

Why Wait?

A Century of Education, Marriage Timing and Gender Roles*

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Abstract

This paper documents that over the last century, U. S. marriage patterns and the gender educational gap followed a non-monotone pattern. Cohorts born around the turn of the 20th century married late and they typically had slightly more educated wives than husbands, although the overall spousal education levels were very low. For cohorts born between the two World Wars, marriages occurred earlier and they involved husbands who were significantly more educated than their wives. Among the later born cohorts, marriages began to occur later and they involved more educated spouses with narrower gender gaps. In order to explain these patterns, we propose a multi-period framework in a frictionless matching model where educational and marriage decisions are endogenous. The two key features of our theory are that marriage requires a fixed entry cost and that married couples cannot study simultaneously. This simple model can replicate the aforementioned stylized facts. We finally present evidence that exogenous delays in marriage age caused by minimum marriage age laws decreased the educational difference between women and men, in accordance to the predictions of our model.

PRELIMINARY, PLEASE DO NOT CITE

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1 Introduction

Age at first marriage has risen dramatically over the last 40 years in many advanced economies, particularly in the United States. However, hardly any attention has been paid to the fact that early marriages actually a recent phenomenon and that individuals at the beginning of the 20th century were marrying at ages similar to the ones reported at the turn of the 21st century. Moreover, this non-monotonic evolution was accompanied by matching changes in educational differences between men and women. Broadly put, periods of late marriage are strongly correlated with women acquiring more education than their spouses. Hence, this paper first carefully documents these facts to then propose a theoretical framework to explain them. It then tests whether exogenous delays in the age of first marriage can lead to a narrower gender gap between husbands and wives, as observed in the data.

We first document through a number of different sources the existence of a pattern that was previously ignored in the economic literature. Numerous papers have emphasized the recent upwards trends in age at first marriage and the reversal of the gender gap in education. Nevertheless, these trends actually came on the back of a similar but opposite evolution that had occurred around the turn of the 20th century. We are able to present these longer-term stylized fact using a number of different sources which, while they all potentially suffer from some bias, give us a similar picture. While the last part of this evolution has been the topic of numerous studies (theoretical models as those of Mullin and Wang 2002, Olivetti 2006, Gustafsson 2001 and Conesa 2002), the initial portion of this pattern has been practically ignored by the literature.¹ Our work thus hopes to provide a unified framework to explain the full pattern and various other stylized facts.

We then develop frictionless matching model in which education, spousal matching, timing of marriage and divorce are all endogenous. According to our theoretical framework, individuals live for three periods. In the first period, they can match with a spouse or choose to remain single. During this period, individuals also decide whether to invest in education. By assumption, while all singles who find it feasible and optimal to invest in education can do so in the first period, only one spouse can get educated if they are married. In the second period of life, all individuals who chose to remain single earlier as well as those who could not afford to marry while young can do so. However, marriage in either period involves a fixed entry cost. At the end of second period, all married couples discover their match-specific quality shocks on the basis of which some couples would divorce and others remain married in the third and final period of life.

Our model predicts homogamy in skills although with some differences in educational matching. In the Census data, we find that 30 percent of Americans over this period married someone with

¹In one rare exception, Parro (2013) does examine the long-term evolution of the gender educational gap in the United States. But he relates it to changes in the labor market only. By contrast, our paper is the first of its kind to link these two patterns together and provide a unified explanation.

exactly the same educational level as their own and 66 percent had a spouse whose highest level of educational attainment was within 2 years of their own. This type of homogamy evolved over time as predicted by our model which also matches the broad stylized facts regarding the educational distribution of men and women.

The key elements that enable our theory to match the empirical regularities are the existence of a fixed cost of marriage and the fact that two spouses cannot both study while married. Our first assumption is particularly salient in the United States where, since the post-colonial times, newlyweds were expected to move out of their parental homes to form their own household (see Shammas, 2002 for a description of U. S. marriage norms until the 20th century). This was also commonly the case in many European societies (Hajnal, 1965). Ruggles (2003) argues that children were often forced to wait until the father would die in order to inherit the property and thus be able to marry. In the Census data, less than 10 percent of newlyweds and 15 percent of young married individuals, live with their parents or parents-in-law. This stands in stark contrast from other cultures where multi-family households are still more the norm than the exception and with youth marriages being prevalent despite limited economic resources. We argue that, as the United States became wealthier and returns to education, in particular for men, increased, fixed costs of marriage became less binding, thereby facilitating younger marriages by the middle of the 20th century. We also argue that this fixed marriage cost was much higher than the cost related to college attendance, for example. A large fraction of individuals attending college historically in the United States continued living with family members, based on the Census data, thus suggesting that “moving out” was related to marriage and not to educational decisions, at least historically.

The other driver of the pattern we document is the inability of spouses to both be studying simultaneously. We argue that when a couple is, in general, living alone, having two studying adults simply does not allow the household to survive. While this assumption is a bit drastic, it does seem to be visible in the data where very few young married adults have both members studying simultaneously. This assumption allows us to explain two different patterns in our time-series evidence. First, it implies that as marriages were procured earlier in the middle of the century, women had to stop their education at an earlier point than before since it was impossible for them to study at the same time as their husband. This can explain the reversal of the educational gap which occurs at the same time as the change in the age at first marriage. Secondly, it also implies that as the returns to education for women increased in the second half of the twentieth century, age at first marriage had to rise again, despite relative low costs in marriage since women would not be able to acquire education at the same time as their spouses were they to marry earlier.

Having established this framework, we then turn to further exploring our data to provide more empirical justification of the mechanisms we propose. We find two additional facts that support our framework. First, the decrease in marriage age in the middle of our period occurs more strongly

from men with high school and university education, as would be the case if these are the men that can reap the benefits of an early marriage. Furthermore, we also find that the increase in educational attainment is particularly marked for married men compared to their unmarried counterparts.

Secondly, because of land values, the fixed cost of marriage may have been higher in urban areas than in rural areas. Land, after all, was relatively cheap in most rural areas of the US in the early part of our period. We observe that this matches the fact that urban dwellers married later than their rural counterpart. Furthermore, it is particularly in urban areas that the fall in age at first marriage correlates strongly with an increase in the male-female educational gap, suggesting that earlier marriages through lower fixed cost, led to males being more educated than their spouses.

Finally, we use laws which limited the age at which teenagers could marry in the US to estimate a causal effect of being forced to delay marriage on educational decisions. While these laws have been previously employed as a source of exogenous variation (Dahl, 2010; Rotz, 2011) for women, we extend the samples to laws that affected males and females and also included a much wider time period. We find evidence that these laws affected the age at which teenagers were able to wed and also appear to have caused a decrease in the absolute difference in education of spouses, as predicted by our model.

Previous papers have tried to explain how partners select each other based on their human capital. The seminal work of Becker (1973) emphasized that marriages are formed when the surplus generated by the union is larger than the sum of what each partner could earn in a different pairing or while remaining single. This simple result also explained that if there are complementarities in the household production function such that the return to being high-skilled increases with the skill of one's spouses, one should observe positive assortative matching, that is males and females of similar skill levels should be married together. Similarly, if there are returns to specialization, the opposite pattern should be observed and high-skill men should focus on their work outside of their house while their low-skill partner should provide child-rearing and household services. This type of result will be the basis for our approach such that, at early periods in life, returns to specialization may exist but disappear as individuals (and their children) age. This could explain that the type of matches sought after by individuals who marry at a young age may be very different from those who marry at a later age. Zhang (1995) argues that marriage age is differently correlated with men's wage depending on whether their spouse is working or not, suggesting that marriage age and specialization may be related.

Most matching models take the education decisions of spouses as fixed and thus do not explore the interaction between the educational decision and the matching process. Konrad and Lommerud (2000) propose a 2-period model where the educational decision is taken non-cooperatively in the first period and then couples bargain in the second. They show that this may lead to spouses overinvesting in their education. Chiappori, Iyigun and Weiss (2009) show that differences in the

returns to education in the labor market and in specialization in the household may lead to males and females electing different levels of education and obtaining different shares of household surplus. Iyigun and Walsh (2007) and Lafortune (2013) study the impact of skewed sex ratios on educational investment of males and females. While all these papers link marriage markets and human capital, in none of these work is the possibility that spouses can coordinate their investment decisions if they marry early enough.

Other explanations have been provided for delaying marriage. Bergstrom and Bagnoli (1993) argue that delaying marriages may allow high quality males the time to reveal their type and as such, capture more attractive young women (as women's attribute, beauty, is easily observable by the market). Oppenheimer (1988) takes a similar approach to argue that the recent delay in marriage age of females is related to the fact that their "quality" now needs more time to be revealed as their labor market success becomes more and more relevant for their spouse. Diaz-Gimenez and Giolito (2013) focus on the age differences between spouses and not the changes in levels.

Empirically, the impact of timing is difficult to estimate as it is a decision that agents undertake. Thus, if one compares simply individuals who marry early and late, the difference in later outcomes may very well depend on the fact that some underlying characteristic induced both the timing of the marriage and other things. For example, studies have documented the recent rise in marriage ages and the simultaneous changes in labor supply, fertility and matching patterns (Goldstein and Kenney 2001, Qian 1998 and Oppenheimer et al. 1997). In the United States, early marriages have been correlated with many negative outcomes (Kalmuss and Namerow 1994, Martin 2004 and Kiernan 1986). For example, married teen mothers are 40 percent more likely to have a second birth within 24 months of their first birth compared to unmarried teen mothers. Women who marry before the age of 19 are 50 percent more likely to drop out of high school and four times less likely to obtain a college degree (Klepinger et al. 1999). In developing countries, youth marriages are considered particularly problematic for girls. Jensen and Thornton (2003) provide an overview of the various problems that are associated with younger marriages: lower schooling, less reproductive control, higher rates of pregnancy-related mortality and domestic violence.

However, it is unclear whether any of these correlations also translate in causal channels as our model would imply. The only available causal estimate is provided by Field and Ambrus (2008). This paper uses variation in the age at menarche in Bangladesh as an instrument for age at first marriage of women. They find that a delay in the age of marriage for females decreases fertility, increases their schooling and literacy level as well as the quality of their marital life.

Finally, given how close the topic of study is to other fields in social sciences, the literature from other disciplines must also be considered. Martin (2004) and Martin (2000) argue that the delay in average age at first marriage differs by educational status of the woman: high-skill women are postponing marriage while low-skill women are simply foregoing it. This is also the result of

forecasts by Goldstein and Kenney (2001). Bitter (1986), using responses of married couples in an interview, argue that late marriages are more likely to involve heterogeneous spouses than earlier ones and that once this is controlled for, late marriages are more stable. Qian (1998) studies the patterns of assortative mating by age and education and how these changed between 1970 and 1990 in the United States. It finds that later age at union promotes stronger educational homogamy, as would be generated by our framework. Oppenheimer et. al (1997) argue that marriage delay is more likely among men of race/schooling groups which experience higher career transition difficulties.

The rest of our paper is organized as follows: Section 2 documents the cross-sectional and the time-series patterns of educational difference and age at first marriage in the US over the last century. Then, 3 presents our theoretical framework. Section 4 explores some other empirical implications of our framework. Section 5 uses legal changes in marriage laws over this period to demonstrate that our previously documented correlations also appear to be causal. Finally, our last section concludes.

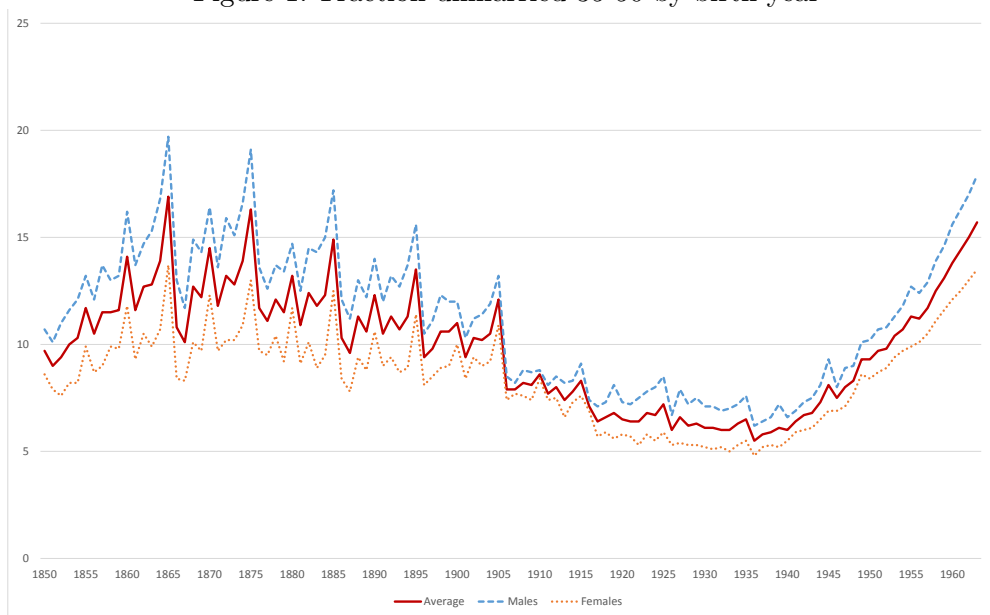
2 Stylized Facts

This section tries to detail the stylized facts we wish to document and the basic correlations we can observe in the data.

2.1 Age at First Marriage

Demographers have previously studied the long-term trends in marriages in the United States. They have argued that this long-term perspective provides a different conclusion to the one that have been offered by looking only at the last 50 years of data. In particular, in an unpublished working paper of the Census Bureau, Elliott et. al (2012) present the fraction of individuals married in Censuses from 1890 to 2010 to argue that instead of being the current period that shows a decrease in the “culture of marriage”, it is the middle of the century that should be seen as an outlier in how early and how much individuals marry. However, the economic literature has remained mostly quiet on this topic, focussing instead on the second half of the “U-shaped” curve for age at first marriage over this period. To demonstrate that this pattern is present, we will focus on the prevalence of marriage and the age at first marriage by cohorts of births. This is because looking at marriage years or census years can confuse the issue of when the marriage occurred and by whom. To study this, we use data from decennial censuses and the American Community Survey from 1850 to 2013 (Ruggles et. al, 2010). We classify individuals based on their year of birth by subtracting their age from the year of the census since the year of birth is not always specifically reported. We know the current marital status of individuals in the Census of 1880 to 2013. We first

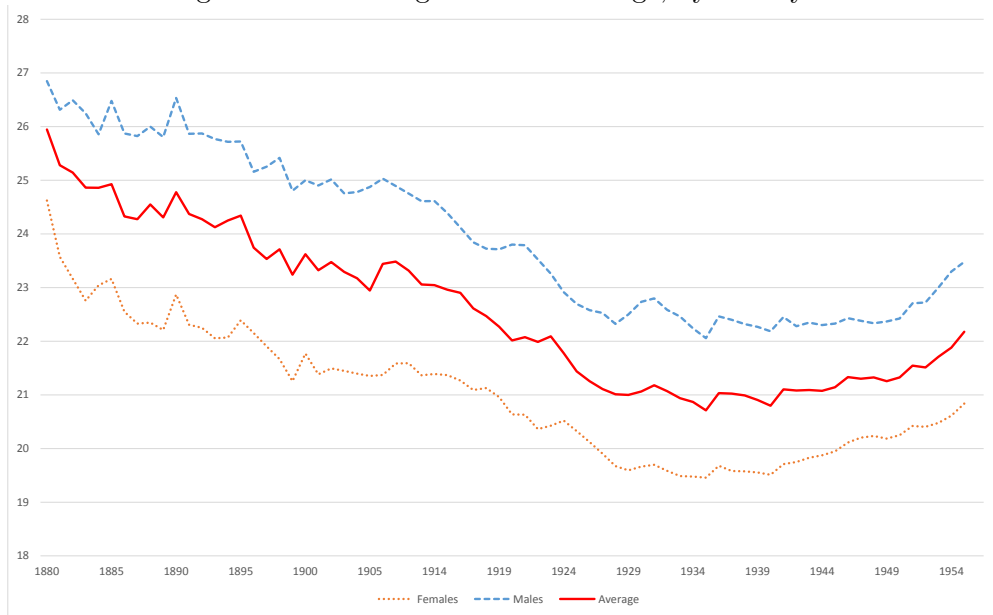
Figure 1: Fraction unmarried 35-50 by birth year



present, in Figure 1, the fraction of individuals aged 35-50 (to avoid problems linked to selective mortality) who have never been married by birth cohort. We restrict our cohorts to those born between 1850 and 1963 given that those are the ones for which we observe individuals over the full range of ages. The figure provides a striking pattern. Individuals born before 1905 had a rate of non-marriage well above 10 percent. This falls for cohorts born between 1905 and 1950 to values closer to 7-8 percent and it is only for cohorts born in 1955-1960, the last of the baby-boomers, where the proportion of unmarried individuals return to the levels observed for the 60 first years of our sample. Throughout this period, the number of women who remain single is strictly smaller than that of men and both genders follow a very similar trend over time. The noisier pattern for the earlier cohorts is due to the fact that we have only decennial information for them, which implies that each cohort is observed at a different age which explain the cyclical pattern displayed. The recent cohorts are observed annually in the ACS which makes the pattern smoother.

If we want to particularly study the age at which individuals marry for the first time, we are slightly more limited in terms of data because the question of when was the first marriage contracted is only asked in the Censuses of 1930, 1940 (only for women), 1960, 1970 and 1980. Furthermore, we face a severe problem in terms of sample selection. All individuals unmarried do not answer this question. To try to solve this problem but continue to include as many cohorts as possible, we use the following strategy. We take only individuals aged 20-50 in each census. We then take all the individuals born in one year and measure at what aged married the 50th percentile of the distribution, assuming that all individuals who have not answered would marry after that median (or not marry at all). Thus, the median age at first marriage we report is not, as usual, conditional

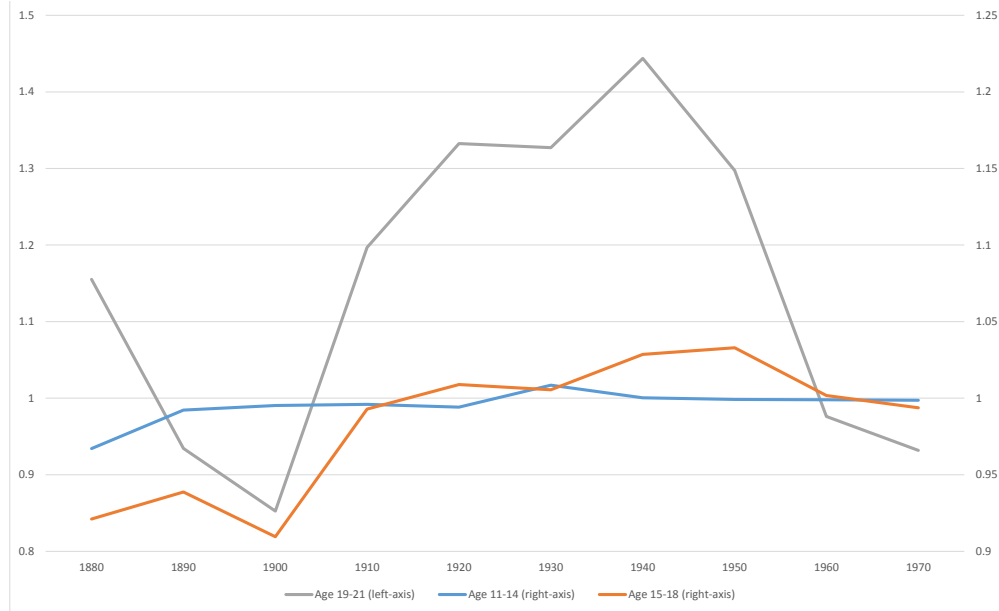
Figure 2: Median age at first marriage, by birth year



on marriage but corresponds to the age at which 50 percent of the cohort has tied the knot. Despite the difference in measurement, Figure 2 suggests that the pattern we observed about the fraction of individuals who did not enter into a marriage is the reflection of a similar pattern in the age at which individuals first married. For cohorts for which we have information, the tendencies are remarkably similar. From 1880 to 1929, cohorts married at a younger and younger age. While we are unable to study the trend for the most recent cohorts, there seems to be, like in the case of the fraction unmarried, a tendency towards an increase in the median age at which individuals marry. And again, the most recent cohorts are in no way very dissimilar to patterns observed around the beginning of the 20th century. It is remarkable to think that for cohorts born around the Great Depression, more than 50 percent of the cohort was already married by age 20 for girls and 23 for boys. The cohort born in 1880, on the other hand, had only seen 20-25 percent of its individuals marry that early.

We have corroborated this pattern in a number of alternative sources. For example, the Vital Statistics compiled by year of marriage shows the median age at marriage falling for marriages performed in the 1950s and 1960s compared to those in the 1920s and 1930s to then start rising again for marriages in the 1970s and 1980s. This matches the pattern observed by cohorts very well.

Figure 3: Male to female ratio in fraction enrolled in school by age, by decade of birth

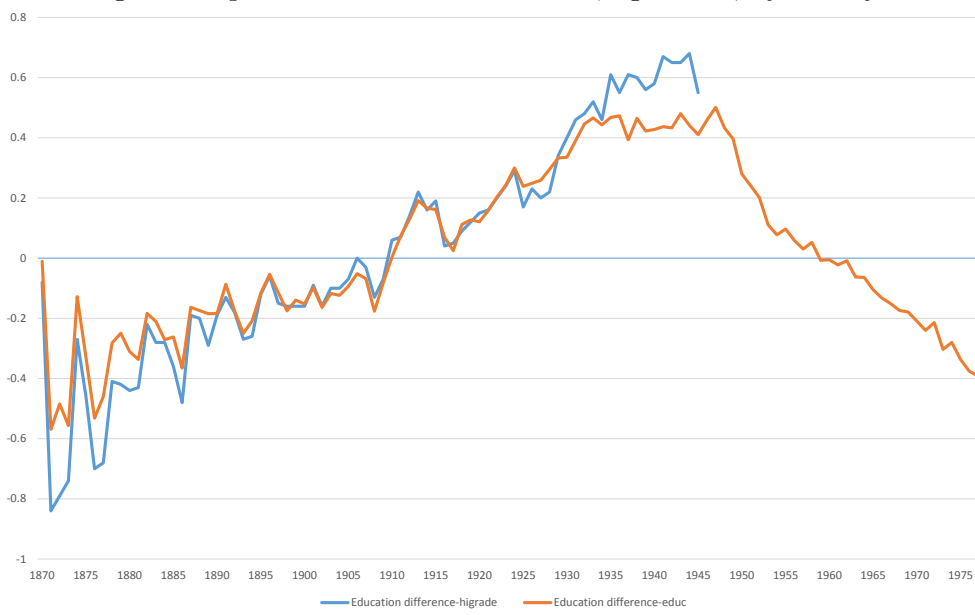


2.2 The Education Gender Gap

At the same time as the age at first marriage evolved as described before, cohorts also experienced some significant changes in the educational attainment they obtained. Over this full period, educational attainment is increasing for men and women but what is interesting is how their increased attainment evolves as compared to the other gender. Figure 3 presents the fraction of a cohort that reports in the decennial census being “in school”. This is a problematic definition as it is unclear exactly what it involves and that this definition has changed over time. However, it is the only definition that allows us to study the educational patterns for this cohort without potentially having problems with survival biases. The results are showing that there is a clear inverse-U relationship over this period in the male-female ratio in school attendance, indicating that in the same time period as younger marriages became the norm, men started attending school more than women, in particular for age groups 15-18 (high school) and 19-21 (college). The pattern is particularly marked for college attendance. It is interesting to note that for cohorts born around the turn of the twentieth century, despite the fact that women participated much less in the labor market than today, women were attending school more regularly than men, at least at the high school level.

To measure actual educational attainment, we are limited by the fact that education only enters the US Census in 1940. However, if we are willing to make the assumption that mortality rates do not significantly affect the differential pattern of education by gender, we obtain Figure 4. This graphic presents the difference in average educational attainment of married males compared to

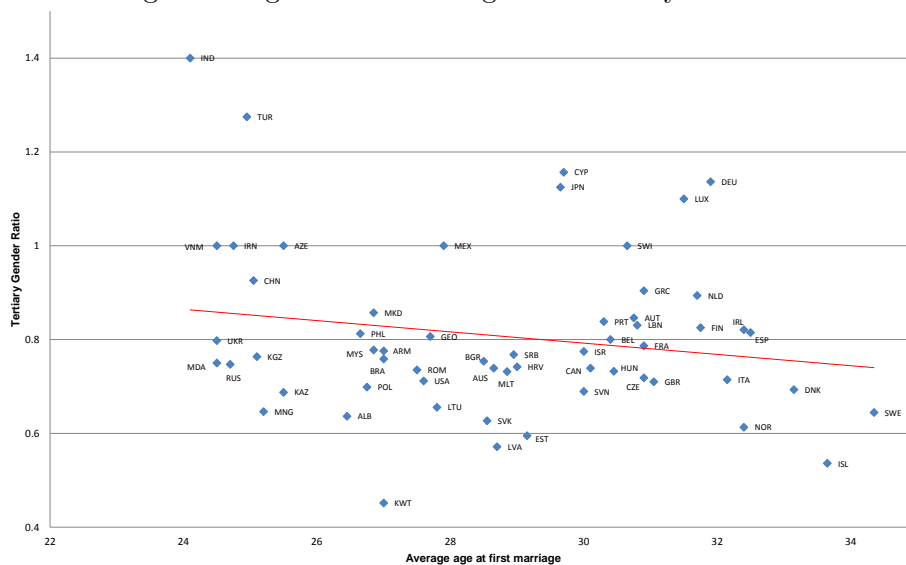
Figure 4: Spousal educational difference, age 35-79, by birth year



that of married females for individuals aged 35-79. It displays two different measures of maximum grade attained, as there are two different alternatives available in IPUMS. “Higrade” is more precise at very low levels of education while the opposite is true for “Educ”. No matter which measure is employed, however, the inverted U-shape pattern is again obvious. It suggests that only for cohorts born between 1905 and 1955 was it the norm that men would be more educated than their spouse. For cohorts born before that period, men were less educated than women. A similar pattern is obtained for unmarried men and women which suggest that what is driving this pattern is not that who marries has changed dramatically over this period, although it is true that high skill women today have a higher probability of marrying than previously, something we will come back to later on.

While this pattern appears in the two measures we have presented so far, one could be worried that these are biased by the fact that we only observe individuals’ education later in their life. Unfortunately, we do not have any other measures of education of the US population before 1940. However, the state of Iowa conducted a Census in 1915 which included the number of years of education attained. For that particular state, our pattern appears to be confirmed. In 1915, there were more women of school-age who attended high or preparatory school or college than men. For those above school age, there were a much larger number of women who attended high school or preparatory school and only a slightly larger number of men than of women who attended college. Using the table provided by the census, we would conclude that men above schooling age on average had about 8.3 years of education while women had 8.6 years, consistent with the cohort results

Figure 5: Age at first marriage and Tertiary Gender Ratio



presented earlier. While this is one simple state that is clearly not representative of the United States, the fact that the results obtained in that one Census matches more or less the results presented above gives us more confidence that the pattern we presented here is not driven by some error in misreporting or bias due to differential survival probabilities, for example.

2.3 Correlations

The graphs presented above thus suggested that in the case of the US, there is a negative correlation over time between the age at which individuals marry and the gender gap in educational attainment. This is confirmed at the micro level. A simple regression of the difference in educational attainment by spouses on the age at first marriage suggests that marriages that are contracted earlier are less homogamous. Furthermore, the source of the difference is that men are more educated than their spouse when the marriage is contracted earlier. We also document that this correlation exists in cross-national data. Figure 5 presents the correlation between the tertiary gender gap and the average age at first marriage in a number of countries. There is clearly a downward correlation that can be observed between the two variables. While these are simple correlations, they suggest that while the level of education and the age at first marriage may have an interesting correlation and causal link, there is also evidence that the educational gender gap and age at first marriage are related and this is what our model will next attempt to explore.

3 The Model

The economy is made up of individuals who live for three periods. There exists a continuum of men and a continuum of women. The measure of men is normalized to unity and, that of women to r , where $r \geq 1$.

3.1 Endowments, Preferences & Matching

In each period, individuals derive utility from consumption. In addition, married individuals derive satisfaction from the quality of their match; i.e., individual utilities take the form

$$U^i = u^i + \theta, \quad i = m, f \tag{1}$$

where u^i and θ denote respectively the monetary and non-monetary components of individual utility.

The Non-monetary Component Individuals can match and marry at the beginning of the first or the second period, although each person can choose to remain single. Marriage involves a fixed cost of F , $F > 0$.

At the beginning of the third and final period, marriage match qualities are revealed.² For any couple, match quality θ is drawn from a distribution Φ with mean zero; that is, each spouse derives the same utility from marriage match quality once it is revealed.³ Once the match quality is revealed, couples can either stay together or divorce in the final period, depending on their marriage match quality. We assume that divorcees cannot remarry.⁴

The Monetary Component Individuals are born with an idiosyncratic (raw) efficiency units of labor endowment, y_1 for men and z_1 for women. The first-period raw endowments of men, y_1 , are distributed over the support $[y_{\min}, y_{\max}]$, $0 < y_{\min} < y_{\max}$, according to some distribution G . Similarly, the first-period raw endowments of women, z_1 , are distributed over the support $[z_{\min},$

²Match qualities are revealed in the third period for keeping the analysis tractable.

³Hence, marriage match quality, θ , is couple specific and does not vary by spouse. If our model were extended so that marriage match quality were individual specific, then our main conclusions would remain intact although such an extension could introduce other interesting aspects of marital matching, spousal allocations and divorce not covered below.

⁴We make these simplifying assumptions to keep our model tractable, although our main qualitative results would still hold if individuals could remarry or different match qualities were revealed at the end of each period of marriage. For further details on remarriage and non-transferable utilities, for example, see Chiappori, Iyigun, Lafortune and Weiss (2014) Chiappori, Iyigun and Weiss, (2008, 2015).

$z_{\max}]$, $0 < z_{\min} < z_{\max}$ according to the distribution \tilde{G} . If individuals choose not to get educated, we assume that their efficiency units of labor can still potentially grow in the second period due to experience or wisdom of age. Hence, the efficiency labor endowments of men and women in the second period respectively equal y_2 and z_2 such that $y_2 = xy_1$ and $z_2 = xz_1$, where $x \geq 1$.⁵

Individuals may choose to get educated in the first period at a cost of c , $c > 0$, per person. We let the education premium be gender specific and denote it by e_i , $i = m, f$, such that $e_i \geq 1$. For educated individuals, the efficiency units of labor endowment equal e_i times their unaugmented labor endowments in each period after they get educated, with the latter being determined as we discussed immediately above. On that basis, the potential per-period incomes (defined as the labor income that would be generated if all available time was devoted to market work) are given directly by the efficiency units of labor endowments.⁶

Single individuals can get educated in the first period provided that it is feasible and optimal. However, we assume that education gets prohibitively costly for married couples if both spouses find it optimal to acquire education. Hence, among the married young couples, who get together in the first period, only one of the spouses can get educated.

Consider a man with a potentially augmented endowment of y who is matched with a woman with an endowment of z . In any given period, the ‘marital production’ technology is given by $h(y, z)$, with the monetary components of individual utilities, u^m and u^f , satisfy

$$u^m + u^f = h(y, z) \equiv \eta(y + z)^2 \quad \eta \geq 1. \quad (2)$$

If a man with an endowment of y remains single, his intra-temporal output is given by $f_m(y) \equiv y^2$ and if a woman with an endowment of z remains single, her intra-temporal output is given by $f_f(z) \equiv z^2$.⁷

Given the specification in (2), note that utility is transferable both between married spouses and divorced ex-spouses, a property that drastically simplifies our analysis.⁸

⁵We further assume no additional growth due age or experience in the third and final period. Hence, $y_3 = y_2$ and $z_3 = z_2$.

Also note that, unless the discussion warrants reference to endowments in any given specific period, we shall generically denote the labor-income generating endowments of men and women — which, over time could be augmented due to age and education as explained above — as y and z , respectively (and hence without the time subscripts).

⁶By normalizing the wage rate to one for both genders, we are, in effect, folding the gender wage gap into the structural differences in the efficiency units of labor endowments of men and women. We do this mainly for expositional simplicity but also because it is inconsequential for our main theoretical and empirical results.

⁷Alternatively, these payoffs could be linear in the endowments, as they are assumed to be in some other papers, such as Chiappori, Iyigun and Weiss (2015), although the qualitative nature of our conclusions below do not rest on either specification.

⁸See Chiappori, Iyigun and Weiss (2015) for a precise investigation of the transferability issue.

Based on equation (2), *the marital output function $h(y, z)$ is super-modular*, i.e. that $\partial^2 h / \partial y \partial z = h_{yz}(y, z) > 0$. The essential feature of the problem is the interaction in the traits that a couple brings to marriage. For instance, when income/endowment is the only important trait and the couple shares a public good, spousal endowments are complements in marital production.

It follows that

$$\begin{aligned} h_y(y, z) &= 2\eta(y+z) \geq h_y(y, 0) = 2y, \\ h_z(y, z) &= 2\eta(y+z) \geq h_z(0, z) = 2z. \end{aligned} \tag{3}$$

Therefore,

$$\begin{aligned} h(y, 0) &= \int_0^y h_y(t, 0) dt \geq y^2, \\ h(0, z) &= \int_0^z h_z(0, t) dt \geq z^2, \end{aligned} \tag{4}$$

and

$$h(y, z) = h(0, z) + \int_0^y h_y(s, z) ds \geq y^2 + z^2. \tag{5}$$

We conclude that for any couple the marital surplus is positive and increasing in the endowments of both spouses.

3.2 Divorce

At the beginning of the third and final period, marriage match qualities are revealed for all couples who have married in the previous two periods, and couples divorce if their realizations are too low. Specifically, the total utility derived in the final period if the couple remains married is $\eta(y+z)^2 + 2\theta$ where the endowments y and z are the effective endowments of a man and a woman (i.e., as described above, y and z are augmented via experience over time and potentially through education as well).

In our context, while the distribution of assets between divorced spouses depends on the legal system, the *total* surplus does not. Indeed, in both cases, it is equal to $y^2 + z^2$. Our model thus satisfies the ‘Becker-Coase theorem’ property that divorce legislation influences the distribution of welfare after divorce but not its incidence.⁹ In particular, divorce occurs ‘efficiently’ when the total surplus generated outside the relationship is larger than what can be achieved within it. Formally,

⁹See Becker et al (1977). This property is obviously due to the transferable utility property assumed here. See Chiappori et al (2015) for a precise investigation.

divorce obtains if

$$\eta (y + z)^2 + 2\theta < y^2 + z^2 , \quad (6)$$

hence, if

$$\theta < \bar{\theta} (y, z) \equiv -\frac{1}{2}[(\eta - 1)(y^2 + z^2) + 2yz] . \quad (7)$$

On this basis, the ex-ante probability of divorce for a couple with the endowments of y and z is

$$\alpha (y, z) \equiv [\Phi \bar{\theta} (y, z)] . \quad (8)$$

In summary, the couple (y, z) generates the output $\eta (y + z)^2$ in the period(s) during which they are married. They stay married in the third period if the realization of the match quality is larger than the threshold $\bar{\theta}$ — an event of probability $1 - \alpha (y, z)$. If (y, z) stay together, they still produce $\eta (y + z)^2$ in the third period. In addition, they each get a positive utility from their marriage match quality, equal in expectation to $E \{ \theta \mid \theta \geq \bar{\theta}(y, z) \}$.

Divorce occurs with probability $\alpha (y, z)$ in which case the total product of the separated couple as singles equals $y^2 + z^2$. In our setting, divorce is a corrective mechanism that enables the dissolution of bad matches. In other words, the possibility of divorce unambiguously increases welfare. Following separation, we assume that the divorce legislation is neutral so that there aren't effectively any income transfers (i.e., alimony payments) between the ex-spouses. In particular, we let the efficiency labor endowments of men and women equal their endowments without any redistribution. Consequently, the husband retains his augmented second-period endowment y , thus generating $f_m (y) \equiv y^2$ upon divorce, and the wife keeps her augmented second-period endowment z , thereby producing $f_m (y) \equiv z^2$.¹⁰

3.3 Expected Lifetime Utilities

We now turn to the marriage market outcomes and the description of maritally sustainable intra-household allocations.¹¹

¹⁰More generally, one could denote by β the share of endowments from which women can draw their incomes in divorce. Then, assuming that these transfers are fully determined by law and no further voluntary transfers are made, if a man with income y marries a woman with income z in the first period, her income following separation would be $z^D = \beta(y + z)$ and his income would be $y^D = (1 - \beta)(y + z)$. Thus the net income of a 'divorced' person would generally be different from what his or her income would have been had he or she not paired up. When the divorce legislation is not redistributive as we assume here, all incomes are considered private so that β that is couple-specific, namely $\beta \equiv \frac{z}{y+z}$.

Also, note that, given that we abstract from savings and the accumulation of human capital, the distinction between the post-divorce division of property and alimony payments is mostly semantic here. But one can interpret the variables y^D and z^D as the stream of incomes generated from the (underlying) assets of the couple which were redistributed according to the alimony laws that apply in legal separation.

¹¹See Browning-Chiappori-Weiss (2003) and Iyigun-Walsh (2007) for two related perspectives.

If an uneducated man and an uneducated woman get married when young (i.e., in the first period), the expected marital sum of utilities generated over the three periods by Mr. y and Mrs. z can be computed as follows:

$$\begin{aligned}
S(y, z) = & \eta(1+x^2)(y_1+z_1)^2 + \alpha(xy_1, xz_1)x^2(y_1^2+z_1^2) - F \\
& + [1 - \alpha(xy_1, xz_1)] \left\{ \eta x^2 (y_1 + z_1)^2 + 2E [\theta \mid \theta \geq \bar{\theta}(xy_1, xz_1)] \right\} \quad (9)
\end{aligned}$$

Instead, if an uneducated man and an uneducated woman get married in the second period, then expected marital sum of utilities generated over the three periods by Mr. y and Mrs. z would be as follows:

$$\begin{aligned}
S(y, z) = & [1 + \alpha(xy_1, xz_1)x^2](y_1^2+z_1^2) + \eta x^2 (y_1 + z_1)^2 - F \\
& + [1 - \alpha(xy_1, xz_1)] \left\{ \eta x^2 (y_1 + z_1)^2 + 2E [\theta \mid \theta \geq \bar{\theta}(xy_1, xz_1)] \right\} \quad (10)
\end{aligned}$$

A couple could marry young and one of the spouses could get educated when married. Then,

$$\begin{aligned}
S(y, z) = & \eta(y_1+z_1)^2 + \eta x^2 (e_m y_1 + z_1)^2 + \alpha(e_m x y_1, x z_1)x^2((e_m y_1)^2 + z_1^2) - F - c \\
& [1 - \alpha(e_m x y_1, x z_1)] \left\{ \eta x^2 (e_m y_1 + z_1)^2 + 2E [\theta \mid \theta \geq \bar{\theta}(e_m x y_1, x z_1)] \right\} \quad (11)
\end{aligned}$$

would apply for couples who marry young and among whom only the husband is educated. An analogous expression would apply for couples married young and among whom only the wife is educated:

$$\begin{aligned}
S(y, z) = & \eta(y_1+z_1)^2 + \eta x^2 (y_1 + e_f z_1)^2 + \alpha(xy_1, e_f x z_1)x^2(y_1^2 + (e_f z_1)^2) - F - c \\
& + [1 - \alpha(xy_1, e_f x z_1)] \left\{ \eta x^2 (y_1 + e_f z_1)^2 + 2E [\theta \mid \theta \geq \bar{\theta}(xy_1, e_f x z_1)] \right\} \quad (12)
\end{aligned}$$

By extension, one would get similar expected lifetime marital sum of utilities when considering the union of educated couples or mixed-education couples. In particular,

$$\begin{aligned}
S(y, z) &= y_1^2 + z_1^2 + \eta x^2 (e_m y_1 + e_f z_1)^2 + \alpha (e_m x y_1, e_f x z_1) x^2 ((e_m y_1)^2 + (e_f x z_1)^2) - F - 2c \\
&\quad + [1 - \alpha (e_m x y_1, e_f x z_1)] \left\{ \eta x^2 (e_m y_1 + e_f z_1)^2 + 2E [\theta \mid \theta \geq \bar{\theta}(e_m x y_1, e_f x z_1)] \right\} \quad (13)
\end{aligned}$$

would apply for couples who marry late and among whom both spouses are educated;

$$\begin{aligned}
S(y, z) &= y_1^2 + z_1^2 + \eta x^2 (e_m y_1 + z_1)^2 + \alpha (e_m x y_1, x z_1) x^2 ((e_m y_1)^2 + z_1^2) - F - c \\
&\quad + [1 - \alpha (e_m x y_1, x z_1)] \left\{ \eta x^2 (e_m y_1 + z_1)^2 + 2E [\theta \mid \theta \geq \bar{\theta}(e_m x y_1, x z_1)] \right\} \quad (14)
\end{aligned}$$

would apply for couples who marry late and among whom the husbands are educated;

$$\begin{aligned}
S(y, z) &= y_1^2 + z_1^2 + \eta x^2 (y_1 + e_f z_1)^2 + \alpha (x y_1, e_f x z_1) x^2 (y_1^2 + (e_f x z_1)^2) - F - c \\
&\quad + [1 - \alpha (x y_1, e_f x z_1)] \left\{ \eta x^2 (y_1 + e_f z_1)^2 + 2E [\theta \mid \theta \geq \bar{\theta}(x y_1, e_f x z_1)] \right\} \quad (15)
\end{aligned}$$

would apply for couples who marry late and among whom the wives are educated.

Note, first, that $S(y, z) > 3(y^2 + z^2) = (1 + 2x^2)(y_1^2 + z_1^2)$ in all of the above cases. Hence, all individuals prefer to get married rather than stay single as long as they can cover the fixed cost of doings so. Under realistic parameter restrictions, it is straightforward to show that $\partial^2 S(y, z) / \partial y_1 \partial z_1 \geq 0$ in all cases. Thus, individuals will sort positively in the marriage market in both periods.¹²

3.4 Marital and Educational Choices

Depending on the labor endowments, y and z relative to the parameterization of the cost of and the returns to marriage (F and η), the returns to experience (x), and the cost of and returns to education ($c_i, e_i, i = m, f$), there are five scenarios on which we shall focus involving each couple:

¹²See Chiappori, Iyigun and Weiss (2015) for a complete proof.

1. $\eta(y_1 + z_1)^2 \geq F$: For a young couple whose endowments (y_1, z_1) are high enough relative F , marriage at a young age is feasible. For such couples, then, the choice is between delaying marriage so that both spouses can get educated and marrying young with one or none of the spouses getting educated. The expected lifetime payoffs to each of those cases are respectively given by (13), (11), (12) and (9).

- (a) If the returns to education are sufficiently low for both men and women, then it is straightforward to verify that (9) would strictly exceed other payoffs in which one or both of the spouses get educated.¹³ The reason is that the cost of delaying marriage, which equals forgone marital gains, exceeds the benefit of it, which equals the education premia. In this case, the couple would marry young and choose not to get educated.
- (b) If, by contrast, the returns to education for men or women are sufficiently high, then it is straightforward to verify that (11) or (12) would strictly exceed the other lifetime payoffs in which both or none of the spouses get educated. In this case, the gains from education for one spouse is high enough for him or her to get educated, although they aren't sufficiently high for both spouses to delay marriage and get educated. Under this scenario, the couple gets married young and one of the spouses gets educated while married.¹⁴
- (c) Finally, if the returns to education are high enough for both men and women, then (13) would strictly exceed all other expected lifetime payoffs. Now, the cost of delaying marriage, which equals forgone marital gains, is lower than the benefit of it, which accrues with both men and women getting educated. Thus, in this case, the couple delays marriage and gets educated when young and marries later in life.

2. $\eta x^2(y_1 + z_1)^2 \geq F > \eta(y_1 + z_1)^2$: For a young couple whose endowments (y_1, z_1) are high enough to cover the fixed cost of marriage, F , only when the couple is older, early marriage isn't feasible. For such couples, then, marriage occurs in the second period and, depending on the returns to education, both or one of the spouses may get educated when they are young and single. Thus, the relevant expected lifetime payoffs for comparison would be given by (10), (13), (15) and (14).

¹³For complete proofs, see Appendix A.

¹⁴We need to think about whether we want to impose the additional condition here that the marital production level with only the spouse who isn't getting educated producing an income by itself exceeds F . In other words, right now we check whether $\eta(y_1 + z_1)^2 \geq F$ to decide if young marriage is feasible. But, if the husband is in school for example, should we consider his endowment to be irrelevant in the marital production so that $\eta(z_1)^2 \geq F$ needs to hold for the couple to be able to marry in the first period and send the husband to school? At least, we need a discussion of this.

- (a) If the returns to education are sufficiently low for both men and women, then (10) strictly exceeds the three other relevant payoffs in which one or both of the spouses get educated. Here, the net benefit of education isn't high enough for anyone to get educated, although marriage is sufficiently expensive for the (uneducated) couple to only be able to marry late.
- (b) If, by contrast, the returns to education for men or women are sufficiently high, then it is straightforward to verify that (14) or (15) would strictly exceed the other lifetime payoffs in which both or none of the spouses get educated. In this case, the gains from education for one spouse is high enough for him or her to get educated, although the couple cannot afford to marry young. Under this scenario, the couple gets married later and after one of the spouses gets educated while young.
- (c) If the returns to education are high enough for both men and women, then (13) would strictly exceed all other expected lifetime payoffs. And the couple, who cannot afford to marry young anyway, gets educated when young and marries later.
3. $\eta x^2 [\max(e_m y_1 + z_1, y_1 + e_f z_1)]^2 \geq F > \eta x^2 (y_1 + z_1)^2$: Here, the endowment bundle (y_1, z_1) isn't even high enough for the couple to cover F and get married later in life if they both stay uneducated. Hence, either marriage isn't feasible for such a pairing so that Mr. y and Ms. z stay single. Or, one or both of them get educated when young and single, so that they can marry in the second period.

The expected lifetime utilities relevant for comparison involve the uneducated singles payoff, $3(y^2 + z^2) = (1 + 2x^2)(y_1^2 + z_1^2)$, as well as (13), (15) and (14). The equilibrium outcome would once again depend on the education premia for men and women: All three cases (2.a), (2.b) and (2.c) above apply in this case as well. In addition, the education premia for both men and women could be low enough, however, that neither the marriage nor the education of this pairing would be feasible or optimal.

4. $\eta x^2 (e_m y_1, e_f z_1)^2 \geq F > \eta x^2 [\max(e_m y_1 + z_1, y_1 + e_f z_1)]^2$: Now the couples' endowment bundle (y_1, z_1) is even lower, so that the couple faces one of two choices:

Either the education premia aren't high enough to warrant *both* the man and the woman getting educated, as a result of which the pair stays single. Nevertheless, the returns to education could still be high enough for either gender so that Mr. y or Ms. z could choose to get educated. Thus, the lifetime payoff of such a pairing would equal

$$3(y+z) = \begin{cases} (1+2x)(y_1+z_1) & \text{if } e_m y_1(1+x) \leq c \text{ and } e_m y_1(1+x) \leq c \\ (1+2x)(e_m y_1+z_1) & \text{if } e_m y_1(1+x) > c \text{ and } e_m y_1(1+x) \leq c \\ (1+2x)(y_1+e_f z_1) & \text{if } e_m y_1(1+x) \leq c \text{ and } e_m y_1(1+x) > c \end{cases} ; \quad (16)$$

Alternatively, the education premia are sufficiently large so that the couple gets educated in the first period and marries in the second period, thereby generating the payoffs expressed in (13).

5. $F > \eta x^2 (e_m y_2, e_f z_2)^2$: In our final scenario, marriage is too expensive for all couples, including those among whom both the man and the woman are educated. Hence, the pair stays single throughout and receives the lifetime payoff given by the following, depending on the education premia:

$$3(y+z) = \begin{cases} (1+2x)(y_1+z_1) & \text{if } e_m y_1(1+x) \leq c \text{ and } e_m y_1(1+x) \leq c \\ (1+2x)(e_m y_1+z_1) & \text{if } e_m y_1(1+x) > c \text{ and } e_m y_1(1+x) \leq c \\ (1+2x)(y_1+e_f z_1) & \text{if } e_m y_1(1+x) \leq c \text{ and } e_m y_1(1+x) > c \\ (1+2x)(e_m y_1+e_f z_1) & \text{if } e_m y_1(1+x) > c \text{ and } e_m y_1(1+x) > c \end{cases} ; \quad (17)$$

3.5 The Equilibria

3.5.1 Who Matches with Whom?

Given transferable utility and the complementarity of individual incomes in generating a surplus, a stable assignment must be characterized by *positive assortative matching*. (Becker 1981). That is, if a man with an endowment y is matched with a woman with an endowment z in the first or second periods, then the mass of men with endowments above y must exactly equal the mass of women with endowments above z . This implies the following spousal matching functions:

$$y = G^{-1} \left[1 - r \left(1 - \tilde{G}(z) \right) \right] \equiv \phi(z) \quad \text{and} \quad z = \tilde{G}^{-1} \left[1 - \frac{1}{r} (1 - G(y)) \right] \equiv \psi(y). \quad (18)$$

For $r > 1$, all men are married and women with endowments below $z_0 = G^{-1}(1 - 1/r)$ remain single. Women with endowments exceeding z_0 are then assigned to men according to $\psi(y)$ which indicates positive assortative matching.

Positive assortative matching has immediate implications for the analysis of separation. Because separation is less likely when a couple has higher total income and individuals sort into unions based on income, individuals with higher income are less likely to separate.¹⁵

3.5.2 Who Marries When

While there would be positive sorting in the marriage markets based on the spousal endowment levels and all matched couples would like to marry as soon as possible due to the marital surplus involved, not everyone may be able to afford to marry when young, as suggested by subsection 2.3.1 above. Hence, we next establish who marries when on the basis of the key parameter values. We also demonstrate that the positive spousal matching profile would remain intact even when some spousal pairings at the lower end of the endowment distribution need to defer marriage until later in life.

For the remainder of our discussion and the derivation of the marriage-market equilibria, we shall make the following two assumptions:

Assumption 1: $\eta(y_{\max}, z_{\max})^2 > F > \eta(y_{\min}, z_{\min})^2$

Assumption 2: $\eta x^2(y_{\min}, z_{\min})^2 > F$

Our first assumption ensures that there will always be some individuals who can afford to marry when they are young and some who cannot. Our second assumption guarantees that all couples can marry either when they are young or middle aged.

Positive sorting in the marriage markets unconditional on delay combined with Assumption 1, enables us to now define an explicit spousal endowment level below which couples would have to defer marriage until the second period when they are older and their incomes are higher. Defining as (\tilde{y}, \tilde{z}) the pairing for which $\eta(\tilde{y}, \tilde{z})^2 = F$, and relying on the fact that $z = \psi(y)$ based on positive assortative matching as in (18), we have

$$\tilde{y} + \psi(\tilde{y}) \equiv \Psi(\tilde{y}) = \sqrt{\frac{F}{\eta}} \quad \Rightarrow \quad \tilde{y} = \Psi \left(\sqrt{\frac{F}{\eta}} \right)^{-1}, \quad (19)$$

¹⁵Such a result is consistent with empirical findings on marriage and divorce patterns by schooling: individuals sort positively into marriage based on schooling and individuals with more schooling are less likely to divorce. See Browning, Chiappori, Weiss (2014, Ch. 1).

with the exposition in (19) assuming that the endowment distributions are such that the matching function $\psi(\cdot)$ is amenable to an inversion as expressed above.

$\forall y < \tilde{y}$, couples would not be able to afford marriage when young and their union would inevitably be delayed until the second period when all such couples would be able to marry based on Assumption 2. $\forall y \geq \tilde{y}$, couples would afford to get married when young and without delay. However, whether or not they do so would depend on the returns to education for both men and women. There are three particular outcomes to consider:

I. With $e_m \rightarrow 1 \wedge e_f \rightarrow 1$, one can confirm that (9) strictly exceeds (11), (12) and (13).¹⁶ In this case, no individual chooses to get educated, couples for whom $y \geq \tilde{y}$ marry young and those for whom $y < \tilde{y}$ marry later. Hence, $\forall y \geq \tilde{y}$, (9) defines the sum of expected lifetime spousal utilities (with case (1.a) in subsection 3.4 above being relevant for all such couples), and, $\forall y < \tilde{y}$, (10) represents sum of lifetime expected utilities (with case (2.a) in 3.4 applying to all of these couples).

II. With $e_m > 1 \wedge e_f \rightarrow 1$, since both (11) and (14) are continuous and strictly increasing in e_m , it is straightforward to verify that $\exists \tilde{e}_m, \tilde{e}_m > 1$, such that (11) strictly exceeds (9) for some couples at the top of the endowment distribution and that $\exists \tilde{e}_m, \tilde{e}_m > \tilde{e}_m > 1$, such that (14) strictly exceeds (10) for some couples in the neighborhood of \tilde{y} from below.¹⁷ In this equilibrium, the threshold \tilde{y} continues to divide the population into two, with $\forall y \geq \tilde{y}$ marrying young and $\forall y < \tilde{y}$ marrying in the second period. However, if $e_m > \tilde{e}_m$, then there would be couples at the top of the endowment distribution among whom men would get educated while they are young and married (with case (1.b) in 3.4 above applying to such couples). And if $e_m > \tilde{e}_m$ as well, the equilibrium would also involve lower-endowment couples — those in the neighborhood of $y \rightarrow \tilde{y}^-$ — such that the husbands are educated and the couple marries later (with either case (2.b) or case (3) in 3.4 being relevant among these couples).

III. With $e_m > 1 \wedge e_f > 1$, the strictly increasing nature and the continuity of (13) in both e_m and e_f ensures that $\exists (\hat{e}_m, \hat{e}_f)$ defined over a continuum and a convex frontier such that, for some couples at the top of the endowment distribution, (13) strictly exceeds (11), (12), and (9), with the latter being strictly larger than (10) by construction. Thus, in an equilibrium such

¹⁶In fact, note that (11) equals (12) which strictly exceeds (13) under these parameter values.

¹⁷Within the relevant parameter ranges, for sufficiently high y and the corresponding $\psi(y)$ such that $y > \psi(y)$, (11) would strictly exceed (9) which would exceed (12) and (10). In turn, (10) would strictly exceed (15), with the latter being strictly larger than (13).

that $(e_m, e_f) \gg (\widehat{e}_m, \widehat{e}_f)$, couples at the top of the endowment distribution would involve educated men and women who marry late (representing couples in case (1.c) of subsection 3.4 above). If $e_m > \widetilde{e}_m$ as well, such couples could be followed potentially by couples who marry young and among whom the men are educated (drawing couples described by case (1.b) in 3.4 above). If in addition $e_m > \widetilde{\widetilde{e}}_m$, then there would be couples in the neighborhood of $y \rightarrow \widetilde{y}^-$ who marry later in life involving educated husbands (such as those couples drawn from cases (2.b) or (3) in 3.4), followed finally by uneducated couples who marry late (described by case (2.a) in 3.4). With sufficiently large (e_m, e_f) , however, note that there would be no couples who marry young and among whom only the husbands are educated. In such an equilibrium, men and women would get educated and marriage would be delayed $\forall y \geq \widetilde{y}$ (with case (1.c) applying to all such couples). And this could potentially hold for some couples who could not afford young marriage to begin with (i.e., those with $y < \widetilde{y}$ and potentially encompassing couples described by cases (2.c), (3) and (4) in subsection 3.4 above).

For all the relevant proofs, see Appendix A.

3.5.3 Stability Conditions & Within-period Utilities

Next, we address the stability of the matching equilibria and within couples allocations intra- and inter-temporally. To that end and for heuristic purposes, we shall assume that there are more women than men on the marriage market in aggregate so that $r > 1$.¹⁸

Stability Conditions The allocations that support a stable assignment must be such that the implied expected lifetime utilities of the partners satisfy

$$U_i(y) + U_j(z) \geq S(y, z) ; \quad \forall y, z , \quad (20)$$

where $U_i(y)$ and $U_j(z)$ respectively represent the expected lifetime utilities of the male and female partners over the two periods.¹⁹ For any stable union, equation (20) is satisfied as an equality, whereas for a pair that is not matched, (20) would be satisfied as an inequality. In particular, we have

$$U_i(y) = \max_z [S(y, z) - U_j(z)] \quad \text{and} \quad U_j(z) = \max_y [S(y, z) - U_i(y)] . \quad (21)$$

¹⁸In fact, over the long timeframe we are carrying out our analysis, the sex ratio varied, with there being more men than women in the cohorts leading up to those born in the 1930s, followed by a sex ratio tilted toward women thereafter. Further below, we shall address the potential effects of a variable sex ratio on who marries whom, who marries when, spousal education patterns as well as intrahousehold allocations intra- and inter-temporally.

¹⁹Some explanation here on how the $S(\cdot)$ differ in interpretation, at least, in the first and second periods and based on whether the couple is together or not.

Using methods described in Browning et al. (2014) and as shown in Iyigun and Walsh (2007), it is possible to determine the life time shares $U_i(y)$ and $U_j(z)$ along the assortative matching profile, based on the distributions of male and female attributes in the population. It is important to stress that the stability conditions and the equilibrium shares can be derived without any assumption regarding the level of commitment attainable by the spouses. Competition in the marriage market determines the allocation of lifetime utilities between spouses. A woman would not agree to 'marry' a man who would provide less than the equilibrium utility because many perfect substitutes exist for each man. Likewise, a man would not 'marry' a woman who demands more than the going share because of the availability of very close substitutes for each woman.

However, for the determination of the *intertemporal distribution* of utility over the three periods, commitment issues are crucial. Two broad views emerge from the existing literature. Some contributors argue that only short-term commitment is attainable and that long-term decisions are generally open to renegotiation at a further stage. Other authors point out that a set of instruments, including prenuptial agreements, are available to sustain commitment. They, therefore, claim that divorce is the only limitation on commitment. For what lies ahead, we consider the second situation - i.e., couples can commit to their spousal allocations in their union *ex ante*. No renegotiation can therefore take place unless separation is credible. Moreover, if renegotiation does occur, it results in the minimal change needed for a union to continue, if that is indeed optimal. The no-commitment case can be solved in a similar way, and generates largely similar qualitative conclusions. Please see Browning et al. (2014) for a more detailed discussion on the topic.

Intra-temporal Spousal Utilities Let $u_i^2(y)$ and $u_i^2(z)$ denote the *economic* components of utility derived from the intra-marital allocations respectively of husband with endowment y and wife with endowment z in the third period should they continue with their partnership. Hence, the husband's (wife's) total second-period utility is $u_i^2(y) + \theta$ (resp. $u_j^2(z) + \theta$) if the union continues. Feasibility constraints require that $u_a^2(y) + u_b^2(z) = \eta(t)$.

As we noted in subsection 2.2 above, we assume that divorce does not entail any income transfers between the spouses, effectively implying that, upon separation, the streams of income generated from individual earnings accrue in their entirety to the individuals themselves. Specifically, that the husband retains his augmented second-period endowment y , thus generating $f_m(y) \equiv y^2$ upon divorce, and the wife keeps her augmented second-period endowment z , thereby producing $f_m(y) \equiv z^2$.

On that basis, individual rationality implies that these outside options cannot exceed the utility payoffs if the union continues. Therefore, it must be the case that

$$u_i^2(y) + \theta \geq y^2 \quad \text{and} \quad u_j^2(z) + \theta \geq z^2, \quad (22)$$

which we shall hereafter refer as the *individual rationality constraints* (*IR*). Note that these conditions jointly imply that

$$u_i^2(y) + u_j^2(z) + 2\theta = \eta(t) + 2\theta \geq y^2 + z^2, \quad (23)$$

or equivalently that $\theta \geq \hat{\theta}(t)$, so that separation is not the efficient outcome.

For any realization of θ , either $\theta < \hat{\theta}(t)$ and separation takes place or $\theta \geq \hat{\theta}(t)$ and utilities are equal to $(1 - \beta)t + \theta - \hat{\theta}(t)$ and $\beta t + \theta - \hat{\theta}(t)$ for the husband and the wife respectively, so that the time-consistency constraints are fulfilled for both spouses. Thus, any increase of a spouse's utility in separation is exactly reflected in that spouse's second-period utility even if the couple does not separate.

Inter-temporal Spousal Utilities The expected two-period utilities equal

$$U_i(y) = u_i^1(y) + \bar{\theta} + (1 - \alpha(t)) \left\{ u_i^2(y) + E \left[\theta \mid \theta \geq \hat{\theta}(t) \right] \right\} + \alpha(t) (1 - \beta) t, \quad (24)$$

$$U_j(z) = u_j^1(z) + \bar{\theta} + (1 - \alpha(t)) \left\{ u_j^2(z) + E \left[\theta \mid \theta \geq \hat{\theta}(t) \right] \right\} + \alpha(t) \beta t, \quad (25)$$

These utilities must coincide with the equilibrium shares discussed above.

3.6 Some Comparative Statics

In order to set in context the empirical regularities we presented above and lay the foundations of the empirical work below, consider the following parameter values, specifically with reference to the quadruplet (F, η, r_m, r_f) :

The 1880s: Holding constant marital gains, if the cost of marriage is relatively but not prohibitively high and the returns to education are low, then the economy is more likely to be in the first equilibrium described above, (I). Here, regime (2.a) in subsection 2.3.1 above is likely to apply to most couples. Recall, then, that a couple would be more likely to marry later in life and stay uneducated. This would be due to the fact that, for most couples with endowments (y_1, z_1) , the condition $\eta x^2(y_1 + z_1)^2 \geq F > \eta(y_1 + z_1)^2$ would be satisfied. At the same time, due to the fact that the returns to education are low, the highest sum of expected lifetime utilities among the feasible choices of (10), (13), (15) and (14), would be attained by (10) for most couples.

The 1950s: Starting from the parameter quadruplet above, now consider a decrease in the cost of marriage, F , along with an increase in the return to education for men, r_m . Now the relevant equilibrium would be (II) above, with more couples likely to find themselves in regime (1.b) above. That is, for given endowment distributions among men and women, $G(y)$ and $\tilde{G}(z)$, more couples would not only find it feasible to marry young, but also optimal for the husbands to get educated. This would be on account of the fact that the first-period endowments (y_1, z_1) could more likely suffice to cover the cost of education when young (i.e., $\eta(y_1 + z_1)^2 \geq F$). But also the fact that, with higher returns to schooling for men, the highest sum of expected lifetime utilities among the optimal and feasible set of (13), (11), (12), (9) would likely be (11) for more couples.

The 1980s: Now consider further increases in the returns to education—this time for both genders—with a less-than proportional decline in the gains from marriage (as exemplified by a lower value of η). Such parameter changes would prompt more men and women to get educated prior to marriage, in effect making the equilibrium (III) the relevant one. However, the decline in marital gains would force a higher proportion of uneducated couples to delay marriage than before. Thus, cases (2.a) and (2.c) would apply to more couples than before under such parameter restrictions. In fact, depending on how large the drop in η is vis-a-vis increases in r_m and r_f , cases 3 and/or 4 could apply to more couples as well.

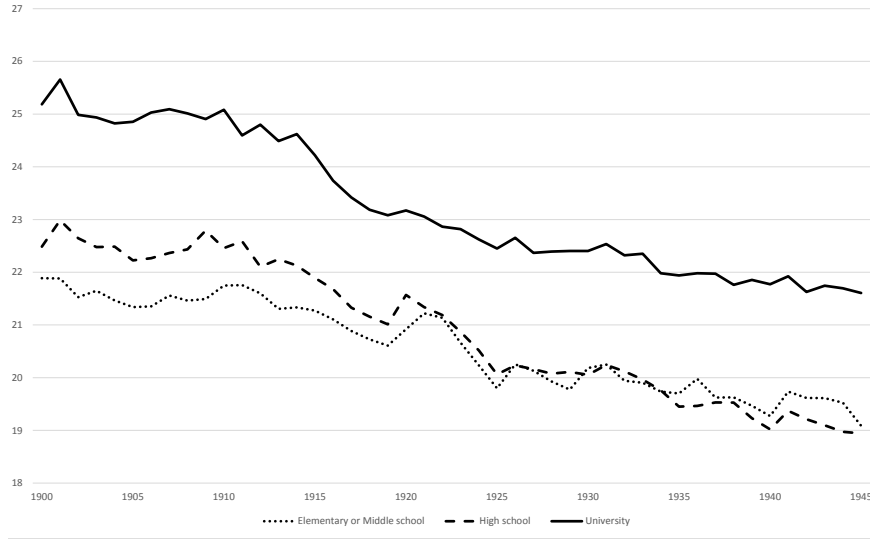
4 Additional Empirical Tests

Having elaborated a model that matches the stylized facts we document, we now attempt to test further implications of this model. First, we test whether it is true that the age at first marriage diminishes more strongly for males with more education since they can now combine education and marriage. Then, we test whether in regions where F was larger, we observe a larger fall in age at first marriage and a larger gap in educational attainment. Finally, we also test whether legal limits imposed on youth marriages had impacts on educational differences between men and women as predicted by our model.

4.1 Age at First Marriage by Educational Attainment

According to our model, the fall in F would particularly affect the age at first marriage of males who want to acquire more education as before, in order to do that, they had to delay marriage

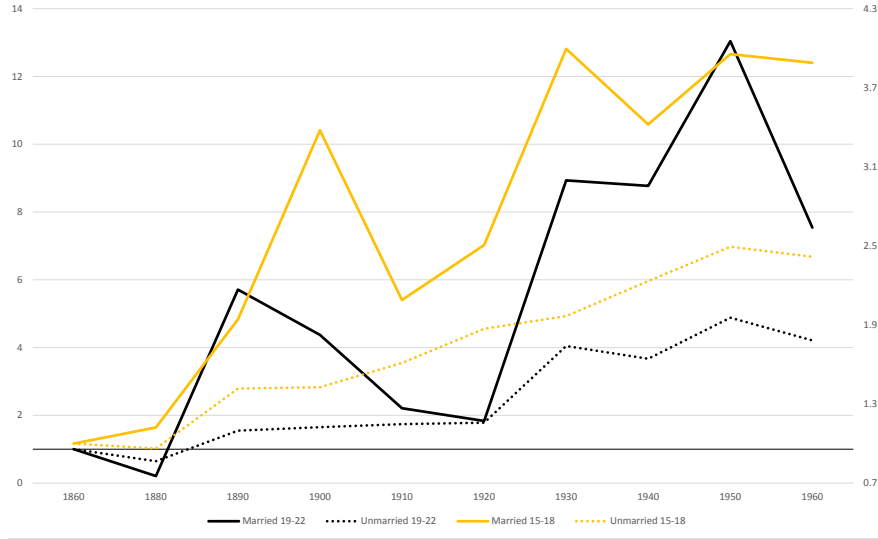
Figure 6: Age at first marriage of males by educational attainment, by year of birth



while now, they can marry immediately and study while being married. While this approximation is clearly too strong, we can test whether it is true that the most educated males also married earlier in the cohorts that lowered their age at first marriage. We present, in Figure 6, the median age at first marriage of males by educational attainment. Splitting our sample by educational attainment reduces significantly the widow we can consider for data reason. However, what is presented in the graph below suggests that high-skilled males decreased significantly their marriage age. Men with at least some high school education, who used to marry about half a year later than those with only elementary or middle school at the beginning of the period were actually marrying earlier than these at the end of the period. For men with at least some college, we do not observe a crossing but we still find that over the period, they reduced their median age at first marriage by more than 3 years, compared to at most 2 for the other educational group. Thus, there is some evidence that our model does provide some valid source of explanation for the change in educational and marriage pattern over the period. It is important to note that these medians were computed only for individuals who had been married because of some data issues. Extremely similar results were obtained for the average age at marriage.

Now, this measure above could be biased because we only measure educational attainment and age at first marriage for a restricted set of cohorts. Instead, Figure 7 shows educational attendance by age group and marital status, information that we can collect for many more cohorts. In that case, we find again that it seems to be the married teenagers and young adult males that have most strongly changed their attendance decision in the period where we observed younger marriages and higher differences in educational attainment between men and women. The contribution of married college-age males is particularly relevant for the period in which the educational gap increases. This

Figure 7: Growth in school attendance by age agroup and marital status, by birth year



is not to say that married individuals attend more frequently school than unmarried individuals. However, what this graph shows is that married men became much more involved in their education while married than they previously had been.

4.2 Variations in the Fixed Cost of Marriage

Another additional prediction we can obtain from our model is that the fixed cost of marriage probably was not the same in all contexts over the period. As such, locations that had a very large cost of marriage, because of the cost of setting up a household, would have been likely to experience the transformation we present in our model in a more marked way.

We show evidence of this dividing our sample by urban/rural and by regions of the United States. Land values were in general lower in rural areas and in parts of the United States that were still part of the frontier. If the largest cost of marriage was linked to the cost of setting up a household, land values would have been a very important determinant of that cost. Thus, we check whether the pattern we identified is visible more strongly in locations where the initial cost of setting up a household may have been larger. Figure 8 show that the fall in the age at first marriage for cohorts born in the first decades of the century is particularly marked for urban dwellers. Similarly, Figure 9 shows that only urban settings saw a significant change in the male-to-female educational gap.

Figure 8: Median age at first marriage by rural/urban, by birth year

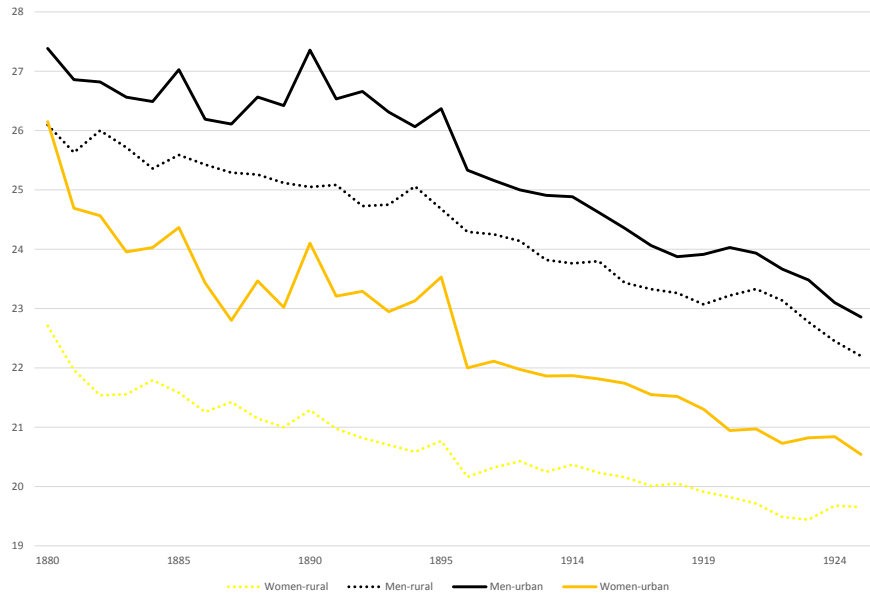


Figure 9: Educational difference between men and women by urban/rural, by birth year



5 The Impact of Legal Changes

Finally, our model predicts that increasing the costs of marrying early would make some couples prefer marrying later and through that, some couples that would have made a decision of marrying early with only the male acquiring education would now be prevented from selecting that option. This would lead to potentially some men educating themselves less while women would acquire more education. While it is true that couples who marry earlier are less assortatively matched than those who match later, this is a simple correlation that could be driven by many alternative factors. To check whether there is a potential causal channel, we explore a shock brought about during this period by state-level legislation which changed the minimum age at which individuals were able to marry. While there is ample evidence that one could likely marry at an age younger than the minimum legal one, it also appears that it would have involved additional costs for the individual (traveling to a different state, forging age credentials, obtaining a false witness, etc).

5.1 Legislative Details

To pursue this strategy, we need a complete survey of the minimum ages at which individuals can marry over the 20th century by state. There is no federal law on this aspect and states have the freedom to determine their own laws regarding requirements for marriage. States specify in general 4 different sets of minimum ages for marriage since the laws are gender-specific and furthermore, have differential rules for marriage with and without parental consent. We thus needed to codify what was the minimum age for marriage in each state over the largest period possible. In order to do that, the legal database of Westlaw was employed. In this digital database, all years and versions of previous version of a given legislation was modified. When this registry did not allow us to codify in what year the law was altered, Westlaw also provides the history of legal cases related to the legislation which can help identifying changes in the laws. This was complemented by internet searches, contemporaneous publications detailing the laws of the time and contacting the legal department of a given state when information remains unavailable. Our database of minimum age at marriage and divorce laws is very extensive and although it includes missing values, we have obtained a fairly consistent panel dataset over the period 1900-1980. This is a much more complete set of laws than what has been previously employed by Dahl (2010), Edlund and Machado (2011) and by Rotz (2011). Furthermore, the Almanach of the United States which previous studies have employed have been found to be inconsistent with legal texts in some instances.

The laws are such that there are many changes across states over time and not in only one direction. Some states rose the minimum age and then lowered it.

5.2 Data and Empirical Strategy

We match the laws described above to individual data from IPUMS from the years 1930-1980. As discussed in Blank et. al (2009), this dataset is to be preferred to Vital Statistics data as it does not suffer from the same bias (individuals are likely to lie on their marriage certificate application in response to the law but not on their Census form). We match an individual with the laws that were in place in her state of birth and the ones that would have applied to her spouse were she to marry an individual who was two years her senior (and at the reverse for men). An individual will potentially face a number of different minimum ages if the law changes during her teenage years. We here present the laws that an individual faced at age 16 since we think this is likely to correspond more closely to what would have been anticipated by teens when taking their marriage/educational decision. However, similar results were obtained with laws at different ages.

The outcomes we measure in this data base include the respondent's age at first marriage, her educational level, that of his spouse, her occupational educational score and that of her spouse and her labor force status and that of her spouse. Those are available for individuals in the Censuses of 1930 through 2000 although some only for a subperiod.

Our analysis is performed employing a difference-in-difference as a strategy, as shown in the equation below.

$$y_{gst} = \beta_1 MLW_{gst} + \beta_2 MLO_{gst} + \beta_3 MLW_{g'st'} + \beta_4 MLO_{g'st'} + \mu_s + \eta_t + \varepsilon_{st} \quad (26)$$

In all regressions, we will thus control for state and year of birth fixed effects. In that case, if we introduce the laws as controls in a regression, the assumption is that, absent of these laws, the trend in the outcomes would have been parallel between states and that the only factor that made it differ from that tendency are these new legislations. We cluster our standard errors at the level of the state of birth

The laws employed in our analysis should lead to delayed marriage as they increase the cost (and potentially make it impossible) to marry young. Table 1 shows that there is a first-stage relationship between the legal environment and the age at which individuals marry. It shows that there is a relatively strong relationship between the own obligations to delay marriage and the age at which individuals marry. Men seem to respond more to the minimum with parental consent while women respond more strongly to the minimum age without parental consent. We have an even stronger first stage if the laws are included as dummies than as a continuous variable.

Table 1: Impact of laws on age at first marriage

	Males	Females
Minimum Age without parental consent	0.021 (0.029)	0.030* (0.016)
Minimum Age with parental consent	0.046*** (0.013)	0.045 (0.026)
F-test of consent law dummies	0.065	17.51***
F-test of no consent law dummies	35.59***	408.10***

Appendix Figures 1, 2, 3 and 4 try to demonstrate graphically that these laws also had an impact on the distribution of ages at first marriage with significant moves in the distribution occurring in response to the legal restrictions in place.

5.3 Results

Our preliminary results indicate that for the entire period, there is some evidence that forcing individuals to delay marriage may lead to some of the changes predicted by our model. First, Table 2 presents the impact of these rules on the educational attainment of men. Since education is only available for some Census periods, we also measure educational attainment by the average education of the occupation in 1950. We present the reduced form estimates only but find that there seems to be evidence of a negative impact of these laws on the educational attainment of men although we only find a significant and negative coefficient on the limits imposed to women of their states, suggesting that the capacity of women to marry early may be crucial to make the educational investment of men profitable.

The next table shows the same regressions but this time focussing on women. We find much weaker evidence of a pattern here. In the top panel, imposing a later age at first marriage for women appears to be raising the highest grade completed but not significantly so. Limits on men appear to have a negative although small and non-significant effect. Finally, as expected since most women over this period had limited labor force attachment, we find no effect of these laws on the educational attainment as predicted by the occupation they practiced.

Finally, Table 4 shows the impact of the laws on the absolute difference between the educational levels of men and their spouses. What we find is that there is a negative coefficient on each laws, including two significantly different from zero for the impact of women's laws. Similar results but not significant were obtained for educational score of the occupations. This suggests that forcing to delay marriage for these cohorts led to women and men having more similar educational attainment

Table 2: Reduced form on own education-Men

	(1)	(2)	(3)
	Highest grade achieved		
Own age (without consent)	-0.009 (0.025)		-0.008 (0.025)
Spousal age (without consent)		-0.005 (0.020)	-0.001 (0.022)
N	2874958	2881603	2873954
	Educational score of occupation		
Own age (without consent)	-0.077 (0.144)		0.079 (0.157)
Spousal age (without consent)		-0.243* (0.121)	-0.289* (0.164)
N	6926146	6950301	6921950

Table 3: Reduced form on own education-Women

	(1)	(2)	(3)
	Highest grade achieved		
Own age (without consent)	0.006 (0.016)		0.011 (0.019)
Spousal age (without consent)		-0.004 (0.020)	-0.012 (0.020)
N	3296163	3288991	3287714
	Educational score of occupation		
Own age (without consent)	-0.185 (0.120)		-0.197 (0.120)
Spousal age (without consent)		-0.098 (0.130)	0.011 (0.122)
N	8016761	7989783	7985185

Table 4: Impact on absolute value of differences in educational attainment

	(1)	(2)	(3)	(4)
Own age (with consent)	-0.011 (0.007)			
Own age (without consent)		-0.002 (0.007)		
Spousal age (with consent)			-0.014*** (0.004)	
Spousal age (without consent)				-0.015* (0.008)
N	2248447	2249254	2255752	2254357

than when they were able to marry at an earlier age. This is consistent with the mechanism our model outlays.

6 Conclusion

We first document that the recent changes in the US marriage and educational markets were preceded by a similarly important but inverse sign pattern. We argue that this is robust to a number of data sources and definitions. We then elaborate a frictionless marriage markets with 2 key features to explain these patterns: there is a fixed cost to getting married and both spouses cannot study and be married. The combinations of these two assumptions allow us to deliver similar patterns to the ones historically observed. It is furthermore corroborated by a number of additional facts and by the behavior of individuals when faced with limits to marital age.

This paper treats divorce as an exogenous, Pareto optimum choice and thus has little to say about the recent rise in divorce experienced at the same time as the documented changes we present. Caucutt et. al (2002) propose a model where women may delay marriage because of the potential probability of divorce. We leave the introduction of a more sophisticated version of divorce decisions into our model for future work.

Furthermore, we hope to later on use the variations we document here to structurally estimate the value of marriage for different educational types at different moments over time. This would further reinforce our conclusion here that early marriage may have been useful for couples where one of the spouse wishes to pursue education once married.

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A Impact of legal changes on age distributions

Figure A.1: Distribution of ages at first marriage of males, impact of ages without consent

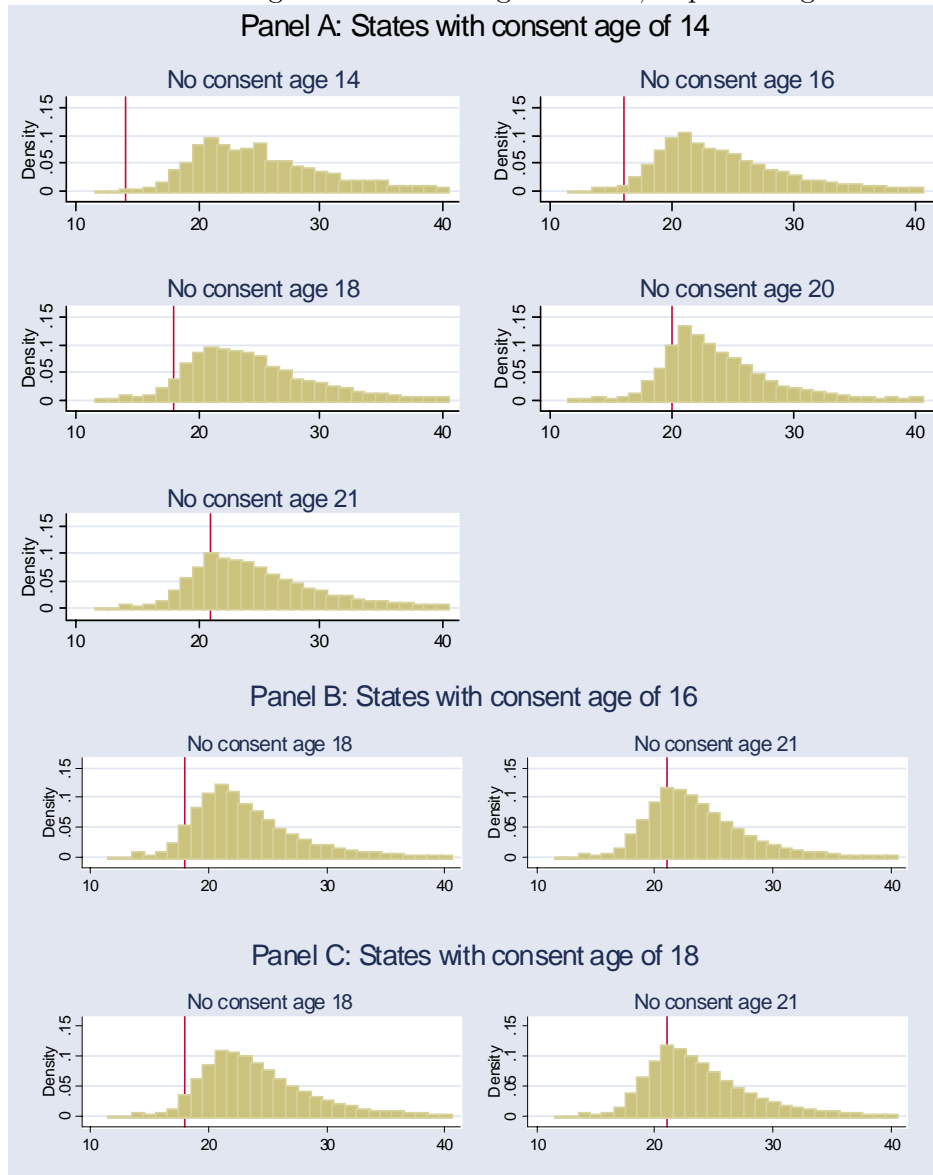


Figure A.2: Distribution of ages at first marriage of females, impact of ages without consent

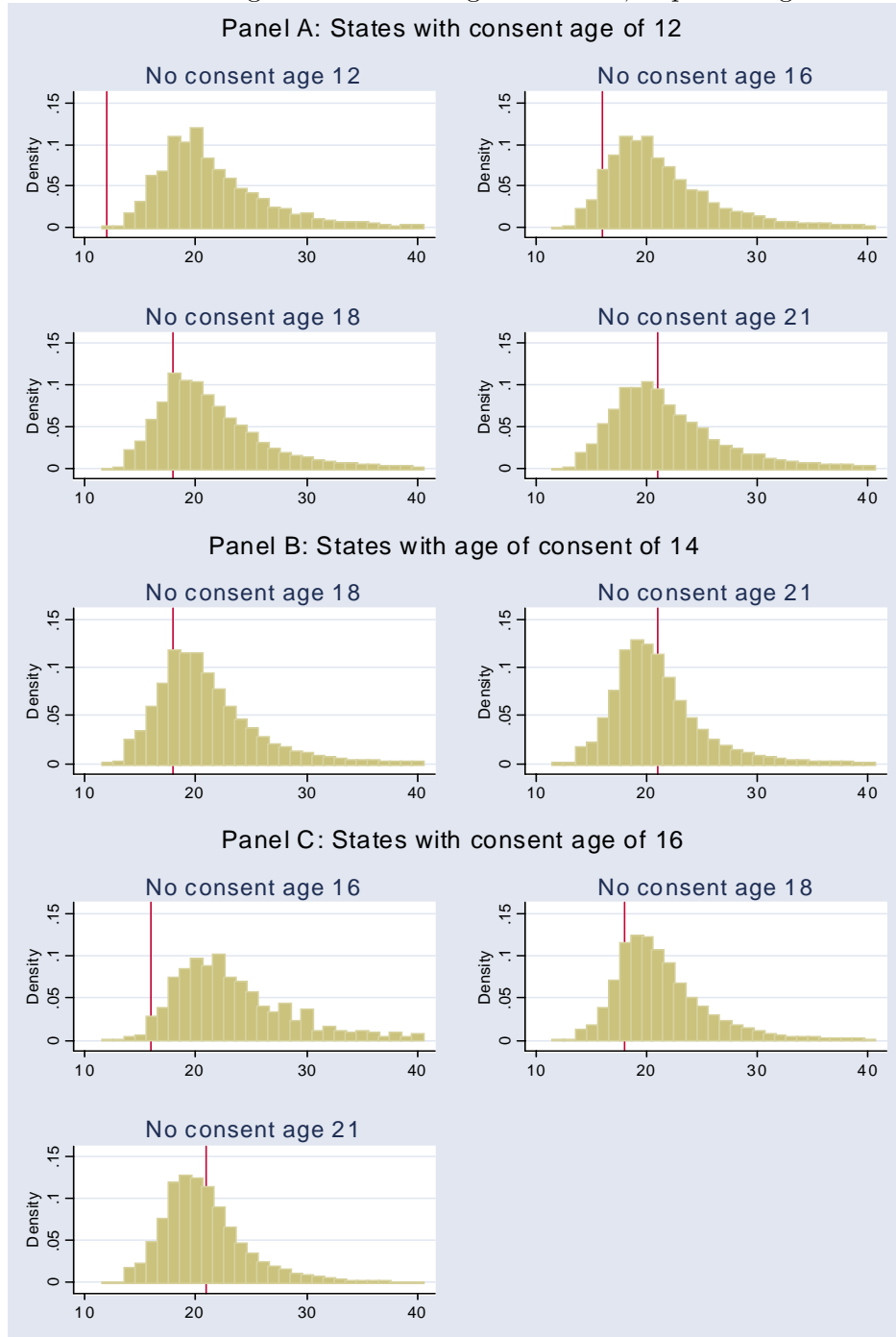


Figure A.3: Distribution of ages at first marriage of males, impact of ages with consent

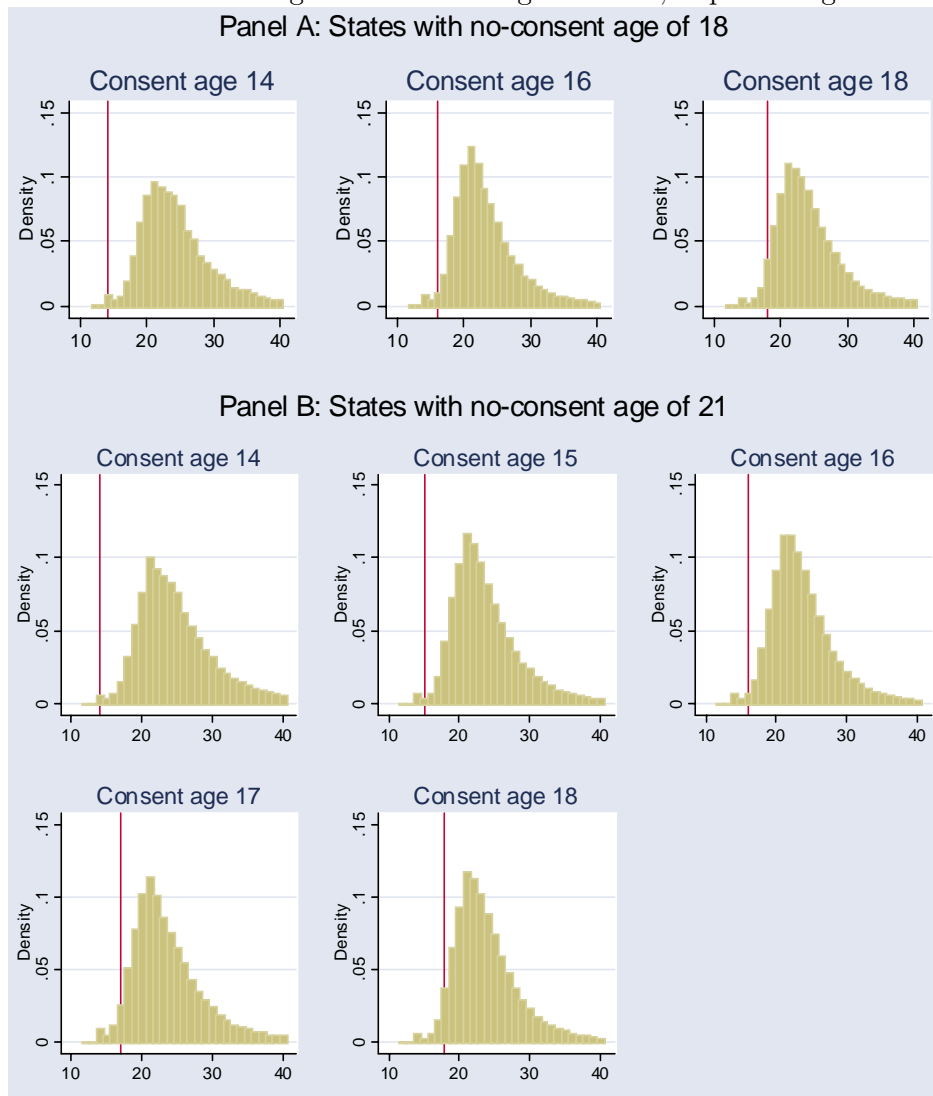


Figure A.4: Distribution of ages at first marriage of females, impact of ages with consent

