Wedding Bells or School Bells: Constraints on Marriage Timing and Women's Educational Investments

Asha Bharadwaj*†

October 24, 2026

Click here for the latest version

Abstract

In many developing countries, women marry young, and married women are substantially less likely to be enrolled in school than single women of the same age. This paper studies how the timing of marriage affects women's educational attainment in India. I exploit variation in marriage timing arising from the common social practice of marrying daughters in birth order. Instrumental-variables estimates imply that a one-year increase in age at marriage raises women's probability of completing high school by 5.6 percentage points. I then develop and estimate a dynamic equilibrium model in which households choose schooling and marriage timing in a directed-search marriage market. Estimates imply that although grooms prefer more educated brides, the value they place on women's education is insufficient to offset their preference for younger brides. This age penalty, along with schooling costs, a finite search horizon, and birth-order constraints, limits the gains from postponing marriage, thereby sustaining early marriage in equilibrium. I use the estimated model to evaluate an increase in the minimum legal marriage age. The policy raises schooling primarily among higher-income women but also reduces marriage rates and generates considerable welfare losses for some groups. These findings show the importance of household resources and marriage-market equilibrium responses for policies aimed at increasing women's education.

*Department of Economics, University of Wisconsin-Madison

†I am deeply grateful to my advisors, John Kennan, Rasmus Lentz, Corina Mommaerts, and Chris Taber, for their guidance and support over the past five years. I thank Andrew Foster for generously sharing the 2006 Rural Economic and Demographic Survey (REDS) data. For helpful comments and conversations, I thank Naoki Aizawa, Mary Ann Bronson, Rossella Calvi, Taryn Dinkelman, Chao Fu, Jessica Goldberg, Claudia Goldin, Daniel Haanwinckel, Priya Mukherjee, Claudia Olivetti, Fernanda Rojas-Ampuero, Laura Schechter, Jeff Smith, Alessandra Voena, and Melanie Wasserman. Funding from the Gates Foundation Predoctoral Fellowship on Gender in the Economy, awarded through the National Bureau of Economic Research, is gratefully acknowledged.

1 Introduction

Across much of the developing world, women marry young and few continue their education after marriage. For some women, acquiring more education therefore means delaying marriage. Yet delay may come at a cost, as it leaves less time to find a spouse, and prospective grooms may prefer younger brides. A delay in marriage can thus create opportunities for additional schooling while also worsening marriage-market prospects. This trade-off raises a central policy question: Can constraints on marriage timing increase women's schooling? Many countries have adopted minimum marriage-age laws partly with this objective. Yet the consequences of constraints on marriage timing for schooling and marriage outcomes are not well understood.

This paper studies how constraints on marriage timing affect women's educational attainment, marriage-market outcomes, and welfare. To do so, I combine a design-based approach with a structural model. In the first part of the paper, I estimate the causal effect of age at marriage on women's schooling using plausibly exogenous variation in marriage timing. In the second part, I develop and estimate a dynamic equilibrium model of education and marriage decisions. The model quantifies the trade-off between early marriage and schooling and evaluates the equilibrium effects of policies such as minimum marriage-age laws. I use the causal effects from the first part to estimate the model's key parameters.

I study this question in India, where early marriage and low educational attainment remain widespread. Among women aged 20 to 24, fewer than half have completed high school, while a majority are already married (National Family Health Survey, 2019). Against this backdrop, the government has debated raising the minimum legal age of marriage for women from 18 to 21 (PRS Legislative Research, 2021), making the trade-off between early marriage and women's education an active policy question.

The first part of the paper estimates the causal effect of women's age at marriage on schooling. My empirical strategy leverages variation in age at marriage generated by a common marriage practice in India. Parents tend to arrange marriages for their daughters in order of birth, so a younger daughter typically marries only after her older sisters.[1] Because finding a match takes time, women with older sisters tend to marry at a later age. This pattern motivates an instrumental-variables strategy. Specifically, I instrument age at marriage with the sex of a woman's next-older sibling. A woman with a next-older sister typically waits for that sister to marry and is therefore more likely to marry at a later age than a woman with a next-older brother. Identification comes from comparing women who

[1] A few studies have documented the effects of these birth-order norms on marriage timing (Malhotra and Tsui, 1996; Vogl, 2013; Guha et al., 2026).

share the same overall birth order, family size, and birth cohort, but differ in the sex of the next-older sibling. The exclusion restriction requires that the sex of this sibling affect schooling only through marriage timing. One concern is that having a next-older sister may reduce a woman's caregiving responsibilities and thereby increase her schooling directly. I find that school enrollment and time spent in home production follow similar patterns by the sex of the next-older sibling at younger ages, and that the estimates are similar when I restrict the sample to women with at least one sister born before their next-older sibling. The estimates are also robust to specifications that address alternative channels related to son preference, fertility stopping behavior, and changes in household resources following daughters' marriages.

First-stage estimates using the 2006 Rural Economic and Demographic Survey show that having a next-older sister delays marriage by approximately 0.4 years. Instrumental-variable estimates imply that delaying marriage by one year increases educational attainment by about 1.6 years and raises the probability of completing high school by 5.6 percentage points.

These results establish that marriage timing is an important determinant of educational attainment in this setting. However, the design-based approach answers only part of the research question. First, it does not quantify the trade-offs families face when jointly choosing daughters' schooling and marriage timing. These choices depend on marriage-market incentives, including how brides' age and education are valued, as well as expected marriage payments. Quantifying these incentives reveals how the marriage-market benefits of additional schooling compare with those of marrying young, and therefore why early marriage persists in equilibrium. Second, the instrument identifies a local effect of marriage timing induced by sibling composition under prevailing market conditions. It therefore cannot by itself evaluate market-wide policies. A minimum marriage-age law, for example, changes the constraints faced by many families simultaneously. As matching patterns and dowries adjust in equilibrium, the marriage market returns to brides' education and age may also change.

The second part of the paper therefore develops and estimates an equilibrium life-cycle model of marriage and schooling. The model incorporates three distinctive features of the Indian marriage market. First, families arrange 95% of marriages (IHDS, 2012). I therefore model the household, rather than the daughter, as the decision-maker. The household chooses marriage and schooling for each daughter and bears the cost of supporting all of them while they remain unmarried. Second, as documented in the first part of the paper, households marry daughters in birth order. A household searches only for its oldest unmarried daughter in any given period. A younger sister enters the marriage market only after her older sister marries. Third, dowries, which are transfers from the bride's family to the groom's family at

marriage, are widespread in this setting (REDS 2006). In the model, households set dowries, which serve as the terms of trade in the marriage market.

Motivated by these features, I model households with one or two daughters, who are eligible to marry between ages 16 and 27. Prospective grooms are eligible between ages 24 and 29. The market has an overlapping-generations structure. A new cohort of households and grooms enters each period. In each period, a household decides whether an unmarried daughter searches for a husband in a frictional marriage market. If she remains unmarried, the household also decides whether she continues in school. Daughters who do not search or marry may search in the next period. Married women and grooms exit the market, making the distribution of unmarried participants endogenous. The model therefore links a woman's schooling directly to her marital status and the timing of her marriage.

The marriage market features directed search. In each period, a household decides whether to search for a match for its oldest unmarried daughter. If it searches, it posts a menu of dowries indexed by groom type. Men observe all posted menus, and each man chooses one household to approach with a proposal. A man values the woman's age and schooling as well as the offered dowry. In addition, because men cannot coordinate their proposal decisions, some households may receive many proposals while others receive none. This congestion creates uncertainty in matching, so each man also accounts for the expected competition from other suitors. Households anticipate these decisions when setting their dowry menus. A higher dowry offer can attract more proposals and more desirable suitors, but it also increases the transfer paid upon marriage. After receiving proposals, a household selects one based on the man's type and the required dowry payment.

A daughter can accumulate schooling only while she remains unmarried. Households therefore face a trade-off between arranging an early marriage and keeping her in school. The trade-off depends crucially on men's preferences for women's age and education. Delaying marriage to acquire more education can be beneficial if educated brides are more attractive in the marriage market. However, delay is also costly along four dimensions. First, schooling requires a direct monetary investment. Second, if older brides are less attractive, postponing marriage may worsen the quality of available matches. Third, delay shortens her remaining search horizon. Finally, postponing the older daughter's marriage also delays the younger daughter's entry into the marriage market.

I estimate the model using indirect inference. Because marriage in India is largely arranged within caste groups, I estimate the model separately for lower- and upper-caste marriage markets. A key feature of this approach is that the causal evidence from the first part of the paper enters directly into estimation. I simulate data from the model and run the same first-stage and IV regressions. The GMM estimator selects parameters to match

the resulting coefficients, alongside other moments, to their empirical counterparts. The IV estimate helps discipline men's preferences for educated brides. Having an older sister delays a woman's marriage, creating more time for schooling, but households have an incentive to invest in additional education only if its expected returns are sufficiently high. In the model, these returns depend on how much men value a bride's schooling. I also target observed dowries and marriage patterns, which further help identify men's preferences for brides' age and education.

The estimated preferences imply that a man is 25–54 times as likely to propose to a household with a daughter aged 19–21 as to one with a daughter aged 22–24, even if both households offer the same dowry, are otherwise identical, and would accept his proposal with certainty. [2] Men's valuation of a bride's schooling is modest by comparison. Under the same conditions, a man is only 1.1–1.7 times as likely to propose to a household whose daughter completed high school as to one whose daughter did not. Thus, the schooling premium is not large enough to induce households to delay marriage and invest in their daughters' schooling. Men's preferences for younger brides, together with the high cost of schooling, the cost of supporting unmarried daughters, the finite search horizon, and the birth-order constraint, outweigh the gains from additional schooling.

I then use the estimated model to study an increase in the minimum legal age of marriage. The reform raises women's schooling by reducing the opportunity cost of remaining unmarried to acquire additional education. Its effects vary substantially by income. High school completion among higher-income women rises by 15–24 percentage points, compared with only 1–4 percentage points among lower-income women. The policy's welfare effects are heterogeneous. Most household types lose, while men gain. Most strikingly, higher-income households in the lower-caste market gain, despite losing the option to marry their daughters early. By reducing the number of households searching for grooms, the policy increases competition among men, allowing households to attract more proposals for the same dowry. For higher-income households, this benefit outweighs the loss of early marriage, whereas for other household types, it does not.

I compare this reform with a conditional cash transfer that offsets schooling costs, financed by a tax on higher-income households. The transfer substantially increases high school completion among lower-income women by 27–64 percentage points. The transfer also delays marriage among these women, especially in the upper caste, where the share marrying before age 19 falls from 34% to 25%. Because daughters must remain unmarried between ages 16 and 18 to complete high school, the transfer induces households to offer

[2] Throughout the introduction, reported ranges span the results for the lower- and upper-caste marriage markets. The model is estimated separately for each market.

lower dowries during this period, reducing the likelihood of early marriage.

Together, these counterfactuals demonstrate that restricting early marriage creates additional opportunities for education, but does not ensure that financially constrained households can take advantage of them. If the objective is to increase educational attainment among lower-income women, directly offsetting schooling costs is substantially more effective in the model.

This paper makes four contributions to the literature. First, I provide new causal evidence from India on how constraints on marriage timing affect women's educational attainment. A small literature examines how marriage timing shapes women's schooling in developing countries, with mixed findings. Field and Ambrus (2008) and Jafarey et al. (2020) find that delaying marriage increases schooling in Bangladesh and Nepal, respectively, while Wilson (2022) finds mixed effects of minimum marriage-age laws on schooling in several countries.[3] I contribute to this literature by using a novel instrument based on birth-order marriage practices that constrain marriage timing in India. To my knowledge, only three studies document these norms in South Asia (Vogl, 2013; Guha et al., 2026; Malhotra and Tsui, 1996). I bring these two strands of literature together by documenting the prevalence of birth-order marriage practices and using variation induced by sibling composition to show that later marriage increases women's high school completion.

Second, I develop and estimate an equilibrium model that quantifies the trade-off between early marriage and educational attainment in developing countries. The model's directed-search framework builds on Shimer (2005). I extend this framework to incorporate life-cycle dynamics and endogenous schooling during search. Most empirical models of equilibrium matching are static (Choo and Siow, 2006; Arcidiacono et al., 2016), and only a few incorporate dynamics (Choo, 2015; Shephard, 2019; Gayle, 2019). Existing dynamic models also typically fix education when agents enter the marriage market and therefore cannot study schooling choices during search (Beauchamp et al., 2021; Chiappori et al., 2009, 2018; Ciscato, 2021). These models therefore cannot capture the central trade-off in my setting: delaying marriage allows women to acquire more schooling but leaves them less time to find a husband before the end of the search horizon.[4]

[3] Other studies evaluate minimum marriage-age reforms in particular settings, including McGavock (2021) in Ethiopia, Batyra and Pesando (2021) across six low- and middle-income countries, Bellés-Obrero and Lombardi (2023) in Mexico, and Bella et al. (2025) in Indonesia. See also Bharadwaj (2015) for a marriage-law reform in Mississippi and Tam and Roy (2026) for the Sarda Act in India.

[4] A related labor-market literature studies endogenous human-capital investment under search frictions. Moen and Rosén (2004) analyze firms' provision of general training under competitive search with poaching, while Flinn et al. (2017) model cooperative worker-firm investment in general and match-specific ability during ongoing employment. In both settings, the price-setting agent invests in the searching agent's productivity. In my setting, the price-setting agent—the household—chooses investments that affect its own

Third, to my knowledge, this is the first equilibrium model of marriage and schooling to incorporate a household's joint optimization problem for multiple children. As shown in the first part of the paper, birth-order constraints create a direct link between sisters' outcomes. Delaying an older daughter's marriage imposes an additional cost on the household by also delaying her younger sister's entry into the marriage market. This intrahousehold externality is important for quantifying the trade-off between early marriage and education. It also matters for evaluating minimum marriage-age laws, which change the household's joint problem rather than merely the decision facing each daughter in isolation.

Fourth, I model dowries as posted prices in a directed-search marriage market. Each posted dowry reflects the value of matching with that type of groom, the probability of attracting him, and the transfer the household must pay upon marriage. This mechanism is important in the Indian context. Existing work documents that dowry payments in India are large, have risen over time, and vary systematically with the characteristics of the bride and groom (Anderson, 2007; Chiplunkar and Weaver, 2023), and that the direction of marriage payments shapes household decisions about marriage timing and investment in daughters (Corno et al., 2016; Ashraf et al., 2020). Understanding how dowries are determined is therefore central to understanding women's outcomes in this setting.

Existing theories treat dowries as a market-clearing price (Rao, 1993; Becker, 1973), a bequest from the bride's parents (Botticini and Siow, 2003), or both (Borker et al., 2026). Market-clearing approaches assume a frictionless marriage market, so dowries reflect match quality and the relative scarcity of different types of grooms but not search congestion. Beauchamp et al. (2021) incorporate search frictions but treat dowry as a match attribute on which agents sort. By contrast, my framework treats dowry as a posted price that the household chooses before grooms decide where to propose. Equilibrium dowries depend on search congestion, the household's budget constraint, groom quality, and relative scarcity.

The remainder of the paper is structured as follows. Section 2 provides motivation and describes the setting. Section 3 presents the design-based empirical strategy and estimates the causal effect of marriage timing on educational attainment. Section 4 develops a dynamic equilibrium model with marriage and education choices, and Section 5 discusses estimation. Section 6 evaluates counterfactual policies using the estimated model. Section 7 concludes.

daughters' marriage-market prospects. The labor-market analogue would be a firm investing in its own productivity.

2 Motivation and Setting

This section describes salient features of marriage and education in India to motivate the paper's central question. The prevalence of arranged marriage makes marriage timing a household decision, while large dowry payments make it financially consequential. Early marriage remains common, girls' enrollment declines sharply during secondary school, and married women are substantially less likely to be enrolled than unmarried women. Together, these patterns suggest that marriage timing may be closely linked to educational investment. The patterns documented in this section are descriptive and do not distinguish a causal effect of marriage timing from selection: households that arrange earlier marriages may also invest less in their daughters' schooling. Section 3 addresses this identification problem when estimating the causal effect of marriage timing on schooling.

2.1 Marriages in India

Three features of marriage in India are central to this paper. First, most women's spouses are chosen by their parents or relatives. Only 5 percent of women reported choosing their spouses on their own, while about 72 percent reported that their spouses were chosen solely by parents or other relatives (IHDS, 2012). The remaining women participated in the choice made by their parents or relatives. This is important for two reasons. First, it identifies the family, rather than the woman, as the relevant decision-maker. Second, parents make these choices for all their children. Thus, when deciding whether one daughter should remain in school or marry, they consider not only her outcomes but also the consequences for her siblings' marriage and schooling.

Second, dowry payments are widespread and quantitatively important. In most Indian marriages, the bride's family transfers cash and gifts to the groom's family. Using data from the 1999 Rural Economic and Demographic Survey, Chiplunkar and Weaver (2023) show that around 90 percent of marriages in each wealth category involve a dowry payment. In the 2012 IHDS, the median dowry amount was approximately Rs. 16,500, or around USD 300 in 2012. These transfers are large relative to household resources: the median household spends more than twice its annual income on a daughter's wedding (Chiplunkar and Weaver, 2023).

Dowries also tend to vary systematically with the characteristics of the bride and the groom. Dowries are higher for grooms with greater education and vary with the bride's age and education (Table 1). These relationships remain after accounting for marriage cohort, state and caste. These patterns are consistent with dowries adjusting to differences in how brides and grooms are valued in the marriage market. For example, families may offer larger

dowries to secure matches with more educated grooms, while dowries may compensate for bride characteristics that grooms value less.

These relationships should not, however, be interpreted as the causal effects of a bride's age or education on dowries. Spouses do not match randomly: brides and grooms with different characteristics may come from different types of households and sort into systematically different matches. Moreover, dowries are equilibrium prices that depend on the relative supply of and demand for different types of brides and grooms. The observed dowry gradients may therefore reflect marriage-market valuations, selection into matches, and market conditions.

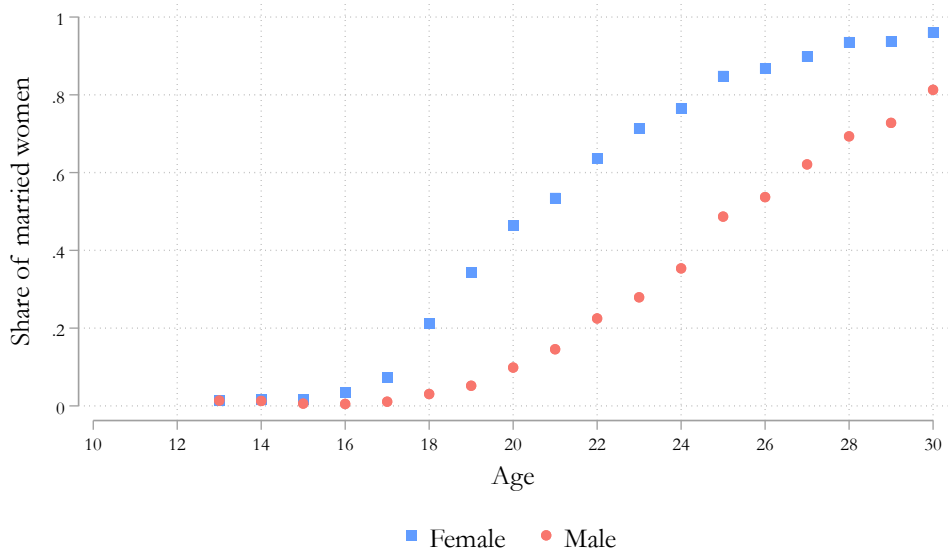
Table 1: Real net dowry, age at marriage, and spousal education

	(1) Real net dowry
Bride's years of education	2306.505***
	(157.51)
Bride's age at marriage	1004.866***
	(221.11)
Groom's years of education	1103.804***
	(133.37)
Constant	1705444.140***
	(205606.20)
Observations	6825

Notes: OLS estimates. The dependent variable is the real net dowry (gross dowry paid by the bride's family net of transfers from the groom's side), expressed in constant 2005 rupees. The explanatory variables are the bride's age at marriage, the bride's completed years of education, and the groom's completed years of education. All specifications include fixed effects for year of marriage, state and caste group. The sample is all ever-married women aged 25–40 at the time of the survey. Standard errors are reported in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Source: Own calculations using Rural Economic and Demographic Survey (REDS) 2006.

Third, women in India continue to marry at relatively young ages. Figure 1 shows that, in 2019, nearly half of Indian women had married by age 20, compared with age 25 for men. The current law prohibits marriage for women under age 18 and for men under age 21. However, enforcement is imperfect: around 10 percent of both men and women marry before the legal minimum marriage age.

Figure 1: Share ever-married by age



Source: Own calculations using NFHS 2019-21.
Sample: Individuals between 13 to 30 years of age

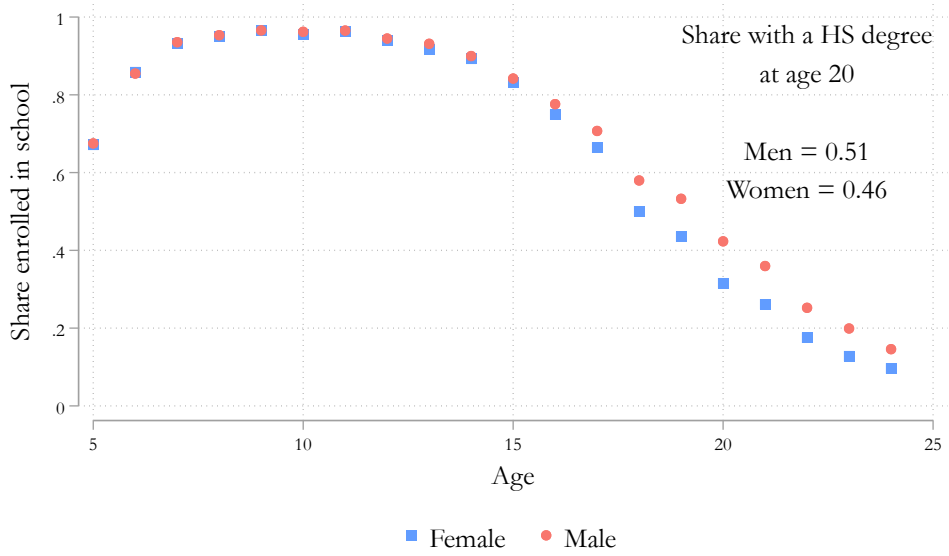
2.2 Education in India

School enrollment in India has risen substantially in recent decades for both boys and girls. Schooling is compulsory from ages 6 to 14, and enrollment in primary and middle school is nearly universal. Figure 2 shows that school enrollment rates for both boys and girls were close to 100 percent at younger ages in 2019. However, enrollment declines sharply at the secondary level, with a somewhat steeper drop for girls. By age 20, only 46 percent of women had completed high school in 2019.[5]

This decline in girls' schooling is unlikely to be explained by strong labor-market opportunities outside school (see Figure A.1). In the 2019 National Family Health Survey (NFHS), only around 20 percent of women who were not enrolled in school at age 18 reported having worked in the last 12 months, compared with around 80 percent of men of the same age. This suggests that, for many girls, leaving school is closely tied to marriage rather than to labor-market entry.

[5]Because this figure is based on the NFHS, it may partly reflect cohort differences. Using the panel structure of the IHDS, I find similar patterns: among girls who were enrolled in middle school in 2005, 62.5 percent report having completed high school by 2012.

Figure 2: Share enrolled in school by gender



Source: Own calculations using NFHS 2019-21.
Sample: Individuals between 5 to 24 years of age

2.3 Marriage and schooling

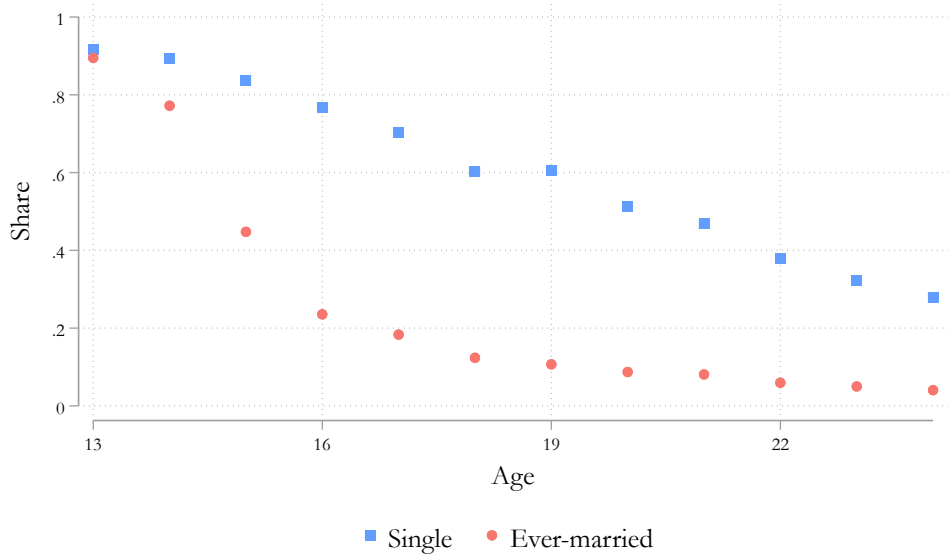
Marital status and schooling are strongly negatively correlated in the data. Figure 3 shows a large gap in school enrollment between married and unmarried women in India. At age 18, the gap in enrollment in high school or college is nearly 50 percentage points.

This gap does not necessarily represent a causal effect of marriage on schooling. It may partly reflect selection: households that plan to invest less in a daughter's education may also arrange her marriage earlier. Differences in household resources, preferences for girls' education, and access to schools or marriage opportunities may therefore affect both marriage timing and schooling. School exit may also lead to earlier marriage, generating reverse causality.

At the same time, marriage may reduce a woman's ability to remain in school. Marriage often requires moving to the husband's household and may bring domestic responsibilities, childbearing, or restrictions on attending school.[6] The observed enrollment gap may therefore combine selection into early marriage with a causal effect of marriage itself. The empirical analysis that follows seeks to isolate this causal effect from these sources of selection.

[6]Rosenzweig and Stark (1989) document the role of marriage in women's migration to their husband's household in rural India.

Figure 3: Share enrolled in school by marital status



Source: Own calculations using NFHS 2019-21.
Sample: Individuals between 13 to 24 years of age

3 Causal Effects of Marriage Timing

The descriptive evidence above suggests a relationship between marriage timing and women's schooling, but does not establish whether this relationship is causal. I begin by discussing the challenges to identifying the causal effect of marriage timing on schooling and presenting OLS estimates. I then introduce an instrumental variables strategy that exploits variation in marriage timing generated by the sex of a woman's next-older sibling and present the resulting estimates.

3.1 OLS estimates

Consider the following equation relating educational attainment, E_i, to age at marriage, A_i, for each woman i:

$$E_i = \beta_0 + \beta_1 A_i + \beta_2 X_i + \epsilon_i^E, \tag{1}$$

where X_i is a vector of observables such as wealth and caste.

Table 2 reports OLS estimates of equation (1) for three outcomes: years of schooling, tenth-grade completion, and high-school completion. The estimates suggest that delaying

marriage by one year is associated with an increase in schooling by 0.4 years, tenth-grade completion by 3 percentage points, and high-school completion by 1.5 percentage points.

Table 2: OLS estimates of the association between age at marriage and educational attainment

Dep. var.:	(1) Years of education	(2) Tenth grade or more	(3) HS or more
Age at marriage	0.396***	0.030***	0.015***
	(0.02)	(0.00)	(0.00)
Mean of dep variable	4.49	0.20	0.08
N	6,053	6,053	6,053

Notes: The table reports OLS estimates of the association between age at marriage and completed years of schooling (column 1), tenth grade completion (column 2), and high school completion (column 3). All columns include controls for the number of siblings, year of birth, birth order, and the age gap between siblings. The sample comprises women aged 25-40. Standard errors clustered at the household level are reported in parentheses.
Source: Author's calculations using REDS 2006.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

These estimates do not, however, identify the causal effect of age at marriage on education, for two reasons. First, schooling and marriage timing are jointly determined within the household. Marriage may cause a woman to leave school because she moves to her husband's household or assumes new domestic responsibilities. But the relationship may also run in the opposite direction. Parents who intend for a daughter to complete high school may postpone her marriage until she graduates, while parents who decide to end her schooling may begin searching for a spouse sooner. This creates a simultaneous-causality problem: marriage timing affects schooling, but schooling also affects marriage timing.

Second, unobserved household characteristics may influence both decisions. For example, parents who place greater value on their daughters' education may keep them in school longer and arrange their marriages later. Household resources, religious beliefs, attitudes toward women, local school access, and marriage-market opportunities may similarly affect both educational investment and marriage timing. Women who marry at different ages may therefore differ in ways that affect their educational attainment through channels other than marriage. This selection into marriage timing generates omitted-variable bias. The OLS estimate may attribute to marriage timing educational differences that are actually driven by these unobserved factors. Together, simultaneous causality and omitted-variable bias prevent OLS from identifying the causal effect of marriage timing on schooling.

To address these concerns, I adopt an instrumental variables strategy. Specifically, I exploit plausibly exogenous variation in age at marriage generated by a common social

practice of arranging daughters' marriages in order of birth.

3.2 The older-sister instrument

In India, parents or relatives commonly arrange children's marriages in order of birth. Among daughters, marriages are therefore arranged from oldest to youngest. Because finding a suitable match takes time, a delay in a daughter's marriage can also delay the marriages of her younger sisters. Having an older sister therefore generates exogenous variation in a woman's age at marriage. Throughout the paper, I refer to the practice of arranging daughters' marriages in birth order as the *birth-order rule*.

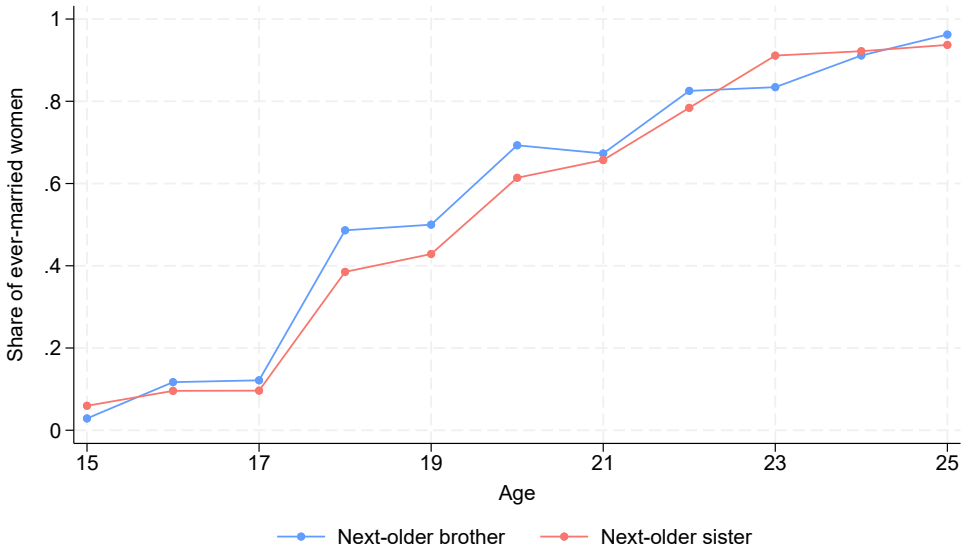
Several studies have documented the influence of this birth order rule on marriage timing. For instance, research in Sri Lanka found that fourth or younger order sisters were only 42 percent as likely to marry at any given age as elder sisters (Malhotra and Tsui, 1996). Similar findings have been observed in Nepal, Bangladesh, India, and Pakistan, with younger daughters marrying roughly two years later than the median older daughter (Vogl, 2013).

Several theories may explain the persistence of the birth-order rule. First, families may follow the rule because delaying marriage is more costly for an older daughter. Individuals have a finite window in which to marry. Thus, when two daughters are both old enough to marry, the older daughter has less time remaining to find a suitable spouse. Men's preference for younger brides further increases the cost of delay because her marriage prospects may decline as she ages (Buchmann et al., 2021; Banerjee et al., 2013). The younger daughter, by contrast, has more time and can wait until her older sister marries. Prioritizing the younger daughter would postpone efforts to find the older daughter a match, further shortening her remaining window and worsening her marriage prospects. Families therefore have an incentive to prioritize the oldest unmarried daughter. Second, adhering to a birth order rule may reduce direct competition between siblings over potential spouses (Vogl, 2013).

Figure 4 shows descriptive evidence for the birth order rule. Oldest daughters are more likely to be married than younger daughters of the same age up to age 23. The trend reverses after age 23, supporting the idea that older and younger sisters do not fundamentally differ in their likelihood to ever marry. In the data, around 10% of women marry out of birth order, meaning that they marry either before an older sister or after a younger sister. Around 70% of women marry at the same age or at an older age than their immediately older sister.

Prior work has documented the effects of the birth-order rule on marriage outcomes. In Nepal, Vogl (2013) finds that having a younger sister reduces a woman's age at marriage and the quality of her spouse. Work conducted concurrently with this paper documents similar patterns in India (Guha et al., 2026).

Figure 4: Share of married women by next-older sister



Notes: The figure plots the share of women who had married by each age, separately by whether their next-older sibling is a sister or a brother.
Source: Author's calculations using REDS 2006.

Together, these patterns motivate the instrument used in the empirical analysis. Throughout the paper, I use the term "next-older sibling" to denote the sibling immediately preceding a woman in her family's birth order. Under the birth-order rule, a woman whose next-older sibling is female may have to wait until her older sister marries, whereas a woman whose next-older sibling is male does not face the same constraint. I therefore use an indicator for having a next-older sister as an instrument for age at marriage in my main specification. In addition, I assess the robustness of the results to alternative formulations of the instrument.

3.3 Specification

I estimate the effect of age at marriage on educational attainment using Two-Stage Least Squares. Let A_i denote woman i's age at marriage, Y_i an educational outcome, and Z_i an indicator equal to one if the sex of the next-older sibling is female.

The first-stage equation is:

$$A_i = \alpha_1 Z_i + \alpha_2 X_i' + \varepsilon_i, \tag{2}$$

and the reduced-form equation is

$$Y_i = \gamma_1 Z_i + \gamma_2 X_i' + u_i, \tag{3}$$

The vector X_i contains the number of siblings, birth order, year-of-birth fixed effects and age gap between siblings. Standard errors are clustered at the household level.

The identifying comparison is therefore between two women who were born in the same year and have the same total number of siblings, birth order and age gap with the next-older sibling, but differ in whether the next-older sibling is female. Under the birth-order rule, a woman with a next-older sister will have to wait until her sister marries, whereas a woman with a next-older brother does not face this constraint. The instrument therefore predicts that women with next-older sisters marry later, generating a positive first-stage relationship between Z_i and A_i. Family-size controls ensure that the comparison is not driven by differences in the total number of siblings, while year-of-birth fixed effects account for cohort differences. Controlling for birth-order isolates variation in the sex composition of older siblings from any direct effects of a woman's position in the sibling order.

Identification. Identification relies on two key assumptions: instrument relevance and the exclusion restriction. Relevance requires that the sex of the next-older sibling affects a woman's age at marriage. I test this condition directly using the first-stage equation (2). Exclusion requires that, conditional on X_i, having a next-older sister affects educational attainment only through its effect on age at marriage. Section 3.9 examines the principal threats to this assumption. Because the model is just identified, the 2SLS estimand is

$$\beta^{2SLS} = \frac{\gamma_1}{\alpha_1}. \tag{4}$$

Under the exclusion restriction and the usual monotonicity condition, this parameter is a local average treatment effect for women whose marriage timing is shifted by the norm that older daughters marry before younger daughters.

Alternative specifications. I consider two alternative specifications. First, I use a binary indicator for whether a woman has an older sister as the instrument, conditional on total number of siblings, year-of-birth fixed effects, and birth order. Second, I use the number of older sisters as the instrument, conditional on the total number of siblings and year-of-birth fixed effects.

3.4 Sample

I restrict the sample to women between the ages of 25 and 40 with at least one older sibling. This ensures that most women in my analysis sample have completed their marriage and education choices at the time of the survey.

3.5 Data

The empirical analysis requires linking a woman's age at marriage and educational attainment to the sex and birth order of her siblings, particularly whether her next-older sibling is a sister. Constructing these links is difficult with standard Indian household surveys. Because marriage is predominantly patrilocal, married women typically leave their natal households and move to their husband's household upon marriage (Rosenzweig and Stark, 1989). Although they may be interviewed in their marital households, in general, they are not asked about their siblings, and they cannot be linked back to complete rosters of their natal siblings.

My primary data source is the Rural Economic and Demographic Survey (REDS), a panel survey conducted by the National Council of Applied Economic Research in 17 of India's most populous states. These states account for approximately 96% of India's population, although the REDS sample is restricted to rural areas.[7]

The REDS is uniquely suited to this analysis because it provides information on household heads' children and siblings, including those who no longer reside in the household. For non-coresident children and siblings, the 2006 retrospective marriage questionnaires record year of birth, age at marriage, own and spouse's educational attainment, and transfers made by the bride's and groom's families at the time of marriage. My analysis uses the records for household heads' daughters and sisters. Because women typically leave their natal households upon marriage, restricting the detailed marriage records to non-coresident relatives excludes relatively few married daughters or sisters.

To reconstruct each household head's complete family structure, I combine the records for coresident and non-coresident children and, analogously, the records for coresident and non-coresident siblings. I order individuals by year of birth to recover each woman's birth order and identify the sex of her next-older sibling. I then link these family-structure measures to her age at marriage, educational attainment, spouse's educational attainment, and dowries.

3.6 First stage results

Table 3 presents estimates of equation (2). Column (1) uses an indicator for whether the next-older sibling is female, column (2) uses an indicator for having an older sister and

[7]Because the REDS is restricted to rural households, the estimates need not generalize to urban women. The India Human Development Survey (IHDS) is nationally representative and covers both rural and urban households, but it does not directly ask married women about their natal siblings or collect detailed information on non-resident children and siblings. I therefore use the IHDS only for a supplementary analysis that exploits its panel structure. The IHDS tracking survey records when and why members of first-wave households left before the second wave. I restrict the sample to women who were unmarried in the first wave and left their natal households to marry between waves. For these women, I infer age at marriage from the year in which they left and construct birth order using their mothers' fertility histories. Appendix F provides further details and reports comparable estimates.

column (3) uses the number of older sisters. Having a next-older sister increases age at marriage by about 0.4 years, which is about 5 months. Having at least one older sister raises age at marriage by about 0.5 years, or 6 months. Column (3) shows that the effect rises monotonically in the number of older sisters. For example, having one older sister increases age at marriage by about 0.3 years, while having 4 or more older sisters can increase age at marriage by about 0.8 years.

I use column (1) as my preferred specification. For robustness, I also present IV results using the alternate specifications in column (2) and column (3) in Appendix C.

Table 3: First stage estimates of age at marriage on next-older sister

Dep. var.: Age at marriage	Next-older sister	Has an older sister	Number of older sisters
	(1)	(2)	(3)
Next-older sister=1	0.405***		
	(0.09)		
Has an older sister=1		0.470***	
		(0.10)	
1 older sister			0.343***
			(0.10)
2 older sisters			0.734***
			(0.15)
3 older sisters			0.759***
			(0.21)
4 or more older sisters			0.832***
			(0.30)
F	20.17	20.39	6.19
N	6,053	7,481	6,054

Notes: The table reports first-stage estimates of the effect of having a next-older sister on age at marriage. Column (1) uses the preferred instrument, an indicator for having a next-older sister; columns (2) and (3) show alternative measures. Column (2) shows results using an indicator for having an older sister, and column (3) shows results using the number of older sisters. All columns control for the number of siblings, year of birth, and birth order. Column (1) additionally controls for the age gap between the woman and her next-older sibling. The sample comprises women aged 25-40. Standard errors clustered at the household level are reported in parentheses.
Source: Author's calculations using REDS 2006.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

3.7 Reduced form results

Table 4 reports results from regressing educational attainment on the instrument, an indicator equal to one if a woman's next-older sibling is a sister. Having a next-older sister raises completed schooling by 0.6 years, around 14% of the sample's average years of schooling. It increases tenth-grade completion by 5.1 percentage points and high-school completion by 2.3 percentage points, relative to means of 20% and 8% respectively.

Table 4: Reduced form estimates of educational outcomes on next-older sister

Dep. var.:	(1) Years of education	(2) Tenth grade or more	(3) HS or more
Next-older sister=1	0.629***	0.051***	0.023***
	(0.12)	(0.01)	(0.01)
Mean of dep variable	4.49	0.20	0.08
N	6,053	6,053	6,053

Notes: The table reports reduced-form estimates of the effect of having a next-older sister on completed years of schooling (column 1), tenth grade completion (column 2), and high school completion (column 3). All columns control for the number of siblings, year of birth, birth order, and the age gap between siblings. The sample comprises women with at least one older sibling, aged 25-40. Standard errors clustered at the household level are reported in parentheses.
Source: Author's calculations using REDS 2006.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

3.8 IV results

Table 5 reports 2SLS estimates for educational attainment. The IV estimates suggest that delaying marriage by one year raises schooling by about 1.6 years, tenth-grade completion by 13 percentage points, and high-school completion by 5.6 percentage points. The effects are large relative to the sample means (4.5 years, 0.2, and 0.08, respectively), consistent with marriage being a binding terminal date for schooling in this setting.

Table 5: IV estimates of educational attainment on age at marriage

Dep. var.:	(1) Years of education	(2) Tenth grade or more	(3) HS or more
Age at marriage	1.554***	0.126***	0.056***
	(0.37)	(0.03)	(0.02)
Mean of dep variable	4.49	0.20	0.08
N	6,053	6,053	6,053

Notes: The table reports 2SLS estimates of the effect of age at marriage on educational attainment, instrumenting age at marriage with an indicator for having a next-older sister. The dependent variable is completed years of schooling (column 1), an indicator for tenth grade completion (column 2), and an indicator for high school completion (column 3). All columns control for the number of siblings, year of birth, birth order, and the age gap between siblings. The sample comprises women with at least one older sibling, aged 25-40. Standard errors clustered at the household level are reported in parentheses.
Source: Author's calculations using REDS 2006.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

3.9 Identifying assumption: The exclusion restriction

The exclusion restriction requires that, conditional on X_i, having a next-older sister affects schooling only by delaying marriage. I consider five ways it could fail and conduct robustness checks for each.

3.9.1 Differential time in home production by sex-specific birth order

Even after controlling for overall birth order, women with a next-older sister may spend less time on home production than women with a next-older brother. If older daughters bear a larger share of household work or care for younger siblings, a next-older sister may reduce a woman's domestic responsibilities and allow her to spend more time in school. Having a next-older sister would then affect education through a channel other than marriage timing, violating the exclusion restriction.

Two pieces of evidence suggest that differences in home production are unlikely to drive the results. I then assess the robustness of the findings using an alternative specification.

First, Table 6 shows no statistically significant difference in school enrollment at ages 6–12 between girls with a next-older brother and those with a next-older sister. Because enrollment is observed only for girls still living in the household at the time of the survey, this sample is younger than the estimation sample. Nevertheless, the results provide descriptive evidence that school enrollment at younger ages does not differ significantly by the sex of

the next-older sibling.

Table 6: Reduced-form estimates of school enrollment on next-older sister

	(1) Currently in school
Next-older sister	-0.005
	(0.01)
Observations	1398

Notes: The table reports the effect of having a next-older sister on school enrollment for girls between the ages of 6 and 12. All columns include controls for the number of siblings, year of birth, birth order and the age gap between siblings. The sample comprises girls with at least one older sibling, aged 6–12. Standard errors clustered at the household level are reported in parentheses.
Source: Author's calculations using REDS 2006.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Second, using the 1999 wave of the REDS, which collected time-use data from mothers and their children, Figure 5 plots the time daughters spent in home production by whether they have a next-older sister between ages 5 and 14 and shows almost no difference at these ages. I restrict the figure to these ages because marriage becomes increasingly common at older ages, around the same time that daughters' responsibilities for home production may increase. Since time use is observed only for daughters still living in the household, comparisons at older ages would be subject to selection into marriage. The figure therefore provides descriptive evidence for younger girls but cannot rule out differences in home production at older ages.

As an additional robustness check, I hold the home-production channel fixed while preserving variation in marriage timing. I restrict the sample to women who already have an older sister among the siblings born before their next-older sibling. Within this subsample every woman has an elder sister higher up in the birth order, so the eldest-daughter's caregiving burden is held fixed regardless of the value of the instrument. The only remaining variation is whether the *immediately* next-older sibling is specifically a sister rather than a brother—the sibling whose presence delays a woman's own marriage under the rule that older daughters marry first. If the reduced-form relationship reflected differential home production by birth order, it should disappear once the eldest-daughter role is held fixed; if it reflects marriage timing, it should persist.

Figure 5: Time spent in home production



Notes: This figure plots average time spent in home production at each age by sex of the next-older sibling. *Source*: Author's calculations using REDS 1999.

Table 7 shows the latter. The first stage is about the same as the baseline. Having a next-older sister raises age at marriage by 0.46 years (column 3), compared with 0.40 in the full sample. The 2SLS estimate is 0.08 (column 4), larger than the baseline effect of 0.056, even though the restriction roughly halves the sample to 3,027 women. Holding the eldest-daughter role fixed leaves the estimated effect of marriage timing essentially unchanged, which is difficult to reconcile with differential home production by birth order driving the result.[8]

[8]There might still be a concern that caregiving may fall on whichever older sister remains at home rather than on the eldest daughter specifically, so once the eldest marries and leaves the household the next-older sister can inherit the burden—in which case holding the eldest-daughter role fixed does not fully shut down the home-production channel. To assess this concern, I restrict the sample to households in which at least one additional adult woman, such as a grandmother, lives with the woman. This additional household member may substitute for daughters in home production and caregiving, weakening the relationship between a daughter's birth order and her domestic responsibilities. This exercise is difficult using the 2006 REDS alone because I do not observe the composition of a woman's natal household before her marriage. I therefore exploit the panel structure of the REDS and restrict the sample to women who married between 1999 and 2006. For these women, the 1999 round records their natal household composition before marriage, allowing me to assess this channel. The results are reported in the Online Appendix.

Table 7: IV estimates of high-school completion on age at marriage for women with at least one older sister

Dep. var.:	Baseline		At least one older sister	
	(1) First-stage	(2) 2SLS	(3) First-stage	(4) 2SLS
Next-older sister=1	0.405***		0.463***	
	(0.09)		(0.13)	
Age at marriage		0.056***		0.080***
		(0.02)		(0.03)
First-stage F	20.17	.	12.43	.
N	6,053	6,051	3,027	3,027

Notes: The table reports IV estimates of the effect of age at marriage on high school completion, instrumenting with an indicator for having a next-older sister. Columns (1) and (2) report the baseline estimates; columns (3) and (4) report the estimates when the sample is restricted to women with at least one older sister among siblings born before their next-older sibling. All columns include controls for the number of siblings, year of birth, birth order and the age gap between siblings. The baseline sample comprises women with at least one older sibling, aged 25–40. Standard errors clustered at the household level are reported in parentheses.
Source: Author's calculations using REDS 2006.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

3.9.2 Differential investment between sons and daughters

Many studies document strong son preference in India and associated gender disparities in parental investments in schooling and health (see Jayachandran (2015) for a review of this literature). These investments are moreover disproportionately directed toward the eldest son (Jayachandran and Pande, 2017), consistent with the patrilocal and patrilineal Hindu kinship system, under which eldest sons typically provide old-age support and inherit property.

A potential concern is that parents allocate resources differently between sons and daughters within the household. Consider two otherwise similar families in which the woman has either a next-older sister or a next-older brother. Holding family size constant, the second family has one more son and one fewer daughter. If parents allocate a disproportionate share of household resources to sons, fewer resources may remain for the woman's education. This concern may be particularly important when the next-older brother is the eldest son, who may receive an especially large share of household resources. A woman with a next-older brother may therefore receive less schooling than a woman with a next-older sister for reasons unrelated to marriage timing, violating the exclusion restriction.

Table 8: Robustness: IV estimates of high-school completion on age at marriage

	(1) Baseline	(2) Household FE	(3) Older-sibling composition	(4) At least one older brother	(5) Number of sons
Panel A: First stage (dep. var. = age at marriage)					
Next-older sister=1	0.405***	0.381***	0.424***	0.261**	0.317***
	(0.09)	(0.08)	(0.11)	(0.12)	(0.10)
First-stage F	20.17	20.15	15.36	4.88	10.44
Panel B: 2SLS (dep. var. = High school completion)					
Age at marriage	0.056***	0.039*	0.046**	0.048	0.029
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
N	6,051	3,544	4,515	3,780	6,051

Notes: The table reports IV estimates of the effect of age at marriage on high school completion, instrumenting with an indicator for having a next-older sister. Panel A reports the first stage; Panel B reports the 2SLS estimates. All columns include controls for the number of siblings, year of birth, and the age gap between siblings. Column (1) adds birth-order controls; column (2) household fixed effects; column (3) the sex composition of siblings born before the next-older sibling; column (4) restricts to women with at least one older brother among siblings born before their next-older sibling; column (5) adds birth order and number of sons. The sample comprises women with at least one older sibling, aged 25–40. Standard errors clustered at the household level are reported in parentheses.
Source: Author's calculations using REDS 2006.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

I address this concern in two ways; results appear in Table 8. I first control for the exact composition of siblings born *before* the next-older sibling (column 3). Second, to assess whether the results are driven by eldest-son preference, I restrict the sample to women who have an older brother born before their next-older sibling (column 4). In this sample, all women already have an older brother, and a next-older brother cannot be the family's eldest son. Across these specifications, the 2SLS estimates remain positive, corresponding to increases of 3–5 percentage points in high school completion per year of delayed marriage, relative to a baseline effect of 5.6 percentage points (column 1).

3.9.3 Son-preference and fertility stopping rules

A further concern is that sibling sex composition may not be random in the presence of son preference. Two mechanisms are relevant. First, families may use sex-selective abortion to influence the sex composition of their children. Second, families may follow differential fertility stopping rules, continuing childbearing until they have a son.

Sex-selective abortion is unlikely to be a major concern in my setting. Ultrasound technology that allowed parents to determine fetal sex was introduced in India only in the early 1980s, and its adoption in rural areas remained limited until the late 1980s. Because the women in my sample were born between 1966 and 1983, most were born before prenatal sex determination became widely accessible in rural India. It is therefore unlikely that sex-

selective abortion substantially shaped the sibling sex compositions observed in my sample.[9]

Differential stopping behavior is potentially more relevant. Families with a strong preference for sons may continue childbearing after the birth of a daughter but stop after the birth of a son. Consequently, a woman with a next-older sister may be disproportionately drawn from a family that continued childbearing in pursuit of a son. If these families also invest less in daughters' schooling for reasons unrelated to marriage timing, the older-sister instrument may be correlated with the error term, violating the exclusion restriction.

I address this concern in three ways. First, I include household fixed effects, which absorb fixed family characteristics such as attitudes towards daughters (Table 8, column 2). Second, I control for the exact sex composition of siblings born before the next-older sibling (column 3). This specification compares women whose families had the same prior sex composition but whose next-older siblings differ in sex. Finally, I restrict the sample to women who have an older brother born before their next-older sibling (column 4). Because these families already had a son, their decision to continue childbearing could not have been motivated by the pursuit of a first son. This restriction therefore weakens the selection generated by son-preferring fertility stopping rules. The estimates remain positive in all three specifications.

3.9.4 Dowry payments for older daughters

Another concern is that dowry payments may deplete the household's resources. When an older sister marries, the dowry payment may deplete the household's savings, leading the family to delay the younger daughter's marriage while it rebuilds resources. The same financial shock may directly affect resources available for the younger daughter's education. Having a next-older sister could therefore affect schooling through household finances rather than solely through the marriage timing channel, violating the exclusion restriction.

Two pieces of evidence argue against this. First, if an older sister's dowry depleted the resources available for education, women with a next-older sister should attain less schooling. Instead, women with a next-older sister attain more schooling, contrary to the prediction of this channel. Second, such a channel should bind most tightly for less wealthy households. Table 9 shows that the 2SLS estimates are positive across landholding terciles, ranging from 0.030 to 0.063. The estimates are statistically significant in the bottom and top terciles, with no evidence that the effect is concentrated among poorer households.

[9]Female infanticide could also generate nonrandom sibling sex composition if the survival of a daughter depended on her birth order and the sex composition of her older siblings. I do not focus on this mechanism because its quantitative importance for the cohorts and regions in my sample is difficult to assess.

3.9.5 Increases in per-capita consumption

A related concern is that after a daughter marries and leaves the household, per-capita resources increase for the remaining children, which could improve education outcomes for younger siblings. As with the dowry-rebuilding channel, this mechanism should matter most for credit-constrained families. Yet the estimates in Table 9 are stable across landholding terciles, suggesting that per-capita resource effects are not a major threat to the exclusion restriction.

Table 9: IV estimates of high-school completion on age at marriage by wealth

	Landholding tercile		
	(1) Bottom	(2) Middle	(3) Top
Panel A: First stage (dep. var. = age at marriage)			
Next-older sister	0.498***	0.278*	0.458***
	(0.16)	(0.16)	(0.15)
Panel B: 2SLS (dep. var. = High school completion)			
Age at marriage	0.063**	0.030	0.062**
	(0.03)	(0.05)	(0.03)
N	2,078	1,968	2,002

Notes: The table reports IV estimates of the effect of age at marriage on high school completion, instrumenting with an indicator for having a next-older sister. Panel A reports the first stage; Panel B reports the 2SLS estimates. All columns include controls for the number of siblings, year of birth, birth order and the age gap between siblings. Column (1) reports results for households in the bottom tercile of the land area distribution; columns (2) and (3) report results for households in the middle and top terciles, respectively. The sample comprises women with at least one older sibling, aged 25–40. Standard errors clustered at the household level are reported in parentheses.
Source: Author's calculations using REDS 2006.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

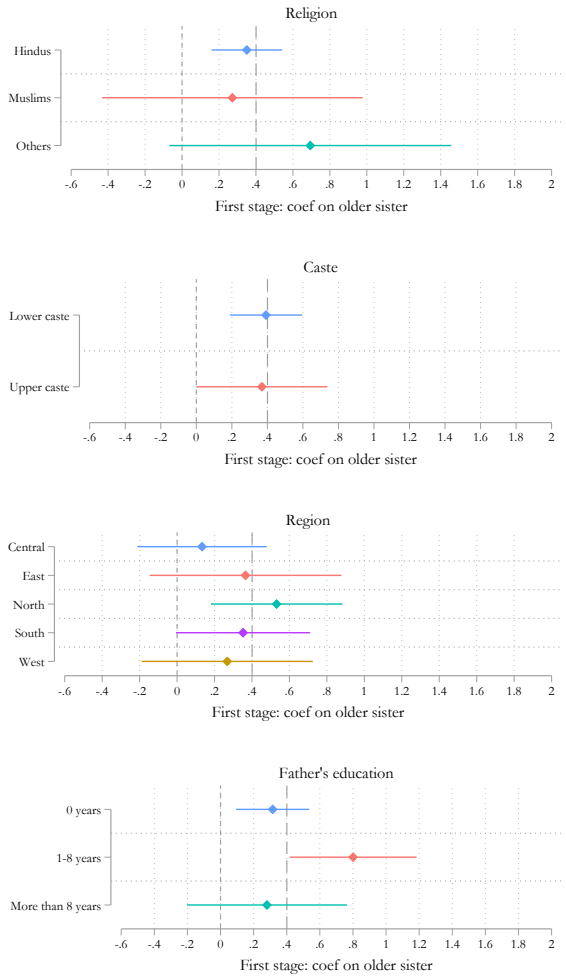
3.10 Who are the compliers?

Compliers in this setting are women who delayed marriage because their next-older sister had not yet married — that is, women for whom the birth-order norm was binding. Figure 6 characterizes this group by plotting the first-stage coefficient separately by religion, caste, region, and father's education.

The instrument operates most precisely among Hindus. The point estimate for Muslims is similar though imprecisely estimated. Across caste groups, the first stage is similar for lower- and upper-caste women, indicating that compliers are not concentrated along caste lines. Regionally, the instrument is strongest in North India, where patriarchal marriage market structures and adherence to birth-order norms are most prevalent, and weaker in Central and West India, though estimates are imprecise. Across father's education groups, the norm appears operative at all levels of paternal schooling, though it is larger for women whose fathers have 1-8 years of schooling, relative to fathers with no education or more than 8 years of schooling.

Taken together, the instrument draws variation primarily from women in Northern India, whose fathers have 1-8 years of education, while showing no strong differential by caste or religion. The LATE identified by this instrument should be interpreted with this population in mind.

Figure 6: First-Stage Heterogeneity by Subgroup



Notes: Each coefficient is the OLS estimate of having a next-older sister on age at marriage, estimated separately within each subgroup. Point estimates are shown with 95% confidence intervals based on standard errors clustered at the household level. The dashed vertical line indicates the baseline first-stage coefficient of 0.4. The sample includes ever-married women between the ages of 25 and 40 with at least one older sibling.
Source: Author's calculations using REDS 2006.

3.11 Discussion of results

The results in this section establish a robust causal relationship between age at marriage and educational attainment for women in rural India. Across a range of specifications, a one-year delay in age at marriage leads to approximately 1.5 additional years of schooling, a

13 percentage point increase in the probability of completing 10th grade, and a 6 percentage point increase in high school completion.

These effects are large relative to prior estimates in the existing literature. Field and Ambrus (2008), instrumenting marriage age with age at menarche in rural Bangladesh, find that each additional year of delay raises schooling by 0.22 years; Wilson (2022), using child-marriage bans across 17 countries, finds effects of about 0.4 years per year of delay in urban areas and null effects in rural settings with weak enforcement. Two features of my design likely account for the larger estimates. First, the complier population is distinctive: the birth-order norm binds for women actively approaching the marriage market, precisely those for whom an additional year before marriage translates into schooling completed. Second, neither study examines India, so the estimates are not directly comparable. Reassuringly, my first-stage magnitude of about 0.4 years per older sister lines up with independent evidence on the birth-order queuing norm (Vogl, 2013; Guha et al., 2026).

These results show that marriage timing is a first-order determinant of women's schooling and underscore the importance of evaluating policies that directly target it. However, the 2SLS estimate identifies a local average treatment effect in partial equilibrium. It neither reveals the mechanisms driving household choices nor captures market-wide responses to policy. To quantify these mechanisms and evaluate such policies, I next develop and estimate a dynamic equilibrium model.

4 Model

Section 3 establishes the causal effect of delaying marriage on women's educational attainment. However, quantifying the mechanisms underlying these choices, and evaluating policies such as a minimum marriage-age law, requires going beyond this estimate in several respects.

First, quantifying the mechanisms underlying marriage and schooling choices requires a framework that captures the benefits and costs of both schooling and delayed marriage. Additional schooling may improve a daughter's marriage prospects, but households incur schooling costs. Delaying marriage also requires the household to support her for longer and leaves her less time to find a match. These trade-offs depend on marriage-market incentives, including the education premium and age penalty brides face and the expected dowries required to attract different types of grooms. In households with multiple daughters, the birth-order constraint also links decisions across sisters. Delaying an older daughter's marriage may postpone her younger sister's entry into the marriage market and change the younger daughter's marriage and schooling opportunities.

Second, the instrument identifies a local effect of marriage timing induced by sibling

composition under prevailing market conditions. It shifts marriage timing for an individual woman without changing the pool of potential partners, congestion across market segments, matching probabilities, or dowries. A minimum marriage age law, by contrast, changes the constraints faced by many families simultaneously. By changing the composition of women eligible to marry, the law may alter the set of feasible matches, congestion, proposal and matching probabilities, and equilibrium dowries. These equilibrium adjustments may also change the age penalty and education premium brides face. The reform may further induce households to reallocate marriage timing and schooling across daughters. Its effects therefore cannot be recovered from the individual-level estimate.

Quantifying these mechanisms and market-wide responses requires a dynamic equilibrium framework. I therefore develop and estimate a directed-search model with endogenous schooling and joint household decisions across daughters. I use the model to quantify the trade-off between early marriage and schooling and to evaluate the effects of a minimum marriage age reform on marriage outcomes, educational attainment, and welfare.

4.1 Overview

Households have one or two daughters, live for a finite number of periods, and participate in a directed-search marriage market. They search for their daughters sequentially, in birth order. In each period, a household posts a menu of dowries for the oldest unmarried daughter who is eligible to search, specifying the transfer associated with each type of groom. Men direct proposals toward households based on the posted dowry, the daughter's characteristics, and the probability that their proposal will be accepted. A household that receives at least one proposal accepts one of them. Following the marriage stage, households choose schooling for their unmarried daughters. At the start of the next period, married agents exit the model, while unmarried agents age by one period and may search again. All search takes place within caste-specific marriage markets.

The marriage-market component of the model builds on the static directed-search assignment model in Shimer (2005). Search is directed because men choose where to send their proposals, taking into account both the attractiveness of the match and their probability of acceptance. Because men send proposals without coordinating with one another, some households may receive multiple proposals while others receive none. This generates uncertainty in matching for both sides. By adjusting the dowry menu, households can influence both the likelihood of receiving a proposal and the types of grooms they attract.

I embed this mechanism in a finite-horizon household problem in which daughters age over time and households choose their schooling while they remain unmarried. Marriage

outcomes therefore affect subsequent schooling choices, while schooling investments shape future search incentives and marriage outcomes.

4.2 Environment

Time is discrete. In each period, a new cohort of young men enters alongside a new cohort of households whose oldest daughter has reached marriageable age. For expositional convenience, I refer to the decision-maker on the groom's side as the man; this agent may be interpreted as the man or his family. Households remain in the model for T periods, while their daughters exit upon marriage or when they age out of the marriage market. Men remain in the model for at most T_m periods and exit upon marriage or when they age out.

Households. A household is described by a permanent type (y, r) and an evolving component. Income y is fixed over the model horizon, $r \in \{1, 2\}$ is the number of daughters. When $r = 2$, sisters are born g years apart, with g common to all households.

Daughters are indexed by birth order $b \in \{f, \ell\}$, where f is the first-born and ℓ the last-born. A household with $r = 1$ has only daughter f, so all terms involving ℓ are omitted. Daughter b has marital status $m^b \in \{0, 1\}$ and schooling $s^b \in \{0, 1, \dots\}$, measured in years completed since the household entered the market. Age advances deterministically and the age gap is fixed, so the age of the last-born daughter is pinned down by the first-born's age $a^\ell = a^f - g$. The household state is therefore

$$\mathbf{h}_t = \big(\underbrace{y,\ r,}_{\text{permanent}}\ \underbrace{a_t^f,\ \mathbf{m}_t,\ \mathbf{s}_t}_{\text{evolving}}\big), \qquad \mathbf{m}_t = (m_t^f, m_t^\ell), \quad \mathbf{s}_t = (s_t^f, s_t^\ell). \tag{5}$$

For notational simplicity, I suppress time subscripts where no ambiguity arises. Let $n(\mathbf{h})$ denote the number of unmarried daughters. A household enters the market when its first-born daughter reaches age $\underline{a}$, with $\mathbf{m} = \mathbf{0}$ and $\mathbf{s} = \mathbf{0}$. Each daughter is eligible to search for a match in the marriage market between ages $\underline{a}$ and $\bar{a}$.

All households remain in the model for a fixed horizon of $T = \bar{a} + g - \underline{a} + 1$ periods. For a two-daughter household, this horizon extends from the period in which the first-born daughter reaches age $\underline{a}$ through the period in which the last-born daughter reaches $\bar{a}$. A one-daughter household remains in the model for the same number of periods, although its daughter can participate in the marriage market only between ages $\underline{a}$ and $\bar{a}$. Once she marries or ages out, the household makes no further marriage or schooling decisions but remains in the model until the common terminal period.

A share λ of entrants has one daughter, and the remaining $1 - \lambda$ have two. Let $\nu(\mathbf{h})$

denote the mass of households in state $\mathbf{h}$.

Men. A man is described by his type $j = (a_j, s_j) \in \mathcal{J}$, where a_j is his age and s_j his schooling. His education is fixed prior to entering the marriage market. Men are in the market between ages $\underline{a}_m$ and $\bar{a}_m$, and exit upon marriage or when they age out. Let μ_j denote the mass of unmarried type-j men. Let j' denote a man's type in the next period, when he is one year older, with the same education.

Preferences. A household values its own consumption and the education of the men its daughters marry. It has log utility over consumption and receives a match payoff τ_j when a daughter marries a type-j man. A man values the bride's age and schooling, and the dowry. A man who marries a bride of age a and schooling s in exchange for a dowry d receives utility $\gamma(a, s) + \log d$. Preferences over partner characteristics are common within each side of the market and do not depend on the agent's own type. Both sides discount the future using a discount factor β.

Daughters' schooling provides no direct systematic utility to the household. Instead, schooling affects men's valuation of the match through $\gamma(a, s)$. It therefore changes the proposals a household receives and the equilibrium dowry required to attract different types of grooms.

Income and costs. The household pays for dowries, schooling, and supports unmarried daughters from its per-period income y. The household pays ϕ for each daughter enrolled in school in a given period. In addition, each unmarried daughter requires a per-period cost of κy. A daughter who ages out of the marriage market unmarried remains in the household and continues to impose this cost through the terminal period.

Marriage eligibility. Households with two daughters marry daughters in order of birth. In each year, a household searches only for its oldest unmarried daughter who is still within the marriage-market age window $[\underline{a}, \bar{a}]$. Let $b(\mathbf{h})$ denote this daughter, with $b(\mathbf{h}) = \varnothing$ if no daughter is unmarried and within the window. In households with two daughters, the younger daughter can therefore enter the marriage market only after her older sister marries or ages out of the market. Delaying the older daughter's marriage may thus postpone her sister's entry, linking the household's decisions across daughters. A household with one daughter faces no sequencing restriction.

For estimation, age is discretized into three-year bins, with each model period corresponding to one age bin. Figure 7 illustrates the sequencing restriction under this discretization.

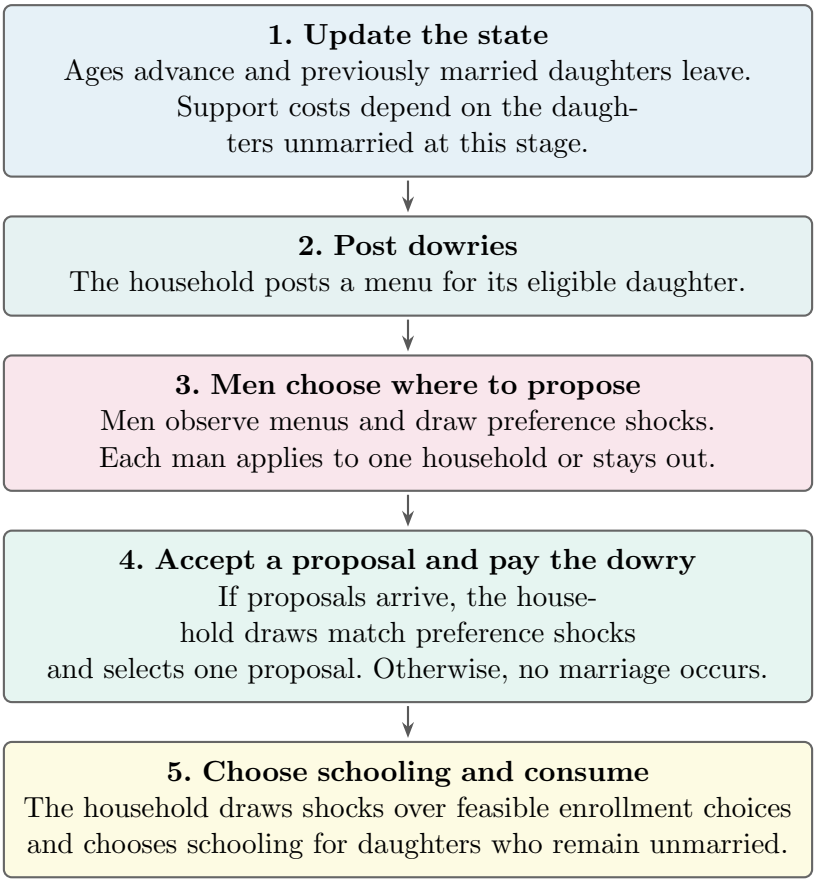
Figure 7: Illustration of the household life cycle with two daughters (three-year age bins)

	Period 1	Period 2	Period 3	Period 4	Period 5
First-born	16–18	19–21	22–24	25–27	
Last-born		16–18	19–21	22–24	25–27

Timing. Each period proceeds in five stages (Figure 8). First, ages advance, daughters who married in the previous year leave the household, and the state updates. Second, the household posts a menu of dowries for its eligible daughter. Third, men observe all posted menus, draw idiosyncratic shocks over households, and each directs an application to one household. Fourth, a household that receives at least one proposal draws idiosyncratic shocks over the types represented among its proposals, accepts the proposal that yields the highest value, and pays the corresponding dowry. Fifth, the household chooses schooling for unmarried daughters and consumes.

Matching therefore occurs before the schooling decision, and schooling is chosen only for daughters who remain unmarried. Once a daughter marries, the household makes no further decisions on her behalf.

Figure 8: Period timing



Sources of uncertainty. Uncertainty in the model arises from marriage market frictions and three sets of preference shocks. First, marriage market frictions, described in Section 4.4, make matching outcomes uncertain for both households and men. Second, men draw preference shocks over households after observing posted dowry menus and before choosing where to apply. Third, households draw preference shocks over the groom types represented among their proposals before deciding which proposal to accept. These shocks are therefore unknown when households post their dowry menus. Finally, households draw preference shocks over schooling before choosing schooling.

I now present each of these stages in more detail in reverse chronological order. I first characterize the schooling decision and then describe the marriage market and the household's dowry-posting problem.

4.3 Schooling decision

After the marriage stage, the household chooses which unmarried daughters to enroll in school. Let $\boldsymbol{e} = (e^f, e^\ell)$, where $e^b \in \{0, 1\}$ indicates whether daughter b attends school. For a one-daughter household, all terms involving ℓ are omitted. Let $\mathcal{A}^e(\mathbf{h}, j)$ denote the feasible schooling choices.

Let j denote the marriage outcome, with $j \in \mathcal{J}$ identifying the groom's type and $j = 0$ indicating no match. Before choosing enrollment, the household observes a preference shock $\varepsilon(\boldsymbol{e})$ for each feasible schooling vector. These shocks are i.i.d. Type-I extreme value with scale parameter σ_s.

Let $V(\boldsymbol{h})$ denote the household's value at the start of a period in state $\boldsymbol{h}$. Conditional on the match outcome j for the eligible daughter, the household's expected value before observing the schooling shocks is:

$$W(\boldsymbol{h}, j; d_j) = \tau_j + \mathbb{E}_\varepsilon \left[\max_{\boldsymbol{e} \in \mathcal{A}^e(\boldsymbol{h}, j)} \{u(c) + \beta V(\boldsymbol{h}') + \varepsilon(\boldsymbol{e})\} \right], \tag{6}$$

where consumption is income net of support costs, the dowry, and schooling expenditures:

$$c = y - \kappa y \, n(\boldsymbol{h})^\chi - d_j - \phi(e^f + e^\ell). \tag{7}$$

Here, $n(\boldsymbol{h})$ denotes the number of unmarried daughters in the household at the start of the period, and $\chi \in (0, 1]$ governs economies of scale in supporting unmarried daughters, with lower values implying greater economies of scale.

When no match occurs, $\tau_0 = d_0 = 0$. Feasible schooling choices require positive consumption. The next-period state $\mathbf{h}'$ incorporates the marriage outcome, aging, and schooling accumulation, with $s^{b\prime} = s^b + e^b$.

Schooling therefore trades off current consumption against future marriage-market returns. The realized marriage outcome determines both which daughters remain in the schooling decision and the resources available after the dowry payment.

4.4 Marriage market

Marriage takes place in a frictional marriage market. I incorporate search frictions in the marriage market for two reasons. First, they are important for generating the empirical first-stage relationship between having an older sister and age at marriage (Section 3). Under the birth-order norm, a younger daughter cannot enter the marriage market until her older sister marries. In a frictionless marriage market, the older sister could match immediately once the household decides to marry her, allowing the younger daughter to enter the market

without further delay. With search frictions, however, the older sister may remain unmarried for multiple periods because she does not receive a proposal. The younger daughter must therefore wait even if she is otherwise ready to marry, generating a delay in her marriage that would not arise in the absence of search frictions.

Second, search frictions reflect the challenges of forming a match in the Indian marriage market, where finding a suitable spouse requires gathering information about potential partners, often through family and social networks (Beauchamp et al., 2021). The resulting uncertainty about whether and when a match occurs shapes households' marriage timing and schooling decisions.

I model the marriage market using directed search, where households post dowries and then men choose which household to approach. The central friction in the marriage market is that men choose which household to approach without coordinating with each other. As a result, some households receive multiple proposals while others receive none, and no household is guaranteed a match even when acceptable partners are available.

Throughout I restrict attention to symmetric equilibria. I assume that households in the same state post the same menu of dowries. See Section 4.7 for a more detailed discussion of this assumption.

I describe the market in four steps: households post dowries, men choose where to apply, proposals arrive, and households choose which proposal to accept.

4.4.1 Dowry menus and participation

Each period, a household posts a menu of dowries for its *eligible* daughter $b(\boldsymbol{h})$. Dowries may depend on a man's age and education but not on his identity. A household in state $\boldsymbol{h}$ posts

$$\mathbf{d}(\mathbf{h}) = \big(d_1(\boldsymbol{h}), \ldots, d_J(\boldsymbol{h})\big) \in \mathbb{R}_+^J,$$

where $d_j(\boldsymbol{h})$ is the dowry offered to a man of type j. Within the household's own problem, the state is fixed, so I suppress it and write $\boldsymbol{d} = (d_1, \ldots, d_J)$ in this section. I set $d_j \equiv 0$ by convention when $j = 0$ denotes the event that no match occurs.

The household pays the dowry out of current income in the year of the match, alongside the cost of supporting its unmarried daughters.

A household can choose not to participate in the marriage market for its daughter in a given period. Equivalently, this option can be represented as posting a dowry arbitrarily close to zero, which gives men utility approaching negative infinity and therefore attracts no proposals.

4.4.2 Men's proposals

After observing all posted dowries, each man chooses one household to approach or remains out of the market that period. A household may receive proposals from multiple men in a period and must decide which proposal to accept. Thus, sending a proposal does not guarantee marriage. If a man's proposal is accepted, he receives utility from the daughter's age and education and the dowry. If he remains unmatched at the end of the period, he returns to the market in the next period, when he is older. When deciding where to apply, a man therefore considers both the value of the marriage and the probability that his proposal will result in a match.

Let $p_j(\boldsymbol{h})$ denote the probability that a type-j man's proposal to a household in state $\boldsymbol{h}$ results in marriage.

Before making their choices, men draw idiosyncratic shocks to the payoff from approaching each household and from remaining out of the market. These shocks can be interpreted as differences in application costs and are i.i.d. Type I extreme-value.

Let $\bar{J}_j$ denote the value of an unmarried type-j man at the start of a period, before he draws his shocks and chooses where to propose. The deterministic part of his payoff from proposing to a household in state $\boldsymbol{h}$ is

$$J_j(\boldsymbol{h}) = p_j(\boldsymbol{h}) \left[\gamma(a, s) + \log(d_j(\boldsymbol{h}))\right] + \left[1 - p_j(\boldsymbol{h})\right] \beta \bar{J}_{j'}. \tag{8}$$

If a man's proposal is accepted, he gets a utility $\gamma(a, s)$ from the bride's age and education, and also gets a utility from the associated dowry. If a man remains unmatched at the end of the period, he ages and can search again in the next period. Not applying gives him the same continuation value. I normalize the terminal value of an unmarried man who has aged out of the market to zero.

The preference shocks generate logit application probabilities. The probability that a given type-j man directs his proposal to a household in state $\boldsymbol{h}$ is

$$\pi_j(\boldsymbol{h}) = \exp\left(\frac{J_j(\boldsymbol{h}) - \bar{J}_j}{\sigma_m}\right), \tag{9}$$

where σ_m governs the dispersion of men's idiosyncratic shocks. The expression for $\bar{J}_j$ is provided in Appendix D.2.

4.4.3 Proposal arrival rates

Men's application choices determine the expected number of proposals received by each household. Given a mass μ_j of unmarried type-j men, the expected number of type-j pro-

posals received by a household in state $\boldsymbol{h}$ is

$$q_j(\boldsymbol{h}) = \mu_j \, \pi_j(\boldsymbol{h}). \tag{10}$$

In a large market, men choose where to apply independently, without coordinating their applications. As a result, the number of type-j proposals received by a household follows a Poisson distribution with mean $q_j(\boldsymbol{h})$. The probability that the household receives at least one type-j proposal is therefore[10]

$$1 - \exp\big(-q_j(\boldsymbol{h})\big). \tag{11}$$

Proposal arrivals are independent across groom types. The distribution of proposal arrivals determines which types of men a household receives proposals from.

I now describe how households choose among these proposals.

4.4.4 Household acceptance decision

I assume that a household always accepts a proposal if it receives at least one, and remains unmatched only if no proposals arrive. If proposals from multiple male types arrive, the household draws a Type-I extreme-value shock associated with each type and chooses the type that maximizes its value. If multiple men of the selected type propose, the household is indifferent among them and selects one at random.

Recall that $W(\boldsymbol{h}, j; d_j)$ is the household's value from the marriage outcome onward when the eligible daughter matches with a type-j man and pays dowry d_j. Conditional on receiving proposals from the set of types R, the household chooses type $j \in R$ that maximizes $W(\boldsymbol{h}, j; d_j) + \eta_j$, where η_j is an i.i.d. Type-I extreme value shock associated with that groom type.

Let $R \subseteq \mathcal{J}$ denote the set of male types from which the household receives at least one proposal. The probability that a type-j groom is picked can be written as:

$$\Pr(j \mid R, \boldsymbol{d}) = \frac{\exp\big(W(\boldsymbol{h}, j; d_j)/\sigma_h\big)}{\sum_{i \in R} \exp\big(W(\boldsymbol{h}, i; d_i)/\sigma_h\big)}, \tag{12}$$

where σ_h governs the dispersion of the household's idiosyncratic groom-type shocks.

Combining the acceptance rule with the distribution of arriving proposal sets, let $P_j(\boldsymbol{h})$ denote the probability that a household in state $\boldsymbol{h}$ accepts a proposal from a type-j man.

[10] The quantitative implementation includes an additional assignment round as a way of controlling the degree of search frictions in the model. This extension is described in Section 5.1.

The expected number of type-j applicants to a household is $q_j(\boldsymbol{h})$, while the probability that the household selects a type-j man is $P_j(\boldsymbol{h})$. Since applicants of the same type are treated symmetrically, the probability that an individual type-j applicant marries the household is

$$p_j(\boldsymbol{h}) = \frac{P_j(\boldsymbol{h})}{\mu_j \, \pi_j(\boldsymbol{h})}. \tag{13}$$

If the household receives no proposals, it proceeds to the schooling stage. Its value in this case is $W(\boldsymbol{h}, 0; 0)$, where $j = 0$ denotes no match, so no dowry is paid and no match payoff accrues.

A higher expected queue length increases the probability that a household receives at least one type-j proposal, but also increases competition among type-j men, reducing the probability that any individual man's proposal is accepted. These acceptance probabilities, in turn, influence men's application choices and hence the expected queue lengths. In equilibrium, the acceptance probabilities that men take as given must be consistent with those generated by their application choices.

4.5 Household problem

The household chooses a dowry menu to maximize its expected value at the beginning of the period. Higher dowries make a household more attractive to men, increasing the number of proposals it can expect to receive, but reduce the resources available for consumption and schooling if a marriage occurs. Through men's application decisions, the posted dowries determine the distribution of proposal sets the household may receive. Conditional on receiving at least one proposal, the household accepts one proposal and then chooses schooling for each daughter who remains unmarried.

Let $\Pr(R \mid \boldsymbol{d})$ denote the probability that a household receives proposals from a subset of men R, as determined by the independent Poisson arrivals. The household solves

$$V(\boldsymbol{h}) = \max_{\boldsymbol{d} \in \mathcal{D}(\boldsymbol{h})} \left\{ \underbrace{\sum_{\substack{R \subseteq \mathcal{J} \\ R \neq \varnothing}} \Pr(R \mid \boldsymbol{d}) \mathbb{E}_{\boldsymbol{\eta}} \left[\max_{j \in R} \{ W(\boldsymbol{h}, j; d_j) + \eta_j \} \right]}_{\text{at least one proposal}} + \underbrace{\Pr(R = \varnothing \mid \boldsymbol{d}) W(\boldsymbol{h}, 0; 0)}_{\text{no proposals}} \right\}. \tag{14}$$

The value W is given by (6), and the distribution of proposal sets is determined by the independent Poisson arrivals.

A household is atomistic and takes the men's equilibrium values $\bar{J}_j$ as given, but it internalizes the effect of its own posting on the market it faces. The household's choice of dowries affects queue lengths through men's logit demand. Queue lengths in turn determine proposal arrival probabilities, and through the household's acceptance rule, the probability of matching with each male type.

Two-daughter households. A two-daughter household solves (25) in each period in which it has an eligible daughter. If $b(\boldsymbol{h}) = \emptyset$, the household has completed its search problem and makes no further marriage or schooling choices. It consumes all of its income, net of supporting any unmarried daughters.

One-daughter households. A one-daughter household is a simpler case of the two-daughter household problem. Because there is a single daughter, she is always the eligible daughter, the birth-order restriction never binds, and no schooling decision remains once she marries.

4.6 Stationary equilibrium

A stationary competitive search equilibrium consists of household value functions and policies, men's value functions and application probabilities, queue lengths and matching probabilities, and stationary masses of household and male types such that:

1. *Household optimality.* For every state $\boldsymbol{h}$ with $b(\boldsymbol{h}) \neq \varnothing$, the dowry menu $\boldsymbol{d}(\boldsymbol{h})$ solves the household problem in (25), and the schooling value $W(\boldsymbol{h}, j; d_j)$ is given by (16).

2. *Men's optimality.* For each male type j, the values $J_j(\boldsymbol{h})$ and $\bar{J}_j$ satisfy (8) and (17), and application probabilities satisfy the logit rule (9).

3. *Queue consistency.* For every male type j and household state $\boldsymbol{h}$,

$$q_j(\boldsymbol{h}) = \mu_j \pi_j(\boldsymbol{h}). \tag{15}$$

4. *Matching consistency.* Proposal-set probabilities are generated by the Poisson arrival process in (24); household match probabilities $P_j(\boldsymbol{h})$ satisfy (30); and applicant match probabilities $p_j(\boldsymbol{h})$ satisfy (13).

5. *Stationarity.* Given constant cohort inflows, the masses $\{\nu(\boldsymbol{h})\}_{\boldsymbol{h}\in\mathcal{H}}$ and $\{\mu_j\}_{j\in\mathcal{J}}$ are invariant under the transition rules induced by equilibrium marriage and schooling

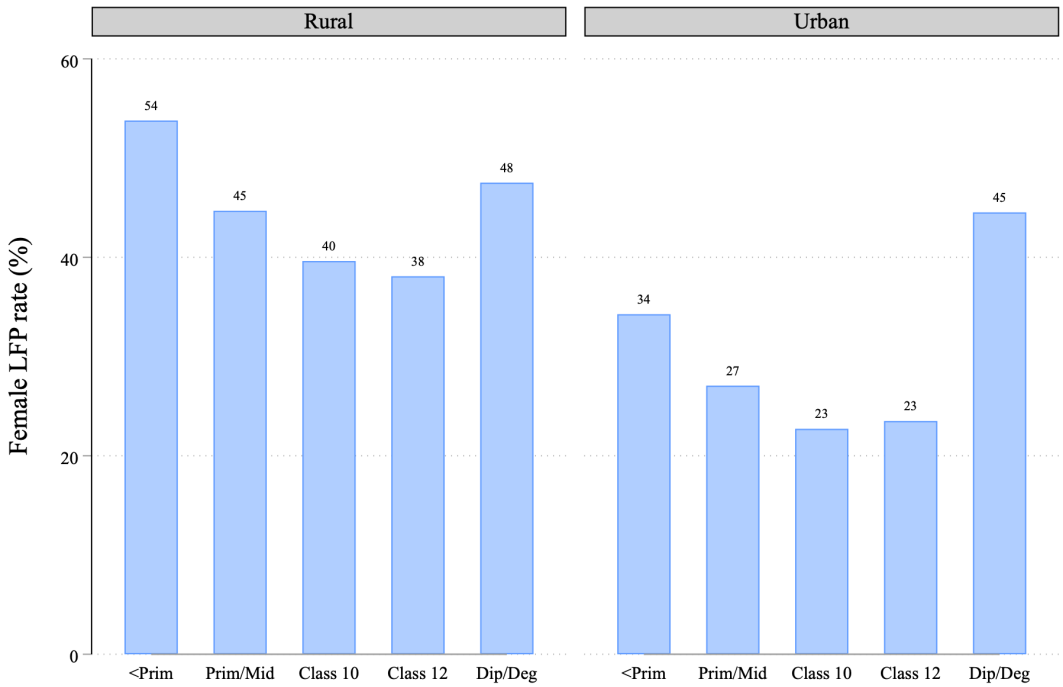
choices, aging, and exit. Household cohorts exit after the common horizon of T periods, while men exit upon marriage or after aging out of the marriage market.

In practice, I solve for equilibrium as a fixed point in household policies, men's application behavior, and the stationary distribution of types.

4.7 Discussion of assumptions

Returns to schooling. An important limitation of the model is that it does not explicitly incorporate women's labor supply decisions or labor-market returns to education. Instead, the returns to schooling operate through men's preferences for educated brides and idiosyncratic household payoff shocks. The model is agnostic about why men value educated women; to the extent that men value women's potential labor-market earnings, these returns may be implicitly reflected in their preferences.

Figure 9: Female employment rate by education, 2025



Notes: Each bar shows the share of women aged 20–59 in wage employment, by education level and sector, using survey weights. Employment status is measured using usual principal activity status (365-day reference period); subsidiary activity is not counted. Source: Periodic Labour Force Survey (PLFS) 2025, National Statistical Office, Ministry of Statistics and Programme Implementation, Government of India.

Labor-market returns could affect marriage and schooling decisions through two channels. First, women may choose to delay marriage to acquire education and participate in the labor

market while unmarried. I abstract from this channel because women's labor-force participation in rural India does not increase systematically with education below the college level (Figure 9). Among rural women aged 20–59, only 3% of women with less than secondary schooling and 7% of those with secondary schooling are in regular salaried employment (PLFS, 2025). More broadly, between 2000 and 2020, female secondary-school enrollment in India increased from 39% to 77%, while female labor-force participation declined from 34% to 26% (World Bank, World Development Indicators). A large literature examines why rising female education has not translated into corresponding increases in labor-force participation (Afridi et al., 2018; Fletcher et al., 2019; Field et al., 2021). Second, education may improve women's employment opportunities and earnings after marriage. Since the model does not follow daughters after marriage, these outcomes are beyond its scope. Incorporating labor supply and post-marriage outcomes would therefore be an important extension for understanding the broader consequences of marriage timing and education.

This abstraction has several implications for the counterfactual analysis. First, a policy such as an increase in the minimum legal age of marriage may encourage women to pursue education beyond secondary school, where labor-market returns appear to be substantially larger. By excluding this margin, the model may understate the incentives to invest in education. Moreover, if unmarried daughters work and contribute income to the household, their earnings could relax household budget constraints and affect schooling, marriage, and dowry decisions. These channels could be incorporated by allowing households to choose between schooling, market work, and home production for unmarried daughters. Second, an increase in the supply of educated women may itself affect equilibrium wages, which would require jointly modeling the labor and marriage markets. I abstract from these channels because incorporating labor supply decisions and wage determination would substantially increase the model's complexity and computational burden.

No savings. The model does not explicitly incorporate savings or borrowing decisions. In the model implementation (Section 5.1), each period represents three years. I therefore multiply annual household income by three to obtain the resources available to households within a period. This allows households to finance dowries that exceed their annual income, as is commonly observed in the data. While this approach implicitly allows households to use income earned over a three-year period to finance dowries, it abstracts from savings decisions across periods and potential borrowing constraints. Consequently, the model does not capture how households may accumulate savings in anticipation of marriage expenses.

Imperfectly-transferable utility. The model assumes imperfectly transferable utility. Although households can transfer resources to grooms through dowries, utility is nonlinear in consumption, so a given dowry payment imposes a greater utility cost on poorer households than on wealthier households. This is particularly important in my setting, where households differ in income and face substantial schooling and marriage expenses. A transferable-utility framework with linear payoffs would abstract from these income effects, which are central to households' schooling and marriage decisions. Imperfect transferability is also consistent with the broader marriage-matching literature, which recognizes that monetary transfers need not translate into equivalent utility gains and losses for the two sides of the market (Galichon et al., 2019; Beauchamp et al., 2021). The model therefore allows both dowries and matching probabilities to adjust in equilibrium, rather than assuming that monetary transfers alone clear the marriage market. Imperfect transferability is also consistent with the institutional features of the Indian marriage market, where social norms may constrain monetary transfers and other forms of bargaining (Beauchamp et al., 2021).

Family composition. The model focuses on two representative daughters, capturing the marriage and schooling decisions concerning any two daughters within a household while abstracting from the presence of other children, including additional daughters and sons. Furthermore, I model grooms as separate agents, although in reality most households have both sons and daughters, and decisions regarding their marriages may be jointly determined. While households likely optimize over all their children, the empirical evidence suggests that abstracting from other children is a reasonable simplification. In particular, the IV estimates of the effect of marriage timing on schooling remain robust to controlling for the number of sons and older brothers in the household. This suggests that the relationship between daughters' marriage timing and schooling is not substantially affected by differences in family composition. One extension would be to introduce heterogeneity in family composition and allow the number of children to affect household budget constraints and marriage decisions. I abstract from these additional dimensions to keep the model computationally tractable.

5 Estimation

I estimate the model using indirect inference. The parameters to estimate are men's valuations of brides' age and education, households' valuation of grooms' education, baseline match utilities on both sides of the market, schooling costs for each income group, and the scales of men's and households' idiosyncratic preference shocks.

5.1 Mapping the model to data and quantitative implementation

I use the REDS 2006 data described in Section 3.5 to estimate the model.

Age bins. The model in Section 4 is written with annual periods and general age bounds. For the quantitative implementation, I approximate this environment by grouping ages into discrete bins.

Households remain in the model for five periods. Women's ages are grouped into four bins: 16–18, 19–21, 22–24, 25–27. Sisters are separated by one age bin. Thus, the first-born daughter enters the model at ages 16–18 in period 1, while the second-born daughter enters the same age bin in period 2, when her older sister is aged 19–21. One-daughter households also remain in the model for five periods.

Men participate in the marriage market for two periods. Young men are aged 24–26, and older men are aged 27–29.

Terminal value. At the end of the model horizon, households receive a terminal value equal to their utility from income minus the lifetime cost of supporting any daughters who remain unmarried. I assume that households continue to support unmarried daughters for 30 years.

Married men exit the model upon marriage. Unmarried men exit the model at the end of the second period, and their terminal value is normalized to 0.

Schooling. Schooling is binary and corresponds to high school completion. A daughter makes a schooling choice only at ages 16-18. If she remains unmarried and attends school during this period, she enters the next age bin having completed high school. No further schooling choice is available once she is 19 or older. I do not model college attendance, since relatively few women in the data attend college.

Men's schooling is fixed and classified as either low (less than high school) or high (high school or more).

Caste. Marriage in the data is highly segmented by caste. Only 8 percent of women marry outside the four broad caste categories recorded in REDS 2006: Upper Caste, Other Backward Class, Scheduled Caste, and Scheduled Tribe. For the estimation, I combine the latter three categories into a single lower-caste group. Under this binary classification, only 5 percent of women marry across groups. Motivated by this pattern, I assume that households and men can match only within their own caste group. I therefore solve the model separately for the upper- and lower-caste marriage markets.

Income. Within each caste market, I divide households into two equally sized income groups and assign each group its median income. Household income remains fixed throughout the model.

Household composition. I classify households with one daughter as one-daughter households and those with two or more daughters as two-daughter households. I set the relative masses of these household types to match their proportions in the data. Thus, the two-daughter model represents households with at least two daughters, abstracting from decisions involving additional daughters.

Men's education and market size. I set the relative masses of high- and low-education men to match the distribution of educational attainment among men aged 24–29 in the REDS. I assume a sex ratio of 1.05 men per woman, consistent with the rural population sex ratio in the 2011 Census of India, and scale the relative masses of men and households accordingly, accounting for the number of daughters per household.

Search frictions. To parameterize the degree of search frictions, I introduce a second assignment round within each period. Following the initial matching round, a fraction ω of unmatched men are randomly reassigned to households that received no proposals, within the household state they initially chose. Men do not make another application decision or draw new preference shocks. As in the first round, households may receive multiple proposals. They draw preference shocks over the types of grooms who propose and select one proposal to accept. The originally posted dowries apply in both rounds. A higher ω reduces search frictions by increasing the probability of matching within a period. Men who chose not to propose to any household, men who are not reassigned, and reassigned men who are not selected in the second round, return to the market in the next period. Appendix D.6 describes how the second round affects matching probabilities for men and households.

The causal effect of age at marriage. To map the birth-order restriction in the model to the data, I target the first-stage coefficient on having an older sister in column (2) of Table 3. I also use having an older sister as an instrument for age at marriage when estimating the IV effect on schooling. While both this instrument and the sex of the next-older sibling exploit the same birth-order norm, the former maps more naturally to the model, which includes at most two daughters and abstracts from sons and other siblings.

5.2 Functional forms

The household has log utility over consumption, $u(c) = \log(c)$. The household's match utility from a man of type j is

$$\tau_j = \alpha_0 + \alpha_1 \mathbb{1}[s_j = \text{high}],$$

where s^j denotes men's education. Thus α_1 captures the household's gains from the man's education.

The household's valuation of a match depends on the groom's education, but not his age. This restriction is motivated by data limitations. The REDS reports the education of spouses of non-resident siblings and children of the head, but not their ages. Consequently, I cannot compute the joint shares of married women by their age and education and their spouses' age and education. Similarly, I do not observe dowries conditional on all four characteristics.[11]

A groom's match utility from marrying a bride with characteristics (a, s) is

$$\gamma_{\boldsymbol{i}} = \psi_0 + \delta(\boldsymbol{i}) + \psi_3 \mathbb{1}[\boldsymbol{i} = \text{high educ. woman}], \qquad \delta(\boldsymbol{i}) = \begin{cases} 0 & \text{Ages 16–18} \\ \psi_1 & \text{Ages 19–21} \\ \psi_1 + \psi_2 & \text{Ages 22–24} \\ \psi_1 + 2\psi_2 & \text{Ages 25–27} \end{cases}$$

Thus, $\delta(\boldsymbol{i})$ captures men's utility from the woman's age, while ψ_3 captures their utility from her education. For the oldest age bin (25–27), I assume that utility follows the linear trend implied by the preceding two age bins, since relatively few women marry at these ages and a more flexible specification cannot be estimated precisely.

5.3 Equilibrium Solution

Solving the model requires finding household decisions and men's application choices that are consistent with the equilibrium distribution of unmarried agents. For each candidate parameter vector, I solve for a stationary equilibrium in men's values and the distributions of unmarried men and households. Given initial guesses for these objects, I solve households' dynamic optimization problems by backward induction. In each household state, I solve for

[11] This restriction applies only to preferences. Households can still post dowries that vary with both age and education of the groom. Differences in posted dowries by groom age arise from differences in men's equilibrium values, $J_j \boldsymbol{h}$, given by Equation 8. Men's values differ by age for two reasons. First, younger men have a higher value of remaining unmarried because they have another opportunity to search when they are older, whereas older men are in their final period of searching. Second, the mass of grooms varies by age, affecting matching probabilities, and consequently, their equilibrium values.

the optimal dowry menu, accounting for men's application decisions, matching probabilities, and households' schooling choices. The resulting policy functions are used to update men's values and the distributions of unmarried agents. I iterate on these objects jointly until convergence. Appendix D.7 provides details of the computational algorithm.

5.4 Estimation Procedure

I estimate the model by indirect inference. The estimator targets five groups of moments: the joint distribution of match types; the marginal rates of marriage at ages 16–18 and high school completion; the first-stage effect of having an older sister on age at marriage; the causal effect of marriage age on high school completion; and the dowries paid for different match types. To estimate the causal effect of marriage age on high school completion, I instrument for marriage age with having an older sister and control for year of birth and number of siblings (as described in Section 3). To express the coefficients in terms of the three-year age bins used in the model, I multiply the IV coefficient by three and divide the first-stage coefficient by three. The full list of targeted moments is provided in Appendix E.

The estimator minimizes the distance between the simulated and empirical moments. The weighting matrix is diagonal, with each diagonal element equal to the inverse of the sampling variance of the corresponding data moment.

5.5 Identification

This section discusses how the targeted moments identify the key parameters governing preferences over spouse characteristics, schooling decisions, and search frictions.

Preferences over spouse characteristics. Men's preferences for brides' age and education are disciplined by observed dowries and marriage patterns. In particular, differences in dowries and matching probabilities across women of the same age but different education levels provide information about men's willingness to pay for bride education. Similarly, differences in dowries and marriage patterns across women's age groups help identify men's preferences over bride age. Households' preferences for groom education are also disciplined by dowries and matching patterns across groom types.

The IV estimate provides additional information about men's preferences for educated brides by measuring how schooling responds to a delay in marriage induced by having an older sister. Such delays reduce the opportunity cost of schooling, but households have an incentive to invest in additional education only if its expected benefits are sufficiently high. Since the idiosyncratic schooling shocks have mean zero, the systematic returns to education

arise from its marriage-market benefits, which depend on men's preferences for educated brides.

Schooling costs and preference shocks. The overall high school completion rate primarily disciplines the cost of schooling, conditional on the expected returns to education. The dispersion of idiosyncratic schooling preference shocks is disciplined by the sensitivity of schooling decisions to changes in economic incentives. A smaller dispersion makes schooling choices more responsive to changes in the net benefits of education, while a larger dispersion makes them less responsive.

Search frictions. Search frictions are disciplined by observed marriage rates and the first-stage relationship between having an older sister and age at marriage. Higher search frictions reduce the probability of finding a match in any given period, affecting the share of women who marry at different ages. Moreover, the extent to which having an older sister delays a woman's marriage depends on how long it takes the older sister to find a match. When matching probabilities are high, older sisters tend to marry quickly, imposing little delay on their younger sisters.

5.6 Parameters set outside the estimation

I set several parameters outside the estimation. Each model period corresponds to three years, so I set the discount factor to $\beta = 0.95^3 = 0.857$, corresponding to an annual discount factor of 0.95.

Cost of supporting unmarried daughters. I use data from the REDS 2006 on household expenditures on food and clothing to calibrate the cost of supporting an unmarried daughter. Specifically, I use per capita household food expenditures and per capita clothing expenditures for females aged 16–60. Then, I use the mean expenditure-to-income ratio across households, and set the cost of supporting an unmarried daughter to 10% of household income for both caste groups. To allow for economies of scale in supporting multiple daughters, I assume that total support costs scale with the square root of the number of unmarried daughters, following the OECD square-root equivalence scale.

Logit scale parameters. I calibrate the logit scale parameters governing households' marriage acceptance decisions to 1.5 for upper-caste households and 4.0 for lower-caste households.

5.7 Estimated parameters

Table 10 reports the estimated parameters, obtained separately for the lower and upper castes.

Across both castes, men strongly prefer brides aged 19–21 to older brides. The estimated utility from marrying a bride aged 19–21, relative to ages 16–18, is 2.61 in the upper caste and 3.37 in the lower caste. In contrast, the corresponding coefficients for brides aged 22–24 are −6.88 and −3.81, and for brides aged 25–27 are −16.40 and −11.00. The estimates suggest a particularly sharp decline in men's valuation of brides after age 22, especially in the upper caste. These age preferences create strong incentives for households to marry their daughters before age 21.

Men also value brides' education, although the estimated preference differs considerably across castes. The coefficient on a bride's high school completion is 1.32 in the upper caste and 0.24 in the lower caste, with only the former statistically significant. Because men's utility is additive in $\log d$, the estimated schooling coefficient can be interpreted in terms of the dowry required to make a groom indifferent between brides. Holding age fixed, a high-school-educated bride needs to offer $e^{-1.32} \approx 0.27$ times the dowry required of an otherwise comparable bride without a high school education in the upper caste. Thus, men would accept approximately 73 percent less dowry to marry a high-school-educated bride, conditional on age. The corresponding point estimate for the lower caste implies a 21 percent reduction in dowry, although this estimate is not statistically distinguishable from zero. These estimates suggest that the marriage-market return to women's education is substantially stronger in the upper caste.

In contrast, households' estimated valuation of a groom's high school education is small and statistically insignificant in both castes. The coefficient is 0.05 for both groups. Since the household's valuation of a groom's schooling enters additively in $\log c$, this estimate can be expressed in consumption-equivalent terms. A household would be willing to give up $1 - e^{-0.05} \approx 4.9$ percent of its consumption to match with a high-school-educated groom rather than one without a high school education, holding other characteristics fixed.

The estimated cost of three years of schooling varies by household income and caste. For upper-caste households, the cost is Rs. 16,800 for low-income households and Rs. 26,700 for high-income households. The corresponding estimates for lower-caste households are Rs. 18,400 and Rs. 32,500, although these are estimated less precisely. Importantly, these estimates capture not only the direct monetary costs of schooling, such as fees and supplies, but also the opportunity costs of keeping daughters in school, including foregone household labor. Schooling represents a larger share of income for poorer households. In the upper caste, the estimated cost amounts to approximately 29 percent of income for low-income house-

Table 10: Estimated Parameters

Parameter	Upper caste	Lower caste
A. Preferences		
Men's utility, wife age 19–21	2.61***	3.37***
	(0.56)	(0.64)
Men's utility, wife age 22–24	−6.88**	−3.81*
	(3.51)	(2.06)
Men's utility, wife age 25–27	−16.40**	−11.00**
	(7.52)	(4.50)
Men's utility, wife schooling	1.32***	0.24
	(0.40)	(0.55)
HH utility, husband schooling	0.05	0.05
	(0.07)	(0.25)
Men's baseline utility	4.17***	10.00***
	(0.80)	(1.52)
HH baseline utility	0.40	0.70***
	(0.28)	(0.25)
B. Costs		
Schooling cost, low income (Rs. 000s)	16.80***	18.40
	(3.90)	(13.50)
Schooling cost, high income (Rs. 000s)	26.70***	32.50
	(6.67)	(25.60)
C. Logit scales		
Men's proposal	2.38	2.24
	(0.82)	(0.60)
Schooling	0.08	0.25
	(0.03)	(0.28)
D. Re-matching		
Share of men not chosen who propose again	0.44***	0.20***
	(0.12)	(0.05)

Notes: Parameters are estimated by indirect inference using REDS 2006, separately for lower- and upper-caste households. Standard errors are reported in parentheses. Men's match utility depends on the bride's age category and high school completion, while household match utility depends on the groom's high school completion. The omitted bride age category is the youngest age category. Schooling costs vary by household income group and are expressed in thousands of rupees. The re-matching parameter is the share of men not chosen in the first round who propose again. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

holds, compared with 11 percent for high-income households. Thus, financial constraints may limit poorer households' ability to invest in daughters' education despite its potential marriage-market benefits.

Finally, the estimated re-matching parameter is 0.44 in the upper caste and 0.20 in the lower caste. This implies that 44 percent of upper-caste men and 20 percent of lower-caste men who are not chosen in the first round get a second chance to match through the assignment round.

5.8 Model fit

To assess model fit, Figure 10 compares the simulated moments with their empirical counterparts, separately for upper- and lower-caste households. Each point represents a targeted moment, with the data value on the horizontal axis and the model value on the vertical axis. The dashed 45-degree line indicates perfect fit, with points above (below) the line representing moments that the model overpredicts (underpredicts).

Overall, the model reproduces several key features of the data, including the distribution of women's age at marriage and the share of men marrying young. However, the model substantially underpredicts the share of women marrying high-school-educated grooms in both castes.

One limitation of the model is the assumption that preferences for spouse characteristics do not vary by one's own education. In particular, all brides place the same value on groom education, and all grooms place the same value on bride education. This rules out complementarities in preferences between bride and groom education, potentially limiting the model's ability to reproduce educational sorting in the data.

Allowing for such complementarities would require identifying how preferences vary across bride-groom education pairs. While the joint distribution of matches provides information about assortative matching, dowries across education pairs are important for distinguishing preferences on the two sides of the market. However, the interaction between bride and groom education in observed dowries is imprecisely estimated due to the limited sample size. Moreover, since education and caste are the only groom characteristics observed in the data, education may also proxy for other unobserved groom attributes. I therefore maintain the more parsimonious preference specification and leave the estimation of heterogeneous preferences for future work.

The model also closely matches the IV estimates of the effect of marriage timing on high school completion. However, it overpredicts the first-stage coefficients for both caste groups. This discrepancy may partly reflect how the birth-order restriction is modeled. First,

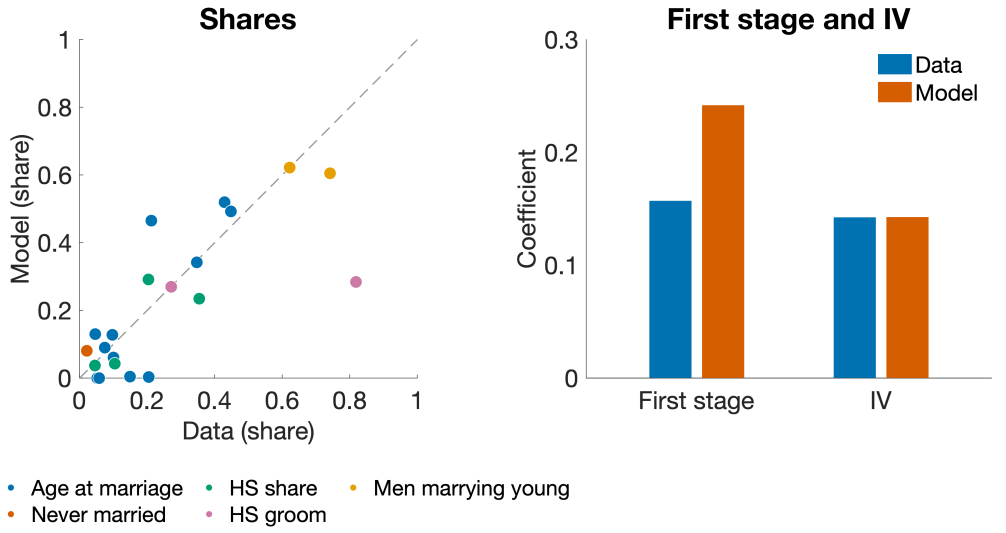
the model strictly enforces marriage in birth order, whereas approximately 10% of women marry out of birth order in the data. A more flexible specification would allow households to violate the birth-order restriction at a utility cost, rather than imposing it as a hard constraint. Second, each model period spans three years, so the birth-order restriction can delay marriage only in three-year increments. In the data, by contrast, having an older sister delays marriage by approximately six months on average. Together, these assumptions may exaggerate the effect of the birth-order restriction on marriage timing. Relaxing these assumptions would increase the computational complexity of the model, particularly because finer age intervals would require solving the model over more periods.

6 Counterfactual Analysis

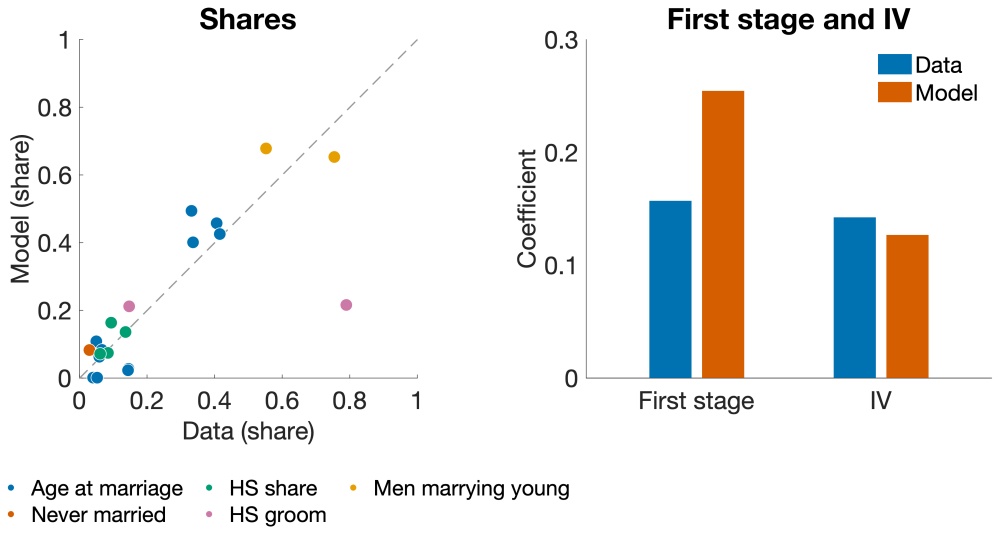
Using the estimated model, I now quantify the mechanisms underlying the trade-off between early marriage and schooling and evaluate how alternative policy interventions affect women's educational attainment, marriage timing, and welfare.

Figure 10: Model fit

(a) Upper caste



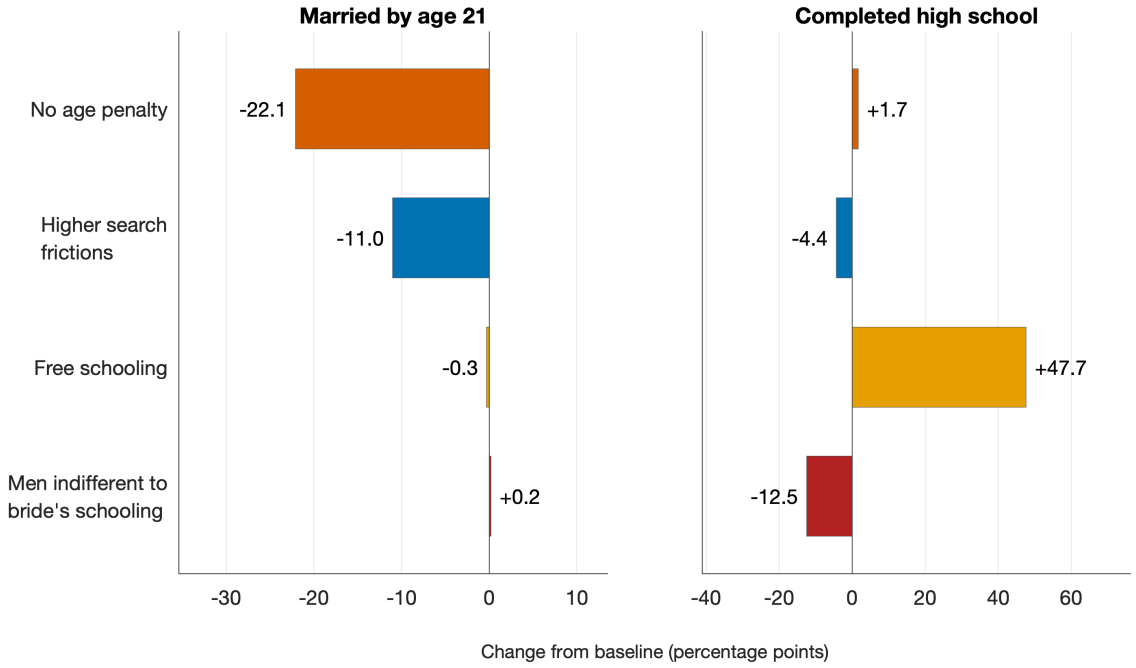
(b) Lower caste



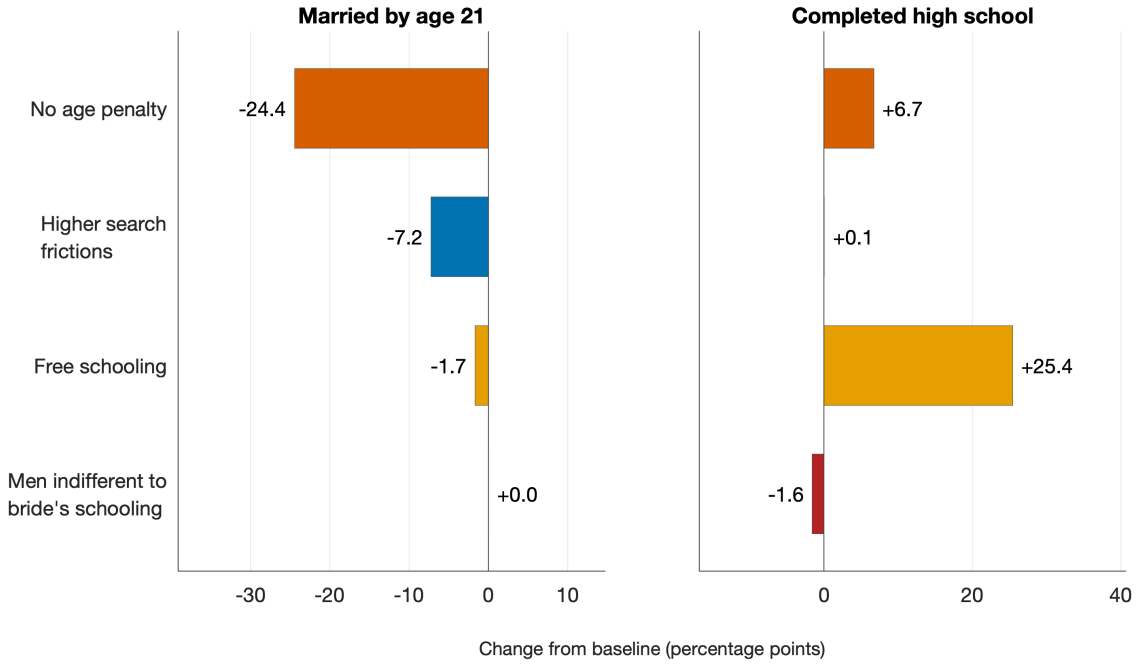
Notes: The left panels plot simulated shares against their empirical counterparts. The dashed line is the 45° line of perfect fit. The right panels compare the first-stage and IV coefficients in the data and the model. Parameters are estimated separately for upper- and lower-caste households.

6.1 Decomposing the mechanisms

Figure 11: Mechanism decomposition



(a) Upper caste



(b) Lower caste

In the estimated model, delaying marriage allows households to invest in a daughter's education, which the parameter estimates imply is highly valued by men. This benefit is weighed

against several forces that encourage earlier marriage. First, the estimates imply that men prefer younger brides to older brides who have not completed high school. Households must therefore offer a higher dowry for an older daughter to make a prospective groom indifferent between her and an otherwise comparable younger bride. Second, in households with two daughters, delaying the firstborn daughter's marriage also delays the younger daughter's marriage. Third, supporting an unmarried daughter is costly because the household pays for her consumption in every period she remains at home. Fourth, women have a limited number of periods in which to search for a spouse, making postponement costly when matches are uncertain. Finally, the estimated cost of education is high, particularly for low-income households, limiting the gains from postponing marriage to invest in schooling.

To assess the importance of these mechanisms, I conduct a series of counterfactual exercises in which I eliminate men's age penalty, increase search frictions, eliminate schooling costs, or make men indifferent to brides' education. Figure 11 presents the resulting changes in the share of women married by age 21 and the share completing high school, relative to the baseline equilibrium.

The results suggest that men's preference for younger brides plays an important role in explaining early marriage. Eliminating the age penalty, by setting men's payoff from brides of all ages equal to their payoff from brides aged 19–21, reduces the share of women married by age 21 by 22.1 percentage points among upper castes and 24.4 percentage points among lower castes. However, the effects on high school completion are much smaller, with increases of only 1.7 and 6.7 percentage points, respectively. Even when households no longer face a penalty for delaying marriage, the high cost of schooling continues to discourage investment in daughters' education.

Conversely, eliminating schooling costs substantially increases educational attainment but has little effect on early marriage. High school completion increases by 47.7 percentage points among upper castes and 25.4 percentage points among lower castes, while the share married by age 21 declines by only 0.3 and 1.7 percentage points, respectively. This is because the increase in schooling is driven primarily by women who remain unmarried after failing to receive a marriage proposal, rather than by households choosing to delay marriage to invest in education. When schooling becomes free, these women choose to attend school instead of remaining out of school while unmarried. However, men's strong preference for younger brides continues to incentivize households to marry daughters early. Consequently, eliminating schooling costs increases educational attainment without substantially changing marriage timing.

Men's preference for educated brides also provides an important incentive for households to invest in daughters' education, particularly among upper castes. When men are made

indifferent to brides' education, high school completion falls by 12.5 percentage points among upper castes, compared with only 1.6 percentage points among lower castes. However, this change has virtually no effect on the share married by age 21 in either caste. Thus, while men's valuation of education encourages households to invest in schooling, their preference for younger brides continues to dominate marriage timing decisions.

Finally, search frictions also affect marriage outcomes. Increasing search frictions, by eliminating the second assignment round, reduces the share of women married by age 21 by 11 percentage points among upper castes and 7.2 percentage points among lower castes. Higher search frictions also reduce high school completion by 4.4 percentage points among upper castes, but have almost no effect on schooling among lower castes. One reason for this is that higher search frictions lead to higher dowries, tightening households' budget constraints and making schooling less affordable.

Taken together, these findings highlight the important roles of men's preferences and schooling costs in shaping household decisions. Men's valuation of education creates incentives for households to invest in daughters' schooling, but the high cost of education limits their ability to respond to these incentives. At the same time, men's strong preference for younger brides encourages households to marry daughters early, even when schooling is free. Consequently, eliminating either the age penalty or schooling costs in isolation generates substantial changes in one outcome without correspondingly large changes in the other. These findings suggest that interventions aimed at improving educational attainment and delaying marriage may need to address both channels.

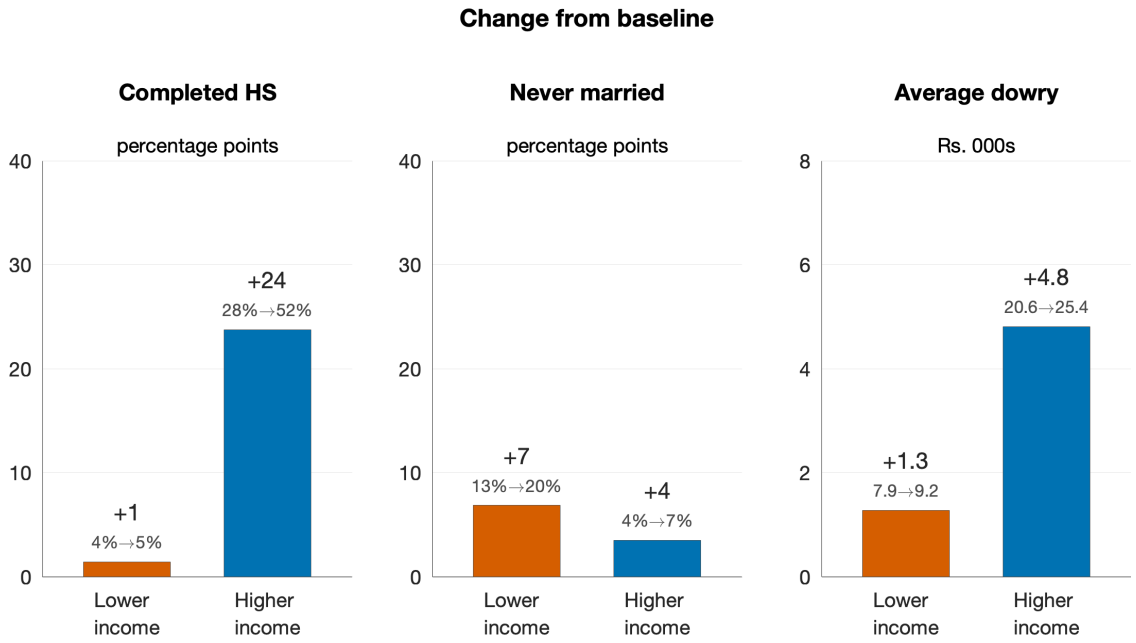
These findings motivate two policy counterfactuals. First, the decomposition shows that men's strong preference for younger brides is an important driver of early marriage, even when schooling is free. Raising the minimum legal age of marriage offers a way to constrain the influence of these preferences by making younger brides unavailable in the marriage market, without directly changing men's preferences. Second, the important role of schooling costs in limiting educational attainment motivates a conditional cash transfer for low-income households, equal to the estimated cost of schooling. This exercise examines whether offsetting schooling costs for financially constrained households can increase educational attainment and delay marriage, even when men's preferences for younger brides remain unchanged.

6.2 A minimum marriage age policy

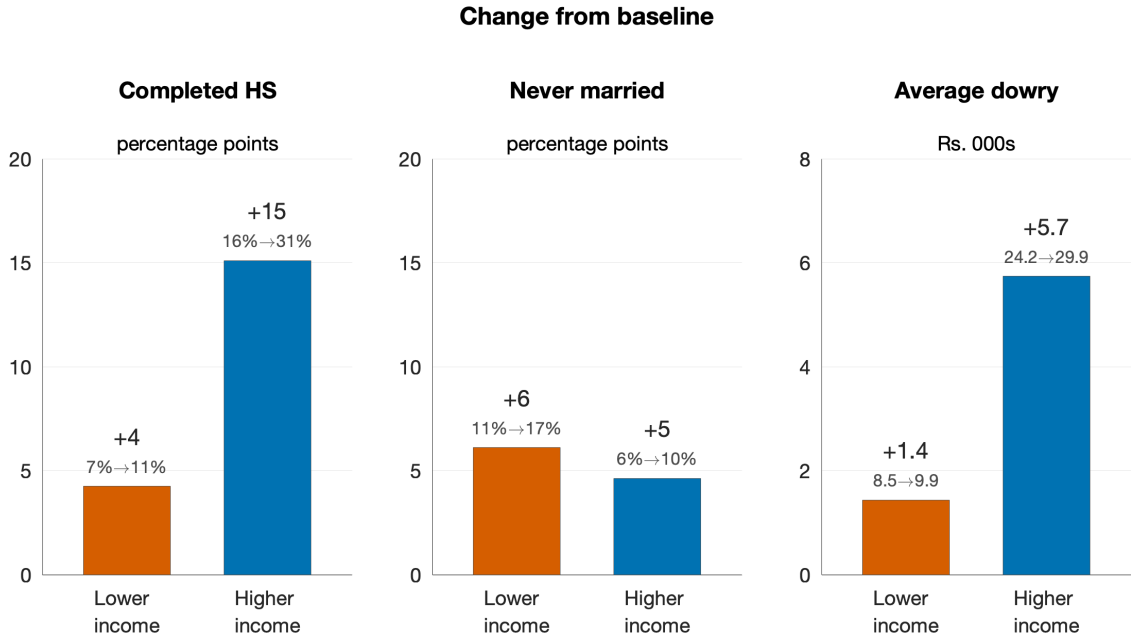
I first examine the effects of raising the minimum age of marriage to 19. I implement this reform by restricting marriage market participation: daughters are no longer eligible to marry between ages 16 and 18 and can enter the marriage market starting at age 19. Figure 12

presents the effects of the reform on high school completion, the probability of never marrying, and average dowries, separately by household income and caste.

Figure 12: Effects of a minimum marriage age law



(a) Upper caste



(b) Lower caste

Effects on educational attainment. The reform substantially increases high school completion, but the gains are concentrated among higher-income households. Among lower

castes, high school completion increases from 16% to 31% for daughters from higher-income households, compared with an increase from 7% to 11% for daughters from lower-income households. The differences are even more pronounced among upper castes: high school completion increases from 28% to 52% among higher-income households, but only from 4% to 5% among lower-income households.

These results highlight the importance of schooling costs in shaping households' responses to the reform. By preventing marriage before age 19, the policy creates additional opportunities for households to invest in their daughters' education. However, lower-income households are largely unable to take advantage of these opportunities because the direct cost of schooling remains high.

Effects on match rates. The reform also increases the share of women who never marry, particularly among lower-income households. Among lower castes, the share of women who never marry increases from 11% to 17% for lower-income households and from 6% to 10% for higher-income households. Among upper castes, the corresponding increases are from 13% to 20% and from 4% to 7%. By eliminating the opportunity to marry between ages 16 and 18, the reform reduces the number of periods available for women to find a spouse. Moreover, since men strongly penalize brides older than 21, households face considerable pressure to secure a match when their daughters are between ages 19 and 21. Women who fail to marry during this period face less favorable marriage-market conditions at older ages.

Effects on dowries. The reform also increases dowries in both caste markets. Among lower castes, average dowries increase from Rs. 8,500 to Rs. 9,900 for lower-income households and from Rs. 24,200 to Rs. 29,900 for higher-income households. Among upper castes, dowries increase from Rs. 7,900 to Rs. 9,200 and from Rs. 20,600 to Rs. 25,400, respectively.

Several competing forces determine dowries in equilibrium. First, because men strongly penalize brides older than 21, households have a strong incentive to secure a match when their daughters are between ages 19 and 21. Restricting marriage at younger ages concentrates competition within this age category, putting upward pressure on dowries. Second, the reform changes the composition of realized marriages. As educational attainment increases, marriages increasingly involve educated women, who tend to come from wealthier households that pay higher dowries. This shift in the composition of married women may therefore increase average dowries. Finally, men's preference for educated brides puts downward pressure on the dowries required to secure a match with an educated woman. The results suggest that the forces increasing dowries dominate in equilibrium.

Welfare implications. The reform also has important distributional consequences. Table 11 reports the effects on expected lifetime utility, expressed as consumption-equivalent variations. The welfare effects differ substantially across caste markets, reflecting differences in men's preferences and marriage-market conditions.

In the upper-caste market, all household types experience welfare losses, with larger losses among lower-income households. Welfare declines by 9.7% for lower-income two-daughter households and 7.0% for lower-income one-daughter households, compared with 2.4% and 1.9%, respectively, among higher-income households. These losses are consistent with several costs imposed by the reform: households must support daughters for longer before marriage, face higher dowries when a match occurs, and face a greater risk that their daughters never marry. Lower-income households are particularly affected because they experience these costs without correspondingly large gains in educational attainment.

In contrast, young men in the upper-caste market experience welfare gains of 6.1% for men without high school education and 5.2% for men with high school education. The reform changes the composition of matches toward brides aged 19–21 and more educated brides, whom men value, while also increasing dowries.

The pattern is quite different in the lower-caste market. Young men experience welfare losses of 10.3–14.4%, while most household types gain. In this market, men place less value on brides' education, so the increase in female schooling generates smaller gains in match utility. At the same time, restricting marriage before age 19 reduces the supply of eligible brides in each period, increasing competition among men. This places downward pressure on the dowries households need to offer to attract a groom and improves their position in the marriage market. The estimated parameters imply that this competition effect is more important in the lower-caste market. As a result, higher-income households gain substantially, with welfare increasing by 7.7% for two-daughter households and 7.0% for one-daughter households. Lower-income one-daughter households experience a small gain of 0.5%, while lower-income two-daughter households lose 2.4%, suggesting that the benefits of increased competition are insufficient to offset the costs of the reform for these households.

These welfare estimates, however, should be interpreted with caution. They capture changes in expected lifetime utility within the model, rather than the full social benefits and costs of restricting early marriage. In particular, the model does not explicitly capture many important benefits of delaying marriage and increasing education, such as improvements in women's health, bargaining power within marriage, and other long-term outcomes. The welfare estimates therefore should not be interpreted as a comprehensive evaluation of the desirability of minimum marriage age laws.

Rather, the counterfactual highlights potentially important unintended consequences of

Table 11: Welfare effects of the minimum marriage age reform (consumption-equivalent variation, %)

	Lower caste	Upper caste
Households		
Two-daughter, lower income	−2.4	−9.7
Two-daughter, higher income	+7.7	−2.4
One-daughter, lower income	+0.5	−7.0
One-daughter, higher income	+7.0	−1.9
Young men		
No HS	−10.3	+6.1
HS	−14.4	+5.2

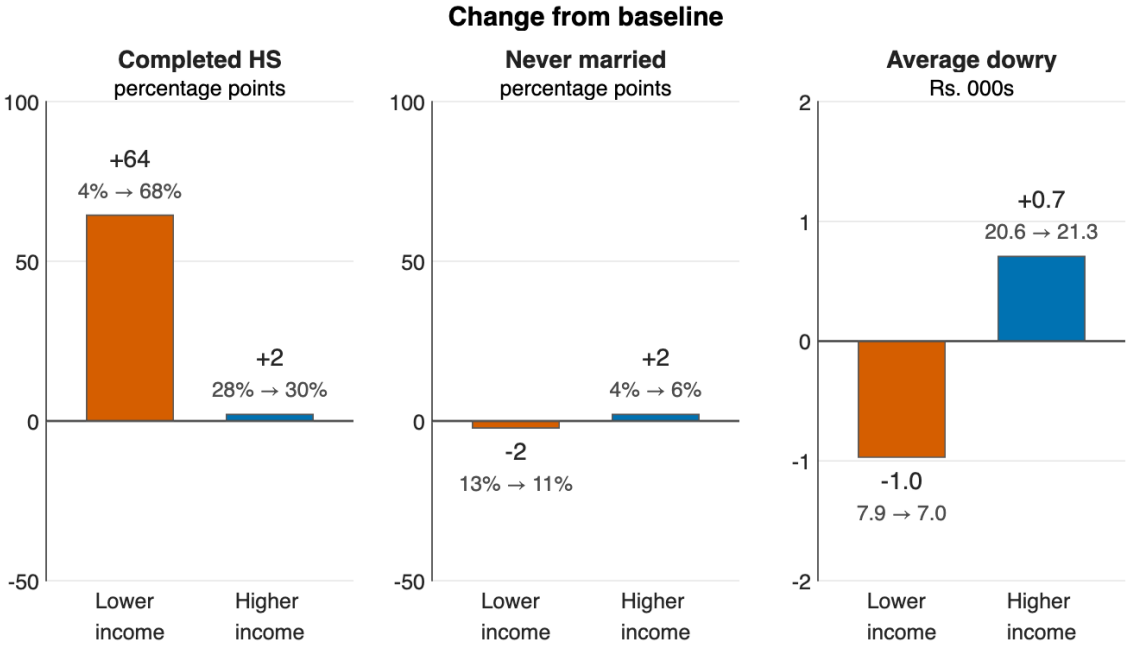
Notes: Both panels report consumption-equivalent variation under log utility. A man's consumption is the dowry he receives (flow $\log(d) + \gamma(a, s)$); a household's consumption is income net of the dowry it pays and daughter support (flow $\log(y - \kappa y n^{\chi} - d) + \tau$). Positive is a welfare gain.

restricting early marriage without addressing other constraints faced by households. Although the reform creates additional opportunities for education, the households that might benefit most from these opportunities are often unable to take advantage of them because of schooling costs and other financial constraints. At the same time, the reform increases their exposure to marriage-market risks and raises the dowries required to secure a match. These findings suggest that policies restricting early marriage may be more effective at improving educational outcomes when accompanied by measures that relax the financial constraints on schooling. This motivates the next counterfactual, which examines a conditional cash transfer targeted at lower-income households.

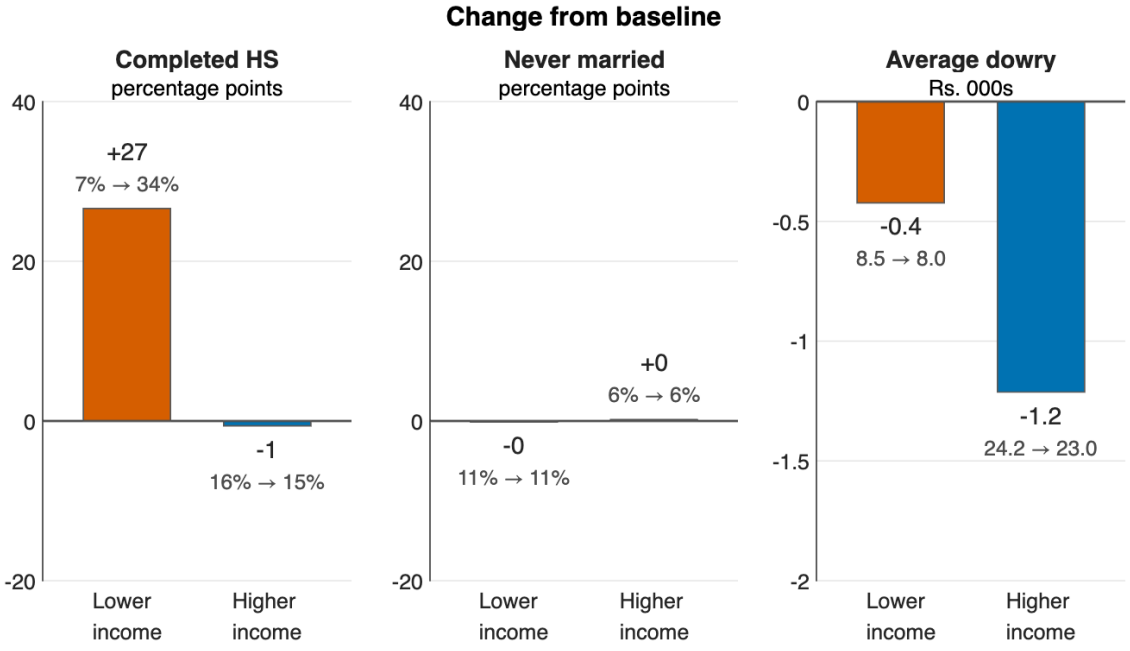
6.3 A conditional cash transfer

The second policy counterfactual examines a conditional cash transfer targeted at low-income households and designed to offset schooling costs. Low-income households receive a transfer equal to the estimated schooling cost when their daughters attend school, making schooling free ($\phi \to 0$). The policy is financed through a proportional income tax on higher-income households, with the tax rate chosen to balance the government budget separately within each caste market.

Figure 13: Effects of a conditional cash transfer



(a) Upper caste



(b) Lower caste

The policy substantially increases high school completion, particularly among lower-income households (Figure 13). Among lower castes, high school completion increases by 27 percentage points for daughters from lower-income households, from 7% to 34%. Among upper castes, the increase is even larger, at 64 percentage points, from 4% to 68%. In con-

trast, high school completion among higher-income households changes very little, declining from 16% to 15% among lower castes and increasing from 28% to 30% among upper castes. These results reinforce the findings from the minimum marriage age counterfactual: for lower-income households, the direct cost of schooling is an important barrier to educational attainment. While raising the minimum marriage age creates additional opportunities for schooling, the conditional cash transfer allows financially constrained households to take advantage of these opportunities by making education more affordable.

The transfer raises schooling substantially but changes marriage timing only modestly. Among lower-income women, the share marrying in the first age category falls from 40% to 38% in the lower caste and from 34% to 25% in the upper caste. Among higher-income women, this share is unchanged in the lower caste and falls from 47% to 41% in the upper caste. In the model, a woman makes a schooling decision only if she remains unmarried after the first age category. Free schooling makes it more valuable for a household to keep a daughter unmarried at that age, so lower-income households offer lower dowries in the first period. For example, for an older daughter aged 16–18, the dowry offered to a young groom without high school falls by 25 percent in the lower caste and by 39 percent in the upper caste.

Marriage timing also changes among higher-income upper-caste households, which do not receive the transfer. The transfer increases the number of women with high school in the upper-caste marriage market. Because upper-caste men value a bride's schooling, grooms become harder to attract. Daughters in higher-income upper-caste households therefore marry early less often, and the share who never marry rises from 4% to 6%.

Welfare implications. The conditional cash transfer generates substantial welfare gains for lower-income households in both caste markets. Among lower castes, the lifetime consumption-equivalent welfare gain is 21.1% for two-daughter households and 8.3% for one-daughter households. Among upper castes, the corresponding gains are 15.5% and 6.0%. In contrast, higher-income households, whose taxes finance the policy, experience substantial welfare losses. These range from 32.4% to 33.2% in the lower-caste market and from 45.3% to 48.5% in the upper-caste market.

The effects on men's welfare differ substantially across caste markets. In the upper-caste market, young men experience welfare gains of approximately 49%, regardless of their education. These large gains are consistent with men's strong valuation of education in this market, which makes the substantial increase in the share of educated brides particularly beneficial to them. In contrast, the welfare effects on men in the lower-caste market are much smaller, ranging from a loss of 0.8% for young men without high school education to a gain

Table 12: Welfare effects of the conditional cash transfer (consumption-equivalent variation, %)

	Lower caste	Upper caste
Households		
Two-daughter, lower income	+21.1	+15.5
Two-daughter, higher income	−33.2	−48.5
One-daughter, lower income	+8.3	+6.0
One-daughter, higher income	−32.4	−45.3
Men		
Young, no HS	−0.8	+49.1
Young, HS	+1.2	+48.9
Old, no HS	−0.5	+36.3
Old, HS	+1.3	+37.1

Notes: Both panels report consumption-equivalent variation under log utility. A man's consumption is the dowry he receives (flow $\log(d) + \gamma(a, s)$); a household's consumption is income net of the dowry it pays and daughter support (flow $\log(y - \kappa y n^{\chi} - d) + \tau$). Positive is a welfare gain.

of 1.2% for young men with high school education. This difference is consistent with the weaker preference for educated brides estimated in the lower-caste market.

Taken together, the two policy counterfactuals highlight the importance of addressing financial constraints alongside restrictions on early marriage. While raising the minimum marriage age creates additional opportunities for education, lower-income households are largely unable to take advantage of them because schooling remains costly. In contrast, the conditional cash transfer generates large improvements in educational attainment among these households, even without substantial changes in marriage timing. However, the persistence of early marriage despite these educational gains underscores the importance of men's age preferences in shaping households' marriage decisions.

7 Conclusion

This paper studies how marriage timing shapes women's educational attainment and evaluates policies designed to delay marriage. I combine a design-based empirical strategy with a dynamic equilibrium model of marriage and schooling.

The empirical analysis exploits the norm that Indian households marry daughters in

birth order. Conditional on overall birth order, family size, and birth cohort, women with a next-older sister marry approximately 0.4 years later than women with a next-older brother. Instrumental-variable estimates imply that delaying marriage by one year increases educational attainment by about 1.6 years and raises high school completion by 5.6 percentage points. These estimates establish that marriage timing is an important determinant of women's schooling in this setting.

The design-based estimates do not reveal why households choose early marriage or how a cohort-wide policy would change the marriage market. I therefore develop and estimate a dynamic directed-search model in which households jointly choose marriage timing and schooling for one or two daughters. Birth-order constraints link decisions across sisters. Households post dowry menus, and grooms direct their proposals toward particular households. This structure makes schooling, marriage timing, matching probabilities, and dowries jointly endogenous.

The estimated model implies that although grooms prefer more educated brides, their preference for younger brides is substantially stronger. The marriage-market premium for schooling is therefore insufficient to induce most households to delay marriage, especially given the costs of schooling and of supporting daughters while they remain unmarried. Delaying marriage also leaves less time to find a match and, for households with two daughters, postpones the younger daughter's entry into the marriage market. Together, these forces sustain early marriage despite positive marriage-market returns to education.

These findings motivate two policy counterfactuals. First, I consider raising the minimum legal age of marriage to 19. By restricting early marriage, the reform lowers the opportunity cost of schooling and increases women's educational attainment. The gains are concentrated among higher-income women: high school completion rises from 16 to 31 percent in the lower-caste market and from 28 to 52 percent in the upper-caste market. Among lower-income women, high school completion increases by only 1 to 4 percentage points, as schooling remains costly relative to household resources. The reform also increases the share of women who never marry and raises average dowries. Its welfare effects differ substantially across caste markets. In the upper-caste market, households lose and men gain. In the lower-caste market, high-income households gain, low-income households with two daughters lose, and men also lose. These contrasting welfare effects reflect differences in grooms' preferences for brides' age and education, as well as how marriage-market competition adjusts in equilibrium.

Second, I examine a conditional cash transfer that offsets schooling costs and is financed by a tax on higher-income households. The transfer raises high school completion among lower-income women from 7 to 34 percent in the lower-caste market and from 4 to 68 percent in the upper-caste market. Because free schooling makes it more attractive to delay marriage,

lower-income households offer lower dowries in the first age category, by 10 to 25 percent in the lower caste and by 28 to 39 percent in the upper caste. As a result, the share of lower-income women marrying between ages 16 and 18 falls from 40% to 38% in the lower caste and from 34% to 25% in the upper caste. These changes in marriage timing are smaller than under the minimum marriage age, which eliminates marriage at these ages. Lower-income households gain from the transfer, and higher-income households, who pay the tax, lose.

Taken together, these results highlight the limits of using marriage regulation alone to increase women's schooling. Delaying marriage can create time for additional education, but it does not ensure that households can afford to use that time for schooling. Conversely, reducing schooling costs substantially increases educational attainment, but men's strong preference for younger brides continues to encourage early marriage. While the model does not capture all the benefits of delaying marriage, including improvements in women's autonomy, reproductive health, and labor market opportunities, it highlights the potentially unequal and unintended consequences of marriage regulation.

Several extensions of the model are promising avenues for future research. First, incorporating women's labor supply decisions and labor market returns would allow the analysis to examine how marriage timing and education affect women's employment and earnings over the life cycle, an important dimension of women's economic opportunities that the current model abstracts from. Second, extending the framework to model women's welfare after marriage would allow the analysis to capture broader consequences of marriage timing and education for women's well-being. Women's education could affect their intrahousehold bargaining power and thus the allocation of resources within marriage. Finally, allowing preferences over spouse characteristics to vary more flexibly across bride and groom types would capture additional heterogeneity in marriage-market incentives and responses to policy.

While these extensions would broaden the scope of the analysis, the central contribution of this paper is to show why the causal effect of delaying an individual woman's marriage does not necessarily predict the consequences of policies that change marriage opportunities for everyone in the marriage market. Equilibrium marriage-market responses, household constraints, and spillovers across daughters jointly shape how these policies affect marriage timing, educational attainment, and welfare.

References

Afridi, F., Dinkelman, T., and Mahajan, K. (2018). Why are fewer married women joining the work force in rural India? A decomposition analysis over two decades. *Journal of Population Economics*, 31(3):783–818.

Anderson, S. (2007). Why the marriage squeeze cannot cause dowry inflation. *Journal of Economic Theory*, 137(1):140–152.

Arcidiacono, P., Beauchamp, A., and McElroy, M. (2016). Terms of endearment: An equilibrium model of sex and matching. *Quantitative Economics*, 7(1):117–156.

Ashraf, N., Bau, N., Nunn, N., and Voena, A. (2020). Bride price and female education. *Journal of Political Economy*, 128(2):591–641.

Banerjee, A., Duflo, E., Ghatak, M., and Lafortune, J. (2013). Marry for what? Caste and mate selection in modern India. *American Economic Journal: Microeconomics*, 5(2):33–72.

Batyra, E. and Pesando, L. (2021). Trends in child marriage and new evidence on the selective impact of changes in age-at-marriage laws on early marriage. SSM-Population Health, 14, 100811.

Beauchamp, A., Calvi, R., and Fulford, S. (2021). Terms of engagement: Migration, dowry, and love in Indian marriages. *Working Paper*.

Becker, G. S. (1973). A theory of marriage: Part I. *Journal of Political Economy*, 81(4):813–846.

Bella, A., Black, N., Dartanto, T., Jayawardana, D., and Petrie, D. (2025). Beyond the minimum: The impact of Indonesia's marriage age law on child marriage and education. *Monash Business School*.

Bellés-Obrero, C. and Lombardi, M. (2023). Will you marry me, later? Age-of-marriage laws and child marriage in Mexico. *Journal of Human Resources*, 58(1):221–259.

Bharadwaj, P. (2015). Impact of changes in marriage law: Implications for fertility and school enrollment. *Journal of Human Resources*, 50(3):614–654.

Borker, G., Eeckhout, J., Luke, N., Minz, S., Munshi, K., and Swaminathan, S. (2026). Wealth, marriage, and sex selection. *American Economic Journal: Applied Economics*, 18(2):107–146.

Botticini, M. and Siow, A. (2003). Why dowries? *American Economic Review*, 93(4):1385–1398.

Buchmann, N., Field, E., and Glennerster, R. (2021). The marriage market value of bride age and education: A vignette approach to decomposing marriage transfers in rural Bangladesh.

Chiappori, P.-A., Dias, M. C., and Meghir, C. (2018). The marriage market, labor supply, and education choice. *Journal of Political Economy*, 126(S1):S26–S72.

Chiappori, P.-A., Iyigun, M., and Weiss, Y. (2009). Investment in schooling and the marriage market. *American Economic Review*, 99(5):1689–1713.

Chiplunkar, G. and Weaver, J. (2023). Marriage markets and the rise of dowry in India. *Journal of Development Economics*, 164:103115.

Choo, E. (2015). Dynamic marriage matching: An empirical framework. *Econometrica*, 83(4):1373–1423.

Choo, E. and Siow, A. (2006). Who marries whom and why. *Journal of Political Economy*, 114(1):175–201.

Ciscato, E. (2021). The changing wage distribution and the decline of marriage. *Unpublished manuscript*.

Corno, L., Hildebrandt, N., and Voena, A. (2016). Weather shocks, age of marriage and the direction of marriage payments. Technical report, Working Paper.

Field, E. and Ambrus, A. (2008). Early marriage, age of menarche, and female schooling attainment in Bangladesh. *Journal of Political Economy*, 116(5):881–930.

Field, E., Pande, R., Rigol, N., Schaner, S., and Troyer Moore, C. (2021). On her own account: How strengthening women's financial control impacts labor supply and gender norms. *American Economic Review*, 111(7):2342–2375.

Fletcher, E., Pande, R., and Troyer Moore, C. (2019). Women and work in India: Descriptive evidence and a review of potential policies. *India Policy Forum*, 15(1):149–216.

Flinn, C., Gemici, A., and Laufer, S. (2017). Search, matching and training. *Review of Economic Dynamics*, 25:260–297.

Galichon, A., Kominers, S. D., and Weber, S. (2019). Costly concessions: An empirical framework for matching with imperfectly transferable utility. *Journal of Political Economy*, 127(6):2875–2925.

Gayle, G.-L. (2019). Dynamic frictionless marriage matching: Commitment and household behaviour. In *2019 Meeting Papers*, number 796. Society for Economic Dynamics.

Guha, A., Keskar, A., and Mookerjee, S. (2026). Waiting your turn: Sibling rivalry, birth order, and dowry in rural India. *Available at SSRN 7176601*.

Jafarey, S., Mainali, R., and Montes-Rojas, G. (2020). Age at marriage, social norms, and female education in Nepal. *Review of Development Economics*, 24(3):878–909.

Jayachandran, S. (2015). The roots of gender inequality in developing countries. *Annual Review of Economics*, 7(1):63–88.

Jayachandran, S. and Pande, R. (2017). Why are Indian children so short? The role of birth order and son preference. *American Economic Review*, 107(9):2600–2629.

Malhotra, A. and Tsui, A. O. (1996). Marriage timing in Sri Lanka: The role of modern norms and ideas. *Journal of Marriage and the Family*, pages 476–490.

McGavock, T. (2021). Here waits the bride? The effect of Ethiopia's child marriage law. *Journal of Development Economics*, 149:102580.

Moen, E. R. and Rosén, Å. (2004). Does poaching distort training? *The Review of Economic Studies*, 71(4):1143–1162.

PRS Legislative Research (2021). The Prohibition of Child Marriage (Amendment) Bill, 2021.

Rao, V. (1993). The rising price of husbands: A hedonic analysis of dowry increases in rural India. *Journal of Political Economy*, 101(4):666–677.

Rosenzweig, M. R. and Stark, O. (1989). Consumption smoothing, migration, and marriage: Evidence from rural India. *Journal of Political Economy*, 97(4):905–926.

Shephard, A. (2019). Marriage market dynamics, gender, and the age gap. PIER Working Paper 19-003, Penn Institute for Economic Research, University of Pennsylvania.

Shimer, R. (2005). The assignment of workers to jobs in an economy with coordination frictions. *Journal of Political Economy*, 113(5):996–1025.

Tam, E. and Roy, S. (2026). Sarda Act of 1929: Law and child marriage in India. *Journal of Economic History*.

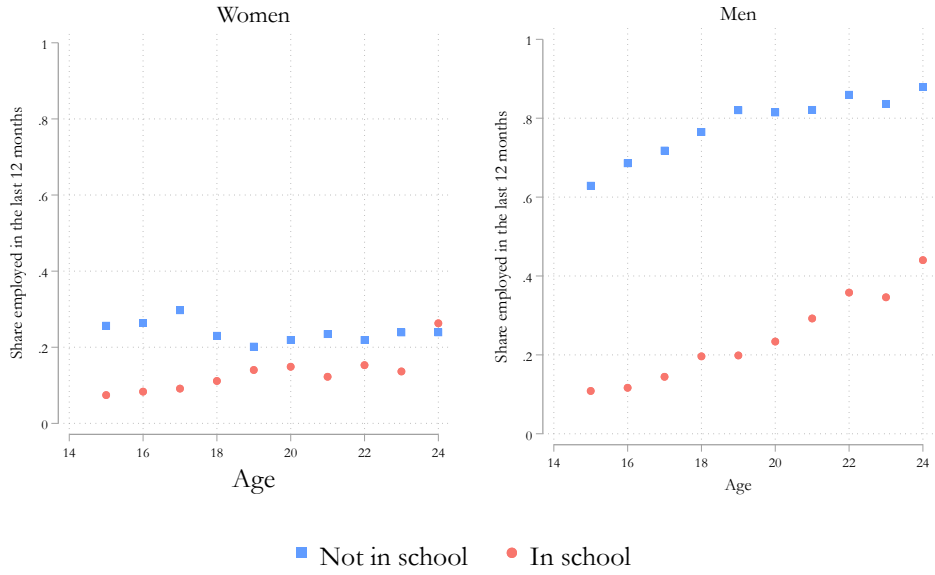
Vogl, T. S. (2013). Marriage institutions and sibling competition: Evidence from South Asia. *The Quarterly Journal of Economics*, 128(3):1017–1072.

Wilson, N. (2022). Child marriage bans and female schooling and labor market outcomes: Evidence from natural experiments in 17 low-and middle-income countries. *American Economic Journal: Economic Policy*, 14(3):449–477.

Appendix

A Labor force participation

Figure A.1: Labor force participation of men and women



Source: Own calculations using NFHS Eligible Women and NFHS Men (2019-21).

B Data

I use two sources of data for this study. First, the National Family Health Survey (NFHS) is a repeated cross-sectional survey of representative households in India, comprising five waves of data available from 1992, 1998, 2005, 2015, and 2019. The survey collects data on demographic characteristics, fertility, reproductive health, and nutrition. Additionally, it includes information on women's age at marriage and educational attainment. The 2019 sample consisted of data from 636,691 households across India.

Second, I use data from the Rural Economic and Demographic Survey (REDS), a detailed panel survey of rural households conducted by the National Council of Applied Economic Research across the 17 most populous states in India. Data were collected in 1969–71, 1982, 1999 and 2006. The original sample of villages was drawn in the first round and was meant to be a representative sample of the rural population in India in those states. All original households, including split households, were followed over time, and retrospective information was collected on deceased members. The 17 surveyed states contain roughly 96% of the

population of India [12].

The 1999 and 2006 rounds collected detailed retrospective information on the marriages of household heads and their relatives, including parents, siblings, and children. In the 2006 round, however, the sibling and child questionnaires cover only non-coresident family members. The information includes age at marriage, own and spouse's educational attainment, and gifts paid by the bride and groom at the time of marriage. My analysis uses the records for daughters and sisters.

Although the marriage records for daughters and sisters are limited to those who are non-coresident, this restriction omits relatively few married women because women typically leave their natal households after marriage. I construct birth order from the complete rosters of household heads' siblings and children. These rosters include all brothers, sisters, sons, and daughters regardless of whether they reside in the household.

Summary statistics:

	All women Mean	Regression sample Mean
Number of children	5.38	5.58
Number of daughters	2.84	2.96
Age gap	3.60	3.45
age	40.10	33.08
Years of education	3.97	4.34
HS or more	0.08	0.08
Married	0.94	1.00
Age at marriage	17.70	17.87
Observations	18107	6054

Source: Own calculations using REDS 2006.
Column 1 includes all women in the household, head's sisters and head's daughters who are at least 18 years of age.
Column 2 restricts to married women between the age of 25 and 40 with at least one older sibling.

[12]Since this is a rural sample, my results may not extend to urban areas. However, I find comparable results using the Indian Human Development Survey (IHDS), which is nationally representative.

C IV Results with other instruments

Table C.1: IV estimates of educational attainment on age at marriage

Dep. var.:	(1) Years of education	(2) Tenth grade or more	(3) HS or more
Age at marriage	1.608***	0.113***	0.058***
	(0.39)	(0.03)	(0.02)
Mean of dep variable	4.49	0.20	0.08
N	7,481	7,481	7,481

Notes: The table reports 2SLS estimates of the effect of age at marriage on educational attainment, instrumenting age at marriage with an indicator for having an older sister. The dependent variable is completed years of schooling (column 1), an indicator for tenth grade completion (column 2), and an indicator for high school completion (column 3). All columns control for the number of siblings, year of birth, and birth order. The sample comprises women aged 25-40. Standard errors clustered at the household level are reported in parentheses.
Source: Author's calculations using REDS 2006.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table C.2: IV estimates of educational attainment on age at marriage

Dep. var.:	(1) Years of education	(2) Tenth grade or more	(3) HS or more
Age at marriage	1.791***	0.141***	0.082***
	(0.38)	(0.03)	(0.02)
Mean of dep variable	4.49	0.20	0.08
N	7,481	7,481	7,481

Notes: The table reports 2SLS estimates of the effect of age at marriage on educational attainment, instrumenting age at marriage with the number of older sisters. The dependent variable is completed years of schooling (column 1), an indicator for tenth grade completion (column 2), and an indicator for high school completion (column 3). All columns control for the number of siblings, year of birth, and birth order. The sample comprises women with at least one older sibling, aged 25-40. Standard errors clustered at the household level are reported in parentheses.
Source: Author's calculations using REDS 2006.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

D Model

D.1 Schooling value function

The i.i.d. Type-I extreme-value schooling shocks imply that the expected maximum in equation (6) has a closed-form expression. Under the mean-zero normalization of the shocks, the household's value conditional on marriage outcome j is

$$W(\boldsymbol{h}, j; d_j) = \tau_j + \sigma_s \log \sum_{\boldsymbol{e} \in \mathcal{A}^e(\boldsymbol{h}, j)} \exp\left(\frac{u(c(\boldsymbol{h}, j, \boldsymbol{e})) + \beta V(\boldsymbol{h}'(\boldsymbol{h}, j, \boldsymbol{e}))}{\sigma_s}\right), \tag{16}$$

where

$$c(\boldsymbol{h}, j, \boldsymbol{e}) = y - \kappa y\, n(\boldsymbol{h})^{\chi} - d_j - \phi(e^f + e^{\ell}).$$

The feasible set $\mathcal{A}^e(\boldsymbol{h}, j)$ includes only schooling choices that leave consumption strictly positive. When no marriage occurs, $\tau_0 = \eta_0 = d_0 = 0$.

D.2 Men's application choices

Let $\bar{J}_j$ denote the expected value of an unmarried type-j man before observing his application preference shocks. The value of remaining out of the market for the current period is $\beta \bar{J}_{j'}$, while the deterministic payoff from applying to a household in state $\boldsymbol{h}$ is $J_j(\boldsymbol{h})$, defined in equation (8).

Given the i.i.d. Type-I extreme-value shocks, the ex ante value of a type-j man is

$$\bar{J}_j = \sigma_m \log \left[\exp\left(\frac{\beta \bar{J}_{j'}}{\sigma_m}\right) + \sum_{\boldsymbol{h} \in \mathcal{H}} \nu_h \exp\left(\frac{J_j(\boldsymbol{h})}{\sigma_m}\right)\right], \tag{17}$$

where ν_h is the mass of households in state $\boldsymbol{h}$. The expression uses the mean-zero normalization of the extreme-value shocks.

The probability that a type-j man applies to a household in state $\boldsymbol{h}$ is

$$\Pr(\text{apply to state } \boldsymbol{h}) = \nu_h \exp\left(\frac{J_j(\boldsymbol{h}) - \bar{J}_j}{\sigma_m}\right) = \nu_h \pi_j(\boldsymbol{h}). \tag{18}$$

The probability that he remains out of the market is

$$\Pr(\text{no application}) = \exp\left(\frac{\beta \bar{J}_{j'} - \bar{J}_j}{\sigma_m}\right). \tag{19}$$

These probabilities satisfy

$$\sum_{\boldsymbol{h}\in\mathcal{H}} \nu_h \pi_j(\boldsymbol{h}) + \exp\left(\frac{\beta \bar{J}_{j'} - \bar{J}_j}{\sigma_m}\right) = 1. \tag{20}$$

D.3 Proposal arrivals

As defined in the main text, the expected number of type-j proposals received by a household in state $\boldsymbol{h}$ is

$$q_j(\boldsymbol{h}) = \mu_j \pi_j(\boldsymbol{h}). \tag{21}$$

To see why the realized number of proposals follows a Poisson distribution, consider a finite-market approximation with $N\nu_h$ households in state $\boldsymbol{h}$ and $N\mu_j$ unmarried type-j men. Each type-j man independently applies to a particular household in state $\boldsymbol{h}$ with probability $\pi_j(\boldsymbol{h})/N$.

The number of type-j proposals received by a household therefore follows

$$A_j^{(N)}(\boldsymbol{h}) \sim \text{Binomial}\left(N\mu_j, \frac{\pi_j(\boldsymbol{h})}{N}\right). \tag{22}$$

As $N \to \infty$, the number of proposals converges in distribution to a Poisson random variable with mean $q_j(\boldsymbol{h})$:

$$A_j(\boldsymbol{h}) \sim \text{Poisson}\big(q_j(\boldsymbol{h})\big). \tag{23}$$

Since application decisions are independent across groom types, the numbers of proposals received from different types are independent Poisson random variables.

Let $R \subseteq \mathcal{J}$ denote the set of groom types from which the household receives at least one proposal. The probability of receiving proposals from exactly the types in R is

$$\Pr(R \mid \boldsymbol{d}) = \prod_{i\in R} \left(1 - e^{-q_i(\boldsymbol{h};\boldsymbol{d})}\right) \prod_{i\notin R} e^{-q_i(\boldsymbol{h};\boldsymbol{d})}, \tag{24}$$

where $q_i(\boldsymbol{h};\boldsymbol{d})$ makes explicit the dependence of the expected queue length on the household's posted dowry menu.

D.4 Household's expected value

Let $\Pr(R \mid \boldsymbol{d})$ denote the probability that a household receives proposals from a subset of men R, as determined by the independent Poisson arrivals. The household solves

$$V(\boldsymbol{h}) = \max_{\boldsymbol{d} \in \mathcal{D}(\boldsymbol{h})} \left\{ \underbrace{\sum_{\substack{R \subseteq \mathcal{J} \\ R \neq \varnothing}} \Pr(R \mid \boldsymbol{d})\, \sigma_h \log \sum_{j \in R} \exp\left(\frac{W(\boldsymbol{h}, j; d_j)}{\sigma_h} \right)}_{\text{at least one proposal}} + \underbrace{\Pr(R = \varnothing \mid \boldsymbol{d}) W(\boldsymbol{h}, 0; 0)}_{\text{no proposals}} \right\}. \tag{25}$$

D.5 Derivation of marriage probabilities

Consider a household in state $\boldsymbol{h}$ posting dowry menu $\boldsymbol{d}$. Let $q_j \equiv q_j(\boldsymbol{h}; \boldsymbol{d})$ denote the expected number of type-j proposals received by the household.

D.5.1 Probability that a man is selected among applicants of his own type

Consider a type-j man who proposes to the household. Let Z denote the number of other type-j men who also propose to the same household. Under the Poisson assumption on arrivals, $Z \sim \text{Poisson}(q_j)$. Conditional on $Z = z$, the household is indifferent between men of the same type and selects the given man with probability $1/(z+1)$.

Taking expectations over Z, the probability that the man is selected among applicants of his own type is

$$\begin{aligned} \mathbb{E}\left[\frac{1}{Z+1} \right] &= \sum_{z=0}^{\infty} \frac{1}{z+1} e^{-q_j} \frac{q_j^z}{z!} \\ &= \frac{e^{-q_j}}{q_j} \sum_{z=0}^{\infty} \frac{q_j^{z+1}}{(z+1)!} \\ &= \frac{e^{-q_j}}{q_j} (e^{q_j} - 1) \\ &= \frac{1 - e^{-q_j}}{q_j}. \end{aligned} \tag{26}$$

D.5.2 Probability that a man is accepted conditional on proposing

Let $R \subseteq \mathcal{J}$ denote the set of male types from which the household receives at least one proposal. Conditional on a type-j man proposing, type j is necessarily included in R.

For each other type $k \neq j$, the probability that the household receives at least one type-k proposal is $1 - e^{-q_k}$, while the probability of receiving none is e^{-q_k}. Since arrivals are independent across types, the probability of receiving proposals from exactly the other types in R is

$$\Pr(R \mid \text{type-}j \text{ man proposes}) = \prod_{k \in R \setminus \{j\}} (1 - e^{-q_k}) \prod_{k \notin R} e^{-q_k}, \qquad j \in R. \tag{27}$$

Conditional on receiving proposals from the set of types R, the household draws a Type-I extreme-value shock associated with each arriving type and selects the type that maximizes its value. The probability that type j is selected is

$$\Pr(j \mid R, \boldsymbol{d}) = \frac{\exp\big(W(\boldsymbol{h}, j; d_j)/\sigma_h\big)}{\sum_{k \in R} \exp\big(W(\boldsymbol{h}, k; d_k)/\sigma_h\big)}. \tag{28}$$

Combining these expressions, the probability that a type-j man is accepted conditional on proposing to the household is

$$\begin{aligned} p_j(\boldsymbol{h}; \boldsymbol{d}) = \underbrace{\frac{1 - e^{-q_j}}{q_j}}_{\text{within-type selection}} \sum_{\substack{R \subseteq \mathcal{J} \\ j \in R}} \underbrace{\left[\prod_{k \in R \setminus \{j\}} (1 - e^{-q_k}) \prod_{k \notin R} e^{-q_k} \right]}_{\text{arrival of other types}} \\ \times \underbrace{\frac{\exp\big(W(\boldsymbol{h}, j; d_j)/\sigma_h\big)}{\sum_{k \in R} \exp\big(W(\boldsymbol{h}, k; d_k)/\sigma_h\big)}}_{\text{choice among arriving types}}. \end{aligned} \tag{29}$$

The probability that the household marries a type-j man is

$$P_j(\boldsymbol{h}; \boldsymbol{d}) = (1 - e^{-q_j}) \sum_{\substack{R \subseteq \mathcal{J} \\ j \in R}} \left[\prod_{k \in R \setminus \{j\}} (1 - e^{-q_k}) \prod_{k \notin R} e^{-q_k} \right] \Pr(j \mid R, \boldsymbol{d}). \tag{30}$$

Comparing the two expressions gives

$$p_j(\boldsymbol{h}; \boldsymbol{d}) = \frac{P_j(\boldsymbol{h}; \boldsymbol{d})}{q_j(\boldsymbol{h}; \boldsymbol{d})}, \tag{31}$$

for $q_j(\boldsymbol{h}; \boldsymbol{d}) > 0$, as stated in the main text.

D.6 Second assignment round

Following the initial matching round, a fraction ω of unmatched men are randomly reassigned to households that received no first-round proposals, within the household state they initially chose. Men do not make another application decision or draw new preference shocks. As in the first round, a household may receive proposals from multiple groom types. It draws a new set of idiosyncratic preference shocks and selects one groom using the acceptance rule in Equation (12). The originally posted dowries apply in both rounds. Men who chose not to propose to any household, men who are not reassigned, and reassigned men who are not selected in the second round, return to the market in the next period.

Second-round proposal arrivals. Let $q_j(\boldsymbol{h})$ denote the first-round arrival rate of type-j men to a household in state $\boldsymbol{h}$, and let $P_j^{(1)}(\boldsymbol{h})$ denote the probability that the household marries a type-j man in the first round, as derived in Appendix D.5.

The probability that a household receives no first-round proposals is

$$\Pr_1(R = \varnothing \mid \boldsymbol{d}) = \exp\left(-\sum_{j \in \mathcal{J}} q_j(\boldsymbol{h})\right). \tag{32}$$

Given a mass ν_h of households in state $\boldsymbol{h}$, the mass of households available for reassignment is therefore

$$\nu_h \Pr_1(R = \varnothing \mid \boldsymbol{d}).$$

The mass of type-j men who initially apply to households in state $\boldsymbol{h}$ is $\nu_h q_j(\boldsymbol{h})$, while the mass who marry in the first round is $\nu_h P_j^{(1)}(\boldsymbol{h})$. Thus, the mass of unsuccessful type-j applicants is

$$\nu_h \left[q_j(\boldsymbol{h}) - P_j^{(1)}(\boldsymbol{h})\right].$$

A fraction ω of these men is randomly reassigned across the households available in the same state. Hence, the expected number of second-round proposals from type-j men received by an available household is

$$\begin{aligned} q_j^{(2)}(\boldsymbol{h}) &= \omega \frac{\nu_h \left[q_j(\boldsymbol{h}) - P_j^{(1)}(\boldsymbol{h})\right]}{\nu_h \Pr_1(R = \varnothing \mid \boldsymbol{d})} \\ &= \omega \frac{q_j(\boldsymbol{h}) - P_j^{(1)}(\boldsymbol{h})}{\Pr_1(R = \varnothing \mid \boldsymbol{d})}. \end{aligned} \tag{33}$$

Under independent random reassignment in a large market, second-round proposal counts are Poisson with mean $q_j^{(2)}(\boldsymbol{h})$, conditional on the household having received no first-round

proposals. Arrivals are independent across groom types.

Let $\Pr_2(R \mid R_1 = \varnothing, \boldsymbol{d})$ denote the probability that an available household receives proposals from exactly the groom types in R in the second round. Then

$$\Pr_2(R \mid R_1 = \varnothing, \boldsymbol{d}) = \prod_{j \in R} \left(1 - e^{-q_j^{(2)}}\right) \prod_{j \notin R} e^{-q_j^{(2)}}. \tag{34}$$

The dependence of the arrival rates on the household state and equilibrium dowry menus is suppressed for notational simplicity.

Overall proposal-set probabilities. A household that receives at least one proposal in the first round selects a groom and does not participate in the second round. Only households that receive no first-round proposals remain available for reassignment.

Let $\Pr_1(R \mid \boldsymbol{d})$ denote the first-round proposal-set distribution derived in Appendix D.3. The probability that a household receives proposals from the set of groom types R, accounting for both rounds, is

$$\Pr(R \mid \boldsymbol{d}) = \begin{cases} \Pr_1(R \mid \boldsymbol{d}) + \Pr_1(\varnothing \mid \boldsymbol{d}) \Pr_2(R \mid R_1 = \varnothing, \boldsymbol{d}), & R \neq \varnothing, \\ \Pr_1(\varnothing \mid \boldsymbol{d}) \Pr_2(\varnothing \mid R_1 = \varnothing, \boldsymbol{d}), & R = \varnothing. \end{cases} \tag{35}$$

Thus, the second assignment round changes the probability distribution over proposal sets, but not the household's choice rule conditional on receiving a particular set of groom types.

Overall matching probabilities. Conditional on receiving proposals from the set of groom types R, the household selects groom type $j \in R$ with probability $\Pr(j \mid R, \boldsymbol{d})$, as defined in Equation (12).

The unconditional probability that a household marries a type-j man in the second round is

$$P_j^{(2)}(\boldsymbol{h}; \boldsymbol{d}) = \Pr_1(\varnothing \mid \boldsymbol{d}) \sum_{\substack{R \subseteq \mathcal{J} \\ j \in R}} \Pr_2(R \mid R_1 = \varnothing, \boldsymbol{d}) \Pr(j \mid R, \boldsymbol{d}). \tag{36}$$

The overall probability that the household marries a type-j man is therefore

$$P_j(\boldsymbol{h}; \boldsymbol{d}) = P_j^{(1)}(\boldsymbol{h}; \boldsymbol{d}) + P_j^{(2)}(\boldsymbol{h}; \boldsymbol{d}). \tag{37}$$

Since men are reassigned only within the household state they initially chose, all type-j men who initially apply to state $\boldsymbol{h}$ are treated symmetrically. The probability that an

individual type-j applicant marries by the end of the period is consequently

$$p_j(\boldsymbol{h};\boldsymbol{d}) = \frac{P_j(\boldsymbol{h};\boldsymbol{d})}{q_j(\boldsymbol{h};\boldsymbol{d})}, \tag{38}$$

for $q_j(\boldsymbol{h};\boldsymbol{d}) > 0$.

The probability $p_j(\boldsymbol{h};\boldsymbol{d})$ enters the man's application value in Equation (8), while the overall distribution $\Pr(R \mid \boldsymbol{d})$ enters the household's value function in Equation (25). Thus, the second assignment round is incorporated through matching and proposal-arrival probabilities, without changing the conditional values of marriage or remaining unmatched.

D.7 Numerical solution of the equilibrium

For each candidate parameter vector, I solve for a stationary equilibrium in men's values and the distributions of unmarried men and households. The solution algorithm consists of an inner step that solves households' dynamic optimization problems by backward induction and an outer fixed-point iteration that updates men's values and the distributions of unmarried agents.

Let $\bar{\boldsymbol{J}}$ denote the vector of men's ex ante values, $\boldsymbol{\mu}^o$ the masses of unmarried older men, and $\boldsymbol{\nu}$ the distribution of households across states. I begin with initial guesses for these objects. Taking them as given, I solve the household problem and compute updated equilibrium values and distributions. I repeat this procedure until convergence.

Household optimization. Given $\bar{\boldsymbol{J}}$, $\boldsymbol{\mu}$, and $\boldsymbol{\nu}$, I solve households' dynamic problems by backward induction, starting from the terminal period.

In each period and household state $\boldsymbol{h}$, the household chooses a dowry menu for its eligible daughter, taking into account men's application decisions and the resulting matching probabilities. Conditional on each possible marriage outcome, the household also chooses schooling for any daughter who remains unmarried and is eligible to attend school.

For each candidate dowry menu $\boldsymbol{d}$, I first calculate the household's values $W(\boldsymbol{h}, j; d_j)$ for each groom type j, together with the value $W(\boldsymbol{h}, 0; 0)$ of remaining unmatched. These values incorporate the optimal schooling decisions and the continuation values obtained from backward induction.

I then solve for the expected proposal queues. For each groom type j, the queue length must satisfy

$$q_j(\boldsymbol{h};\boldsymbol{d}) = \mu_j \exp\left(\frac{J_j(\boldsymbol{h};\boldsymbol{d}) - \bar{J}_j}{\sigma_m}\right), \tag{39}$$

where $J_j(\boldsymbol{h}; \boldsymbol{d})$ is the man's expected payoff from applying to the household, defined in Equation (8).

The matching probability entering J_j depends on the proposal queues and the household's acceptance decisions. Thus, I solve Equation (39) by fixed-point iteration. Given a guess for the queues, I compute the first-round proposal-set probabilities, the matching probabilities accounting for the second assignment round, and the resulting expected application values. These values imply updated queues through Equation (39). I iterate until the implied queues are consistent with the initial guesses.

Given the converged queues, I compute the probabilities of each possible proposal set and the household's expected value under the candidate dowry menu. I enumerate all subsets of the four groom types, including the possibility of receiving no proposals. The household then chooses the feasible dowry menu that maximizes its expected value in Equation (25). Repeating this procedure across household states and periods yields the optimal dowry policies, schooling policies, and household value functions.

Updating men's values. Given the household policies and the current distribution of households, I update men's ex ante values using the logit inclusive-value formula:

$$\bar{J}_j^{new} = \sigma_m \log \left[\exp\left(\frac{\beta \bar{J}_{j'}}{\sigma_m} \right) + \sum_{\boldsymbol{h} \in \mathcal{H}} \nu_h \exp\left(\frac{J_j(\boldsymbol{h})}{\sigma_m} \right) \right]. \tag{40}$$

For older men in their final period of searching, the continuation value $\bar{J}_{j'}$ is replaced by the normalized terminal value of zero.

Updating the distributions of unmarried agents. The household policies and matching probabilities also determine the distributions of unmarried men and households in the following period.

The mass of older unmarried men is determined by the mass of younger men who remain unmatched or choose not to apply. For a young male type j whose next-period type is j', the updated mass is

$$\mu_{j'}^{o,new} = \mu_j^y \left[\exp\left(\frac{\beta \bar{J}_{j'} - \bar{J}_j}{\sigma_m} \right) + \sum_{\boldsymbol{h} \in \mathcal{H}} \nu_h \pi_j(\boldsymbol{h}) \big(1 - p_j(\boldsymbol{h})\big) \right]. \tag{41}$$

The first term is the probability of remaining out of the market, while the second is the probability of applying but remaining unmatched. The matching probabilities $p_j(\boldsymbol{h})$ account for both assignment rounds. Older men who remain unmatched after their final period exit

the market.

I update the distribution of households by iterating forward from the entering cohorts. The transition probabilities depend on whether the eligible daughter marries, the groom type she matches with, and the schooling decisions for daughters who remain unmarried. They also incorporate the aging of daughters and the movement of households into new states when an older daughter marries.

Let $T(\boldsymbol{h}' \mid \boldsymbol{h})$ denote the probability that a household in state $\boldsymbol{h}$ transitions to state $\boldsymbol{h}'$ under the optimal policies. The updated distribution is

$$\nu_{h'}^{new} = \nu_{h'}^{entry} + \sum_{\boldsymbol{h} \in \mathcal{H}} \nu_h T(\boldsymbol{h}' \mid \boldsymbol{h}), \tag{42}$$

where $\nu_{h'}^{entry}$ is the exogenous mass of newly entering households in state $\boldsymbol{h}'$. Households that have completed their model horizon exit the distribution.

Equilibrium fixed point. The updated men's values and distributions define a new guess for $(\bar{\boldsymbol{J}}, \boldsymbol{\mu}^o, \boldsymbol{\nu})$. I update these objects jointly using damped iteration and repeat the household optimization and distribution updates until convergence.

At convergence, men's application values are consistent with the matching probabilities generated by households' dowry menus, households optimize given these probabilities, and the distributions of unmarried agents are stationary.

I then use the equilibrium policies and distributions to construct the model-implied moments used in the indirect-inference estimator.

E Targeted Moments

The model is estimated separately for each caste, and each estimation targets the 30 moments listed in Table E.1. For each moment, the table reports its value in the data, its standard error, and its simulated value at the estimated parameters. The simulated moments are computed from the simulated population using the same definitions as the data moments. Section 5 describes the weight assigned to each moment. Unless stated otherwise, a moment is a share among all women in the caste and income group, including women who never marry.

Age at marriage and matching. Panel A reports the share of women who marry in each of the four age categories. Because every marriage in the model falls in one of the four categories, these shares also determine the never-married share, which is not targeted separately. Panel

B reports the share of women who marry a high-school-educated groom in age category 1 or 2 without having completed high school.

Schooling. Panel C reports the share of women who complete high school, by income group and by the number of daughters in the household.

Educational sorting. Panel D reports, among married women without high school and among married women with high school, the share whose husband completed high school. Both rates pool the two income groups.

Dowries. The first five rows of Panel E report the coefficients from an OLS regression of the log dowry on indicators for the bride's age category at marriage (categories 2 to 4), for the bride's completion of high school, and for the groom's completion of high school. The omitted group is a bride who married in age category 1 without high school. The regression is estimated on married women who report a positive net real dowry. The real net dowry is defined as the gross dowry paid by the bride's family net of transfers from the groom's side, expressed in constant 2005 rupees. The last two rows report the mean log dowry among married women who report a positive dowry, by income group.

Men's age at marriage. Panel F reports the share of married men who married young, separately for men with and without high school.

Birth order. Panel G reports the moments from the birth-order design. The first stage is the coefficient from an OLS regression of the age category at marriage on an indicator for having an older sister. The IV estimate is the coefficient on the age category at marriage in a regression of high school completion, with the older-sister indicator as the instrument. Both are estimated on ever-married women, between the ages of 27 and 45 at the time of the survey. The last row reports the never-married share of last-born daughters minus that of first-born daughters in two-daughter households.

The five dowry-regression coefficients, the first stage, and the IV estimate are computed on the sample that pools both castes, and they therefore take the same values in the two estimations, since the effects don't differ significantly by caste and pooling helps improve precision.

Table E.1: Targeted Moments

	Lower caste			Upper caste		
Moment	Data	s.e.	Model	Data	s.e.	Model
A. Married in each age category						
Age category 1, lower income	0.336	(0.017)	0.401	0.347	(0.029)	0.342
Age category 1, higher income	0.331	(0.017)	0.494	0.212	(0.025)	0.465
Age category 2, lower income	0.406	(0.017)	0.458	0.429	(0.030)	0.520
Age category 2, higher income	0.415	(0.018)	0.426	0.448	(0.031)	0.492
Age category 3, lower income	0.145	(0.012)	0.027	0.149	(0.022)	0.004
Age category 3, higher income	0.143	(0.012)	0.023	0.205	(0.025)	0.003
Age category 4, lower income	0.040	(0.007)	0.001	0.052	(0.014)	0.000
Age category 4, higher income	0.052	(0.008)	0.001	0.058	(0.015)	0.000
B. Married to a high-school-educated groom, bride without high school						
Age category 1, lower income	0.035	(0.006)	0.082	0.075	(0.016)	0.090
Age category 1, higher income	0.049	(0.008)	0.109	0.046	(0.013)	0.130
Age category 2, lower income	0.066	(0.009)	0.083	0.097	(0.018)	0.128
Age category 2, higher income	0.058	(0.008)	0.063	0.100	(0.019)	0.061
C. Completed high school						
One daughter, lower income	0.084	(0.023)	0.074	0.104	(0.044)	0.043
One daughter, higher income	0.136	(0.031)	0.136	0.354	(0.069)	0.235
Two daughters, lower income	0.061	(0.009)	0.072	0.045	(0.014)	0.037
Two daughters, higher income	0.094	(0.011)	0.164	0.204	(0.028)	0.291
D. Married to a high-school-educated groom, among married women						
Bride without high school	0.147	(0.010)	0.212	0.271	(0.021)	0.270
Bride with high school	0.789	(0.038)	0.216	0.818	(0.047)	0.284
E. Dowries						
Log dowry regression:						
Bride married in age category 2	0.170	(0.037)	0.256	0.170	(0.037)	0.286
Bride married in age category 3	0.317	(0.055)	0.775	0.317	(0.055)	0.632
Bride married in age category 4	0.386	(0.089)	0.682	0.386	(0.089)	0.476
Bride completed high school	0.458	(0.070)	0.277	0.458	(0.070)	0.361
Groom completed high school	0.657	(0.043)	0.708	0.657	(0.043)	0.402
Mean log dowry, lower income	9.45	(0.05)	8.98	9.80	(0.07)	8.94
Mean log dowry, higher income	9.65	(0.05)	9.97	10.19	(0.08)	9.86
F. Married young, among married men						
Men without high school	0.754	(0.016)	0.653	0.741	(0.033)	0.605
Men with high school	0.552	(0.040)	0.678	0.622	(0.054)	0.622
G. Birth order						
First stage	0.157	(0.036)	0.254	0.157	(0.036)	0.242
IV estimate	0.142	(0.052)	0.127	0.142	(0.052)	0.143
Never married, last-born minus first-born	0.029	(0.006)	0.083	0.021	(0.008)	0.081

Notes: Standard errors of the data moments are in parentheses. Model values are evaluated at the estimated parameters. Shares in Panels A to C are computed over all women in the caste and income group. The two rates in Panel D enter the criterion only through the overall rate, weighted by the shares of brides with and without high school in the data, and the two mean log dowries enter only through their average. The dowry-regression coefficients, the first stage, and the IV estimate are computed on the sample that pools both castes.

F Supplementary Evidence from the India Human Development Survey

The main empirical analysis uses the 2006 Rural Economic and Demographic Survey (REDS), which covers rural households in India. As a supplementary exercise, I examine whether the relationship between birth-order constraints, marriage timing, and educational attainment is also present in the India Human Development Survey (IHDS), a nationally representative survey covering both rural and urban households. Tables F.1–F.3 report estimates from the two datasets side by side.

F.1 Data and sample selection

I use the 2005 and 2012 waves of the IHDS. Unlike the REDS, the IHDS does not collect detailed information on the siblings of married women who have left their natal households. I therefore exploit its panel structure to identify women who were unmarried and living in their natal households in 2005 and left to marry between the two waves. The tracking survey records the year and reason for leaving the household, allowing me to infer age at marriage. I use mothers' fertility histories to reconstruct sibling composition and identify whether a woman's next-older sibling is a sister.

This approach introduces sample selection concerns. Women who married before 2005 may already have left their natal households, while those who had not married by 2012 do not have an observed age at marriage. To mitigate these concerns, I restrict the sample to households in which all daughters were living in the household in 2005 and the second daughter was at least 15 years old in 2012. The first restriction reduces the likelihood that older daughters who married before the first wave are omitted from the reconstructed sibling structure; the second limits the inclusion of families whose younger daughters were too young to marry by the second wave. I further restrict the sample to women with at least one older sibling. For the IHDS schooling regressions, I include women aged at least 16 in 2012 when examining tenth-grade completion and at least 18 when examining high school completion. I do not report completed years of schooling for the IHDS because many women in this sample were still too young in 2012 to have completed their education.

These restrictions reduce, but do not eliminate, selection concerns: age at marriage is still observed only for women who married between the two waves. The IHDS estimates should therefore be viewed as supplementary evidence rather than a direct replication of the REDS results.

F.2 OLS estimates

Table F.1 compares the OLS relationship between age at marriage and educational attainment in the two surveys.

Table F.1: OLS estimates of the association between age at marriage and educational attainment: REDS and IHDS

	REDS 2006		IHDS 2005-2012	
	(1) Tenth grade or more	(2) HS or more	(3) Tenth grade or more	(4) HS or more
Age at marriage	0.030***	0.015***	0.058***	0.053***
	(0.00)	(0.00)	(0.01)	(0.01)
Mean of dep. variable	0.20	0.08	0.44	0.29
N	6,053	6,053	2,218	2,064
Age-gap control	Yes	Yes	No	No

Notes: The table reports OLS estimates of the association between age at marriage and tenth grade and high school completion. The REDS columns control for the number of siblings, year of birth, birth order and the age gap between the woman and her next-older sibling, and are unweighted. The IHDS columns control for age in 2005, the number of living children and birth order, and are weighted by the 2005 sampling weights. In the REDS columns, the sample comprises women aged 25-40 with at least one older sibling. In the IHDS columns, the sample comprises women who were unmarried and living in their natal household in 2005, left it to marry between the two waves, and have at least one older sibling, in households in which all daughters lived in the household in 2005 and the second daughter was at least 15 years old in 2012. Standard errors clustered at the household level are reported in parentheses.
Source: Own calculations using REDS 2006, IHDS I (2004-05) and IHDS II (2011-12).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In both datasets, women who marry later have higher educational attainment. In the IHDS, an additional year of age at marriage is associated with a 5.8 percentage point increase in tenth-grade completion and a 5.3 percentage point increase in high school completion. The corresponding REDS estimates are 3.0 and 1.5 percentage points. These associations are larger in the IHDS, although neither set of OLS estimates has a causal interpretation because schooling and marriage timing are jointly determined.

F.3 First-stage results

Table F.2 reports the relationship between having a next-older sister and age at marriage.

Table F.2: First stage estimates of age at marriage on next-older sister: REDS and IHDS

Dep. var.: Age at marriage	REDS 2006 (1)	IHDS 2005-2012 (2)
Next-older sister	0.405***	0.634***
	(0.09)	(0.10)
F	20.17	43.24
N	6,053	2,331
Age-gap control	Yes	No

Notes: The table reports first-stage estimates of the effect of having a next-older sister on age at marriage. F is the F-statistic on the next-older sister indicator. The REDS columns control for the number of siblings, year of birth, birth order and the age gap between the woman and her next-older sibling, and are unweighted. The IHDS columns control for age in 2005, the number of living children and birth order, and are weighted by the 2005 sampling weights. In the REDS columns, the sample comprises women aged 25-40 with at least one older sibling. In the IHDS columns, the sample comprises women who were unmarried and living in their natal household in 2005, left it to marry between the two waves, and have at least one older sibling, in households in which all daughters lived in the household in 2005 and the second daughter was at least 15 years old in 2012. Standard errors clustered at the household level are reported in parentheses.
Source: Own calculations using REDS 2006, IHDS I (2004-05) and IHDS II (2011-12).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Having a next-older sister increases age at marriage by 0.41 years in the REDS and 0.63 years in the IHDS.

F.4 IV estimates

Table F.3 presents 2SLS estimates of the effect of age at marriage on educational attainment, using the next-older sister indicator as the instrument in both datasets.

Table F.3: IV estimates of educational attainment on age at marriage: REDS and IHDS

	REDS 2006		IHDS 2005-2012	
	(1) Tenth grade or more	(2) HS or more	(3) Tenth grade or more	(4) HS or more
Age at marriage	0.126***	0.056***	0.159***	0.137***
	(0.03)	(0.02)	(0.05)	(0.04)
First-stage F	20.17	20.17	35.30	34.90
Mean of dep. variable	0.20	0.08	0.44	0.29
N	6,053	6,053	2,218	2,064
Age-gap control	Yes	Yes	No	No

Notes: The table reports 2SLS estimates of the effect of age at marriage on tenth grade and high school completion, instrumenting age at marriage with an indicator for having a next-older sister. The first-stage F is the F-statistic on the next-older sister indicator in the REDS columns and the Kleibergen-Paap Wald F-statistic in the IHDS columns. The REDS columns control for the number of siblings, year of birth, birth order and the age gap between the woman and her next-older sibling, and are unweighted. The IHDS columns control for age in 2005, the number of living children and birth order, and are weighted by the 2005 sampling weights. In the REDS columns, the sample comprises women aged 25-40 with at least one older sibling. In the IHDS columns, the sample comprises women who were unmarried and living in their natal household in 2005, left it to marry between the two waves, and have at least one older sibling, in households in which all daughters lived in the household in 2005 and the second daughter was at least 15 years old in 2012. Standard errors clustered at the household level are reported in parentheses.
Source: Own calculations using REDS 2006, IHDS I (2004-05) and IHDS II (2011-12).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In the IHDS, a one-year increase in age at marriage raises the probability of completing tenth grade by 15.9 percentage points and high school by 13.7 percentage points. The corresponding REDS estimates are 12.6 and 5.6 percentage points. Thus, while both datasets suggest that delaying marriage increases educational attainment, the estimated effect on high school completion is considerably larger in the IHDS.

Overall, the IHDS evidence is qualitatively consistent with the main REDS findings: women with next-older sisters tend to marry later, and the resulting variation in marriage timing is associated with higher schooling attainment.