The Demographic Transition and Long-Term Marriage Trends

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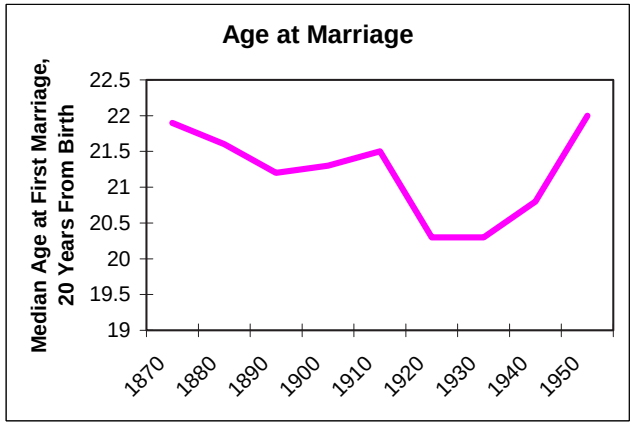
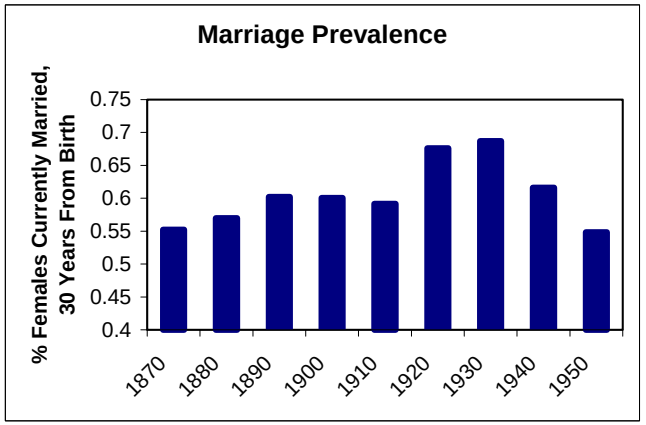
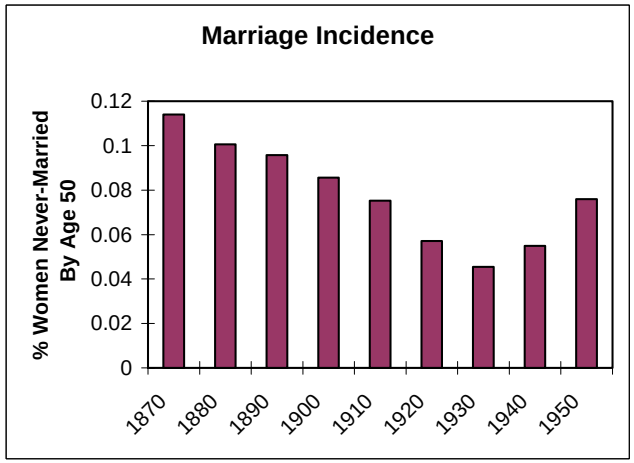
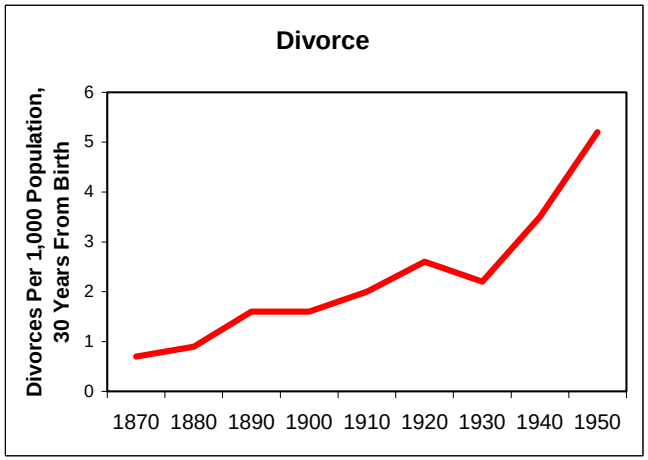
Trends in Marriage: 1870 to 1950 Birth Cohorts









Marriage: Two Transitions

Between the **1870** and **1930** birth cohorts:

- Age at marriage **decreased** by 7.3%
- Fraction never-married by age 50 **decreased** by 55.9%
- Marriage prevalence **increased** by 28.6%
- Divorce **increased** by 214.3%

for women

Between the **1930** and **1950** birth cohorts:

- Age at marriage **increased** by 8.4%
- Fraction never-married by age 50 **increased** by 22.2%
- Marriage prevalence **decreased** by 20.1%
- Divorce **increased** by 136.4%

for women

Demographics: Two Transitions

Transition 1: High sex ratio, low life expectancy in 1870 to high sex ratio, high life expectancy in 1930

- Small decline in sex ratio (0.95% per decade)
- Large increase in life expectancy (4.05% per decade for women, 3.0% per decade for men)

Transition 2: High sex ratio, high life expectancy in 1930 to low sex ratio, high life expectancy in 1950

- Large decline in sex ratio (2.8% per decade)
- Small increase in life expectancy (3.8% per decade for women, 1.8% per decade for men)

Demographics (plus biology) may shape family structure:

- Women face biological constraints that may reduce their attractiveness as mates as they age (men do not).

- Increases in life expectancy translate into reductions in the gains to marriage (to one woman) for men and into increases in the gains to marriage (to one man) for women

- The sex in short supply can afford to be choosier. A decline in the sex ratio translates into a movement from an environment with choosy women to one with choosy men

Our Paper

1. We construct a model of marriage where demographics play several roles:
   (a) The sex ratio determines the speed at which men and women meet each other.
   (b) The gains to marriage and costs of investing in marriage change as agents age (in part through life expectancy).

2. We calibrate our model to match the main facts on marriage and divorce for the cohort born in 1950.

3. We pose the demographic structure faced by those born in 1870 and 1930 and ask what they would have done.

The Model: Demographics

1. OLG with stochastic aging. Three biological ages, $i \in \{a, y, o\}$, with aging transitions $\Gamma^f_{i,i'}$ and $\Gamma^m_{i,i'}$.
   - Adolescents (a) can make contacts in the marriage market but cannot form relationships
   - Young (y) and Old (o) agents vary in attractiveness and can form relationships

2. n^g newborns are born every period.

3. Men and women die at rates π^m and π^f, respectively

4. Age is in the eye of the beholder: **biological age** (adolescent, young, or old) is not observed in the data but determines how attractive one is to the opposite sex. **Calendar age**, the number periods since birth is observed but does not determine attractiveness.

The Model: Notation, Meeting, and Marriage

Marital Status: single $(z = 0)$, dating $(z = 1)$, married $(z = 2)$

Random Dating: with matching technology $\psi^f = min\{1, \frac{x^m}{x^f}\}$

Preferences: agents only care about the age of their spouse $u^g(j) = \alpha^g_j$

Effort: When a new meeting occurs agents exert costly effort to influence the probability a relationship forms or remains together

- Agents play Nash with perfect foresight of what the future offers (who else is out there)
- The cost of investing effort varies with biological age and marital status $\xi^g_{i,z}(e^g_{i,j,z})^2$

The Model:

Single women (young and old)

$$V^{f,i}(0,0) = u^f(0)+\beta\ (1-\pi^f)\ \sum_i \Gamma^f_{i,i'}\Bigg\{\ \psi^f\ \sum_{j'}\ \frac{x^{m,j'}(0)+x^{m,j'}(1,.,.)}{x^{m,\cdot}(0)+x^{m,\cdot}(1,.,.)}\ V^{f,i'}(1,j')$$

$$+\ \Big[1-\psi^f\Big(\sum_{j'}\ \frac{x^{m,j'}(0)+x^{m,j'}(1,.,.)}{x^{m,\cdot}(0)+x^{m,\cdot}(1,.,.)}\Big)\Big]\ V^{f,i'}(0,0)\Bigg\},\quad j'\in\{y,o\}$$

Paired (married or dating) women

$$V^{f,i}(z,j) = \xi\left[e^{f,i}(z,j)\right]^2\ +\ \Big\{1-p\left[z,e^{f,i}(z,j),e^{m,j}(z,i)\right]\Big\}\ V^{f,i}(0,0)$$

$$+\ p\left[z,e^{f,i}(z,j),e^{m,j}(z,j)\right]\Big\{u^f(j)$$

$$+\ \beta\ (1-\pi^f)\Big[(1-\pi^m)\ \sum_{i',j'}\Gamma^f_{i,i'}\,\Gamma^m_{j,j'}\,V^{f,i'}(2,j')+\ \beta\ \pi^m\ V^{f,i}(0,0)\Big]\Big\}$$

The Model: Marriage Takes Effort

$$e^{f,i}(z,j,e) = \max_{e^{f,i}} \Big\{ \xi \left(e^{f,i}\right)^2 + \left[1 - p\left(z, e^{f,i}, e\right)\right] V^{f,i}(0,0) + p\left(z, e^{f,i}, e\right) \Big\{ u^f(j) + \beta \ (1-\pi^f) \Big[(1-\pi^m) \sum_{i',j'} \Gamma^f_{i,i'} \Gamma^m_{j,j'} V^{f,i'}(2,j') + \beta \ \pi^m \ V^{f,i}(0,0) \Big] \Big\} \Big\}$$

Pairs play Nash resulting in equilibrium in

$$\begin{aligned} e^{f,i}(z,j) &= e^{f,i}[z,j,e^{m,j}(z,i)] \\ e^{m,j}(z,i) &= e^{m,j}[z,i,e^{f,i}(z,j)] \end{aligned}$$

Model Estimation

- The model has 17 parameters, including:
  - Demographic parameters (3)
  - Preference parameters and aging transition rates (8)
  - Cost of effort (4)
  - Effort technology (2)

- We set the parameters to match 25 moments:
  - Age structure and sex ratio (3 targets)
  - Marriage and divorce rates by calendar age (12 targets)
  - Fraction of men and women that are never married by age 50 (2 targets)
  - Ensure no extraneous uncertainty from the effort investment games (8 targets)

Estimation Details

1. We assume individuals are born at calendar age 16

2. To weight the moments in estimation, we:

   (a) calculate the variance for the fractions never-married directly from Census samples
   (b) assume marriage and divorce outcomes are draws from a binomial distribution
   (c) impose a weight of one on the effort targets
   (d) assume the off-diagonal elements of the weighting matrix are zero

3. We estimate the parameters using GMM

Parameter Estimates

Preferences:

- On average, men prefer marriage to women between the calendar ages of 21 and 26
- On average, women prefer marriage to men over 30

Cost of effort:

- Effort exerted to $enter$ marriage is most costly for the old
- Effort exerted to $remain$ married is most costly for the young

Table 1: Estimated values of the preference parameters in the baseline model

Parameter	Value
Female's preferences over young spouse (α_y^f)	-0.0005
Female's preferences over old spouse (α_o^f)	0.0081
Male's preferences over young spouse (α_y^m)	0.3369
Male's preferences over old spouse (α_o^m)	-0.0080
Average age at which women become young	20.6
Average age at which women become old	25.8
Average age at which men become young	19.9
Average age at which men become old	30.5

Table 2: Estimated values of the effort parameters in the baseline model

	Single and Paired ($z=1$)	Married ($z=2$)
Effectiveness of effort (ρ_z)	0.1649	0.1865
Cost of effort ($\xi^g(i,z)$)		
Young	0.0117	0.0873
Old	0.0776	0.0086

Model Performance

Table 3: Marriage Statistics

	Women		Men	
	Data	Model	Data	Model
Marriage Rates by Age, per 1,000 Unmarried				
20-24 in 1970	234.2	230.5	205.7	204.1
30-34 in 1980	95.0	97.0	122.8	126.1
40-44 in 1990	50.0	46.8	69.7	68.5
% Never-Married by Age 50				
	5.5	5.1	6.2	6.3

Model Performance

Table 4: Model Performance: Divorce Rates by Age

	Women		Men	
	Data	Model	Data	Model
Divorce Rates by Age, per 1,000 Married				
20-24 in 1970	33.3	34.6	33.6	35.2
30-34 in 1980	29.2	25.8	33.8	29.2
40-44 in 1990	19.3	21.4	21.9	23.0

Model Performance

Table 5: % of Age i Agents Who Desire Marital Status z But Do Not Achieve It

	Women		Men	
	Target	Model	Target	Model
Young, Marry	0.0000	0.0141	0.0000	0.0030
Old, Marry	0.0000	0.0194	0.0000	0.0141
Young, Divorce	0.0000	0.0033	0.0000	0.0001
Old, Divorce	0.0000	0.0114	0.0000	0.0033

Table 6: Additional Statistics Implied by the Model (1980)

	Data	Model
Divorce Rate, per 1,000 in Population		
	5.2	5.2
Age at Marriage		
Women	22.0	22.7
Men	24.7	24.4
Gap	2.7	1.7
% Aged 16 to 49 that are Married		
Women	56.7	56.7
Men	52.8	61.7
Sex Ratio at Birth		
	105.4	104.1

Demographic Experiment 1: What would the 1950 birth cohort do if they faced the population structure of 1930?

To answer this question, we choose mortality and immigration rates to match the age and sex structure for the 1930 birth cohort, holding all other parameters constant

	1930	1950
Life expectancy of women (at age 15)	56.7	61.0
% Change		**7.6**
Life expectancy of men (at age 15)	52.5	54.4
% Change		**3.6**
Men per 100 women (aged 15 and above)	98.4	92.9
% Change		**-5.6**

Results

	Data		Model	
	1930	1950	1930	1950
Age at Marriage				
Women	20.3	22.0	20.6	22.7
% Change		(8.4)		(10.2)
Men	22.8	24.7	23.7	24.4
% Change		(8.3)		(3.0)

Results

	Data		Model	
	1930	1950	1930	1950
% Aged 16 to 49 that are Married				
Women	71.0	56.7	58.9	56.7
% Change		(-20.1)		(-3.7)
% of Never-Married by Age 50				
Women	4.5	5.5	4.0	5.1
% Change		(22.2)		(21.4)
Men	6.2	6.5	6.3	6.3
% Change		(4.8)		(0.8)

Results

	Data		Model	
	1930	1950	1930	1950
Divorce Rate, per 1,000				
	2.2	5.2	5.0	5.2
% Change		(136.4)		(3.0)

Results

The demographic transition from 1930 to 1950 can explain $much$ of the transition in marital status for women and $some$ of the transition in marital status for men

- The model with changes in the age and sex structure between the 1930 and 1950 birth cohorts is consistent with:
  1. The delay in marriage for women (121.4%) and some of the delay for men (36.1%)
  2. The fall in the incidence of marriage for women (96.4%) and some of the fall for men (16.7%)
  3. Some of the decreased prevalence of marriage (18.5%)

- Virtually none of the rise in divorce (2.2%)

Intuition

The population shifted from a **high sex ratio/high life expectancy regime** in 1930 to a **low sex ratio/high life expectancy** regime in 1950.

- In both regimes, the average gains to marriage are high for women and low for men.
- There is a shift from an environment where women are choosy to one where men are choosy.

As a result:

- Men marry later (men can afford to be choosy and wait).
- Women marry later (it is difficult to find a spouse)
- Marriage prevalence and incidence fall (the average gains to marriage fell for men)

Demographic Experiment 2: What would the 1930 birth cohort do if they faced the population structure of 1870?

To answer this question, we choose mortality and immigration rates to match the age and sex structure for the 1870 birth cohort, holding all other parameters constant at their 1950 values

	1870	**1930**
Life expectancy of women (at age 15)	45.6	56.7
% Change		**24.3**
Life expectancy of men (at age 15)	44.5	52.5
% Change		**18.0**
Men per 100 women (aged 15 and above)	104.3	98.4
% Change		**-5.7**

Results

	Data		Model	
	1870	1930	1870	1930
Age at Marriage				
Women	21.9	20.3	20.8	20.6
% Change		(-7.3)		(-1.0)
Men	25.9	22.8	25.2	23.7
% Change		(-11.9)		(-6.0)

Results

	Data		Model	
	1870	1930	1870	1930
% Aged 16 to 49 that are Married				
Women	55.2	71.0	58.2	58.9
% Change		(28.6)		(1.2)
% of Never-Married by Age 50				
Women	10.2	4.5	4.2	4.0
% Change		(-55.9)		(-4.8)
Men	14.4	6.2	5.9	6.3
% Change		(-56.9)		(6.8)

Results

	Data		Model	
	1870	1930	1870	1930
Divorce Rate, per 1,000				
	0.7	2.2	5.0	5.2
% Change		(214.3)		(4.0)

Results

The demographic transition from 1870 to 1930 can explain *little* of the transition in marital status:

- The model with changes in the age and sex structure between the 1870 and 1930 birth cohorts is consistent with:
  1. The decreases in age at marriage for women (13.7%) and for men (50.4%)
  2. The rise in the incidence of marriage for women (8.9%)
  3. The increased prevalence of marriage (4.2%)
- The model predict marriage incidence falls slightly for men
- The model explains virtually none of the rise in divorce (1.9%)

Intuition

The population shifted from a **high sex ratio/low life expectancy regime** in 1870 to a **high sex ratio/high life expectancy** regime in 1930.

- In both regimes, women are choosy.
- There is a shift from an environment where the gains to marriage are low for women to one where the gains to marriage are high for women

As a result:

- Women (and men) marry earlier (it is easy to find husbands and women can't afford to wait)
- Marriage prevalence and incidence rise (the average gains to marriage rise for women)

Some Demographic Subtleties

- In 1870, the gender gap in LE is constant as individuals age; in 1950, the gender gap in LE is declining

	1870	**1950**
Gender gap in life expectancy		
Conditional on reaching age 20	1.4	7.0
Conditional on reaching age 30	1.5	6.5
Conditional on reaching age 40	1.8	5.4
Conditional on reaching age 50	0.9	3.8

- The average woman (man) in the model is $older$ ($younger$) than the average woman (man) in the data
  - the gains to marriage (marriage prevalence and incidence) may be underestimated

Future Work

Near Future:

- What other explanations might account for the trends? Changes in the gains to marriage.

Distant Future: To what extent can changes in the age and sex structure of the population account for:

- The secular decline in fertility?
- The Baby Boom?
- The fertility cycle following the Baby Boom?