The Marriage Age U-shape

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Abstract

Data from 160 countries show that during the 20th century, a U-shaped pattern in the age of first marriage of both genders occurred across Western countries, but not in others. I explain the uniqueness of this U-shaped pattern by the low labor force participation of married women at the time the productivity boom started. The rise of the "male" industries decreased the age of marriage as long as the "female" industries were small. The increase in the age of marriage is driven by the technological spillovers into the female industries. Supporting evidence comes from the US by industry Gross State Product data, where the rise of the female sectors explains up to 30% of the U-shape's increasing portion for both genders. Additionally, evidence from the 1970s oil boom in Montana demonstrates how, in accordance with the model, the age of marriage followed a U-shape in the oil counties while it rose monotonically in the rest of the State.

1 Introduction

Today, in the West, development is associated with late marriage, but for most of the 20th century the opposite was true: development was associated with a decreasing age of marriage. Anecdotically, as late as Dixon (1971) predicted that in Western countries the age of marriage would continue decreasing. A U-shaped pattern in the age at first marriage is prevalent in all Western countries, while before the 20th century the patterns were different across countries . For example, for most of the 19th century, the age of marriage increased in the US, but decreased in England and France. In the US, the U-shape started with the Second Industrial Revolution, in Northern and Central Europe it started between the World wars, and in Southern Europe and Ireland it started after WWII. The U-shaped pattern is observed also in Western Offshoots, in Israel and moderately in Chile. Generally, the pattern is sharper among wealthier nations. To show its prevalence in the West, and its absence in other regions, I construct the mean age at first marriage time series for 160 countries and territories[1]. Some examples are shown in Figure 1 (US) and Figure 2 (Australia, Spain and Norway). In contrast, Figure 3 shows a different pattern in Japan and Bulgaria.

The U-shape phenomenon is interesting because of its uniqueness in the West, because of the large changes in the age of marriage during the decreasing and increasing portions, and because of the narrowing spousal age gap. In the US, the median age at first marriage of men decreased from 26.1 to 22.8 between 1890 and 1965, while the one of women decreased only from 22 to 20.6. Between 1965 and 2000, the median age at first marriage of men increased from 22.8 to 26.8 and the one of women increased from 20.6 to 25.1. As a result, the spousal age gap narrowed monotonically over the century. A similar pattern is observed in most European countries.

The uniqueness of the U-shaped pattern in the West is explained by the 20th century dynamics of the two forces pushing the age of marriage in opposite directions: each dollar produced in sectors where women can not, or chose not to work, pushes the age of marriage down, whereas each dollar produced in sectors open for women, and preferred by them over not participating in the labor force, pushes it up. The growth dynamics determined that these two coexisting forces triggered a U-shaped pattern over the century. Across European countries, the U-shape perfectly mirrors the economic growth: the correlation between changes in the mean age at first marriage and changes in income per capita is -0.92 for men and -0.86 for women (see Figure 5). This negative correlation is also observed across the US states. This means that the fast growth at the beginning of the income convergence process is associated with a declining age of marriage, and as growth slows down the age of marriage starts to rise. In Southern Europe and Ireland, where the economy boomed in the 1960s and 1970s, the decreasing portion of the U-shape lasted for only twenty years. But it lasted for 40-50 years in Northern and

[1]See Appendix A for data and Appendix B for details.

Central Europe and for 75 years in the US, where the growth was more gradual.

In the West, the female labor force participation was low at the beginning of industrialization but rose sharply since then. Figure 4 shows the female labor force participation over time in the countries used as examples for the marriage age pattern. In the countries with a U-shaped pattern, the female labor force participation rose sharply since 1950. In contrast, in the countries where no U-shape is observed, the female labor force participation remained constantly high. Another example is China, where female emancipation was a post-revolutionary process, much before the 1990s industrialization. Indeed, Xu et al (2003) report that the recent Chinese growth surge has, opposite to the West, a positive impact on the age at first marriage of men and women. Moreover, Mu and Xie (2011) present evidence of a widening mean spousal age gap in China since 1990.

I develop a simple dynamic model where two forces, growing monotonically over time, affect the age of marriage in opposite directions and the resulting pattern is a U-shape. The economy has two sectors of production. One sector requires male physical strength, while the second does not. Initially, most women are more productive as housewives than in the market and withdraw from the labor force after marriage. The model assumes that technological change starts in the male sector and spills over into the female sector. As the male productivity booms, young low skilled men become acceptable for marriage, so the number of successful offers increases and the mean age of marriage declines for both genders. However, technological spillovers from the male sector into the female one encourage a growing number of married women to work in the market, where their skills are compensated better than their house work. This growing proportion of women develops a high skilled marriage market where the skills of both genders are heterogeneous, individuals search longer for a mate, using college as a marriage market, and postponing marriage to the end of studies.

The evidence for the two forces is observed in both macro and micro data. Empirically, the question of which sectors are "male" and which are "female" is ex-post, because at the beginning of the process all sectors lack women. Thus, I group sectors into fundamentally male and potentially female retrospectively, according to the 1990 employment shares. As explanatory variables, I use the output per capita in the male and female sectors across OECD countries and across the United States. Two independently constructed time series data sets show that although the two inverse effects on the mean age of marriage differ across OECD countries, they are very similar in absolute terms within countries. The across US productivity data set shows that the female sector rise explains 20%-30% of the increase in the proportion of single women and 15% of the increase in the proporion of single men, in their early twenties, for cohorts born between 1945 and 1965. I analyzed ages 19 to 25, and male singlehood at the ages 23-25 is found to be the most sensitive to the sectors' sizes, while female singlehood is similarly sensitive at the all analyzed ages. Finally, I analyze a case study. I use the 1970s sharp increase in oil prices as a natural experiment that struck the marriage market in Montana. Until the oil boom, all parts of Montana had a similar marriage pattern. But as oil prices boomed, the oil-producing counties followed a U-shaped pattern, while in the rest of the state the age of marriage rose monotonically.

The difference between the Western European marriage pattern and the rest of the world has been recorded since the Black Death (Hajnal (1965)). The literature is increasingly interested in the simultaneous relationship between the European Marriage Pattern (EMP) and female labor markets (De Moore and van Zanden (2006), Voigtländer and Voth (2013), Minguela (2011)). EMP depicts a pattern of both late marriage (25 years and later in pre-Industrial Europe) and a high proportion of never-married women. The Malthusian demographic regime explains the persistence of EMP as a fertility restriction mechanism for hundreds of years preceding the Industrial Revolution. Gradually, the role of EMP in fertility declined, leading to a growing independence between the age at first marriage and the age at first birth (Coles and Francesconi (2013)). This growing independence, which started in the Demographic Transition, allowed a lower age of marriage with reduced fertility. The mean female age at first birth in the US *rose* from 23 to 24 between 1890 and 1945, while the age of marriage decreased. The age of marriage and the age at first birth correspond again only from 1945. Between 1945 and 1965 both of them decreased during the post-war Baby Boom, and since 1965 they have both increased. But while birth restriction is no longer the main determinant of marriage age, other factors play a larger role. For example, early urbanization decreased the age of marriage as marriage markets became larger and the dependence of marriage on land ownership diminished (Dixon (1971, 1978); Oppenheimer (1988)). The strongest factor increasing the independence of marriage and fertility was improving birth control technology and especially the introduction of the Pill in 1960s.

While in EMP, birth control was a reason for late marriage, in the late 20th century late marriage was allowed by the improved birth control technology. The Pill explains some 30% of the increase in the young American women singlehood rates in the relevant cohorts (Goldin and Katz (2002), Edlund and Machado (2009)). The reason that women preferred postponing marriage was the increasing importance of female education, careers, and economic independence (Goldin (1990, 2006)). Goldin exhaustively describes the development of female college attendance in the US until it overtook the male one in the 1980s, as well as the rise of female professional careers and married women's labor force participation. This evolution of female labor force participation was implied by decreasing value of the home production on the one hand, and the diminishing advantage of male labor on the other, as mental skills became more important than physical strength (Acemoglu (1999); Galor and Weil (1996); Godin and Katz (2008); Goldin (1995); Greenwood and Guner (2011); Greenwood et al (2012); Mokyr (2000)). An additional factor which started in the late 1970s, is that the redistribution of income has contributed to the increasing age of marriage. The income inequality across skills and ages has increased, while the gender wage gap has narrowed. The increasing inequality encourages women to search longer for a mate and the increasing uncertainty triggers them to prefer older partners whose ex-post income potential is observed (Keeley (1977, 1979); Gould and Passerman (2002); Loughran (2002); Coughlin and Drewianka (2011); Danziger and Neuman (1999); Bergstrom and Bagnoli (1993); Bergstrom and Schoeni (1996); Blau et al (2000); Fortin and Lemieux (2000); Mu and Xie (2011); Bloom and Bennett (1990)).

This paper is concerned with the age at first marriage and not with the prevalence of marriage. While in some Western countries, such as Sweden, the prevalence of marriage has decreased sharply over the last century[2], in others it has not dropped. In the US, for example, the proportion of never married women by age 50 was 10% in 1900 and 7% in 2000[3], while the median female age at first marriage increased from 22 to 25 respectively. Increasing cohabitation is another recent issue not covered in this paper. In most Western countries, especially Catholic ones, cohabitation rates remained very low during the analyzed period. For instance, in early 1980s only about 1% of couples cohabited in Italy,

[2]Although decreasing rates of marriage in Sweden, most of the individuals currently in relationship report that they expect to marry within five years (Bernhard (2004)).

[3]Calculated from Integrated Public Use Microdata Series (IPUMS).

and about 5% of never-married indivuduals cohabited in the US (Sigritta (1988); Casper et al (1999)).

The paper is organized as follows. Section 2 presents the dynamic model. Section 3 analyzes the by-sector output data accross the OECD countries and accross the US to show the opposite impact of the male and female sectors on the age of first marriage of both genders. Section 4 demonstrates the case study of Montana, where the 1970s oil boom in the eastern part of the State triggered a marriage age U-shape. Section 5 concludes.

2 Model

Motivation

This section develops a simple dynamic model with overlapping generations of single individuals to obtain the marriage age U-shape over time. Technological development leads to both a gradual rise of male "marriageability" and of married women labor force participation. While increasing male marriageability leads to a shorter search for mates and decreasing age of marriage, the increased labor force participation of married women has an opposite impact. The basic idea is that while housewives produce a homogenous home product, the productivity of women who work in the market is heterogeneous. Following search and matching literature, the more heterogeneous the marriage market is, the longer the search for a mate is.

This basic model is consistent with the marriage age U-shape and the rise of married women labor force participation in the US, as well as with additional facts observed in the American data. The first fact is that while in 1950 around 80% of young married women did not participate in the labor force regardless of education, in 1980 the educated young married women participated in much larger proportions than the uneducated ones. Second, marriage in the US is positive assortative by education, with about 60% marrying within the same educational group (Schwartz and Mare (2005)).

In the data, the U-shaped patterns differ by length. The US and Northern Europe experienced a long U-shape while Southern Europe and Ireland experienced a short one. The difference is that in the north, technology evolved gradually while the south adopted it intensively during the post-war industrialization boom. Both male productivity and the female labor force participation evolved slowly in the north. In the south, the fast industrialization, as a result of Marshall Plan, triggered an income effect that led to a structural change toward services and high female labor force participation (for example, in Spain it rose from 15% to 55% between 1950 and 2000 (see Olivetti (2013))). In the model, the resulting pattern depends on the tehcnological spillovers function, and may be either "northern" or "southern".

Technology

Let us assume one market good that can be produced with two technologies A and B. Technology A requires male physical strength. Technology B fits both males and females, but as long as it is less productive, men prefer to work with A. Thus, for simplicity, I call technology B "female". The production function is

$$Y_t = A_t H_{At} + B_t H_{Bt}$$

where H_A is the total human capital (integral of workers' abilities) working with technology A and H_B is the total human capital working with technology B. Each worker earns her marginal product. Each individual is endowed with an observed market ability a distributed with a cumulative distribution function $F(a)$. A woman, differently from a man, can be productive at home, if she chooses not to work in the market. The home product does not depend on ability and grows over time, but more slowly than the B-technology (see Greenwood and Guner (2011); Greenwood et al (2012); Mokyr (2000) for theoretical analyses of female home production, and Bridgman (2013) for estimates of the home productivity growth rate relatively to the market productivity). Thus, it can be normalized to one unit.

The technologies A and B grow exogenously with spillovers from A to B à la Acemoglu (1999):

$$B_{t+1} = \lambda(A_t) B_t$$

where the increasing function λ captures technological spillovers from the male sector to the female one.

Utility

The environment exists in the pre-cohabitation paradigm where "It is not good that the man should be alone" (Genesis 2:18), so the utility of singles is normalized to zero. A married couple consumes its production as a public good. The couple's preferences over consumption c are given by $u(c)$ that satisfies the standard assumptions. Saving is not possible.

The consumption consists of market and home products of the spouses

$$c_t = A_t a_m + I_f B_t a_f + 1 - I_f$$

where a_m and a_f are the abilities of the spouses and I_f is the indicator of the wife's market labor force participation. If she does not participate, she produces one unit of home product.

Labor and marriage markets

All men work, but married women work only if their productivity in the market is above their productivity as housewives, that is if $B_t a_f > 1$. Let us define $z_t = F(\frac{1}{B_t})$, the rank of the "worst" woman who participates in the labor market after marriage, where $F(a)$ is the ability cumulative distribution function which is constant over time. From now on, I call "above-z_t" and "below-z_t" individuals ranked above or below z_t in the ability distribution. The definition $z_t = F(\frac{1}{B_t})$ implies that increasing B-technology means increasing the share of women working after marriage. In the beginning stages, the output in the male sector rises fast because the A-technology advances. The output in the female sector rises slowly. Later the female sector output rises fast, as both the female productivity advances faster because of spillovers from A and more married women join the labor market.

A unit mass of risk neutral individuals enter the marriage market each period. The individuals participate in the marriage market for up to two periods. Men date randomly but only with women who say "yes" to their offer, so the search is direct. Each single man makes an offer to a woman, given that there are some available women. The match leads to marriage with probability π, and with probability $1-\pi$ they return to the marriage market or remain never-married. This directed random search follows the Law of Large Numbers for matching of a continuum of individuals, as proven in Duffie and Sun (2012), so that the masses of men meeting each group of women are easily calculated.

The below-z_t women do not plan to work after marriage, so they are identical in the sense that they all offer their mates one unit of home production. The above-z_t women plan to work in the market after marriage, and because their market ability is heterogeneous, they all differ from each other. These above-z_t women meet the above-z_t men. A plausible interpretation is that they meet in a college. At least some proportion of the high-skilled individuals who plan a career go to college and this is their marriage market. An above-z_t woman will not accept an offer from a below-z_t man because she always receives an offer from an above-z_t man since the masses of men and women are equal. The single above-z_t men and women meet each other every period and a meeting leads to marriage with probabiltiy π. To conclude, there are two marriage markets: in the first, identical below-z_t women receive random offers from heterogeneous below-z_t men and marry whenever they receive an offer from a man with ability above the reservation value. In the second, which I name the "college" market, heterogeneous above-z_t women marry heterogeneous above-z_t men. All individuals are allocated to the markets at the beginning of their life.

A first-period below-z_t woman is indifferent to accepting the marriage offer of a man with reservation ability x_t^*or remaining single, according to the conditions

$$u(A_t x_t^* + 1) = V_t \tag{1}$$

where V_t is her value if she rejects the offer: $V_t = \int_0^1 w_{t+1}(x)u(A_t x + 1)dF(x)$ where $w_{t+1}(x)$ is the probability of marrying a man with ability x. The integral of $w_{t+1}(x)$ is smaller than 1, because not all below-z_t women eventually marry, due to the search frictions. Although V_t relates to the next period, A is indexed by t because I do not assume that individuals can predict future technology. The consumption of the couple where the male's ability is x is $A_t x + 1$ because the below-z_t woman offers one unit of home production.

Lemma 1: Keeping the weights $w(x)$ constant, the below-z_t reservation ability x_t^*decreases in A_t.

Proof: The constant term 1 on the left hand side of (1) and concavity of u make the changes in utility disproportional as A_t rises. On the right hand side of (1), the utility function at low values of x is more sensitive to changes in A_t than at the high values. Thus, increasing A_t implies a decrease in x_t^* to hold the indifference condition. ■

The two forces, moving the age of marriage in opposite directions, are the decreasing reservation value x_t^*, as male technology A_t improves, and the decreasing z_t as female technology B_t improves. Decreasing reservation value means decreasing age of marriage for both genders because more young men are "marriageable" and more young women receive offers. Decreasing z_t means increasing the age of marriage of both genders because a larger proportion of individuals go to the college marriage market. The left plot of Figure 6 shows the two forces in a simulated solution: while the reservation value declines over time, the labor force participation of the married women rises. In the simulation, A-technology rises linearly, the spillovers function is hyperbolic, and the abilities distribution is lognormal. The hyperbolic spillovers is a good example of a long and slow rise of the female sector that booms at some point in time leading to a rise in the age of marriage. The resulting mean age of marriage pattern is a U-shape with a long decreasing portion (the right plot of Figure 6).

The dynamics in the model imply more high-skilled women participating in the labor force after marriage, reducing the proportion of low-skilled single women in the female labor force. Thus, the model is associated with recent research on female labor force composition dynamics, such as Mulligan and Rubinstein (2008). Moreover, the interpretation of the above-z_t marriage market as a college marriage market relates to the rising female college attendance over the 20th century (Goldin (2006)). An additional result of the model is that less low-skilled than high-skilled marry. The reason is that young men below x_t^* have only one shot in the marriage market. Because the below-x_t^* first-period men are unmarriagable, the low-skilled women have less offers. Recently, Bruze, Svarer and Weiss (2012) recorded a lower marriage hazard for less educated in Denmark relatively to the highly educated. One more important note is that the age of marriage in the model does not necessarily correlate with the gender wage gap. The gender wage gap may increase or decrease monotonically, depending on specific parametrization, while the age of marriage follows a U-shape.

3 Empirics

In the model, the state variables are the outputs in the male and female sectors, which depend on the advancing technologies and the growing contribution of the married women to the labor force. This section quantifies their impact on the age of first marriage. It uses three independently constructed data bases of output by industry. The two first are OECD countries annual time series: Maddison (1996) and OECD International Sectoral Data Base. The third data set is intra-country: Renshaw et al (1988) data of US Gross State Product by industry. To the best of my knowledge, none of these data sets have been used before by family economists. They testify to the fact that male and female sectors oppositely impact the age of first marriage.

OECD countries

Maddison (1996) and the OECD construct two by-industry productivity data sets for a sample of OECD countries. The two data sets are comparable but Maddison (1996) covers the 1947-2005 period and decomposes GDP into 10 sectors, while the OECD covers the shorter 1960-1997 period but, in more detail, decomposes GDP into 32 sectors. Thus, the two data sets are used separately for the estimation of the marginal effect of each additional per capita dollar produced in the male sectors or in the female sectors on the age of marriage of men and women. I estimate a time series model and not a panel regression for three reasons. First, the number of countries is not large enough to cluster the standard errors. Second, some countries appear in both data sets and can be used to testify to the robustness of the coefficients. Third, I would like to compare the estimated coefficients of different countries.

The decomposition of sectors into male and female is retrospective and uses the employment shares in the US in 1990[4]: sectors with more than 70% male workers are defined as male, and sectors with less than 50% male workers are defined as female[5]. This retrospective view explores the potential of the female labor force, unobserved ex-ante, and solves the endogeneity of the female labor force participation. For example, between 1950 and 1980, the share of female workers among furriers increased from 12% to 70% , the share of female bus drivers increased from 3% to 47%, the share of female bartenders increased from 7% to 48%; the whooping 2% to 65% increase occurred in the share of female crossing watchmen and bridge tenders[6]. The reason for defining the sectors binarily as male or female and not proportionally by the percentage of females, is that in the model I define sectors by technology.

The empirical time series model is

$$A_t^g = \alpha_0^g + \alpha_1^g M_{st} + \alpha_2^g F_{st} + \varepsilon_{st}^g \tag{2}$$

where A_t^g is the mean age at first marriage in years[7] of gender g in year t. The variables M and F are the aggregated value added in the male and female sectors respectively, divided by the size of the population in year t. All values were converted into 1980 US dollars PPP to make the estimated coefficients comparable[8]. The disturbance is corrected for the first order autiregression and moving average[9] .

Table 1 shows the results of estimating Equation 2. Because OECD and Maddison (1996) are independent data sets, countries that appear in both data sets appear twice in the results table.

The results show that almost in all regressions, α_1^g is negative and α_2^g is positive. Moreover, they are

[4]The 1990 Census was used for calculations.

[5]Maddison (1996) data decomposition: the male sectors are agriculture, mining, construction, durable goods manufacturing, transportation and public utilities. The female sectors are retail trade, finance and services. Wholesale trade, public services and non durable goods manufacturing are neither male nor female. OECD International Sectoral Data Base decomposition: the male sectors are agriculture, mining, metal products (all groups), transport equipment, mining (all groups), transport and storage, electricity, gas and water, construction, wood and wood products. The female sectors are financial institutions and insurance, textile and leather industries, restaurants and hotels, real estate and business services, wholesale and retail trade. All the other sectors are neither male nor female.

[6]The figures are calculated using the American Censuses of 1950 and 1980.

[7]Median for the US, because it is provided by Bureau of Census for all years. See Appendix B for details about the construction of the mean age at first marriage variable.

[8]First, OECD PPP converter was used to convert the values into US constant dollars. Than the US GDP deflator (provided by Bureau of Economic Analysis) was used to convert the values into 1980 dollars.

[9]STATA command *arima* was used for estimation.

negative and positive, respectively, in all cases where they are statistically significant. The differences between the countries are generally smaller in the male sector effect α_1^g than in the female sector effect α_2^g. While the male sector effect is about -0.4, the female sector effect varies between 0.05 and 0.5. Generally, the male marriage age is more affected by the sector sizes than the female one. In some countries, such as Netherlands and Norway, the effect of the male sector on the male marriage age is as strong as -1, meaning that a one thousand 1980 dollars increase in the male sector output per capita reduces the mean male age of marriage by one year. An interesting pattern is remarkable in most regressions: the two coefficients α_1^g and α_2^g , despite having opposite signs, are relatively similar in absolute terms within each country. Every dollar added to the female sectors is associated with a similar increase in the age of *marriage* as the decrease associated with every dollar added to the male sectors. Note that the data mostly cover the period when the age of marriage in the analyzed countries was increasing. At the same time, this is the period of the structural change toward services, which means rise in the female sector. Thus, the fact that the effect of the male sector is still observed, is negative and statistically significant, is surprising. This negative effect supports the model's prediction that the two forces coexist.

Across the United States

The same two forces are observed across the US. This is interesting because it shows their simultaneous coexistence within a country. Renshaw et al (1988) construct a data set of Gross State Product (GSP) by industry for the 1963-1986 period. Again, the data were converted into 1980 constant dollars. Because in the US we can use Current Population Survey data (CPS), we can use not only the mean age at first marriage, but a singlehood dummy at a certain age as a dependent variable, including all individuals in the sample and not only the married ones. For each individual, I calculate the sizes of the male and female sectors in her (or his) state when she was 18 years old. At this age, she took decisions about her strategy regarding marriage, education and career. Then I regress her singlehood dummy on these two variables. I estimate the effects separately for each age between 19 and 25, separately for men and women. Thus, there is a total of 14 regressions estimated.

Here again, the industries are decomposed retrospectively, with more than 70% of male workers in 1990 implying a male industry, and less than 50% - a female one. The data allows the decomposition of industries into male and female separately for each state. Appendix C contains this decomposition. The empirical model is

$$S^g(a)_{ist} = \alpha_0^g + \alpha_1^g M_{st} + \alpha_2^g F_{st} + \alpha_3^g W_{ist} + \alpha^g X_{st} + \gamma_s^g + \eta_t^g + \varepsilon_{ist}^g \tag{3}$$

where $S^g(a)_{ist}$ receives 1 if an individual i of gender g, living in a State s, had never been married at her a-th birthday, $19 \leq a \leq 25$. Index t is the year she was 18 years old. The variables M and F are defined similarly to the model in Equation 2. The state and year fixed effects are γ_s and η_t, respectivelly. All of the regressors relate State s to the year t. This way reverse causality is ruled out: first, the definition of male and female sectors is retrospective; second, the regressors are retrospective at the individual level, because they relate to the year she was 18. W is the dummy for whites since whites have a larger than others proportion of ever married. X is a set of controls whose variation during the anayzed period explaines some of the changes in the marriage age:

-The minimal legal age of marriage in State s in year t. Four variables are included: minimal age of marriage for males and females, with and without parental consent.

-A dummy for Early Legal Access (ELA) - the availability of oral contraception for single childless women below age 21[10].

-A dummy for the possibility of no-fault divorce[11].

-A dummy for legal abortion[12].

Table 2 presents the results of the linear probability regression of Equation 3[13]. The standard errors are clustered by state. Figure 7 shows the estimated effects (with a 95% confidence interval) of the male and female sectors outputs on the singlehood probability, as a function of age. For men, the

[10]Source: Bailey et al (2011).

[11]Source: Ashbaugh et al (2002).

[12]Source: Levine et at (1999).

[13]The linear probability model gives consistent estimators, while probit regression estimators of model with fixed effects are non-consistent.

respectively negative and positive effects of the male and female sectors outputs rise with age and become statistically significant at age 22. For women, they are constant and significant for all ages. In absolute terms, the female sectors coefficient is between 1.5 and 2.5 times larger than the male sectors coefficients. For women, every 1000 dollar increase in the output per capita in the female sectors increases the probability of singlehood in their early twenties by about 2.5 percentage points, and every 1000 dollar increase in the output per capita in the male sectors decreases the probability of singlehood by about 1 percentage point. For men, the figures are 1.5 and 1 percentage points, respectively. These results imply that the increase in the size of the female sectors between 1963 and 1983 is responsible for about a 7 to 8 percentage point increase in the probability of female singlehood and a 5 percentage point increase in the probability of male singlehood in their early twenties. This is about 15% of the increase in the singlehood probabilities for the 1945-1965 birth cohorts of men, and about 20%-30% of the increase for the same cohorts of women. For comparison, Goldin and Katz (2002) show that the introduction of the Pill is responsible for a 24%-37% of the increase in the proportion of single women at age 23 for the same birth cohorts.

4 Montana Case Study

This section presents evidence that a positive income shock on male industries triggers a U-shape. I focus on the 1970s oil boom in Montana, since the eastern part of the state has many oil fields and its economy was deeply influenced by the oil prices, which doubled in 1974 and doubled again between 1978 and 1980.

The main finding is shown on Figure 8. It presents the proportion of single men and women at age 21-22, born in Montana, in the oil and non-oil producing parts of the State[14], for each decade between 1960 and 2000[15]. While in the non-oil area the proportion of young singles rises monotonically from 1960, in the oil area it rose until the oil boom in the 1970s and then followed a U-shape. Figure 9

[14]From this point on, for brevity's sake, I simply use "oil" and "non-oil" to name the two parts of the State.

[15]The 1980 Census is the last one that asked for both the marital status and the age at first marriage, and is used to construct retrospectively the singlehood probabilities in 1960 and 1970 in each part of the State, because Censuses before 1980 do not include intra-state division of Montana.

shows the way this finding corresponds to the model. The Figure shows the labor force participation of young women (17-27 year old) in the oil counties of Montana versus the non-oil area, between 1975 and 2000. The left plot relates to all women and the right plot relates only to the married ones. For all women, the participation in the non-oil area was steadily higher than in the oil area and the gap did not change significantly between 1975 and 2000. But for the married women, the participation in the oil area rose sharply during the 1980s, a decade after the oil boom; a much sharper rise than in the non-oil area. This pattern of young married women's increased labor force participation, at some delay after the male sector boom, relates to the U-shaped marriage age pattern mechanism described in the model.

The rest of the section provides the causal inference of the oil boom as a trigger for the U-shape.

I identify the responsibility of the oil income treatment on marriage timing through two methods. First, using a 2SLS regression where income is instrumented by the oil boom. The results show a 6 percentage point decrease in the probability of male singlehood on their 22th birthday for every additional 1000 income dollars. Second, I use a difference-in-difference design where two regions (oil and non-oil) and two periods (before and after the boom) are interacted. The results show a 27 percentage point increase in the male marriage probability within five years after treatment, relative to the non-treatment period, and a 16 percentage point increase in the female marriage probability. The difference between the two methods is that in the first one I look at men at each specific age, and ask how many of them are single as a function of their income. The second method asks how many of all single men marry shortly after they are treated by additional income. Afterward, I refine the estimated coefficient by a triple difference approach. I compare men working in the male sectors directly affected by the oil boom (mining and construction) to the men working in an unaffected male sector (agriculture), and the results show that men working in agriculture do not contribute to the marriage age difference between the two parts of the State.

A small number of family economists use the 1970s energy boom as an instrument for income. As a result of the energy boom, the investment in children's education in the oil area of Norway rose (Løken (2010)) and the fertility in the Appalachia coal areas increased Black et al (2013). In an unpublished dissertation, Buckley (2003) found that the oil boom affected the female marriage hazard in Texas. In contrast, Maurer and Potlogea (2014) did not find any impact of the oil development in the southern US during the 1900-1940 period on female labor force participation, fertility and marriage hazard. My paper adds to the literature by analyzing both females and males in another US region, and uncovering the U-shaped pattern triggered by the oil boom.

Background and data

Montana is an agricultural state with a lower than average US income per capita and a relatively slow economic growth. Almost half of the Montana population is rural, and this figure did not change during the oil boom. The main structural change in the Montana economy until 1970s was the development of the oil and gas fields in the north-eastern part of the State, in a geological area named the Bakken Formation discovered in 1953. However, mining did not dramatically affect the State's economy until the 1974 oil crisis following the Yom Kippur War. As a result of the embargo of oil-producing Arab coutnries, oil prices doubled in 1974 and then again between 1978 and 1980. The oil boom lasted for a decade until the oil sector collapsed in the 1980s.

The eastern county group[16] includes the area of oil exploration, which I define as the "oil area" and the rest of the state as the "comparison area" (see a map on Figure 10). Although most of the oil is concentrated only in the far east of Montana, the data do not allow separation of this specific area from the eastern county group. The data set is the 1980 Census IPUMS. The descriptive statistics, presented in Table 3, show the differences between the oil and comparison areas. Unfortunately, it is not possible to directly compare between the two areas before the oil boom because there was no intra-state division of Montana in the census until 1980. However, I use two age groups, 17-35 and 36-50 year old, to compare the pre-boom and post-boom generations. The ages 17-35 were chosen as these are the marriage ages of over 90% of the ever-married men and women. In both parts of the State, whites constitute more than 90% of the population. The men to women ratio is close to one, and does not differ between the old and new generations. The two parts of the State had some demographic

[16] County group 4 in 1980 Census, PUMA 500 in 1990 Census, PUMA 300 in 2000 Census.

differences, some of which were present for both generations, so these fixed differences collapse in the difference-in-difference design. First, the comparison area has a half year more of schooling, on average. Second, the comparison area has more immigrants, even though it could be thought that the oil boom attracted the immigration of young men. Moreover, the immigration patterns are the same among old and young men, and among women the difference-in-difference estimator uncovers that the share of immigrants decreased in the oil area relatively to the comparison area. To conclude, the descriptive statistics do not suggest an alternative story that could explain the shown above difference in the age of marriage between the oil area and the rest of the State for the specific cohort of 17-35 year old.

Income gap

Figure 11 shows the 1980 total personal income of men by age, for those who had positive income. As the Figure shows, men in their 20s and early 30s earned more in the oil area than in the comparison area. Men at older ages earned more in the comparison area than in the oil area, because of higher earnings among middle age professional workers and a large number of middle age workers in manufacture, which is traditionally more developed in the west of Montana. This is important for the interpretation of the results, as young men are the population of potential marriage partners. Would an income gap in favor of the oil area exist among the "fathers", it might complicate the interpretation of the income effect on the marriage market. But in this case, the income shock affected only the young, thereby the interpretation of the effect is unambiguous.

To see the responsibility of the oil boom for the income gap between the oil and comparison areas, Figure 12 decomposes this gap by industry sector. Each column is $s_{jo}I_{jo} - s_{jc}I_{jc}$ where s_{ji} is the share of sector j out of the 16-24 year old male labor force in area i (oil or comparison) and I is these men's mean income. The Figure shows that mining is responsible for most of the gap between the areas.

2SLS

The first regression estimates the effect of every income dollar on the probability of singlehood at each certain age between 19 and 25. Because the depndent variable is the individual's singlehood dummy, and the explanatory variable is his own income, the regression is estimated for men only. Women are excluded because of the endogeneity of female income, as many women do not work after marriage. Further difference-in-difference analyses include women since they do not connect individual's singlehood to her own income. To exclude migrants who lived in 1980 in either oil or comaprison areas but did not experience the oil boom, I limit the sample to those individuals who lived in the same area (either oil or comparisonl) at the beginning of the oil boom as in 1980, the year the data were collected[17]. This let 1,646 observations in the oil area and 27,218 observations in the compariosn area.

Any OLS estimator of income effect on singlehood may be biased because the 1980 income might be simultaneously influenced by the age of marriage and because of the omitted characteristics that correlate with both income and marriage age. Thus, I instrument the 1980 income with the oil boom's natural experiment. The instrument is a product of two dummies: being an individual in the oil area and belonging to the treated cohort. The treated cohort are men born between 1953 and 1958, who were 15-20 years old when the oil boom started. As shown above, the oil boom is responsible for the income differences between the oil and comparison areas for this cohort, aged 22-27 in 1980, making it a valid instrument[18]. There are no retrospective data regarding income, but only for 1980. I assume that the 1980 income represents the potential observed by the potential female marriage partner when the man was single. The estimated regressions are

$$S_{ij}^A = \beta_0^A + \beta_1^A I_{ij} + \beta_2^A W_{ij} + \gamma_j^A + \delta_{ij}^A + \varepsilon_{ij} \tag{4}$$

where the first stage is

$$I_{ij} = \alpha_0^A + \alpha_1^A C_{ij} O_j + \alpha_2^A W_{ij} + \gamma_j^A + \delta_{ij}^A + u_{ij}$$

where S_{ij}^A is the singlehood dummy of age A of a man i who lives in area j (oil or comparison), I_{ij}

[17]For this purpose, I use two variables. The first is the group of counties of residence five years before the 1980 Census (MIGCOGRP). Unfortunately, this variable exists for only half of the respondents of the IPUMS. Thus, I additionally use the timing the respondents moved to their present residence (MOVEDIN). The sample is limited to those who were in the same area or moved to their present residence at least five years before the 1980 Census.

[18]The first-stage F-statistic in all regressions is between 23 and 40.

is his income in thousands in 1980, γ_j is the area fixed effect and δ_{ij} is the fixed effect of the treated cohort. The instrument is a product of two dummies: the treated cohort C_{ij} and the oil area O_j. W is a dummy for whites. The regression is separately estimated for $19 \leq A \leq 25$. In each regression, only individuals who are at least of age A are included. The standard errors are clustered by birth year and county group (358 clusters). The results are reported in Table 4, and Figure 13 shows the estimated β_1^A as a function of A, where the shaded area is the 95% confidence interval. The results show that the income effect is insignificant at age of 19, but becomes stronger and then stays constant and statisically significant starting with age of 22, reaching a 5-6 percentage point decrease in singlehood probability for each additional thousand dollars of income. The first stage is very significant with F-statistics between 40 and 60.

Difference-in-difference

The second question is what happens to the male and female marriage hazard shortly after the male income treatment. For every single person at the beginning of the oil boom, I calculate the probability of her or his marrying within 5 years, and compare this probability to the parallel period before the oil boom.

The design is as follows. Let us take young individuals (15-20 y.o.) who were single when the oil boom started on 1.1.1974 and calculate their probability to marry within the following five years, until the end of 1978. Then let us calculate the corresponding probability of young individuals who were single on 1.1.1969 to marry within the same-length period, until the end of 1973. To eliminate the bias caused by individuals who immigrated to Montana before 1975, the sample is restricted to individuals born in Montana. Among the comparison cohort, 91% of men and 76% of women were single on 1.1.1969 in the non-oil area, and, respectively, 89% and 88% in the oil area. Among the treated cohort, the figures for 1.1.1974 are 91% and 77% versus 85% and 69%. The figures show that nothing changed in the non-oil area, while in the oil area there are 10 percentage points less single young women at the beginning of the oil boom than five years earlier, so the estimated treatment effect on marriage would have been even stronger if the numbers had stayed the same. The estimated model is

$$Mp^g_{itj} = \beta^g_0 + \beta^g_1 O_j + \beta^g_2 C_t + \beta^g_3 C_t O_j + \beta^g_4 W_{itj} + \varepsilon_{ijt}$$

where Mp^g_{itj} is the marriage-within-5-years dummy of a g-gender single i who was born in cohort t (treated or comparison) and who lives in area j (oil or non-oil). Again, O and C are the area and cohort dummies, respectively. W is a dummy for whites. The parameter of interest is β^g_3.

Figure 14 graphically shows the effect and Table 5 presents the regression results for both men and women. The Figure plots the probability of being single on the 22th birthday (left) and the probability of marrying within five years (right), conditional on singlehood on 1.1.1969 for the comparison cohort and on 1.1.1974 for the treated cohort. On both plots no significant difference between oil and non-oil areas is observed for the comparison cohort, and the comparison cohort is very similar to the treated cohort in non-oil area. However, the treated cohort in the oil area is very different. As regression results on Table 5 show, the oil boom increased the probability of men to marry within five years by 27 percentage points. Column 2 shows that for women, the effect is 16 percentage points, which is significant and large, but smaller than for men. A plausible explanation for this difference is that in the oil area, as stated above, there were 17 percentage points less single women at the beginning of the oil boom relatively to the beginning of the comparison period.

Triple difference

Observe again the last three rows of Table 3. We can see that the young men in the oil area did not earn more in all industries compared to their peers in the rest of the State. In industries directly affected by the oil boom, mining and construction, they indeed earned more. However, it was not the case in the largest sector of Montana economy, agriculture. Moreover, in the oil area the earnings in agriculture were 7% less than in the comparison area. Thus, the DD effect may be underestimated, as it includes the sectors unaffected by the treatment. Figure 15 plots the singlehood probability at the 22th birthday for men working in agriculture, mining and construction, comparing the oil area to the rest of the State. The Figure shows three cohorts, where the rightmost is the treated cohort.

Despite some fluctuation in the singlehood probability among untreated cohorts, the fluctuations are not significant relative to the large drop in the singlehood probability in the oil area for treated miners and constructors. The comparison to agriculture, where no difference between oil area and rest of the state is observed, is the evidence of the treatment effect.

Formally, the estimated model is

$$S^A_{ijkt} = \beta^A_0 + \beta^A_1 O_j + \beta^A_2 C_t + \beta^A_3 F_k + \beta^A_4 C_t O_j + \beta^A_5 C_t F_k + \beta^A_6 O_j F_k + \mu^A O_j F_k C_t + \varepsilon_{ijkt} \quad (5)$$

where $S(A)_{ij}$ is the singlehood dummy at age A of a man i who lives in area j, belongs to cohort t and is occupied in sector k (treated or agriculture). C, O and F are, respectively, the cohort, oil area and industry (treatment or comparison) dummies. The parameter of interest is the triple interaction effect μ. The regression is estimated separately for $19 \leq A \leq 25$. The results are reported in Table 6. Figure 16 shows the estimated μ as a function of age with a 95% confidence interval. Indeed, the treatment coefficients are larger than in the DD regression. The coefficients are statistically significant, going down to -0.5 around age of 22. This drastic coefficient seems to be affected by endogeneous selection into industries. It is plausible to assume that the selection of individuals into industries is not random, and more skilled men were selected into mining. This makes sense as earnings in mining are twice as high as earnings in agriculture, the Montana "default" industry. However, possible selection does not eliminate the oil boom effect, as shown by the triple interaction. If selection exists, it implies that the oil boom helped the skilled men both to earn more and marry younger.

5 Conclusions

This paper quantifies the changes in the age of marriage as a result of gender-biased economic growth. It shows that the mean age of first marriage followed a U-shape in the countries where industrialization preceded, by at least two decades, the formation of the modern female labor force. By ex-post observing the industries that remained "male" and the industries that became "female", I find that in most OECD countries each additional per capita dollar produced in the male sectors decreases the mean age of marriage by the same figure as each additional dollar produced in the female sectors increases it. In the US, the rise of the female sectors explains a large part of the increase in the singlehood probability of men and women in their early twenties, controlling for other factors such as the Pill. The dynamics start with a shock in the male sector that triggers a change in the female sector. The Montana oil boom is an example of such a U-shape event.

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Table 1: Time series estimation, dependent variable: mean age at first marriage

		Men	Women	N (men)	N (women)
OECD data					
Austria	male sectors	-0.062 (0.185)	0.011 (0.154)	28	28
	female sectors	0.077* (0.043)	0.055 (0.036)		
Belgium	male sectors	-0.310 (0.760)	0.236 (0.265)	18	27
	female sectors	0.388 (0.291)	0.052 (0.113)		
Canada	male sectors	-0.161 (0.303)	-0.356 (0.354)	35	35
	female sectors	0.126 (0.0849)	0.213* (0.096)		
Denmark	male sectors	-0.446* (0.254)	-0.365 (0.264)	29	30
	female sectors	0.332*** (0.072)	0.314*** (0.061)		
Finland	male sectors	-0.169 (0.515)	-0.195 (0.194)	33	37
	female sectors	0.143 (0.151)	0.123** (0.062)		
France	male sectors	-0.646 (1.554)	-0.459 (0.338)	37	38
	female sectors	0.155 (0.397)	0.165*** (0.092)		
Germany	male sectors	-0.438 (1.964)	-0.144 (7.346)	7	7
	female sectors	0.473 (1.964)	0.346 (2.052)		
Norway	male sectors	-0.897* (0.531)	-1.049*** (0.340)	36	38
	female sectors	0.086 (0.057)	0.111*** (0.037)		
United Kingdom	male sectors	-0.336 (1.137)	0.176 (0.218)	14	37
	female sectors	0.330 (0.345)	0.001 (0.041)		
United States	male sectors	-0.661*** (0.124)	-0.287* (0.162)	37	37
	female sectors	0.285*** (0.038)	0.228*** (0.037)		
Maddison (1996) data					
Denmark	male sectors	-0.205 (0.160)	-0.100 (0.189)	58	59
	female sectors	0.408** (0.189)	0.350** (0.176)		
France	male sectors	-0.651 (1.481)	-0.201 (0.176)	49	52
	female sectors	0.676 (0.914)	0.418** (0.200)		
Italy	male sectors	-0.080 (0.192)	-0.224 (0.147)	46	51
	female sectors	0.260 (0.251)	0.398*** (0.142)		
Netherlands	male sectors	-0.976* (0.502)	-0.135 (0.251)	44	45
	female sectors	1.007*** (0.288)	0.293** (0.135)		
Sweden	male sectors	-0.358 (0.688)	-0.458 (0.899)	49	52
	female sectors	0.792 (0.651)	1.081 ***(0.791)		
United States	male sectors	-0.181** (0.0923)	0.065 (0.088)	57	57
	female sectors	0.218** (0.085)	0.177** (0.073)		
Western Germany	male sectors	-0.342 (0.264)	-1.137*** (0.254)	34	33
	female sectors	0.452** (0.182)	0.914*** (0.186)		

Standard errors are given in parentheses. The regressions include autoregression (1). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2: The 2SLS regressions of income effect on singlehood, Montana men

Dependent variable: dummy for singlehood (men)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	age=19	age=20	age=21	age=22	age=23	age=24	age=25
Male sectors	-0.003	-0.005	-0.006**	-0.008**	-0.009**	-0.01**	-0.01**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Female sectors	0.006	0.01	0.012	0.014	0.018*	0.019**	0.018**
	(0.012)	(0.011)	(0.01)	(0.01)	(0.01)	(0.009)	(0.008)
White	-0.083***	-0.084***	-0.086***	-0.087***	-0.088***	-0.087***	-0.087***
	(0.011)	(0.011)	(0.011)	(0.01)	(0.01)	(0.009)	(0.009)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.662***	0.647***	0.647***	0.630***	0.144***	0.556***	0.147***
	(0.129)	(0.115)	(0.103)	(0.091)	(0.069)	(0.069)	(0.051)
Observations	512858	489323	466476	443073	419458	395137	370147

Dependent variable: dummy for singlehood (women)							
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	age=19	age=20	age=21	age=22	age=23	age=24	age=25
Male sectors	-0.009**	-0.01**	-0.011**	-0.01**	-0.01**	-0.009**	-0.008**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Female sectors	0.026**	0.028***	0.028***	0.027***	0.026**	0.026***	0.023***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.009)	(0.008)
White	-0.129***	-0.133***	-0.135***	-0.137***	-0.136***	-0.134***	-0.131***
	(0.012)	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)	(0.011)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.504***	0.500***	0.493***	0.480***	0.458***	0.163***	0.408***
	(0.103)	(0.087)	(0.077)	(0.072)	(0.065)	(0.045)	(0.047)
Observations	552007	526686	500978	474745	448786	422229	395456

The by state clustered standard errors are given in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Descriptive statistics, 1980 Census, Montana

	Males							Females						
	17-35 y.o.			36-50 y.o.				17-35 y.o.			36-50 y.o.			
	Comp. area	Oil area	Diff. (t-stat.)	Comp. area	Oil area	Diff. (t-stat.)	Diff. in diff. (t-stat.)	Comp. area	Oil area	Diff. (t-stat.)	Comp. area	Oil area	Diff. (t-stat.)	Diff. in diff. (t-stat.)
Whites	0.95	0.92	0.03	0.97	0.94	0.03	0.00	0.94	0.90	0.04	0.95	0.95	0.00	0.04
			(3.2)			(2.6)	(0.0)			(3.7)			(0.0)	(2.6)
Born in Montana	0.55	0.65	-0.1	0.49	0.61	-0.12		0.56	0.64	-0.08	0.49	0.51	-0.02	-0.06
			(-0.54)			(-4.8)				(-4.5)			(-0.8)	(-1.9)
Years of schooling	12.9	12.4	0.50	13.0	12.4	0.60	-0.10	12.7	12.4	0.30	12.5	12.3	0.20	0.10
	(2.4)	(2.7)	(5.3)	(3.2)	(3.1)	(3.8)	(-0.5)	(2.2)	(2.2)	(3.7)	(2.4)	(2.3)	(1.7)	(0.7)
Income in agriculture	8446	7601	845											
	(8903)	(8727)	(2.7)											
Income in mining	13650	16648	-2998											
	(8902)	(10085)	(8.5)											
Income in construction	11270	11673	-403											
	(8907)	(7708)	(-1.43)											
Observations	5,703	913		2,634	458			5,599	857		2,637	433		

Standard deviations are given in parentheses. Income is total personal income, including negative values. In diff. in diff. columns the t-statistic is given in parentheses.
For income, t-statistics are not given because the number of observations in each industry is not reported here.

Table 4: The 2SLS regressions of income effect on singlehood, Montana men

	Dependent variable: dummy for singlehood						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	age=19	age=20	age=21	age=22	age=23	age=24	age=25
Income	-0.014	-0.031***	-0.04***	-0.061***	-0.055**	-0.05***	-0.056**
	(0.009)	(0.006)	(0.014)	(0.021)	(0.023)	(0.019)	(0.029)
Oil area	-0.004	-0.023	-0.032	-0.067	-0.048	-0.051	-0.071
	(0.013)	(0.017)	(0.028)	(0.044)	(0.108)	(0.04)	(0.054)
Treated cohort	-0.065*	-0.169***	-0.24***	-0.368***	-0.321***	-0.272***	-0.26**
	(0.039)	(0.023)	(0.068)	(0.114)	(0.108)	(0.084)	(0.107)
White	0.142***	0.235***	0.277***	0.385***	0.33**	0.276**	0.285*
	(0.053)	(0.043)	(0.083)	(0.125)	(0.136)	(0.113)	(0.167)
Constant	1.009***	1.127***	1.16***	1.298***	1.157***	1.042***	1.056***
	(0.0845)	(0.064)	(0.143)	(0.229)	(0.241)	(0.201)	(0.302)
First stage F-stat.	46.3	50.64	54.69	60.41	55.24	47.30	40.21
N. of clusters	358	353	348	343	338	333	328
Observations	10817	10572	10308	10029	9760	9485	9225

The clustered standard errors are given in parentheses.

The treated cohort is 1953-1957 born, the instrument is (treated cohort)x(oil area).

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: The effect of the oil boom on the within 5-years marriage probability

	Dependent variable: dummy for marriage within five years	
	(1)	(2)
	Males	Females
(Treated cohort)x(Oil area)	0.265*	0.122*
	(0.136)	(0.072)
Treated cohort	-0.049	-0.08**
	(0.036)	(0.032)
Oil area	0.055	-0.031
	(0.129)	(0.064)
Whites	-0.046	0.148***
	(0.059)	(0.049)
Constant	0.559***	0.504***
	(0.066)	(0.051)
Observations	1336	1058

Standard errors in parentheses

Standard errors clustered by year of birth and group of counties

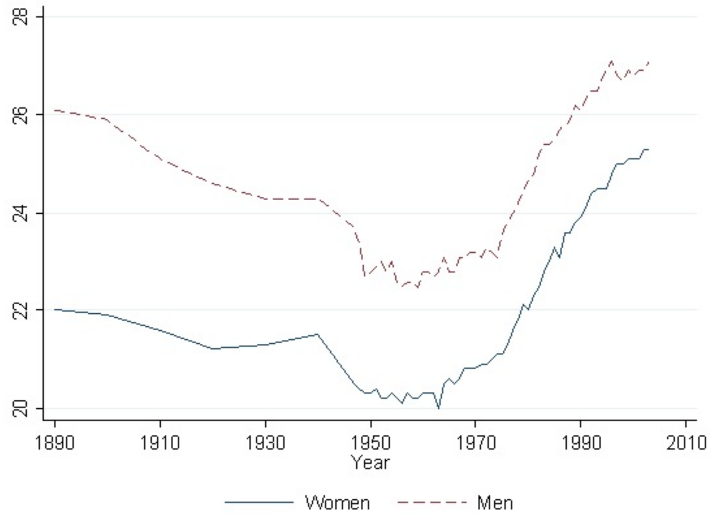
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Tripe interaction regressions of the male singlehood

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	age = 19	age = 20	age = 21	age = 22	age = 23	age = 24	age = 25
(Treated cohort)x(Oil area)x(Treated industries)	-0.0807	-0.0468	-0.296*	-0.564***	-0.259***	-0.0326	0.201*
	(0.0822)	(0.121)	(0.151)	(0.107)	(0.0934)	(0.116)	(0.108)
Treated cohort	-0.0361*	-0.0481	-0.0469	-0.0702	-0.122**	-0.0263	0.0706
	(0.0205)	(0.0355)	(0.0359)	(0.0513)	(0.0581)	(0.0761)	(0.0851)
Oil area	0.000860	0.0128	0.0123	0.0156	0.00417	-0.0154	-0.00749
	(0.0122)	(0.0179)	(0.0266)	(0.0369)	(0.0396)	(0.0437)	(0.0458)
Treated industries	-0.0371***	-0.0496***	-0.0743***	-0.103***	-0.131***	-0.114***	-0.116***
	(0.0104)	(0.0141)	(0.0183)	(0.0212)	(0.0233)	(0.0242)	(0.0226)
(Treated cohort)x(Oil area)	-0.00389	-0.0993	-0.0270	0.00202	-0.178	-0.220*	-0.388***
	(0.0653)	(0.0697)	(0.0722)	(0.0817)	(0.123)	(0.133)	(0.123)
(Treated cohort)x(Treated industries)	0.0515*	0.0745**	0.0455	0.0686	0.131**	0.0366	-0.0902
	(0.0268)	(0.0377)	(0.0440)	(0.0562)	(0.0625)	(0.0737)	(0.0872)
(Oil area)x(Treated industries)	0.0250	0.00926	0.0604	0.0990	0.0776	0.0597	0.0384
	(0.0236)	(0.0338)	(0.0419)	(0.0604)	(0.0620)	(0.0595)	(0.0587)
Whites	0.108***	0.106**	0.0698	0.0723	0.0791	0.00873	-0.0485
	(0.0395)	(0.0481)	(0.0544)	(0.0573)	(0.0565)	(0.0581)	(0.0593)
Constant	0.854***	0.798***	0.761***	0.673***	0.580***	0.553***	0.540***
	(0.0384)	(0.0492)	(0.0560)	(0.0572)	(0.0575)	(0.0589)	(0.0598)
N. of clusters	309	304	299	294	289	284	279
Observations	2927	2860	2801	2720	2649	2573	2492

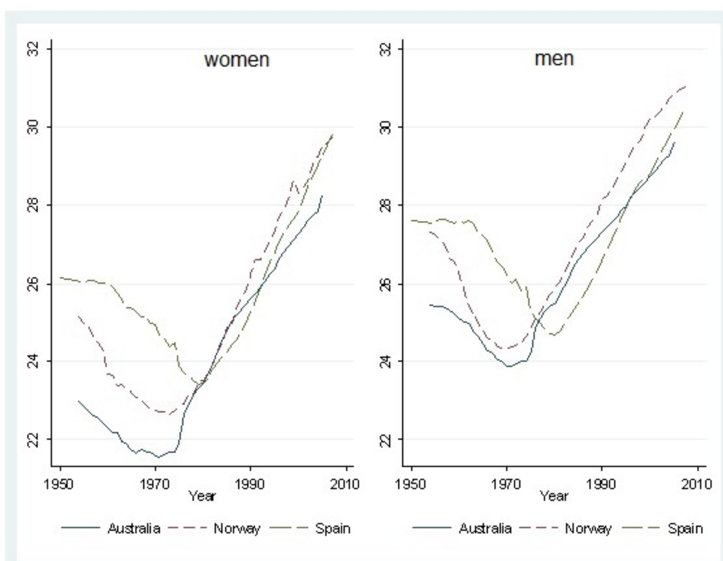
The clustered standard errors are given in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: Median age at first marriage, United States 1890-2005



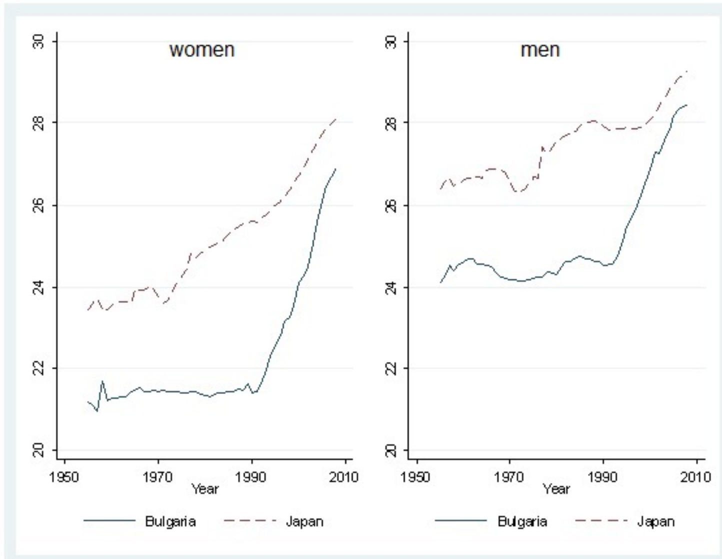
Source: Bureau of Census.

Figure 2: Examples of the U-shaped pattern; women (left) and men (right)



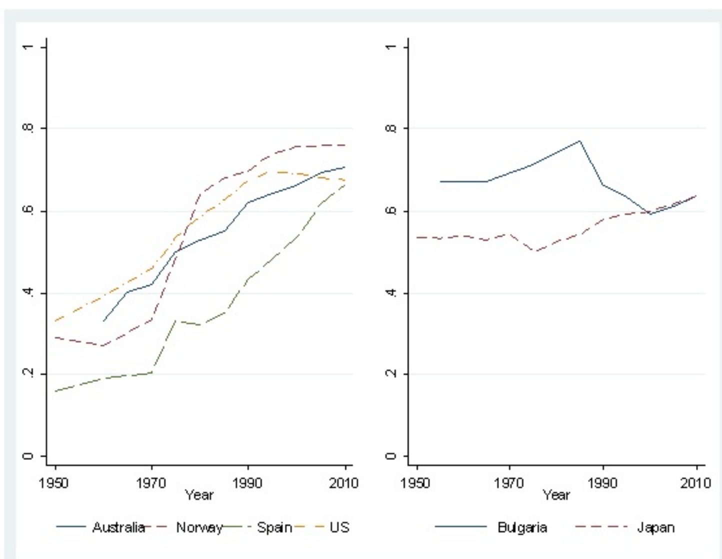
Note: mean age at first marriage, see Appendix A for data and Appendix B for details.

Figure 3: Examples of no-U-shape pattern; women (left) and men (right)



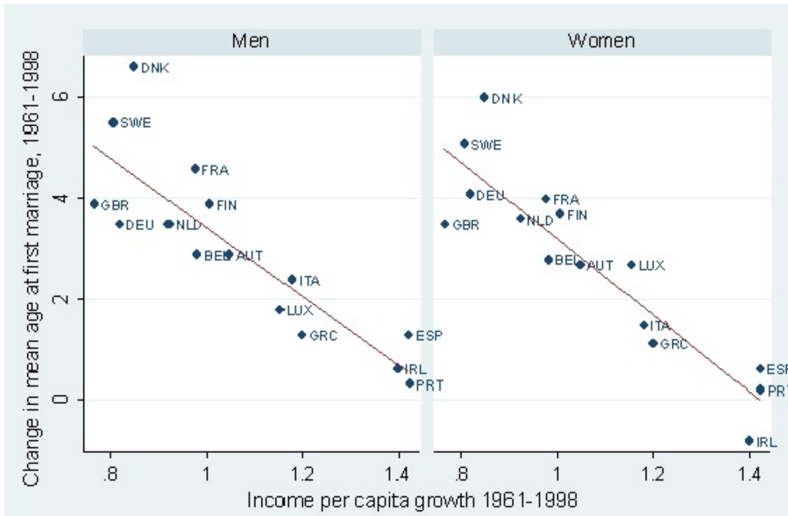
Note: mean age at first marriage, see Appendix A for data and Appendix B for details.

Figure 4: Female labor force participation



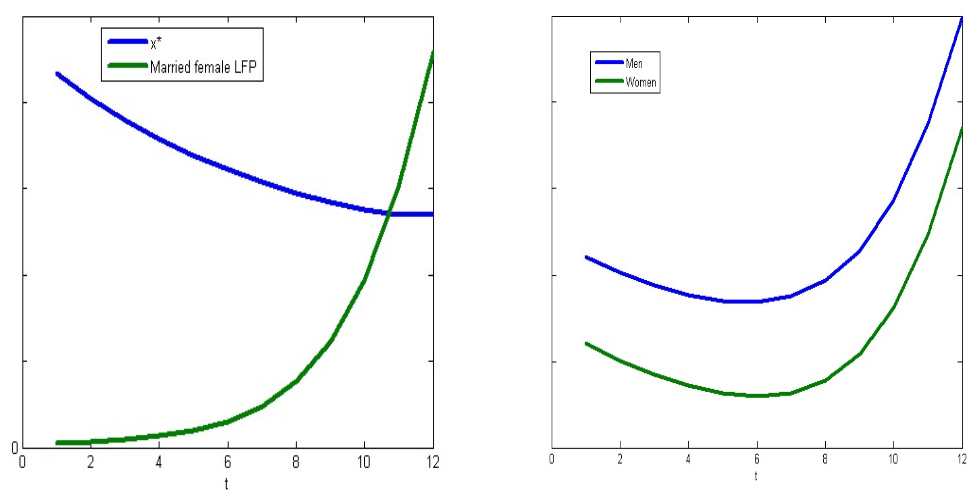
Source: Olivetti (2013).

Figure 5: Relationship between change in real income per capita and change in the age at first marriage (1961-1998), 15 EU countries



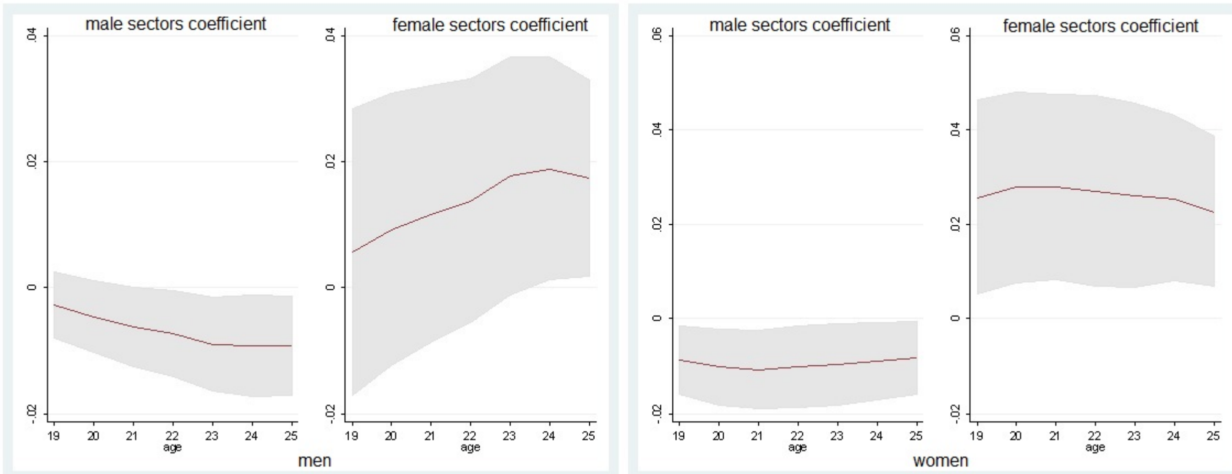
Sources: age at first marriage - Council of Europe, GDP (PPP) per capita - www.gapminder.org

Figure 6: The simulated forces of the model (left) and the mean age of marriage (right)



$g(A_t) = (1 - 0.02A_t)^{-1}$, $u(c) = ln(c)$, $a \sim lognormal(0, 0.25)$, $\pi = 0.7$, $A_t = 0.75 + 0.25t$, $B_1 = 0.5$

Figure 7: The estimated α_1^m and α_2^m (left) and α_1^f and α_2^f (right) coefficients of Equation 7



All regressions include the state and year fixed effects. Standard errors in parentheses, clustered by state. Controls: legal age of marriage with and without parental consent, Early Legal Access to contraception, no-fault divorce and abortion laws. The shaded area is the 95% confidence interval.

Figure 8: Singlehood probability at age 20-21 of women (left) and men (right) in Montana

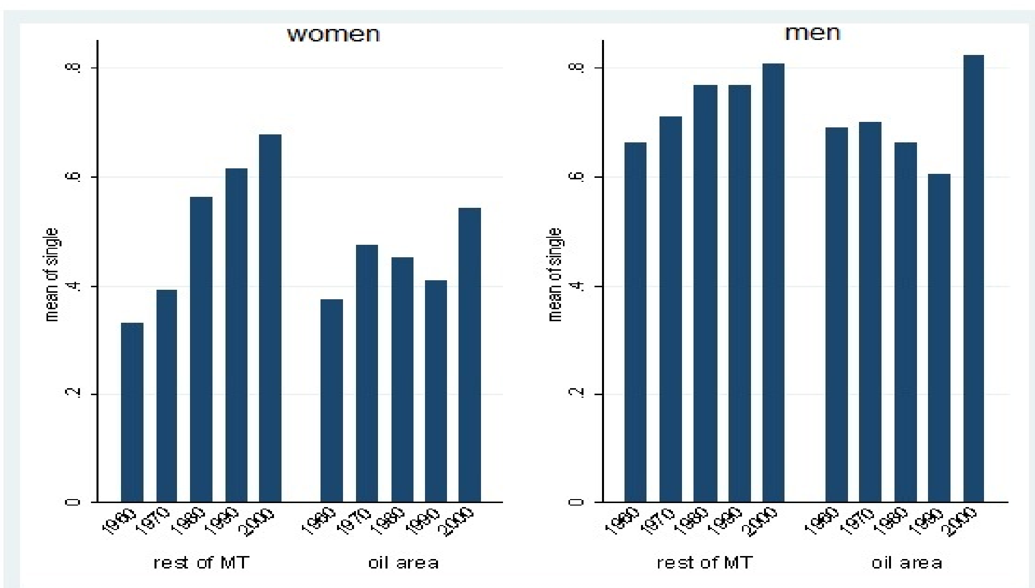
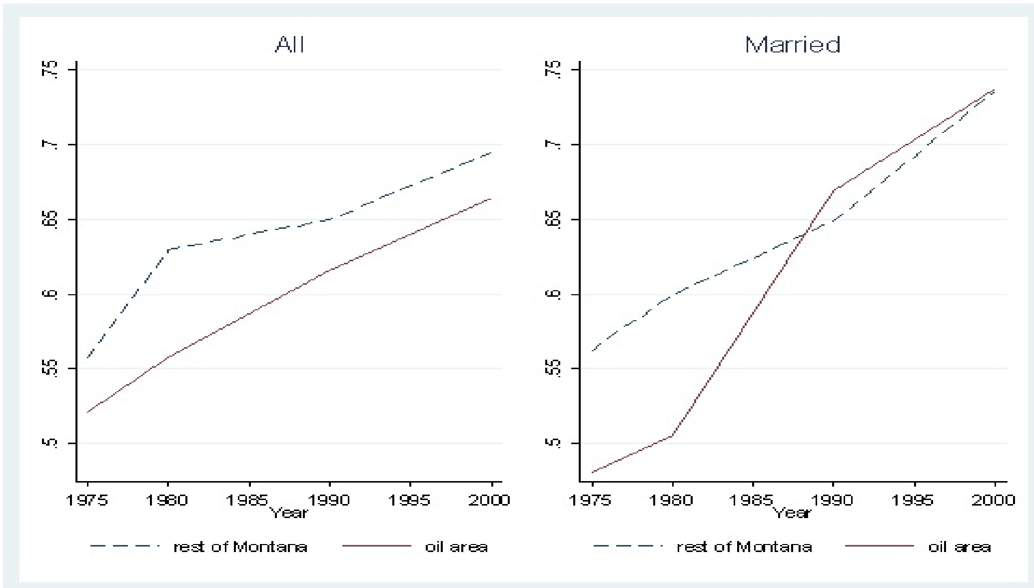


Figure 9: Labor force participation of 17-27 years old women in Montana



Note: calculated using 1980-2000 Census IPUMS. For 1975, the figure is calculated using the 1980 Census variable "activity 5 years ago".

Figure 10: Montana division according to the 1980 Census county grouping

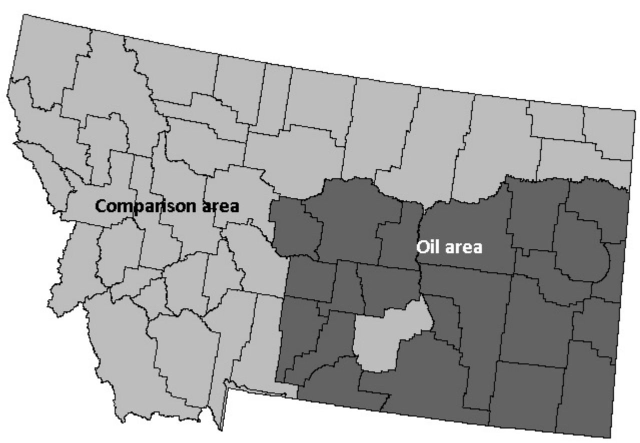


Figure 11: Male income in 1980

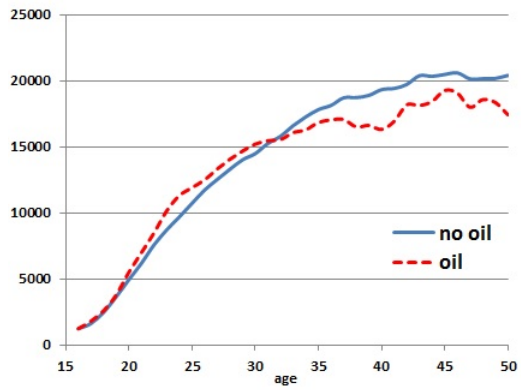


Figure 12: Decomposition of the income gap of 16-24 year old males

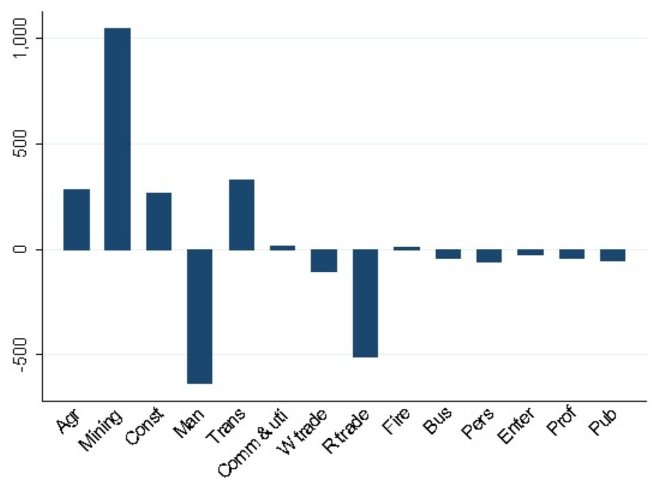
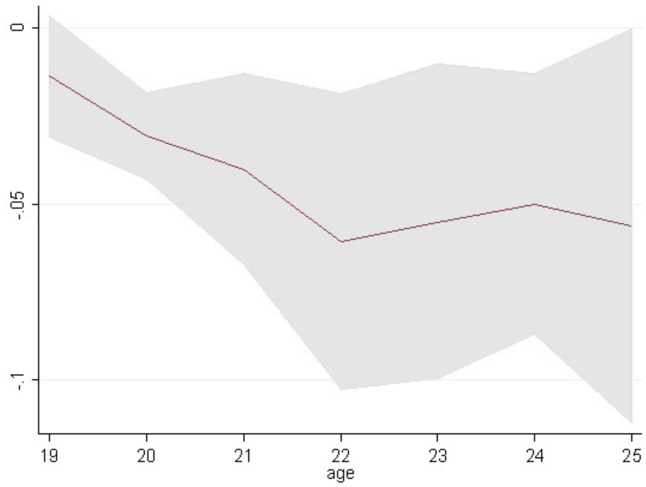


Figure 13: The income coefficient from the 2SLS estimation of Equation 4



Note: The 2SLS coefficients of Equation 4 where singlehood is regressed on 1980 income in thousands of dollars. In the first stage, the income is regressed on the treatment cohort and oil area dummies and the product of the two. The standard errors are clustered by year of birth and group of counties. The shaded area is 95% confidence interval.

Figure 14: Male singlehood probability at the 22th birthday and marriage within "experiment" period

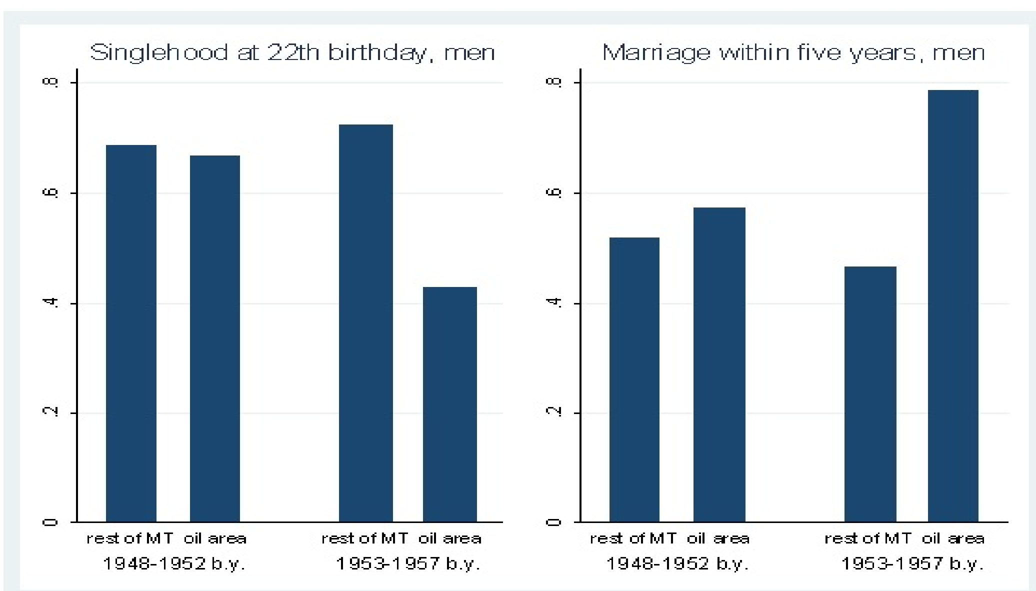


Figure 15: Singlehood probability at the 22th birthday

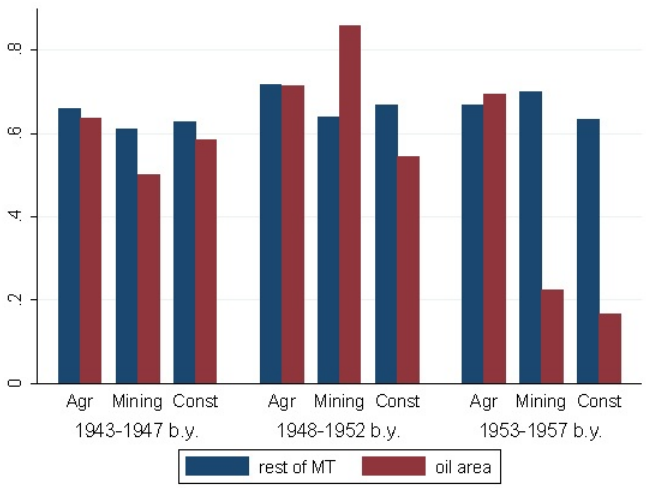
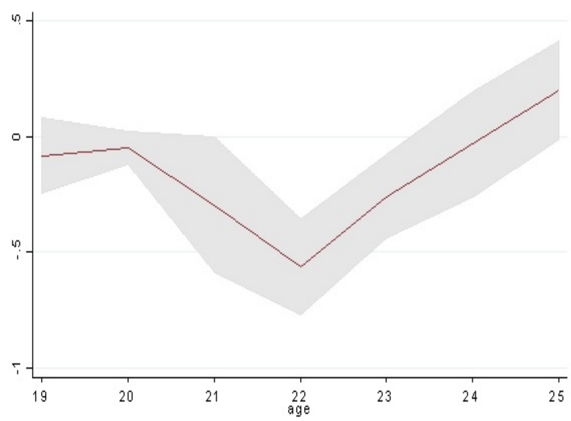


Figure 16: The estimated triple interaction effect on the male singlehood probability (model 5)



Note: in all regressions, the standard errors are clustered by year of birth and group of counties. The shaded area shows the 95% confidence interval.

Appendix A - Mean age at first marriage

Females

	1950-1954	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	2000-2004
Albania	20.5	20.8	21.2	21.4	21.6	22.1	22.5	22.6	22.8	23.4	23.1
Algeria	23.5	23.4	26.1	26.1		21.0	21.0				
American Samoa	23.5	23.5		23.0	23.0	23.0					
Angola	18.2	18.2	18.4	17.9	17.3						
Anguilla											27.2
Antigua and Barbuda	26.1	26.0	25.9	25.7	24.2	24.2	26.6		27.6	27.6	
Argentina		23.4	23.2	23.1	22.9	22.7	22.7				
Armenia								22.3	22.1	22.8	23.2
Aruba											28.7
Australia	22.9	22.6	22.0	21.7	21.7	22.9	24.1	25.2	26.0	26.9	27.7
Austria	24.9	24.4	23.6	23.1	22.8	22.9	23.6	24.5	25.5	26.6	27.4
Azerbaijan								23.8	23.3	23.3	24.4
Bahamas				23.8	23.8	23.9	25.0	26.1	27.7	31.3	27.4
Bahrain						20.1	20.4	22.5	23.0	23.0	23.3
Barbados	25.6	25.7	26.0	25.6	25.3	25.6	26.8	27.5	27.8		
Belarus					23.2	23.2	22.6	22.1	21.8	22.1	22.8
Belgium	23.1	23.1	22.7	22.4	22.1	22.1	22.6	23.6	24.8	25.8	26.8
Belize				21.3					23.4	24.8	
Bermuda	24.3	23.9	23.9	24.7	25.7		27.1	28.2	29.0	29.8	30.2
Bolivia	23.8	23.8		23.0		23.1					
Bosnia and Herzegovina						22.0	22.2	22.9	23.3		
Botswana								25.8			
Brazil						22.0	21.9	22.1	22.4	23.1	24.3
Brunei Darussalam				20.9	21.2	21.7	22.7	25.7	26.1	23.8	24.6
Bulgaria	21.2	21.2	21.3	21.4	21.4	21.4	21.4	21.5	21.9	23.2	24.9
Canada	22.8	22.3	21.8	21.8	22.0	22.9	24.1	25.5	26.6	27.1	27.6
Cayman Islands				22.3	22.3		25.6	26.7	26.8		
Central African Republic		28.7									
Chile	23.2	23.1	22.8	22.5	22.3	22.2	22.6	23.2	23.6	24.2	25.5
Christmas Island		23.7	21.4	20.7	22.6						
Cocos (Keeling) Islands				18.0	20.9						
Colombia	21.9	21.9	21.8	21.6	21.9	22.1	22.2	23.1			
Cook Islands		22.2	21.6		24.4	24.8	24.9	25.0			
Costa Rica	21.7	21.7	21.4	21.1	21.1	21.4	21.8	23.1	23.2	23.6	24.5
Croatia		22.4	22.4	21.7	21.5	21.9	22.3	22.8	23.6	24.9	25.9
Cuba		24.3	24.0	22.6	22.5	22.7	22.3	22.8	24.2	25.5	26.7
Cyprus			23.8	23.9	23.8	23.6	23.8	23.8	24.7	26.0	26.8
Czech Republic		22.0	21.8	21.6	21.7	21.6	21.6	21.6	22.0	23.5	25.4
Denmark	23.8	23.1	22.7	22.6	23.1	24.0	25.4	26.9	28.3	29.4	30.4
Dominica	27.3	27.0	25.6	26.3					27.3		
Dominican Republic	23.3	23.2	23.9	24.0	24.1	23.8	25.3				27.4
Ecuador		21.2	21.4	21.3	21.3	21.5	21.9	22.2	22.3	22.6	23.2
Egypt	21.5	21.1	20.7	20.6	20.5	20.7	20.9	21.7	22.6	25.8	
ElSalvador	22.3	22.2	22.1	22.0	22.2	22.6	23.4	23.6	24.0	24.6	25.1
Equatorial Guinea	27.4	23.6									
Estonia				23.5	23.3	22.8	22.9	22.7	22.9	24.1	25.5

	1950-1954	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	2000-2004
Faroe Islands		23.3	22.5	21.6	22.1	22.9	23.8	24.8	25.5		
Fiji				20.8	21.2	21.3	21.7	22.2			24.0
Finland	23.8	23.8	23.5	23.4	23.5	23.9	24.8	25.6	26.5	27.5	28.5
Former Czechoslovakia		22.0	21.4	21.3	21.7	22.1	22.2	22.2	21.9		
Former East Germany		22.6	22.4	22.0	21.8	21.8	22.2	23.0	24.3	25.3	
Former Panama Canal Zone				23.0	23.3	24.0					
Former West Germany	23.9	23.0	23.4	22.8	22.7	23.0	23.9	25.3	26.1	26.6	
Former Yugoslavia	22.1	22.3	22.5	21.8	21.5	21.9	22.3	22.7	22.9		
France	23.1	23.1	22.9	22.7	22.5	22.7	23.5	24.9	26.3	27.6	28.5
French Guiana	25.7	26.2	26.5	24.3			26.3				28.2
Georgia						26.1	25.2	24.2	23.5	24.3	24.8
Germany		23.5	23.2	22.7	22.4	22.6	23.5	24.7	25.9	26.8	27.3
Gibraltar				23.9	23.7						
Greece		24.5	24.5	23.8	23.7	23.4	23.5	24.2	25.2	26.3	27.5
Greenland	23.5	23.6	23.3	23.8	24.5	25.6	26.2	26.7	27.2		
Grenada	24.7	25.3	25.4	25.2						28.9	28.9
Guadeloupe	23.8	24.2	24.4	23.7	23.4		24.8	25.0	25.9		29.2
Guam		23.2	21.8	21.6	23.1	23.9	24.3	24.6	25.6		26.9
Guatemala	22.0	22.4	21.6	21.2	21.2	21.1	21.7	21.7	21.5	21.7	
Guyana	23.0	23.0	22.9								
Honduras	21.4	21.3	20.9	21.0	21.0	21.7	22.1				
Hong Kong				23.1	23.4	23.8	24.7	25.8	26.4	27.0	27.8
Hungary	21.8	21.8	21.9	21.6	21.3	21.2	21.4	21.7	22.3	23.7	26.0
Iceland	23.5	23.5	23.3	23.0	23.2	23.4	24.4	26.0	27.5	29.2	30.3
Iran, Islamic Republic of				20.8							
Iraq				25.8	26.0	24.0					
Ireland		26.9	26.3	25.3	24.7	24.7	25.2	26.0	27.3	28.4	29.1
IsleofMan	24.1	23.5	22.9	22.4	22.7	23.5	24.2	25.4	26.4	27.8	29.1
Israel	22.0	21.8	21.6	21.4	21.5	21.8	22.3	22.8	22.9	23.3	23.9
Italy	24.8	24.8	24.5	24.1	23.8	23.7	24.1	25.0	26.0	26.9	27.7
Jamaica	26.8	27.0	27.1								28.8
Japan	23.5	23.5	23.7	23.9	23.9	24.6	25.1	25.5	25.7	26.3	27.2
Jordan		19.7	19.7	19.8	19.8	20.0	20.4	21.0	21.3	21.9	
Kazakhstan								22.5	22.1	22.4	23.8
Kenya				24.3							
Korea, Republic of		23.0	22.7			23.3	23.3	24.1	25.0	26.0	27.2
Kuwait				20.3	20.4	20.9	21.5	21.9	21.5	22.6	23.3
Kyrgyzstan								21.8	21.9	21.9	22.7
Latvia					23.5	23.0	22.8	22.6	22.4	23.7	24.9
Liechtenstein			22.7	22.9	24.1	25.4	25.8	26.0		28.8	29.4
Lithuania				24.0	23.9	23.2	23.2	22.8	22.2	22.8	24.3
Luxembourg	24.2	23.9	23.5	23.1	22.7	22.9	23.6	24.7	26.0	27.0	27.8
Macao		27.2	25.0	24.2	23.4	24.3	25.6	26.3	27.3	27.5	27.3
Macedonia, TFYR of											
Madagascar				21.3	21.1						
Mali		22.1	22.2	22.2	22.1	22.2	22.5	22.6	22.7	23.1	24.1

	1950-1954	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	2000-2004
Malta								24.8			
Martinique	25.9	25.8	25.8	25.1	24.4		25.8	26.7			29.9
Mauritius								23.7	23.7	23.8	24.6
Mexico	20.7	20.8		21.3	21.3	21.1	21.4	21.6	21.9	22.4	23.0
Moldova							23.0	22.7	21.9	21.7	21.7
Mongolia										24.3	25.3
Montenegro						22.7	22.7	23.3	23.3	24.0	24.6
Montserrat				23.1	24.9		26.4	27.9			
Mozambique			19.8	19.9	20.4						
Myanmar		22.6	22.4	22.5	23.0	23.2	23.6	24.0	24.0	24.1	25.4
Namibia	27.1	22.5	22.4								
Nauru			24.7	23.1							
Netherlands	25.2	24.8	23.9	23.3	22.7	22.8	23.7	25.1	26.6	27.5	28.3
Netherlands Antilles	23.8	23.6	23.6	23.7	23.4						
New Caledonia						22.6	24.0	25.2	26.2	27.6	28.4
New Zealand					21.8	22.7	24.0	25.1	26.4	27.4	28.1
Norfolk Island					25.0	26.7	25.4	29.8			
Norway	25.1	24.5	23.4	23.0	22.7	23.2	24.1	25.5	26.8	28.0	28.9
Palestinian Authority										19.9	20.1
Panama	23.5	23.2	22.9	23.3	23.3	23.5	23.9	24.4	25.3	26.0	27.1
Paraguay		22.8	22.4	22.5	22.0	22.3	22.7	22.7	22.7		23.5
Peru	22.9	23.1	23.3	23.0	22.9	23.2					
Philippines		21.4	21.5	21.5	21.5	22.0	22.4	22.9	23.8	24.4	24.5
Poland	20.8	21.7	22.1	22.9	22.9	22.7	22.7	22.7	22.8	23.5	25.3
Portugal	25.1	24.9	24.7	24.4	24.0	23.4	23.3	23.7	24.3	25.0	26.1
Puerto Rico	22.2	21.8	21.4		22.2	22.5	23.1	23.6	24.2	24.5	25.3
Qatar							21.0	21.4	22.3	23.1	24.1
Reunion	23.0	22.8	22.8	22.6	22.2		23.0	23.9	24.5	26.8	27.3
Romania		21.9	21.9	21.4	21.8	22.1	21.8	22.1	22.2	23.0	24.0
Russian Federation		24.7	24.3	23.8	22.9	22.5	22.3	22.2	21.9	21.7	21.0
Saint Helena				20.2	21.3	21.4	24.3	23.9			
Saint Kitts and Nevis		26.2	25.6	24.7	24.6					29.3	
Saint Lucia						26.1	26.5	27.2		28.2	28.7
Saint Pierre and Miquelon				21.6							
Sn. Vincent and the Grenadines	24.4	24.5	25.2			25.1	25.1	26.2			
Samoa					23.8	24.7	24.8			25.9	26.0
San Marino			22.8	22.9	22.6	22.4	23.5	25.0	26.9	28.2	28.8
Scotland	23.5	22.8	22.3	22.0	22.0	22.4	23.3	24.0			
Serbia		22.0	22.1	22.4	22.0	22.3	22.7	23.1	23.8	24.5	27.3
Seychelles	24.6		24.7	23.2	22.9	22.4	23.9	26.3	27.6	28.4	28.6
Singapore		23.3	23.0	23.1	23.1	23.2	24.0	25.0	25.8	26.2	26.7
Slovakia		22.1	22.1	22.0	22.0	22.0	21.9	22.0	22.1	23.2	24.8
Slovenia				23.1	22.8	22.6	22.7	23.2	24.4	25.8	27.5
South Africa	22.7	22.5	22.6	22.6	22.6	23.1			27.4	27.7	

	1950-1954	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	2000-2004
Spain	26.1	26.0	25.7	25.1	24.5	23.6	23.8	24.7	26.1	27.4	28.7
Sri Lanka						22.8	23.2	23.6	24.0	24.1	24.9
Suriname										25.0	25.1
Swaziland			24.1								
Sweden	24.6	24.3	23.8	23.7	24.3	25.4	26.6	28.0	28.1	29.4	30.5
Switzerland	25.9	25.4	24.8	24.4	24.2	24.7	25.5	26.5	27.0	27.6	28.2
Tajikistan								21.6	20.2	20.9	20.9
Timor-Leste				23.9	23.3						
Tokelau					24.5	22.0	22.0				
Tonga									23.8	23.8	24.1
Trinidad and Tobago	22.3	22.3	22.4	22.5	22.6	22.8	23.0	23.8	24.1	25.0	26.2
Tunisia	23.7	22.5	20.5	21.1	20.9	20.9	21.5	22.7	23.8	24.4	25.6
Turkey	18.0	18.5	19.0	19.6	20.0	20.4	21.0	21.4	21.8	22.5	22.8
Turkmenistan								22.9			
Turks and Caicos Islands											30.4
Ukraine					22.1	21.9	22.1	22.3	21.9	22.4	23.2
United Kingdom		23.3	23.0	22.5	22.5	22.7	23.4	24.4	25.7	26.9	27.4
United States	20.3	20.2	20.3	20.7	21.1	21.7	22.8	23.9	24.9		
Uruguay						22.6	22.9	23.4	23.6	25.4	25.5
Uzbekistan								21.5	19.8	21.1	21.4
Venezuela	22.1	21.9	21.9	21.7	21.6	21.7	22.1	22.6	23.0	23.7	24.5
Virgin Islands, British					23.8		26.6	28.4			
Virgin Islands, U.S.	24.5	24.1	23.6		24.8		27.4	27.8	28.6		
Zimbabwe						23.2					

Males

	1950-1954	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	2000-2004
Albania	24.8	24.8	25.3				26.0	26.4	26.3		27.8
Algeria	25.9	25.6	21.0	21.0		25.9	25.9				
American Samoa	25.8	25.8		25.5	26.0	25.9					
Angola	18.4	18.5	18.7	18.3	17.7						
Anguilla											27.8
Antigua and Barbuda	29.5	28.9	28.8	28.2	28.2	28.2	29.0	29.2	29.3	29.3	
Argentina		26.5	26.3	26.0	25.7	25.2	25.2				
Armenia								25.4	25.4	26.3	26.5
Aruba											30.1
Australia	25.4	25.3	24.8	24.1	24.0	25.1	26.1	27.0	27.7	28.4	29.1
Austria	26.5	26.5	25.4	25.3	25.3	25.5	25.8	26.5	27.7	29.0	29.8
Azerbaijan								25.6		26.8	26.5
Bahamas				26.0	25.9	26.2	26.9	27.7	29.2	32.6	29.2
Bahrain						24.6	24.8	26.2	26.6	26.5	26.7
Barbados	28.5	28.5	28.3	27.8	27.4	28.0	28.8	29.5	29.5		
Belarus					24.2	24.0	24.0	24.6	24.5	25.0	25.5
Belgium	25.2	25.2	24.6	24.0	23.8	24.2	24.8	25.7	26.9	28.0	28.9
Belize				24.4					25.8	24.8	
Bermuda	25.9	25.7	26.1	26.0	26.1		28.7	29.5	30.2	30.7	31.2
Bolivia	25.5	25.6		25.1		24.3					
Bosnia and Herzegovina								25.7	25.8	27.3	27.2
Botswana								30.8			
Brazil						24.8	24.7	24.9	25.2	25.9	26.7
Brunei Darussalam				25.2	24.4	24.9	25.4	25.9	26.7	26.1	26.9
Bulgaria	24.1	24.4	24.6	24.3	24.2	24.3	24.6	24.7	24.9	26.1	27.5
Canada	25.2	24.9	24.5	24.1	24.1	24.9	26.0	27.1	28.1	28.6	29.0
Cayman Islands				25.2	25.2		27.1	28.0	28.0		
Central African Republic		30.8									
Chile	25.7	25.6	25.2	24.9	24.6	24.5	24.8	25.2	25.7	26.2	27.4
Christmas Island		24.9	24.4	25.7	24.8						
Cocos (Keeling) Islands				19.8	20.8						
Colombia	25.9	25.9	25.7	25.5	25.7	25.5	25.4	26.1			
Cook Islands		24.5	23.9		25.0	26.7	26.5	26.5			
Costa Rica	25.3	25.2	25.0	24.7	24.3	24.3	24.6	25.5	25.6	26.1	26.8
Croatia									26.6	27.1	27.7
Cuba		27.4	27.0	25.6	25.5	25.7	25.0	25.0	26.2	27.7	29.0
Cyprus			25.0	25.1	25.4	25.7	26.1	26.6	27.2	28.2	28.8
Czech Republic									24.7	26.4	28.3
Denmark	26.9	26.3	25.4	24.9	25.7	26.9	28.3	29.5	30.9	32.2	33.2
Dominica	28.3	29.5	28.4	28.7				29.6	29.6		
Dominican Republic	26.9	27.1	27.5	27.4	27.2	26.6	27.8				29.3
Ecuador		24.1	24.3	24.4	24.2	24.3	24.5	24.7	24.7	24.9	25.3
Egypt	26.9	26.8	26.5	26.1	25.5	25.6	25.8	26.8	27.5	27.5	
El Salvador	25.8	25.9	25.5	25.4	25.5	25.7	26.1	26.0	26.2	26.5	27.0
Equatorial Guinea	27.0	28.2									
Estonia								25.2	25.7	26.6	28.0

	1950-1954	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	2000-2004
Faroe Islands		26.3	25.4	24.4	25.1	25.8	26.6	27.0	27.4		
Fiji				24.0	24.3	24.2	24.5	25.1			26.9
Finland	25.6	25.2	24.8	24.2	24.6	25.6	26.7	27.4	28.2	28.8	29.4
Former Czechoslovakia		25.2	24.5	24.0	24.0	24.3	24.6	24.6	24.4		
Former East Germany			24.3	24.6	24.2		25.2	25.2			
Former Panama Canal Zone				24.6	24.8	25.3					
Former West Germany	24.9	24.2	25.6	25.3	25.2	25.5	26.2	26.9	27.9		
Former Yugoslavia	23.9	24.5	25.1	25.1	24.7	25.0	25.5	25.9	26.1		
France	25.4	26.1	26.0	24.4	24.2	24.8	25.8	27.1	28.2	29.1	29.9
French Guiana	28.4	29.2	29.1	27.4	26.7		28.7				30.6
Georgia								25.8		26.2	27.0
Germany									28.4	29.2	30.2
Gibraltar				25.5	25.1						
Greece		27.9	28.1	27.8	27.4	27.0	26.9	27.5	28.3	29.1	30.0
Greenland	25.0	25.6	25.9	26.4	27.4	28.4	29.0	28.9	29.2		
Grenada	28.1	28.5	28.8	28.2						30.6	30.7
Guadeloupe	27.8	28.0	28.1	27.3	26.8		28.0	28.1	28.6		31.4
Guam		25.5	25.0	24.2	25.2	25.8	26.1	26.6	27.0		28.1
Guatemala	25.3	25.6	24.8	24.2	24.1	23.7	24.2	24.2	24.0	25.0	
Guyana	25.0	26.1	26.2								
Honduras	25.3	25.6	25.0	25.1	24.7	25.0	25.2				
Hong Kong				28.2	27.4	27.0	27.4	28.2	29.0	29.4	29.9
Hungary	25.8	25.3	25.0	24.5	24.1	24.2	24.9	25.0	25.0	26.0	27.9
Iceland	25.0	25.7	25.1	24.1	24.2	24.7	25.8	27.3	28.6	30.1	30.4
Iran, Islamic Republic of				26.6							
Iraq				25.8	26.7	27.4					
Ireland		28.0	27.4	26.3	25.5	25.2	25.8	26.6	27.8	29.1	30.1
Isle of Man	26.2	25.7	25.3	24.6	24.9	25.6	26.3	27.1	28.0	29.3	30.0
Israel	25.7	25.4	25.4	24.9	24.4	24.7	25.3	25.8	26.0	26.2	26.7
Italy	27.2	27.4	27.2	26.6	26.1	26.1	26.3	27.1	28.0	29.0	30.1
Jamaica	29.6	29.6	29.4								30.1
Japan	26.4	26.5	26.7	26.8	26.5	27.2	27.7	28.0	27.9	27.9	28.5
Jordan		24.3	24.5	24.9	25.1	25.4	25.4	25.3	25.6	26.4	
Kazakhstan								24.8	24.5	25.0	26.2
Kenya				27.1							
Korea, Republic of		26.5	26.3			26.9	26.5	27.0	27.9	28.5	29.4
Kuwait				26.2	26.1	25.7	25.6	25.7	24.4	25.3	25.8
Kyrgyzstan								24.5	24.3	24.9	26.0
Latvia								24.9	24.9	26.1	27.2
Liechtenstein			25.5	25.7						30.0	
Lithuania								24.4	24.3	25.1	26.4
Luxembourg	26.1	25.9	25.7	25.3	24.9	25.3	26.4	27.2	28.6	28.9	30.2
Macao		30.7	28.6	27.7	27.6	27.6	28.8	28.9	29.9	29.7	29.2
Macedonia, TFYR of									25.3	25.7	26.4
Madagascar				25.2	24.4						
Mali								32.5			

	1950-1954	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	2000-2004
Malta		25.1	25.1	24.8	25.0	25.8	26.2	26.1	26.3	26.5	27.4
Martinique	28.5	28.5	28.4	27.8	27.3		28.1	29.1			31.5
Mauritius								27.7	27.9	28.0	28.2
Mexico	24.1	24.1		24.2	24.2	23.6	23.7	23.8	24.0	24.5	24.9
Moldova								24.4	24.2	24.0	24.2
Mongolia										25.5	26.4
Montenegro						26.6	26.6	27.3	27.3	28.1	28.3
Montserrat				25.5	26.9		28.5	30.6			
Mozambique			23.5	23.3	23.4						
Myanmar											
Namibia	26.5	26.0	25.7								
Nauru			25.8	25.5							
Netherlands	26.6	26.3	25.5	25.3	25.0	24.8	25.8	27.2	28.4	29.3	30.3
Netherlands Antilles	27.1	26.5	26.2	26.1	25.5						
New Caledonia						26.2	27.2	27.9	28.9	29.8	30.3
New Zealand					24.0	24.8	25.9	26.9	27.9	28.8	29.3
Norfolk Island					28.7	29.7	26.7	32.9			
Norway	27.3	26.8	25.4	24.5	24.5	25.4	26.4	27.5	28.5	29.7	30.5
Palestinian Authority										24.5	24.8
Panama	26.8	27.2	26.1	26.1	26.0	26.1	26.4	26.7	27.4	28.0	28.9
Paraguay		26.7	26.4	26.4	24.8	25.9	26.1	26.2	26.0		26.6
Peru	25.9	26.1	26.4	26.2	26.0	26.0					
Philippines		24.0	24.1	24.1	24.0	23.2	23.9	25.2	25.9	26.4	26.6
Poland	25.5	25.2	25.4	25.0	24.3	24.2	24.7	24.9	24.8	25.1	25.9
Portugal	25.6	25.6	25.6	25.3	24.7	24.1	24.3	25.0	25.6	26.1	27.4
Puerto Rico	25.2	24.7	24.0		24.2	24.5	24.9	25.1	25.5	25.9	26.6
Qatar							25.7	25.5	25.9	26.7	27.4
Reunion	26.3	26.1	26.0	25.6	25.3		25.7	26.4	27.0	29.0	29.4
Romania		24.9	25.2	25.0	24.4	24.7	25.1	24.9	24.8	25.7	26.9
Russian Federation		24.1	24.1	23.4	23.4	23.4	23.4	24.5	24.3	24.4	24.9
Saint Helena				24.9	25.6	25.7	27.3	27.5			
Saint Kitts and Nevis		29.1	28.0	27.5	27.6					30.5	
Saint Lucia						27.9	28.9	29.3		29.9	30.5
Saint Pierre and Miquelon				23.9							
Sn. Vincent and the Grenadines	27.7	28.2	28.3			28.3	28.3	29.1			
Samoa					26.3	27.3	27.0			28.6	28.7
San Marino			25.8	25.5	25.3	25.2	25.8	26.7	28.2	29.1	30.3
Scotland	25.6	24.9	24.4	23.7	24.0	24.1	24.9	25.6			
Serbia									26.6	27.0	27.7
Seychelles	28.4		27.3	27.2	26.6	25.8	26.8	28.4	29.5	30.0	30.8
Singapore		26.9	26.9	26.8	26.4	26.2	26.8	27.7	28.4	28.7	29.1
Slovakia									24.2	25.1	26.9
Slovenia									27.1	28.0	29.0
South Africa	25.8	25.5	25.5	25.5	24.9	25.3			29.4	29.7	

	1950-1954	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	2000-2004
Spain	27.6	27.6	27.5	26.7	25.9	24.9	24.9	26.2	27.3	28.4	29.4
Sri Lanka						26.6	26.8	27.2	27.3	27.3	25.9
Suriname										28.1	28.2
Swaziland			28.3								
Sweden	26.8	26.5	25.7	25.2	26.2	27.8	29.0	29.6	29.3	30.2	31.2
Switzerland	27.2	26.8	26.3	25.8	26.0	26.8	27.6	28.3	28.8	29.6	30.2
Tajikistan								23.9	23.1	24.0	24.0
Timor-Leste				26.1	24.2						
Tokelau					24.5	23.7	23.7				
Tonga									25.4	25.8	26.2
Trinidad and Tobago	26.1	25.9	25.7	25.7	25.7	25.9	25.9	26.5	26.6	27.6	28.5
Tunisia	26.8	26.4	26.2	26.8	26.7	25.8	26.3	27.3	28.6	28.8	30.5
Turkey	25.2	25.3	25.5	25.1	24.7	24.6	24.8	24.6	25.0	25.4	25.9
Turkmenistan								23.9			
Turks and Caicos Islands											31.3
Ukraine					24.2	24.0	24.0	24.5	24.3	24.7	25.5
United Kingdom							25.9	26.5	27.6	29.0	29.8
United States	24.6	24.0	23.5	23.1	23.3	23.8	24.8	25.8	26.7		
Uruguay						25.1	25.2	25.6	25.9	27.4	27.3
Uzbekistan								23.7	22.8	23.5	23.9
Venezuela	26.3	26.2	25.9	25.6	24.9	24.7	24.8	25.1	25.3	26.0	26.7
Virgin Islands, British					26.8		28.9	30.5			
Virgin Islands, U.S.	27.1	26.6	25.5		26.8		29.4	29.5	30.0		
Zimbabwe						25.8					

Appendix B - Mean age at first marriage data details

I construced the data in Appendix A using the following sources:

- United Nations Demographic Yearbook for 1948-2010
- Council of Europe - mean female age at first marriage since 1960
- National Statistics Bureaus of France, Norway, Sweden, Iceland, Canada, Denmark
- US National Center for Health Statistics
- US Bureau of Census
- Schoen and Baj (1984)

The UN Demographic Yearbook marriage data is the total number of marriages between brides and grooms where their ages are grouped by five years (for example, 25-29 y.o. grooms with 20-24 y.o. brides). The marriages are not divided into first or subsequent marriages. Thus, I use only marriages until age 40 as approximatisation to the first marriages. The mean age of marriage in the UN data, conditinal on marriage before age 40, strongly correlates with the age of first marriage from other sources, such as Council of Europe and National Statistics Bureaus.

Since the ages in the UN Demographic Yearbook data are totals grouped by 5 years, I consider the calculated mean as less accurate than other sources, where the data is by definition the mean age at first marriage. In countries that have data from the Council of Europe and the UN Demographic Yearbook, but for a longer period in the UN data, I regress the series of Council of Europe on the series of UN data. Where R^2 is above 85%, I extrapolate the Council of Europe data using the values predicted by the regression for the years having UN data but no Council of Europe data.

I calculated the mean age at first marriage in the US using the National Center for Health Statistics marriage records.

Appendix C - Classification of Sectors by State

	Agriculture	Mining	Construction	Durable Goods	Nondurable Goods	Transportation and public utilities	Wholesale Trade	Retail Trade	FIRE	Services	Feredal Public	State and Local Public
Alabama	Male	Male	Male	Male	Female	Male	None	Female	Female	Female	None	None
Alaska	Male	Male	Male	Male	None	Male	Male	Female	Female	Female	Male	None
Arizona	Male	Male	Male	None	None	None	None	Female	Female	Female	None	None
Arkansas	Male	Male	Male	None	None	Male	Male	Female	Female	Female	None	None
California	Male	Male	Male	None	None	None	None	Female	Female	Female	None	None
Colorado	Male	Male	Male	None	None	None	None	Female	Female	Female	None	None
Connecticut	Male	Male	Male	None	None	None	None	Female	Female	Female	None	Male
Delaware	Male	None	Male	Male	None	Male	None	Female	Female	Female	None	None
DC	None	Male	Male	None	None	None	Male	Female	Female	Female	Female	Female
Florida	Male	Male	Male	None	None	None	None	Female	Female	Female	None	None
Georgia	Male	Male	Male	Male	Female	None	None	Female	Female	Female	None	Male
Hawaii	Male	Male	Male	Male	None	None	None	Female	Female	Female	Male	None
Idaho	Male	Male	Male	Male	None	Male	None	Female	Female	Female	None	None
Illinois	Male	Male	Male	None	None	Male	None	Female	Female	Female	None	None
Indiana	Male	Male	Male	Male	None	Male	None	Female	Female	Female	None	None
Iowa	Male	Male	Male	Male	None	Male	Male	Female	Female	Female	Female	None
Kansas	Male	Male	Male	Male	None	Male	None	Female	Female	Female	None	None
Kentucky	Male	Male	Male	Male	None	Male	Male	Female	Female	Female	None	None
Louisiana	Male	Male	Male	Male	None	Male	Male	Female	Female	Female	None	None
Maine	Male	Male	Male	Male	None	Male	Male	Female	Female	Female	None	Male
Maryland	Male	Male	Male	Male	None	None	None	Female	Female	Female	None	None
Massachusetts	Male	Male	Male	None	None	None	None	Female	Female	Female	None	Male
Michigan	Male	Male	Male	Male	None	None	None	Female	Female	Female	Female	None
Minnesota	Male	Male	Male	None	None	Male	None	Female	Female	Female	None	None
Mississippi	Male	Male	Male	None	Female	Male	None	Female	Female	Female	None	None
Missouri	Male	Male	Male	Male	None	Male	None	Female	Female	Female	None	None
Montana	Male	Male	Male	Male	None	Male	Male	Female	Female	Female	None	None
Nebraska	Male	Male	Male	None	None	Male	Male	Female	Female	Female	None	None
Nevada	Male	Male	Male	Male	None	None	None	Female	Female	Female	None	None
New Hampshire	None	Male	Male	None	None	Male	Male	Female	Female	Female	None	Male
New Jersey	Male	Male	Male	None	None	None	None	Female	Female	Female	None	None
New Mexico	Male	Male	Male	None	None	Male	None	Female	Female	Female	None	None
New York	Male	Male	Male	None	None	Male	None	None	Female	Female	None	Male
North Carolina	Male	Male	Male	None	Female	Male	None	Female	Female	Female	Male	Male
North Dakota	Male	Male	Male	Male	None	Male	Male	Female	Female	Female	None	None
Ohio	Male	Male	Male	Male	None	Male	None	Female	Female	Female	None	None
Oklahoma	Male	Male	Male	Male	None	Male	None	Female	Female	Female	None	None
Oregon	Male	Male	Male	Male	None	Male	None	Female	Female	Female	Female	None
Pennsylvania	Male	Male	Male	Male	None	Male	None	Female	Female	Female	None	Male
Rhode Island	Male	Male	Male	None	None	None	None	Female	Female	Female	None	Male
South Carolina	Male	Male	Male	None	None	Male	None	Female	Female	Female	Male	None
South Dakota	Male	Male	Male	None	None	Male	Male	Female	Female	Female	None	None
Tennessee	Male	Male	Male	None	Female	Male	None	Female	Female	Female	None	Male
Teas	Male	Male	Male	Male	None	Male	None	Female	Female	Female	None	None
Utah	Male	Male	Male	Male	None	Male	None	Female	Female	Female	None	None
Vermont	Male	Male	Male	Male	None	Male	Male	Female	Female	Female	None	None
Virginia	Male	Male	Male	Male	None	None	None	Female	Female	Female	None	None
Washington	Male	Male	Male	Male	None	None	None	Female	Female	Female	None	None
West Virginia	Male	Male	Male	Male	None	Male	Male	Female	Female	Female	Female	None
Wisconsin	Male	Male	Male	Male	None	Male	None	Female	Female	Female	None	None
Wyoming	Male	Male	Male	Male	None	Male	Male	Female	Female	Female	None	None