 1995–2004

Prob. no birth yet

(h) 2005–2016

Prob. no birth yet

Figure C.28: Survival curves conditional on parity progression for women with 1 to 7 years of education by month beginning 9 months after prior birth.

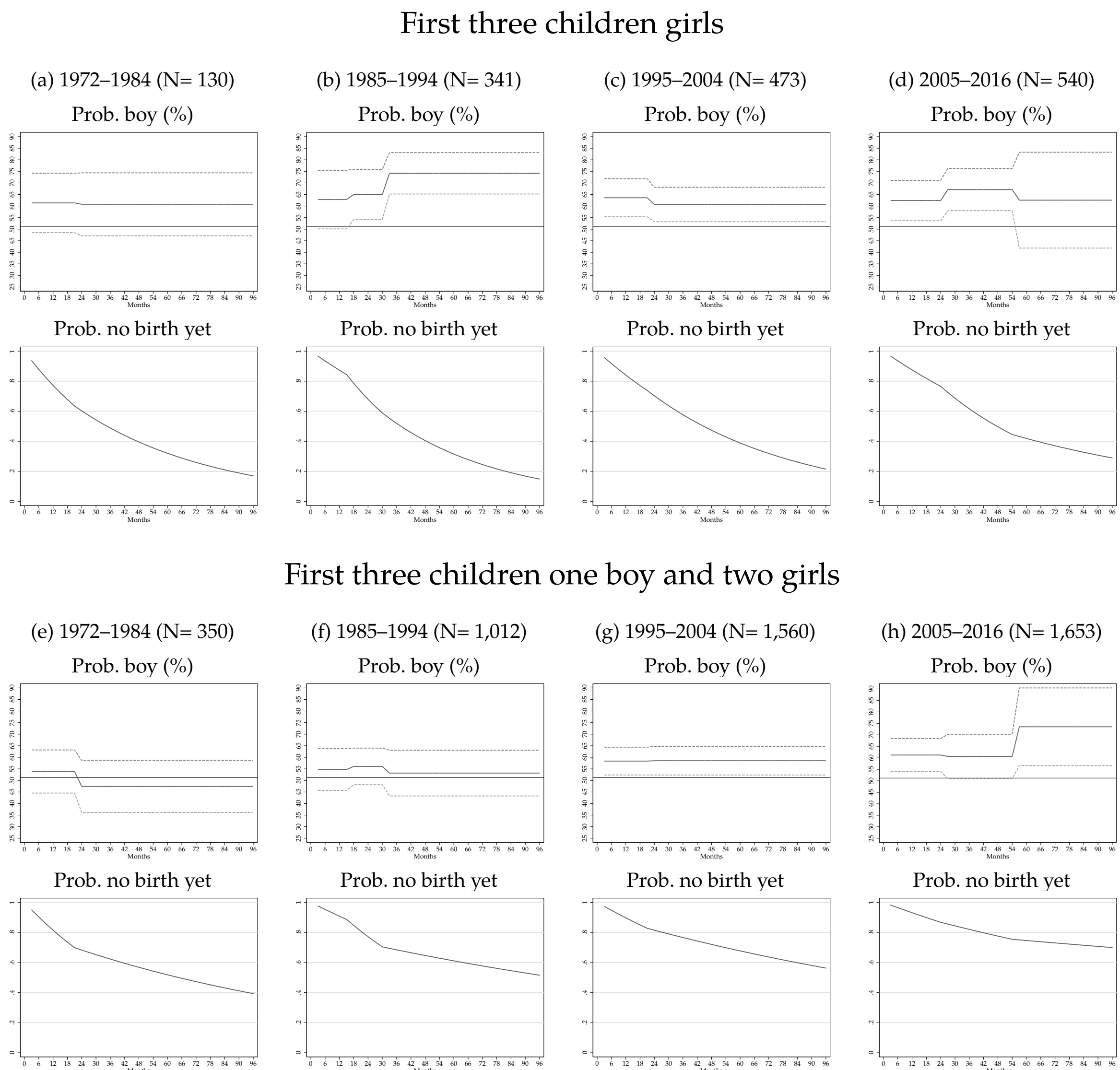


Figure C.29: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with 8 or more years of education by month beginning at 9 months after prior birth. Predictions based on age 25 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

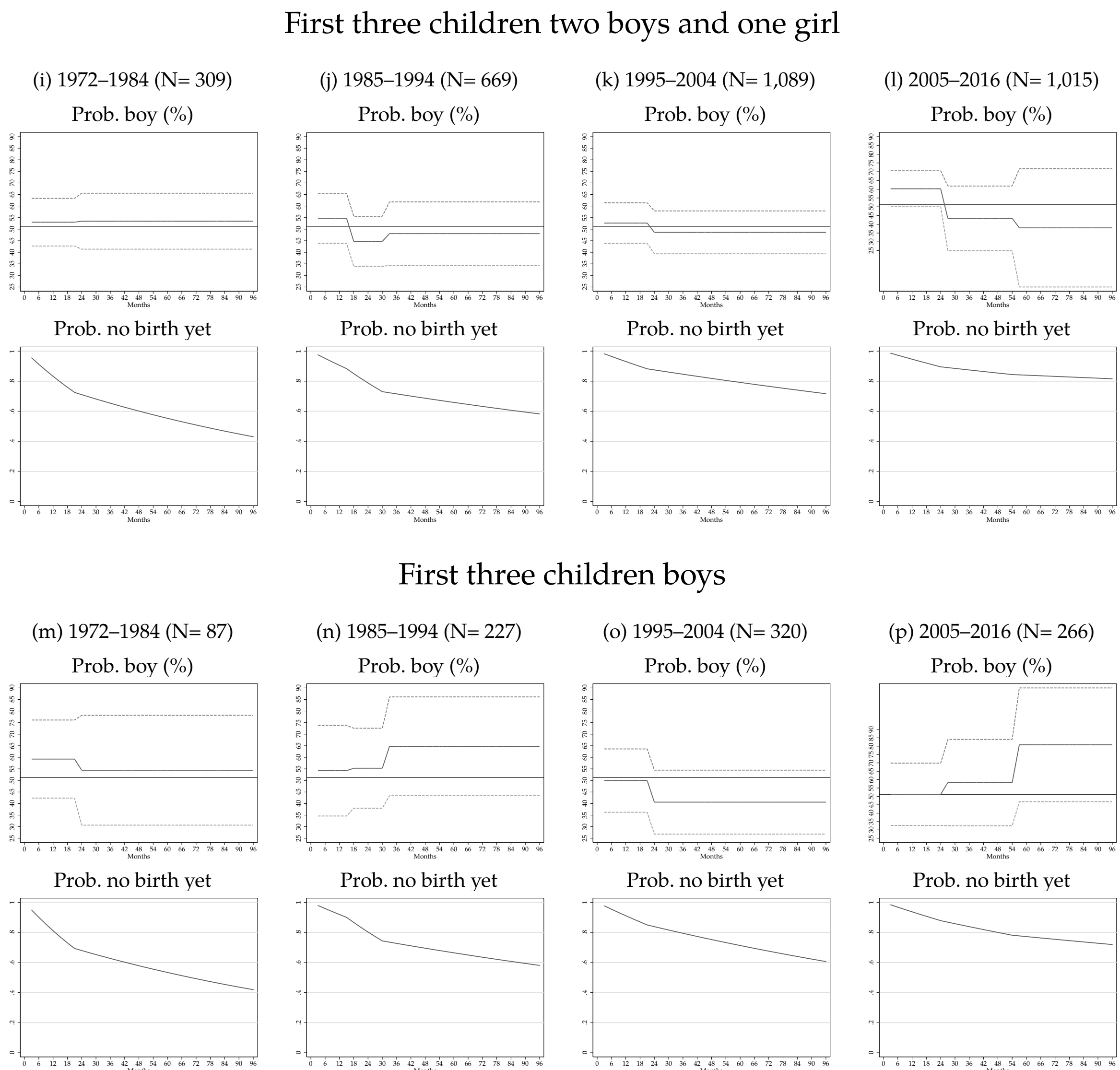


Figure C.29: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for urban women with 8 or more years of education by month beginning at 9 months after prior birth. Predictions based on age 25 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

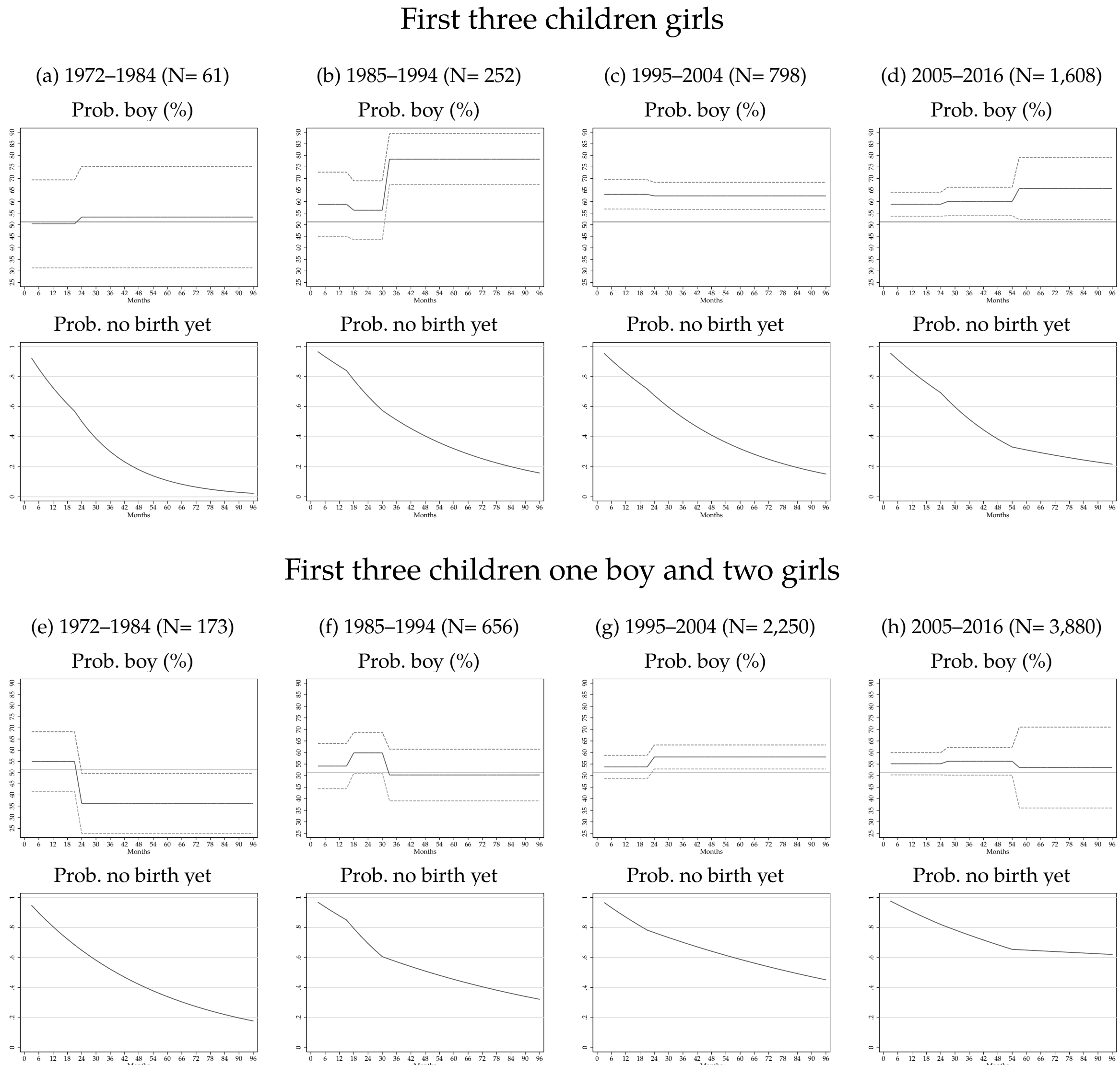


Figure C.30: Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with 8 or more years of education by month beginning at 9 months after prior birth. Predictions based on age 25 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

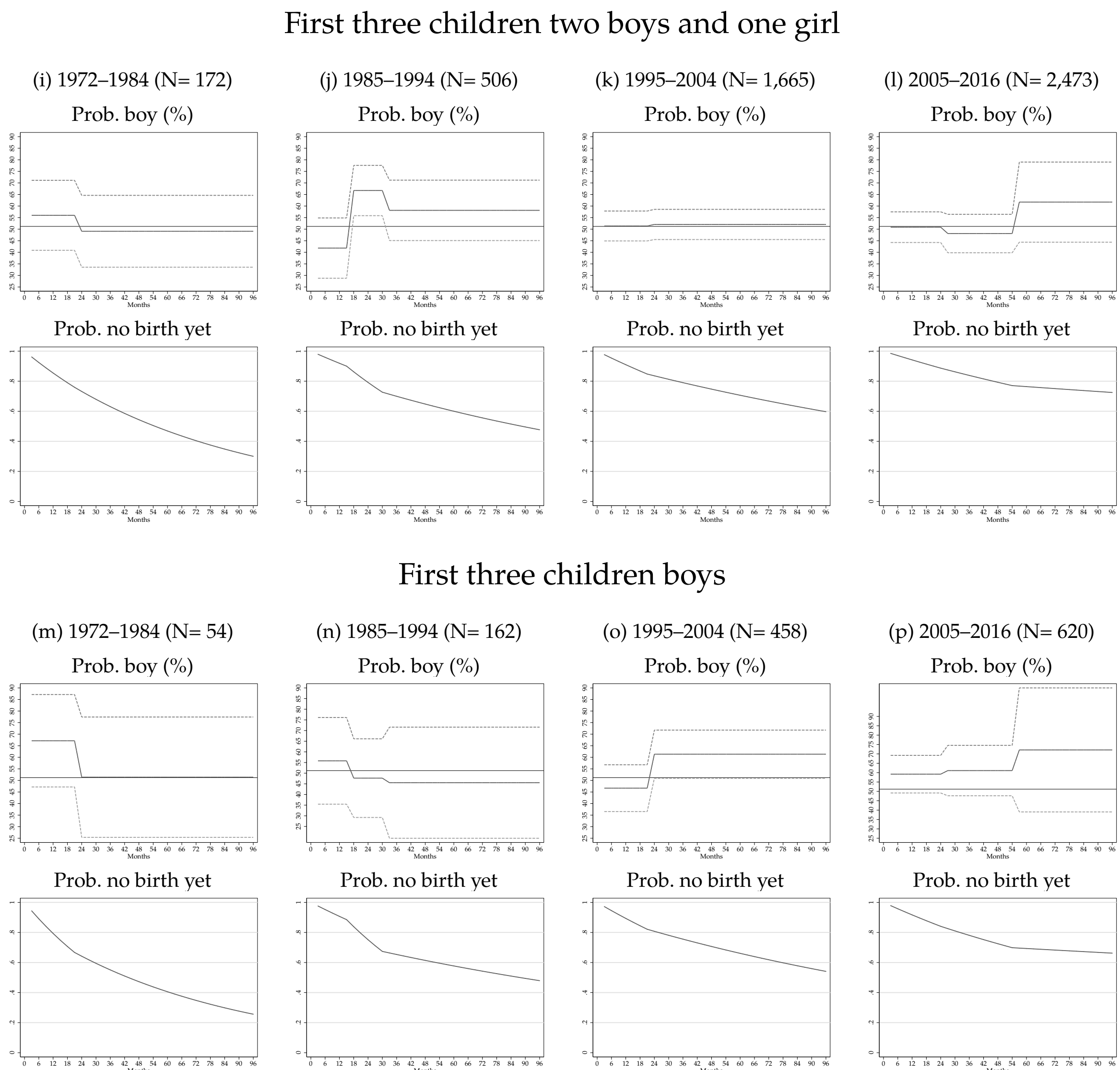


Figure C.30: (Continued) Predicted probability of having a boy and probability of no birth yet from nine months after first birth for rural women with 8 or more years of education by month beginning at 9 months after prior birth. Predictions based on age 25 at third birth. Left column shows results prior to sex selection available, middle column before sex selection illegal and right column after sex selection illegal. N indicates the number of women in the relevant group in the underlying samples.

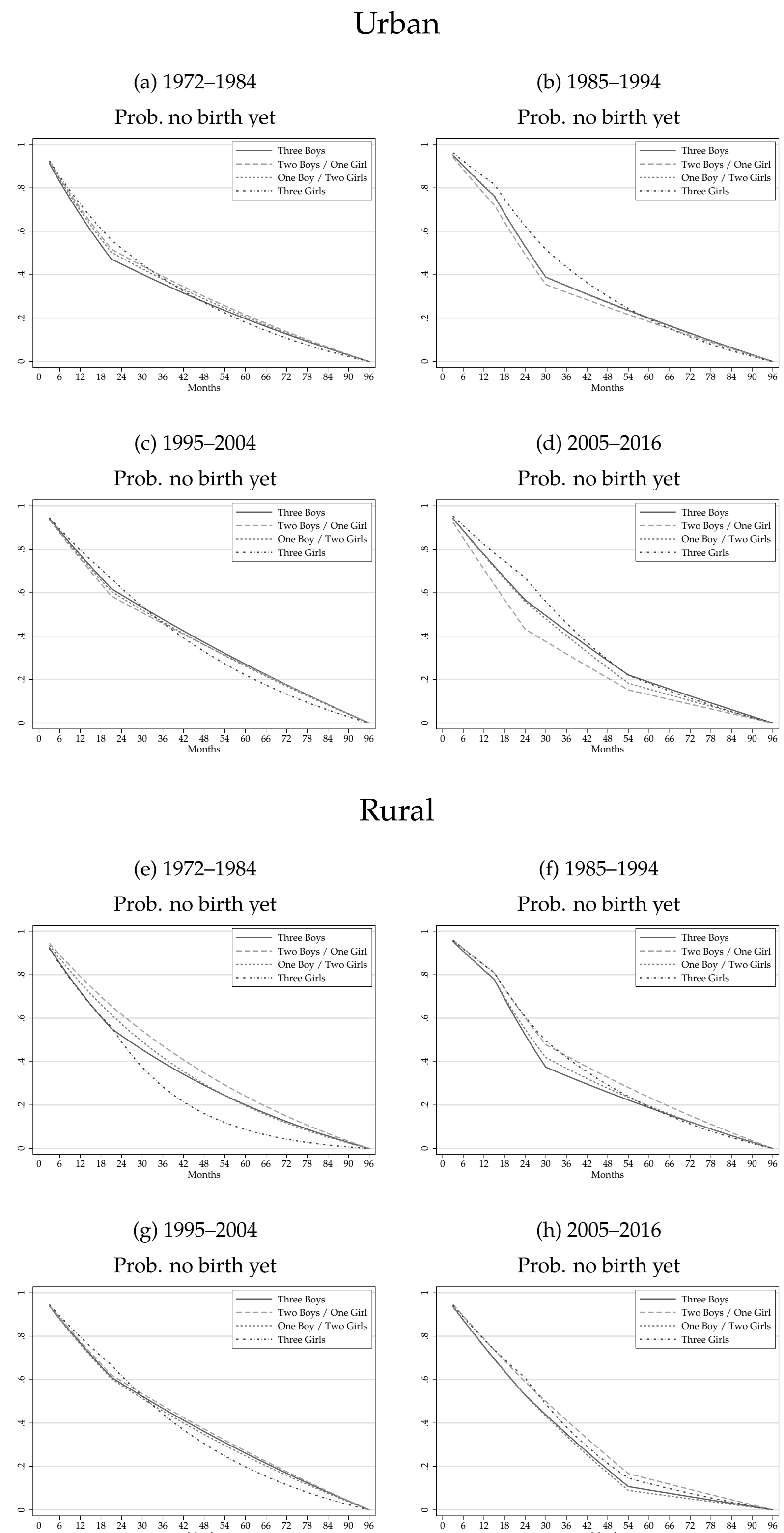


Figure C.31: Survival curves conditional on parity progression for women with 8 or more years of education by month beginning 9 months after prior birth.