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MINIMUM AGE OF MARRIAGE, DOWRY AND INVESTMENT IN DAUGHTER'S HUMAN CAPITAL: A GAME-THEORETIC EXPLORATION

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Abstract. Despite several legal restrictions, early marriage, especially of women, is a common phenomenon in developing countries like India. This paper constructs a simple game-theoretic model to study the impact of a rise in legal minimum age of marriage for women on the amount parents spend on daughter's human capital. It argues, that if the society values age-related traits of a woman more than her education, then such a legal mandate may increase her dowry expenditure at the time of marriage, which forces poor parents to save more for future dowry by spending less on their daughter's human capital.

1. Introduction

Savitri had lost her husband and her two children when a mysterious disease - possibly cerebral malaria - visited her village. A salishi sabha, village council, had sat in judgement and decided that Savitri had a hand in the plague. They declared her a witch and asked her to pay a hefty fine of two lakh rupees and arrange for a feast for the entire village. Her husband owned two acres of land that were now legally hers. ... Savitri had also committed another crime. When the census people came to her village, they had enlisted her as literate. So here was a woman who could read and write, who owned a plot of land, and who, according to the salishi sabha, had killed her husband and children. As a witch Savitri had three options: to pay up, be killed, or flee. She chose the third option. (Page 117, Dumurdi Vidyashram, Ayodhya Hill)

-From Field Notes from a Waterborne Land, Bengal beyond the Bhadralok, by Parimal Bhattacharya

Often there is a yawning gap between an expected or intended outcome and an actual outcome, when a policy is put in place. This paper examines a loophole in such a situation pertaining to minimum marriage age legislations. How does a rise in mandatory minimum age of marriage affect spending on daughter's human capital? Does it unambiguously lead to positive outcomes for her? This is the question we explore here.

Early marriage among girls is a common phenomenon in the developing world. Women who marry early are subject to lower education and lower labour force participation, less autonomy, little bargaining power and decision making power in the household, higher threat of domestic violence, poorer health and health related risk due to early childbearing (see Jensen and Thornton (2003), Field and Ambrus (2008), McGavok (2021), Chari et al. (2017), Parsons et al (2015) for overall discussions on ill-consequences of early marriage). Because of its negative consequences, governments of several countries have considered some form of minimum age of marriage law for women. [1] This paper shows, that in a dowry-paying society, such a law can actually reduce parents' spending on their daughter's human capital.

This seemingly counter-intuitive result of increasing minimum marriage age leading to lower human capital investment comes through the channel of dowry. Dowry is a payment made by the bride's side to the groom's side at the time of marriage (see Anderson (2007)). As widely shown in the literature, a higher age of marriage of the bride leads to a higher dowry payment at the time of marriage (see, for example, Calvi and Keskar (2021), Field and Ambrus (2008)). Again, an increase in daughter's marriage age due to a rise in legal minimum age of marriage can also increase her education level (Field and Ambrus, 2008).

So, following a rise in minimum age of marriage for women, there might be two effects: first, women can now be more educated at the time of marriage, second, their age at the time of marriage is now higher. However, research shows that son's families prefer younger brides and women's education is rarely valued in the marriage market (Calvi and Keskar (2021), Field and Ambrus (2008), Buchman et al (2021)). Given that, a rise in legal minimum age of marriage makes women less attractive in the marriage market. To compensate for that, they need to pay a higher dowry. Anticipating that beforehand[2], daughters' parents save more for paying the higher dowry[3], and therefore, poor families are forced to spend less on their daughters' human capital.[4]

This is more relevant in the context of the recent Prohibition of Child Marriage (Amendment) Bill introduced by the Indian government to increase the minimum age of marriage for women from 18 to 21, keeping that for men unchanged at 21.[5]

How such a policy might affect human capital investment on girls in a dowry-paying society like India is our issue of interest. A rise in minimum age of marriage will increase age at first marriage for women. Along with that, it can increase their education level as well. But as it is the woman's age which is valued more in the marriage market more than her education, such a law can raise the dowry payment, leading to a reduction in what her family spends on her human capital.

[1]See Arthur et al (2018) for a comprehensive discussion on age of marriage laws worldwide. This paper notes, as of 2013, 168 out of 191 countries had 18 as the general minimum age of girls' marriage. However, various kinds of exceptions were granted in various countries, for example, 99 countries allowed girls to marry before 18 with parental consent.

[2]Daughters' parents do form very good forecasts about future dowry payments that they have to make. See Anukriti et al(2022).

[3]As Anukriti et al(2022) says,"...prospect of higher dowry payments at the time of a daughter's marriage leads parents to save more in advance".

[4]"Dowry payments force parents to disinvest in female human capital" - Anderson (2014).

[5]For a discussion on the proposed bill, see : https://www.thehindu.com/news/national/union-cabinet-gives-nod-to-raise-womens-marriage-age-to-21/article37968276.ece (Accessed on - 01-09-2022)

1.1. **Related Literature.** A number of research papers have documented the impact of a rise in marriage age on various demographic and human capital outcomes of girls. Our paper studies the impact of a rise in legal minimum age of marriage on the amount spent on daughter's human capital. It is most closely related with Field and Ambrus (2008), and Bharadwaj (2015). Both these papers study the impact of a minimum age law on girls' educational outcomes.

There are other papers documenting how an age of marriage law affects various women-specific outcomes other than education. McGavock (2021) finds that age of consent law in Ethiopia causes a reduction in probability of under 16 marriage of girls by 6.8 percentage points relative to the mean at baseline. It also shows that women's total lifetime fertility will be lower as a result of later marriage.

Rokicki (2021) also finds a positive impact of such a law in the Ethiopian context. She shows, implementation of the law was associated with a 9-percentage- point reduction in risk of adolescent birth for exposed cohorts, an 8-percentage-point reduction in child marriage, and a 10-percentage-point reduction in sexual initiation before age 18.

Maswikwa et al (2015) also reveals that minimum age laws were successful in reducing child marriage and early motherhood of teenagers in the context of 12 Sub- Saharan African countries. However, Batyra and Pesando (2021) do not find minimum age at marriage laws very effective.

As mentioned earlier, we are interested in the impact of a rise in minimum age of marriage on investment in daughter's human capital in a dowry-paying society. In this regard, the two papers we find to be most closely related to our work are Field and Ambrus (2008), and Bharadwaj (2015).

Bharadwaj (2015) assesses the impact of Mississippi marriage law, which increased the minimum marriage age for women from 12 to 15 years and for men from 14 to 17 years, on human capital investment and finds an increase in school enrollment of girls. However, marriage market in Mississippi is not characterized by the practice of dowry.

Field and Ambrus (2008) study the impact of a delay in marriage on educational outcomes of girls. In the context of rural Bangladesh, the paper finds that such a delay has positive effects on girls' education. Specifically, they show that a delay in marriage by one year between ages 11 and 16 is associated with 0.22 additional year of schooling. They also find an increase in the use of preventive health measures. This paper discusses the prevalence of dowry in rural Bangladesh. In line with our model, it finds an increase in dowry payment with a rise in bride's age as a consequence of the minimum marriage age law, but it shows improved educational outcomes for girls. Now as mentioned in the paper, Bangladesh had a universal stipend program for girls in the secondary education. Specifically, Bangladesh in 1994 introduced the Female Secondary School Stipend Program (FSSSP) making secondary education free for rural girls (Hahn et al (2017)).

This might have reduced the need for investment needed for education for the age group for which the paper finds an increase in educational outcomes. Here we study how the amount spent on girl's human capital, which is also related with her pre-marriage welfare and her position within family, changes with a rise in legal minimum age of her marriage. So we provide a general framework with dowry and spending on human capital where a rise in age of marriage, associated with a rise in the dowry women have to pay, forces poor parents to cut spending on daughter's human capital, so as to pay for the increased dowry.

Using a simple game- theoretic set-up, we show that a rise in minimum age of marriage for women can force poor parents to actually reduce spending on daughter's human capital, because they now have to save more for paying dowry.

The idea here is that, there can be two dimensions of bride qualities, one is age related, and the other is education related. If the society is such that age related traits are valued more than education related traits , then with a rise in legal minimum age of marriage, a woman will bring less quality to the marriage. To compensate for this lower quality, the woman's family will have to pay a higher dowry. Given that dowry has increased, daughter's parents with income constraint are forced to spend less on their daughter's education.

The rest of the paper is organized as follows: section 2 lays down the model, section 3 discusses the comparative statics results, and section 4 concludes.

2. The Model

> Rows of boxes marked with 'P' tapered off into dots and finally joined to become unbroken red lines. ...
>
> 'You could have met some of the girls missing in the classroom if you had come two weeks ago... They had taken shelter in *my* school. This year we shifted forty-two families. Most have returned home. Now they are busy - repairing the cottages, cleaning up homestead lands, preparing the plots for the robi crop. It's a lot of work. Some have lost their cattle, some have lost everything. Those who don't own land will find no work in the village for the next few months. They'll migrate to other states. These girls shall run the household. A few shall go to towns as housemaids. ... The money they earn will buy them a pair of goats, as investments, or a pair of gold earrings for their wedding. A few of them will never return.'
>
> Every year, according to the National Crime Records Bureau, an average of four thousand girls go missing in West Bengal. Many of them are schoolgoing children.
>
> Sometimes, it all begins with dots in the school's attendance register, that soon join to form unbroken red lines.

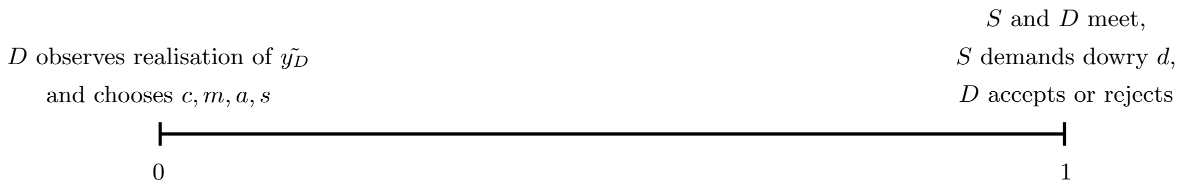

FIGURE 1. Timeline of the game

(Page 33 - 40, A Water Sutra, Ganga Ichhamati, Damodar) -From Field Notes from a Waterborne Land, Bengal beyond the Bhadralok by Parimal Bhattacharya

There are two players, daughter's family, denoted by D, and son's family, denoted by S, and there are two periods, period 1 and period 2.

In period 1, D moves. Let D's income, $\tilde{y_D}$, be random and follow a commonly known distribution. Let y_D be the realised value of $\tilde{y_D}$. This realised value, y_D, is observable only to D and not to S. In period 1, D observes y_D, and then takes decisions on consumption (c), amount to save for paying dowry later on (s), spending on daughter's education (m), and her age of marriage (a).

A possible marital alliance materialises in period 2. In period 2, S and D meet and S demands dowry d. If D accepts, marriage gets realized, otherwise not. We assume that D accepts S's demand whenever the savings that D has, s, is greater than or equal to the dowry demanded, d. The timeline of the game is shown in Figure 1.

So the game we consider here is a sequential game of incomplete information. The equilibrium strategy profile and belief system have to satisfy the two requirements: (i) sequential rationality and (ii) consistency of beliefs with strategies.

Payoffs. D's utility depends on (i) consumption (c), (ii) daughter's education (e), and (iii) her age (a). The daughter's family D derives utility from consumption (c), daughter's education (e), but derives disutility from her age (a). This is a plausible assumption because of the social stigma associated with the presence of an unmarried daughter (see Corno et al, 2020, for example).

Let u_D be D's utility from consumption (c) where $u'_D > 0, u''_D < 0$; As mentioned earlier, m denotes spending on daughter's human capital, and a denotes her age of marriage, which represents her years of education. So her education level e is a function m and a, i.e., $e = e(m, a)$, $e_m > 0$, $e_a > 0$. And let $w(e(m, a), a)$ be D's preference for daughter's education e and her age a. As D gets utility from daughter's education (e), but derives disutility from her age (a), therefore, $w_e > 0, w_a < 0$. Let $\bar{u_D}$ be D's reservation payoff if the match does not occur. Let d^* be the dowry demand made by S in period 2. Also, we assume, in period 1, D can infer the dowry (d^*) that will be demanded by S in period 2.

Now, given the importance of marriage for a daughter's family in a developing country, we assume that whenever D's realised income y_D is greater than S's dowry demand d^* (which D can observe beforehand), D keeps d^* amount for paying dowry, that is, it sets $s = d^*$. And allocates its disposable income ($y_D - d^*$) on consumption (c) and spending in daughter's human capital (m). D's payoff:

$$U_D = \begin{cases} u_D(c) + w(e(m,a),a) & \text{if } \ y_D \geq d^*, \\ \bar{u_D} & \text{otherwise.} \end{cases}$$

When $y_D \geq d^*$, D solves:

$$\begin{aligned} \max_{c,m,a} \quad & U_D = [u_D(c) + w(e,a)] \\ \text{s.t.} \quad & c + m = y_D - d^*. \end{aligned} \tag{1}$$

Now we come to S's payoff. S's utility depends on (i) consumption, (ii) bride's education (e), and (iii) her age (a). Let, u_S is S's utility from consumption with the standard concavity property: $u_S' > 0, u_S'' < 0$. And let $v(e,a)$ captures S's preference for bride's education and age

As mentioned in the introduction, son's families tend to have preferences towards younger brides. We capture this idea by assuming that a higher age of the bride gives a higher disutility to S, the son's family. So we take $v_a < 0$.

S may or may not derive a positive utility from bride's education. An explanation for S having positive utility from bride's education could be due to better outcome for children when they have an educated mother. For example, Buchmann et al (2021) show that children of educated mothers are healthier. However, as Beuchamp et al (2022) show, a higher education of the bride may bring disutility to the groom. To capture both the directions, we assume, v_e can be greater than, equal to or less than 0.

Also, let y_S : S's family income, $y_f(e)$ is bride's income, $y_f'(e) \geq 0$, $\bar{u_S}$ is reservation payoff of S. S's payoff: $[u_S(c) + v(e,a)]$ if marriage occurs, and $\bar{u_S}$ if marriage doesn't occur. S's consumption c equals the total amount of resources available to S that is, $(y_s + y_f(e) + d)$.

So, S's payoff:

$$U_S = \begin{cases} u_S(y_s + y_f(e) + d) + v(e,a) & \text{if marriage occurs,} \\ \bar{u_S} & \text{otherwise.} \end{cases}$$

Now, as mentioned, marriage occurs if $y_D \geq d$, otherwise not. S can not observe y_D, but it is common knowledge that $\tilde{y_D}$ follows a distribution with cdf F. And thus

$$\Pr(marriage) = \Pr(\tilde{y_D} \geq d) = 1 - Pr(\tilde{y_D} < d) = 1 - F(d).$$

So, S's expected utility:

$$EU_s = [u(y_s + y_f(e) + d) + v(e,a)](1 - F(d)) + \bar{u_S}F(d). \tag{2}$$

S maximizes this by choosing d.

2.1. **Analysis.** To solve the model, we start with S's problem:

$$\max_d \quad EU_s = [u_S(y_s + y_f + d) + v(e,a)][1 - F(d)] + \bar{u}_s F(d). \tag{3}$$

Assuming interior optimum, FOC:

$$\frac{\partial(Eu_S)}{\partial d} = 0 \tag{4}$$

$$\implies [\bar{u}_s - (u(y_s + y_f + d) + v(e,a))]F'(d) + [1 - F(d)]u'_S(y_s + y_f + d) = 0 \tag{5}$$

Solving (5), we get the optimum d, d^*. D can foresee this d^* while taking decision. Let $y_D \geq d^*$. So, $s = d^*$. Hence $(y_D - d^*)$ is the disposable income of D. Hence D's problem becomes:

$$\begin{aligned} \max_{c,m,a} \quad & U_D = [u_D(c) + w(e,a)] \\ \text{s.t.} \quad & c + m = y_D - d^*. \end{aligned} \tag{6}$$

$$\implies \max_{m,a} \quad U_D = [u_D(y_D - m - d^*) + w(e,a)]. \tag{7}$$

Now, let, legal minimum age of marriage for women is $\underline{a}$. So, $a = \underline{a} + x$, where $x \geq 0$ denotes a legal marriage and $x < 0$ an illegal one. So, given that there exists legal minimum age of marriage, choosing a is equivalent to choosing x. So, D's problem:

$$\max_{m,x} \quad U_D = [u_D(y_D - m - d^*) + w(e,a)]. \tag{8}$$

Assuming interior solutions for m and x exist, we get the equilibrium m^* and x^* by solving this.

Now as the game here is a sequential game of incomplete information, we have to check whether the equilibrium strategy profile and belief system satisfy sequential rationality and consistency of beliefs with strategies.

For every y_D, D chooses m^* and x^* to maximize its payoff. Given D's choices and the commonly known belief of S about $\tilde{y_D}$, S chooses d^* to maximize its payoff. So the equilibrium

$((m^*, x^*), d^*)$ with belief denoted by the distribution of $\tilde{y_D}$ which is F, satisfies the two requirements of sequential rationality and consistency of beliefs with strategies.

Next we analyse the solutions to derive comparative static results and see how a rise in minimum age of marriage for women affects dowry demand from son's family (S) and consequently human capital spending (m) on the daughter.

3. Impact of a rise in minimum legal marriage age $\underline{a}$

Our main interest is, how a rise in minimum age of marriage ($\underline{a}$) for women affects D's decision on human capital spending (m) on the daughter. So here we consider a rise in $\underline{a}$, and see its impact on the optimal decisions of the players.

As mentioned earlier, we have a two-period set up, where, in period 2 (the period of marriage), son's family S decides how much dowry (d) to ask for, which D, the daughter's family can either accept or reject, depending on whether it can afford the dowry. If D can afford, it always accepts it so as to make the marriage happen, because marriage of a daughter is crucial for her family. So whenever D can afford d , it accepts it, marriage happens, and the players receive their corresponding payoffs, as we discussed in section 2. If D can't afford and thus can't accept the dowry demand d, marriage between this particular D and S fails to happen, and both get reservation payoffs, as mentioned earlier.

Our assumption was that, D can infer d in period 1 itself. So in period 1, taking dowry d payable at the next period as given, D decides how much to save for paying dowry (s), and how much to spend on daughter's human capital (m), and how much to consume (c), and when to get her married (a), which is equivalent to deciding x, where $a = (\underline{a} + x)$, $\underline{a}$ being the minimum legal age of marriage for women. And as mentioned, D always saves exactly the amount d whenever it can afford that.

Given this above set up, now we move to our main objective, which is to see how the human capital spending (m) on the daughter gets affected as minimum age of marriage ($\underline{a}$) is increased.

Now as D's decision making in period 1 takes S's decision (the dowry demand d) in period 2 as given (because D can infer it beforehand), we will first see how such a rise in $\underline{a}$ changes S's dowry demand d, and inferring that change in d beforehand, how D changes its optimal decisions on daughter's human capital spending m. So next we focus on period 2, where S chooses dowry demand d.

3.1. **Period 2.** Let $((m^*, x^*), d^*)$ denote the equilibrium before the rise in $\underline{a}$. Now let minimum legal age of marriage $\underline{a}$ rises ceteris paribus. At the initial equilibrium $((m^*, x^*), d^*)$, such a rise will lead to a ceteris paribus increase in daughter's age at marriage a, where $a = \underline{a} + x^*$. To see how that affects the dowry demand d from son's family (S). That is stated in the following proposition:

Proposition 1. *S's dowry demand d will rise with a rise in D's age a ($\frac{\partial d^*}{\partial a} > 0$) if and only if:*

$$-v_a > v_e e_a - y_f' e_a [(\frac{1 - F(d^*)}{F'(d^*)}) u_S'' - u_S'] \tag{9}$$

That is, if age related traits of the bride are valued sufficiently high relative to her education related traits, then a rise in the bride's age will raise the dowry demanded by the son's family (S).

Proof. In appendix A. ■

The intuition behind the above proposition is as follows:

We look into, how S's demand for dowry (d) changes with a rise in bride's age a. Now as a rises, drawing from the existing literature[6], we can say that S's utility from marriage decreases (in our model, we had $v_a < 0$ to incorporate this fact). However, this rise in age of marriage a can also come with a rise in e, education level of the bride, as we have discussed in the introduction (See Field and Ambrus (2008), for example). And this rise in her education may bring a higher utility to the groom's family S.[7]

Proposition 1 says that the effect of a higher age on dowry demand d will depend on the relative strength of these two effects. One of which, the direct effect of a rise in age a, is negative, and the other, the effect through education e, may be positive[8].

If marginal disutility from a higher age is large enough relative to the marginal utility from education, then the net change in utility of S due to a rise in a will be negative. And in order to overcome that utility loss, it demands a higher dowry.

Observation 1. If labour market opportunities for women are limited such that a higher education doesn't get translated into a higher earning (so that $y_f' = 0$), proposition 1 boils down to the following observation:

[6]This is discussed in the introduction.

[7]Nothing guarantees that bride's education will be a good for S. As discussed in the introduction, it can be a bad also. In order to incorporate this fact, we do not impose any restriction on the sign of v_e. $v_e > 0$ if it is a good, $v_e < 0$, if it is a bad.

[8]If the effect of education e is negative, i.e., $v_e < 0$, then our result holds even more easily.

$\frac{\partial d^*}{\partial a} > 0$ if and only if: $-v_a > v_e e_a$

where $-v_a$ is the absolute value of the fall in utility of S due to a rise in bride's age a, and $v_e e_a$ is the rise in S's utility through a rise in bride's education e when a rises. Given e_a, the above condition holds when S's absolute marginal disutility from age a, $-v_a$ is sufficiently high relative to marginal utility of S from bride's education e. We interpret this as valuation of age-related traits of the bride and her education related traits to the groom's family S.

Given the above discussion on how S responds optimally to a ceteris paribus increase in legal minimum age $\underline{a}$, next we look into how D, observing the change in S's optimum dowry demand that D will have to face in period 2, adjusts its optimum decisions on m, human capital spending on the daughter. So we move to period 1, where D takes decisions on m, x and s.

3.2. **Period 1.** Given that D can infer the dowry d^* and its direction as daughter's age rises, we want to see how a rise in legal minimum age of marriage affects optimum human capital investment (m^*) on the daughter. As discussed, D's problem in period 1 in the case when it can afford the amount d^*:

$$\max_{c,m,a} \quad U_D = [u_D(c) + w(e,a)]$$
$$\text{s.t.} \quad c + m = y_D - d^*.$$
$$\implies \max_{m,a} \quad U_D = [u_D(y_D - m - d^*) + w(e,a)].$$

As mentioned, legal minimum age of marriage for women is $\underline{a}$. So, $a = \underline{a} + x$, where $x \geq 0$ denotes a legal marriage and $x < 0$ an illegal one. So, given that there exists legal minimum age of marriage, choosing a is equivalent to choosing x. So, D's problem:

$$\max_{m,x} \quad U_D = [u_D(y_D - m - d^*) + w(e,a)].$$

Our objective is to see how m^* changes with change in $\underline{a}$. For that, we follow the following two steps: First, we find how m^* changes as a changes.

However, actual age of marriage a may not necessarily increase as minimum legal age of marriage $\underline{a}$ rises. As our objective is to get the effect of a rise in minimum age $\underline{a}$ on m^*, our second step is to examine when a rise in $\underline{a}$ implies a rise in a. So if that condition is satisfied, then a rise in $\underline{a}$ will imply a rise in a, and then, using the sign of $\frac{\partial m^*}{\partial a}$ (obtained in the first step), we can get the impact of a rise in $\underline{a}$ on m^*.

So first, to see how m^* changes as a changes. For that we keep x, and therefore a as given, and solve D's problem stated above. That is, we solve the following problem:

$$\max_{m} \quad U_D = [u_D(y_D - m - d^*) + w(e,a)]. \tag{10}$$

The first order condition:

$$\frac{\partial(U_D)}{\partial m} = 0 \tag{11}$$

$$\implies -u'_D(y_D - m - d^*)(1 + \frac{\partial d^*}{\partial m}) + w_e e_m = 0 \tag{12}$$

Solving, we get the optimum $m^*(a)$ for any given a. From this, we have the following observation:

Observation 2. For any given age a, the optimum investment in daughter's human capital falls as her age of marriage (a) rises ($\frac{\partial m^*}{\partial a} < 0$) under the following assumptions:

(1) $\frac{\partial d^*}{\partial m} > 0$
(2) $w_e e_{ma}$ is not very large, formally,

$$w_e e_{ma} < u'_D(y_D - m - d^*)\frac{\partial}{\partial a}(\frac{\partial d^*}{\partial m}) - (1 + \frac{\partial d^*}{\partial m})u''_D(y_D - m - d^*)\frac{\partial d^*}{\partial a} - w_{ee}e_a - w_{ea}$$

where the RHS is a positive number given the model assumptions.
(3) $e_{ma} > 0$, i.e., as a, years of education rises, marginal increase in education from an increase in m rises.
(4) $w_{ee} < 0$, i.e., as daughter's education e rises, her family D's utility increases at a decreasing rate.
(5) $w_{ea} < 0$, i.e., as the age of an unmarried daughter rises, her family D's marginal utility from her education decreases.

Proof. Using (11), we get:

$$\frac{\partial}{\partial a}[\frac{\partial U_D}{\partial m}] = -u'_D(y_D - m - d^*)\frac{\partial}{\partial a}(\frac{\partial d^*}{\partial m}) + (1 + \frac{\partial d^*}{\partial m})u''_D(y_D - m - d^*)\frac{\partial d^*}{\partial a} + w_e e_{ma} + w_{ee}e_a + w_{ea} \tag{13}$$

It is easy to verify that under the above assumptions, $\frac{\partial m^*}{\partial a} < 0$.

To see when $\frac{\partial d^*}{\partial m} > 0$. To get this we turn to S's problem of choosing optimum dowry demand d in period 2, as given by (3).

From the FOC (5), we get:

$$\frac{\partial d^*}{\partial m} = \frac{F'(d)[(v_e e_m + u'_S y'_f e_m) - (1 - F(d^*))u''_S y'_f e_m]}{[\bar{u_S} - u_S(y_S + y_f + d^*) + v(e, a)]F''(d^*) - 2F'(d^*)u'_S + (1 - F(d^*))u''_S} \tag{14}$$

Again, as d^* is the unique interior maximum, the denominator, which is nothing but $\frac{\partial^2(EU_S)}{\partial d^2}$ evaluated at d^*, is negative.

So, $\frac{\partial d^*}{\partial m} > 0$ if and only if:

$$v_e < [\frac{(1 - F(d^*))}{F'(d^*)} u_S'' - u_S'] y_f' \tag{15}$$

That is, the importance of bride's education in the utility of son's family, which we capture by the marginal utility v_e that S gets from bride's education e, is sufficiently small. Note that the RHS in (15) is a negative number given the model assumptions.

■

Now, to see when a rise in $\underline{a}$ leads to an increase in a. Here we assume, as $\underline{a}$ rises, D can't reduce age further if it already has a very low age of marriage a. So next we examine when or under what condition D has the lowest a, before the policy. So if that condition holds, a rise in $\underline{a}$ implies a rise in a, which in turn implies a fall in m^* (from observation 2), assuming that the assumptions in that observation hold.

We can not proceed further without assuming specific forms for the functions. So next, we consider forms of the functions we have used.

Here we take some standard functional forms:

Let, $u_S(c) = c$,

$v(e, a) = \alpha e - \beta a;\ \beta > 0$

$y_f(e) = \tau e;\ \tau \geq 0$

$u_D(c) = log\ c$

$w(e, a) = \gamma e - \delta a;\ \gamma, \delta > 0$

$e(m, a) = a(1 + m)$. And let y_D follows Uniform distribution over $[\underline{y}, \bar{y}]$

$$EU_S = \frac{(d - \underline{y})}{(\bar{y} - \underline{y})} \bar{u_S} + [1 - \frac{(d - \underline{y})}{(\bar{y} - \underline{y})}][y_S + y_f(e) + d + \alpha e - \beta a]. \tag{16}$$

S maximizes this by choosing d. That turns out to be the following:

$$d^* = \frac{1}{2}[\bar{u_S} + \bar{y} - y_S - (\alpha + \tau)e + \beta a]. \tag{17}$$

So, we get:

$$\frac{\partial d^*}{\partial a} = \frac{1}{2}[\beta - (\alpha + \tau)(1 + m)]. \tag{18}$$

Which is positive when β is sufficiently large relative to α and τ.

Next we have the D's part. D's problem is given by:

$$\max_{m,x} \quad U_D = [log\ (y_D - m - d^*) + \gamma a(1 + m) - \delta a]. \tag{19}$$

We want to derive a condition for having a low age of marriage a, and therefore a low x. For that, we consider any two levels of x, say x_1 and x_0, such that $x_1 \geq 0$ and $x_0 < 0$. So, x_1 is associated with a legal marriage, and x_0 with an illegal one.

Observation 3. $U_D(x_1) \geq U_D(x_0)$ if and only if $y_D \geq \hat{y_D}$. So, there exists a unique threshold of income $\hat{y_D}$ such that daughter's families with income below that will prefer to marry their daughter before the legal age, and vice versa.

Proof.

$$U_D(x_1) \geq U_D(x_0) \iff y_D \geq \hat{y_D}$$

where,

(20)

$$\hat{y_D} = \frac{1}{2}(\bar{u_S}+\bar{y}+y_S)+[1-\frac{1}{2}(\alpha+\tau)a_1][1-\frac{1}{2}(\alpha+\tau)a_0][-1+\frac{X}{\gamma(a_1-a_0)}+\frac{(\beta-\alpha-\tau)}{2}\frac{(a_1+a_0)-\frac{1}{2}(\alpha+\tau)a_0a_1}{(1-\frac{1}{2}(\alpha+\tau)a_0)(1-\frac{1}{2}(\alpha+\tau)a_1)}]$$

where,

$$X = \delta(a_1 - a_0) + log[\frac{1}{\gamma a_0} - \frac{(\alpha+\tau)}{2\gamma}] - log[\frac{1}{\gamma a_1} - \frac{(\alpha+\tau)}{2\gamma}]$$

and $a_1 = \underline{a} + x_1$, $a_0 = \underline{a} + x_0$ ∎

So observation 3 says, if $y_D < \hat{y_D}$, then before the rise in $\underline{a}$, age of marriage a was lower than $\underline{a}$. So, with an increase in the minimum age $\underline{a}$, actual age a will have to be increased. So from observation 2, m^* will fall.

This is our main result which we find combining observations 2 and 3, and it is summarized in the proposition below:

Proposition 2. *As minimum legal age of marriage ($\underline{a}$) rises, daughter's families which have a lower income will reduce their spending on daughter's human capital(m^*).*

4. Conclusion

> In a place where the poverty level was as high as 75 per cent and literacy as low as 20, where the food people grew in their fields barely sustained them for three months a year, a boy or a girl returning home with a bundle of sal leaves or firewood from the jungle was more real, and held more value, than one returning from school. In a place where life was lived from moment to moment, from hunger to hunger, vidya [education] was an obscure investment in a hazy future, Here, the only genuine thing a child brought back from school was tikin mandijom [midday meal] - a quantity of food saved at home, that went to feed another belly. ... 'Many families here with two children will send one to school and the other to the forest ... If it's a girl, they'll keep her at home for household work.' (Page 132 - 133, A Chain Tale, Simlipal)
>
> -From Field Notes from a Waterborne Land, Bengal beyond the Bhadralok, by Parimal Bhattacharya

Literature shows that a rise in minimum age of marriage for women will increase their educational outcomes. However, in a dowry-paying society with women's age-related characteristics valued more than her education, such a policy may lead to an increase in dowry and thus can actually force daughters' parents to spend less on their human capital in order to pay that increased dowry. So we conclude that a policy of an increase in minimum age should be implemented only after taking the social scenario under consideration.

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Appendix A. Proof of proposition 1

Proof of Proposition 1: S's problem:

$$\max_{d} \quad EU_s = [u_S(y_s + y_f + d) + v(e,a)][1 - F(d)] + \bar{u_s}F(d)$$

Assuming interior optimum, FOC:

$$\frac{\partial(Eu_S)}{\partial d} = 0$$

$$\implies [\bar{u_s} - (u(y_s + y_f + d) + v(e,a))]F'(d) + [1 - F(d)]u'_S(y_s + y_f + d) = 0$$

Solving, we get $d^* = d^*(m, a, y_S, \bar{u_S})$. From this:

$$\frac{\partial d^*}{\partial a} = \frac{F'(d)[(v_e e_a + v_a) + u'_S y'_f e_a] - (1-F)u''_S y'_f e_a}{[\bar{u_S} - u_S(y_S + y_f + d^*) + v(e,a)]F''(d^*) - 2F'(d^*)u'_S + (1-F)u''_S} \quad (21)$$

Given d^* is the unique interior maximum,

$$\frac{\partial^2(EU_S)}{\partial d^2} < 0 \tag{22}$$

at $d = d^*$. This is the expression we have here in the denominator, so that is negative.

So, $\frac{\partial d^*}{\partial a} > 0$ if and only if the numerator is negative. i.e.,

$$v_a + v_e e_a < y_f' e_a [(\frac{1 - F(d^*)}{F'(d^*)}) u_S'' - u_S']$$

In other words, $\frac{\partial d^*}{\partial a} > 0$ if and only if v_a (which is negative), is sufficiently high in magnitude relative to v_e. Formally,

$$-v_a > v_e e_a - y_f' e_a [(\frac{1 - F(d^*)}{F'(d^*)}) u_S'' - u_S']$$

where v_a and v_e represents marginal disutility and marginal utility from age and education of the bride respectively. We take these two as representatives of how S values the bride's age and education. Therefore we get the proposition.