What Women See in Men and Viceversa: Hints from Sex Ratios and Marriage Patterns

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Introduction (No Income Dynamics)

- There are some regular patterns in the U.S. population
  - Marriage is Pervasive
  - Women are a little younger than their spouses
  - Divorce and Remarriage happen often
- Interpret Patterns as the Result of Preferences of Men & Women
  - How much do they want a (different-sex) spouse?
  - How much does their Age Matter?
  - What are their notions of young and old?
  - How special are particular people? Does it Matter?
  - What are the dynamics of being seen as special?
  - Are there Systematic Differences between Men and Women?
  - How costly is to Divorce (and to Marry)?
  - How volatile is atraction?

Some (Systematic?) Patterns

- Women Marry Younger. Median age of First Marriage 26.1, 28.2 in (2010)
- Women live Longer. (79.5 vs 73.8 Life Expectancy in 1998)
- The Ratio of Men to Women over 15 is less than 1. (0.94)
- This has not always been the case: large variation over time (80 years) of the relative number of men and women at different ages

  (1.04 adult males to females to .94)

  - Life Expectancy (mortality shrank diff by age and sex); Migration
- Availability shapes incidence & characteristics of marriages
  - Age at first Marriage changed a bit 22.0 26.1 in 1890
  - Incidence (Never married by 50 shrank by 25%)
  - Fraction of prime aged males married increased a lot; not women's
  - Divorce increased sixfold

	Birth Cohort 1870	1930	1950	% Change in the Data
Demographics				
Sex ratio	1.040	0.997	0.939	-9.7
Life expectancy from 15 (female)	43.4	55.0	60.4	37.8
Life expectancy from 15 (male)	43.9	51.4	54.4	25.3
Age at first marriage				
Females	21.9	20.3	22.0	0.5
Men	25.9	22.8	24.7	-4.6
Percentage of never-married by age 50				
Females	10.4	5.7	7.6	-32.6
Men	12.9	6.6	9.3	-28.1
Married as a % of those aged 16 to 49				
Females	59.7	75.4	60.8	1.8
Men	50.8	69.4	56.1	10.4
Divorce rate, per 1,000 people	0.7	2.2	5.2	642.9

Opportunity to Estimate Tastes: Revealed Preference over Time

- We take advantage of the large demographic variation over time
- Variability in Prospective Partners availability shapes the incidence and characteristics of marriages
- We Pose and Estimate an Equilibrium model of marriage and divorce over time to reveal preferences
- Assess what may have changed over time (are we like our great grandparents?)

The Logic

- Consider a World with Men and Women who have preferences over being married or not according to
  - Age of the spouse
  - and the specific person with which one is matched
- Marriage is a possibility
  - One has to be accepted as a spouse
  - One has to want it:
    - Better than alone
    - Better than keeping the option and waiting for a better match (swithching is harder than meeting).
  - Demographics changes these considerations
- Demographic changes allow us to tease the information from the data using theory

Various views based on restrictions fecundity ages

- Siow (1998) highlights the biological clock of women as a constraint of their attractiveness (pure theory logic) (Hamilton and Siow (2007) reduced form)

- Díaz-Giménez and Giolito (2013) model it as a constraint on preferences.

- Zhang (2021) claims it tilts the timing of human capital investments.

- Low (2022) claims that fecundity horizons shape the marriageability of women.

Main Fidings

- We partly confirm Siow's insight, but barely:
  1. Women's prime age does not start earlier than men's one. (17.8 vs. 17.4)
  2. Women's prime age ends earlier than men's one. (27.1 vs. 30.4)
  3. Both male and female prefer a prime-aged parter.
- Other insights we found are:
  1. Match quality process has permanent nature.
     (50% of matches turn out to be permanently good.)
  2. Marriage is costly. (Cost amounts to 3 years of a good marriage)
  3. Divorce is costly. (Cost amounted to 5 years of a good marriage and now down to 3)

The Data

3 10 year Cohorts: Born 1870's, 1930's 1950's

- We use various census (IPUMS) to obtain the relevant Statistics:
  - Life Length Demographics: Sex Ratios and Life Expectancies for men and women. They are inputs to the model and are the exogenous variation.
  - Marital Statistics (28 statistics per cohort).
    1. For six age groups we get marriage rates (12)
    2. Divorce rates of those groups (12)
    3. Incidence (fraction never married by age 50) 2
    4. Average age at first marriage
- We use three cohorts only to ensure that they are spread apart.

84 Moments to Target

Table 1: Marital Statistics Target: 1870, 1930 and 1950 Birth Cohorts

	1870		1930		1950	
	Female	Male	Female	Male	Female	Male
Marriage Rate						
16-19	97.8	20.5	151	48	123.1	58.7
20-24	120.0	97.7	216	181	170.3	148.7
25-29	89.5	90.9	114	137	95.6	111.7
30-34	65.4	70.2	44	80	46.4	55.8
35-40	28.2	42.7	21	31	32.1	39.2
40-44	24.6	48.7	21	42	16.0	24.6
Divorce Rate						
16-19	2.6	2.6	12.9	11.7	16.4	18.5
20-24	1.8	1.6	8.8	9.2	25.5	23.6
25-29	1.4	0.6	4.6	4.3	16.0	17.0
30-34	1.4	1.1	5.4	4.1	16.7	14.8
35-40	0.3	0.6	3.8	3.0	16.2	14.2
40-44	0.2	1.2	08.1	7.1	7.6	7.9
Never-Married by Age 50	11.3	13.0	4.5	6.0	7.6	9.3
Age at First Marriage	21.9	25.9	20.3	22.8	22.0	24.7

The Model

Minimal Model Ingredients

- Males and Females
- Ages:
    - Calendar and
    - Perceived
- Marital Status
- Quality of Partner (if any)
- This Translates into

Model: Demographics

1. OLG with stochastic aging. Blanchard (1985)-Yaari (1965). Three ages $i \in \{a, y, o\}$, Adolescent (a), Young (y), and Old (o). Two sexes $g \in \{m, f\}$.
   - Aging transitions $\Gamma^f_{i,i'}$ and $\Gamma^m_{i,i'}$.
   - So Age as i is **perceived yet real**, but
   - Record keeping allows for calendar age.
2. New entrants due to birth (in equal amounts) and men's migration
   - n^g newborns are born every period.
   - Immigration rate i^m.
3. Differential mortality rates by age and sex. $\left\{\pi^m, \pi^f\right\}$.

- Marital status: Single, dating or married $z \in \{0, 1, 2\}$.
- Random dating: Probability $\psi^f = \min\{1, \frac{x^m}{x^f}\}$. x^g measure of singles (only one disco/church in town)
- Preferences:
  - If single $u_i^g(0) = 0$.
  - If married, $u_i^g(i^*) = \alpha_{i^*}^g + q$. (age plus love)
  - Love may be unrequited (NOT symmetric)
- Match quality q: $q = \mu + \epsilon$,
  - $\mu \in \{\theta, 0, -\theta\}$ Markovian with transition Λ.
  - ϵ Transitory ($\sim G(0, 1)$ (a normalization with variance $\frac{\pi^2}{6}$)
- Newly met start at $\mu = 0$

- Matching: Matches exhaust the short sex of the singles:

$$\psi^g = \min\left\{\frac{x^{g^*,0,\cdot} + x^{g^*,1,\cdot}}{x^{g,0,\cdot} + x^{g,1,\cdot}}, 1\right\}$$

- Marriage:
  - If both agree they get married, $z = 2$.
  - Else they do not $z = 0$.
  - Agent pay a cost c^m when they become married.
- Divorce: Agents pay a cost c^d upon divorce.

- A single gets

$$\Omega^{g,i}(0,0) = 0 + \beta\ (1-\pi^{g})\ \sum_{i'} \Gamma^{g}_{i,i'} \Big\{\ (1-\psi^{g})\ V^{g,i'}(0) + \psi^{g}\ \sum_{i^*} \frac{x^{g^*,i^*}(1,.)}{x^{g^*}(1,.)}\ V^{g,i'}(1,i^*,0,0)\ \Big\}.$$

- A matched ($z=1$) or married ($z=1$) that becomes or stays married gets

$$\Omega^{g,i}(s,z) = u^{g,i}(s,2)\ - c^{m}\ 1_{j=\mathbf{1}} + \ \beta\ (1-\pi^{g})\ \Big[(1-\pi^{g^*}) \sum_{i',i^{*\prime},\mu',\mu^{*\prime}} \Gamma^{g}_{i,i'}\Gamma^{g^*}_{i^*,i^*}\Lambda^{i'}_{\mu,\mu'}\Lambda^{i^{*\prime}}_{\mu^*,\mu^{*\prime}}\ V^{g,i'}(2,i^{*\prime},\mu',\mu^{*\prime}) + \pi^{g^*}\sum_{i'}\Gamma^{g}_{i,i'} \Big((1-\psi^{g})\ V^{g,i'}(0) + \psi^{g}\sum_{i^{*\prime},\mu,\mu^*} p^{g}(i^{*\prime})\Lambda_{\mathbf{0}}(\mu)\Lambda_{\mathbf{0}}(\mu^*)V^{g,i'}(1,i^{*\prime},\mu,\mu^*)\Big)\Big].$$

- Divorcing yields

$$\Omega^{g,i}(s,0) = -c^{d} + \ \Omega^{g,i}(0,0).$$

- A married person will like to choose from

$$\max \quad \left\{ \Omega^{g,i}(s,2) + \epsilon^1, \Omega^{g,i}(s,0) + \epsilon^0 \right\}.$$

- The probability that he/she prefers to remain married is

$$p^{g,i}(s) = \frac{\exp\left[\Omega^{g,i}(s,2)\right]}{\exp\left[\Omega^{g,i}(s,0) + \Omega^{g,i}(s,2)\right]\right]}$$

- The ex-ante value (given the decision of the partner) for $s = \{z, i^*, \mu, \mu^*\}$

$$V^{g,i}(s) = p^{g^*,i^*}(s^*(s)) \ln\left[\exp\Omega^{g,i}(s,1) + \exp\Omega^{g,i}(s,0)\right] + \left[1 - p^{g^*,i^*}(s^*(s))\right]\Omega^{g,i}(s,0)$$

(Steady State) Equilibrium

- Agents do their thing
- Expectations are correct:
  - Who are they likely to meet (age)
  - What are the others likely to do
- Standard Fixed point logic

Estimation

What do we Want to Learn about?

- Which parameters are we estimating?

Parameters to Be Estimated (17)	
Preferences (6)	α_a^f, α_y^f, α_o^f, α_a^m, α_y^m, α_o^m
Aging Transition Process (4)	Γ_{ay}^f, Γ_{yo}^f, Γ_{ay}^m, Γ_{yo}^m. Translate into switching ages
Match Process (5)	θ, λ_1, λ_2, λ_3, λ_4, Tell us about the vagaries of love
Cost of Marriage and Divorce (2)	c^m, c^d

- What about the parameters of the Extreme Value Shocks?
- They are a normalization:
  - The location parameter is irrelevant in action space
  - The scale parameter affects the size of the other parameter estimates given that the value of being single is zero.

Estimation Strategy (Two Steps)

- First step: Obtain demographic parameters. Use only demographic-aging model.

- Second step: Obtain rest of parameters using full model for the three cohorts with some common restrictions.

First Step: Calibration for Demographic Parameters

- $\left(i_{70}^m, \pi_{70}^m, \pi_{70}^f\right)$, $\left(i_{30}^m, \pi_{30}^m, \pi_{30}^f\right)$ and $\left(i_{50}^m, \pi_{50}^m, \pi_{50}^f\right)$ to match:
  1. Sex ratio of those at age 20 - 44 for each cohort.
  2. Life expectancies at age 15 for each gender in each cohort.
- Immigration rates $(i_{70}^m, i_{30}^m, i_{50}^m)$ are targeted to sex ratios.
  - The number of new born is assumed to be same for female and male.
  - Single, prime-aged male immigrants inflow at age 20.
- Mortality rates $\left(\pi_{70}^m, \pi_{70}^f, \pi_{30}^m, \pi_{30}^f, \pi_{50}^m, \pi_{50}^f\right)$ are targeted to life expectancies.
- These are the parameters that should change with each cohort

Second Step: GMM for Preference and Aging Parameters

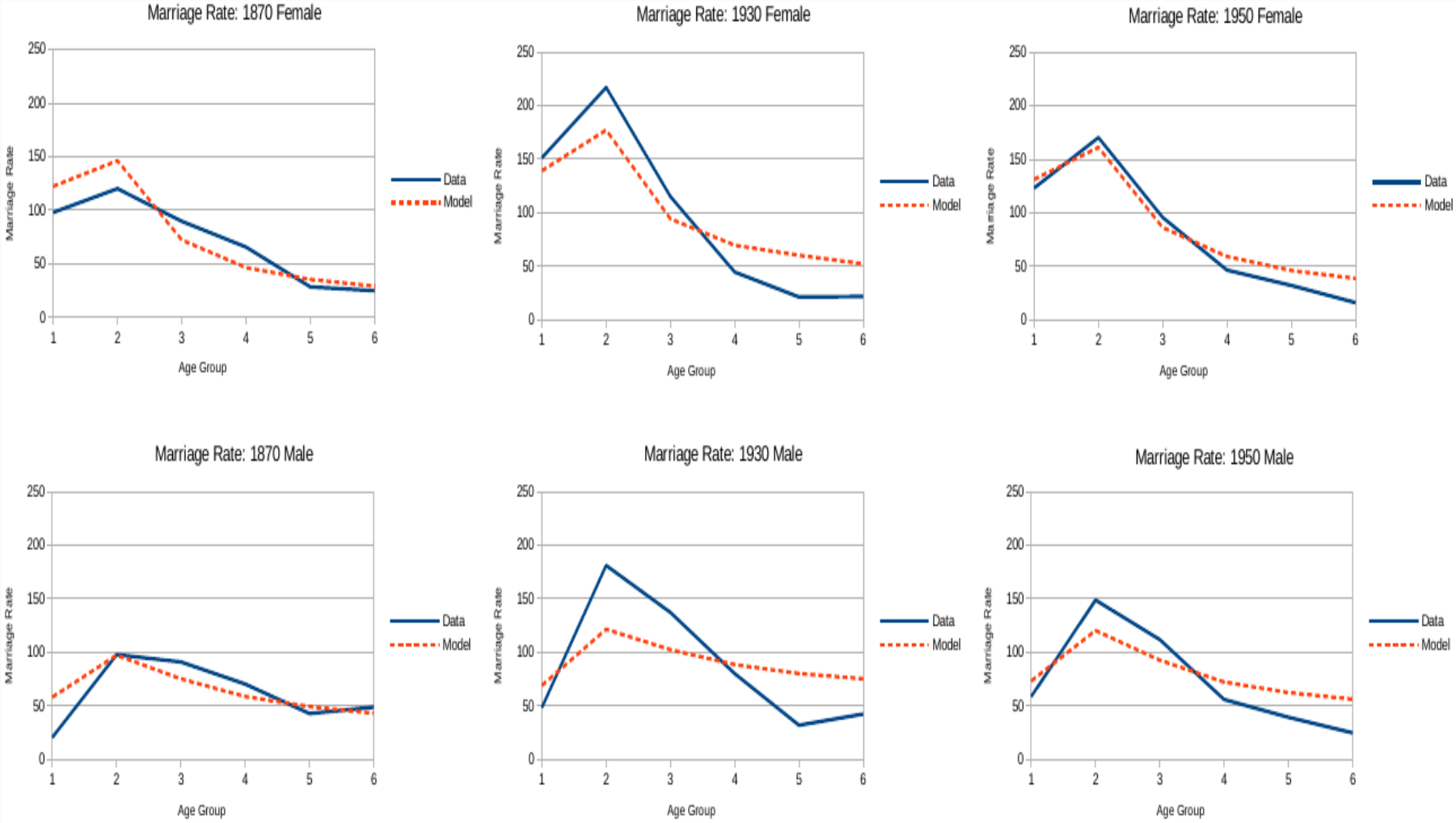
1. Equilibria are solved for each cohort separately putting constraints on what they have in common.

2. Parameters are estimated as

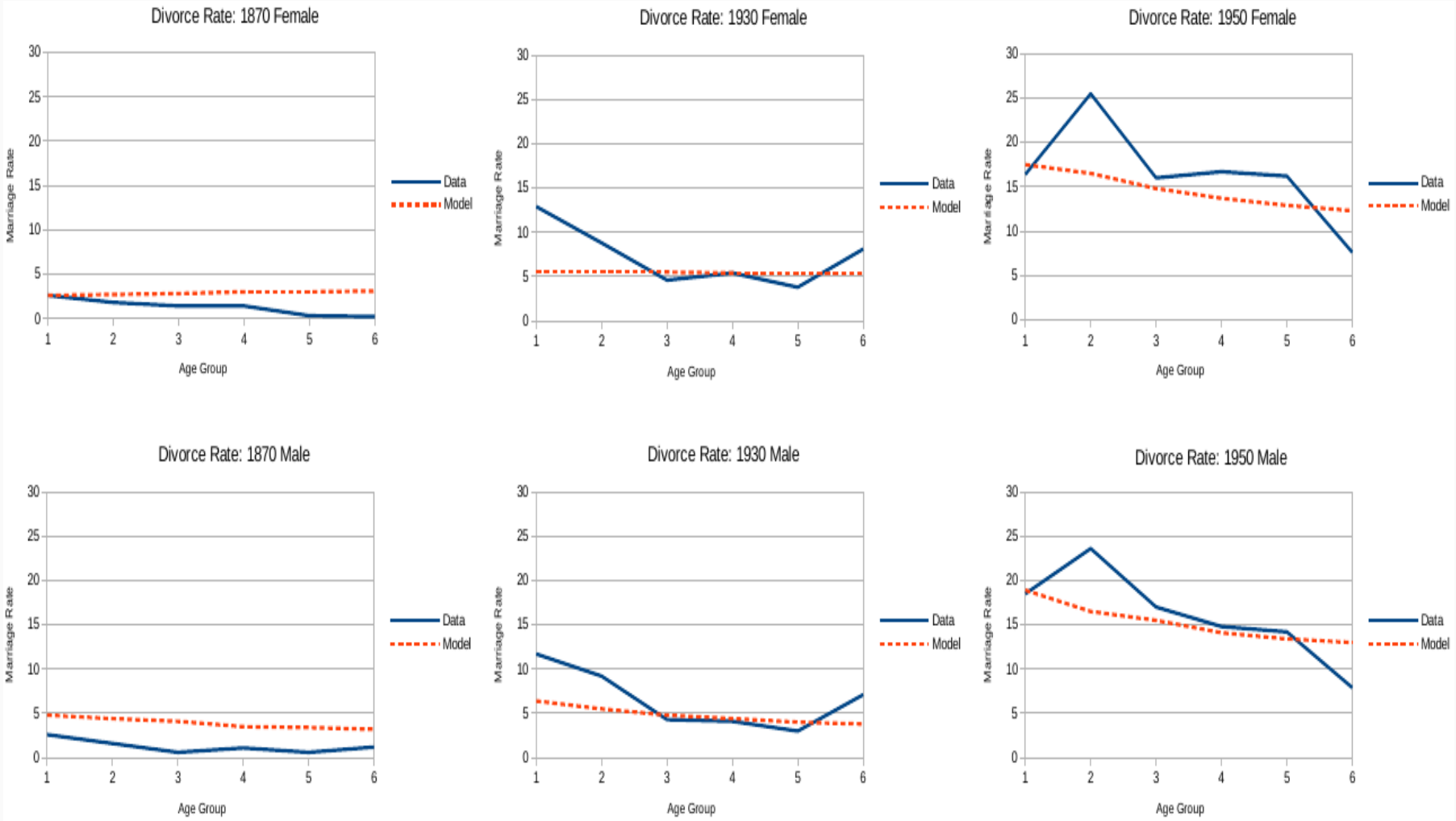
$$\hat{\Theta} = \arg\min_{\Theta} \left(\hat{g}^{DATA} - g^{MODEL}(\Theta)\right)' W \left(\hat{g}^{DATA} - g^{MODEL}(\Theta)\right)$$

where g denotes the vector of moments that inlcudes marital statistics of both cohorts.

Data v.s. Model: Marriage rates



Data v.s. Model: Divorce rates



Findings

First look: Ignore any Difference across Cohorts

(A) Demographics	
Sex ratio	0.992
Life expectancy (female)	52.9
Life expectancy (male)	42.9
(B) Divorce cost	3.30
(C) Preference	
α_a^f Females likening of adolescent males	-1.72
α_y^f Females likening of young males	-0.01
α_o^f Females likening of old males	-0.59
α_a^m Males likening of adolescent females	-5.44
α_y^m Males likening of young females	0.01
α_o^m Males likening of old females	-0.78
(D) Aging process	
Female	
Age of becoming prime	17.9
Age of becoming old	28.7
Male	
Age of becoming prime	18.5
Age of becoming old	31.5
(E) Love shock process	
Gain in H-state (θ)	1.55
Prob. H-state to H-state	1.00
Prob. M-state to H-state	0.50
Prob. M-state to L-state	0.20
Prob. L-state to L-state	0.75
(F) Marriage cost	3.20
Weighted Sum of Squared Errors (WSSE): E_i	0.160
Measure of Fit: $1 - (E_i/E_1)$	0.000

- Common Demographics
- Nobody Likes to be Partnered (Especially to adolescents), but Females depreciate a but more.
- Women peak earlier (0.6 years) and last less (2.2 years). But liyylr.
- Persistent Love almost 15 times larger than generic disgust
- With Prob .5 meeting becomes bliss which is absorbing
- Option likely to survive
- Marriage and Divorce costs large and similar o
- Measures of fit

Second look: Demgrphcs (only) differ x Cohorts: Success: 17% ∇ var

		1870	1930	1950
(A) Demographics				
Sex ratio	0.99	1.04	0.997	0.939
Fem LE	52.9	43.4	54.9	60.4
Mal LE	42.9	43.9	51.4	54.4
(B) Divorce cost	3.30		3.10	
(C) Preference				
α_a^f	-1.72		-4.44	
α_y^f	-0.01		0.10	
α_o^f	-0.59		-0.15	
α_a^m	-5.44		-5.77	
α_y^m	0.01		-0.19	
α_o^m	-0.78		-0.49	
(D) Aging process				
Females				
Adult	17.9		17.8	
Old	28.7		28.5	
Male				
Adult	18.5		17.5	
Old	31.5		31.2	
(E) Love shock process				
(θ)	1.55		0.80	
P_{HH}	1.00		1.00	
P_{MH}	0.50		0.51	
P_{ML}	0.20		0.23	
P_{LL}	0.75		0.70	
(F) Marriage cost	3.20		2.89	
WSSE: E_i	0.160		0.133	
$1-(E_i/E_1)$	0.000		0.169	

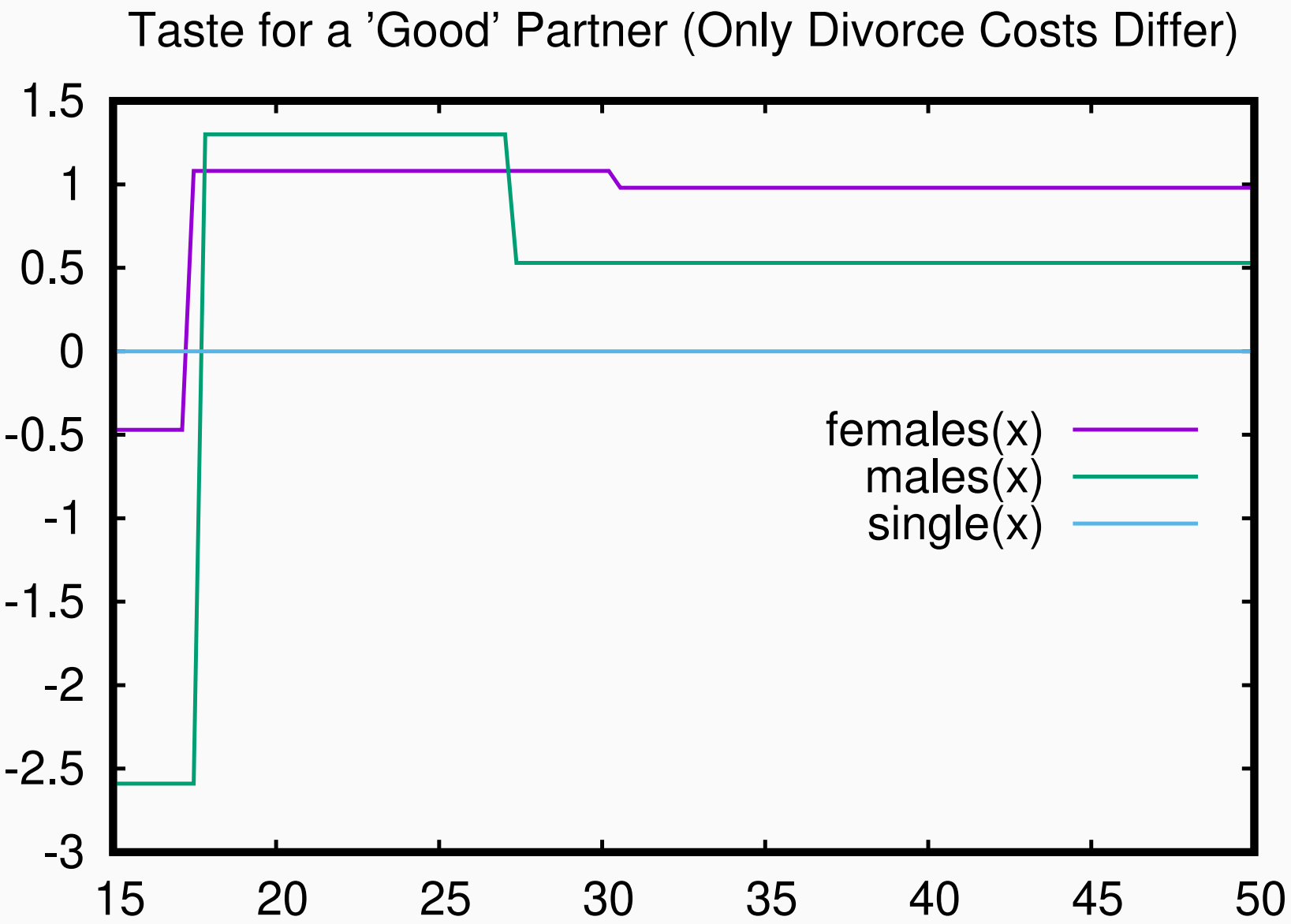
- Females Aging matters less
- Males are Younger Earlier
- Value of Persistent Love Shrinks
- Persistence does not Change
- Large Improvement in Fit: Demographics Matter

Third look: Demographics and Divorce Costs differ across Cohorts

(B) Divorce cost	3.30	3.10	5.51	5.38	3.19
(C) Preference					
α_a^f	-1.72	-4.44		-1.89	
α_y^f	-0.01	0.10		-0.33	
α_o^f	-0.59	-0.15		-0.49	
α_a^m	-5.44	-5.77		-4.00	
α_y^m	0.01	-0.19		-0.11	
α_o^m	-0.78	-0.49		-0.88	
(D) Aging process					
Females					
Adult	17.9	17.8		17.8	
Old	28.7	28.5		27.1	
Male					
Adult	18.5	17.5		17.4	
Old	31.5	31.2		30.4	
(E) Love shock process					
(θ)	1.55	0.80		1.41	
P_{HH}	1.00	1.00		1.00	
P_{MH}	0.50	0.51		0.45	
P_{ML}	0.20	0.23		0.25	
P_{LL}	0.75	0.70		0.70	
(F) Marriage cost	3.20	2.89		3.69	
WSSE: E_i	0.160	0.133		0.089	
$1-(E_i/E_1)$	0.000	0.169		0.444	

- 70% of pairs of adults from 1870 dating marry (given EVS)
- Women now like Men A bit more than the Opposite
- Major Reduction in Difference of Age Definition
- Value of Persistent Love Shrinks
- Persistence does not Change
- Increase in marriage and divorce costs (reduction over time of divorce costs)
- Large Improvement in Fit:

Common Preferences (adding the high persistent term)

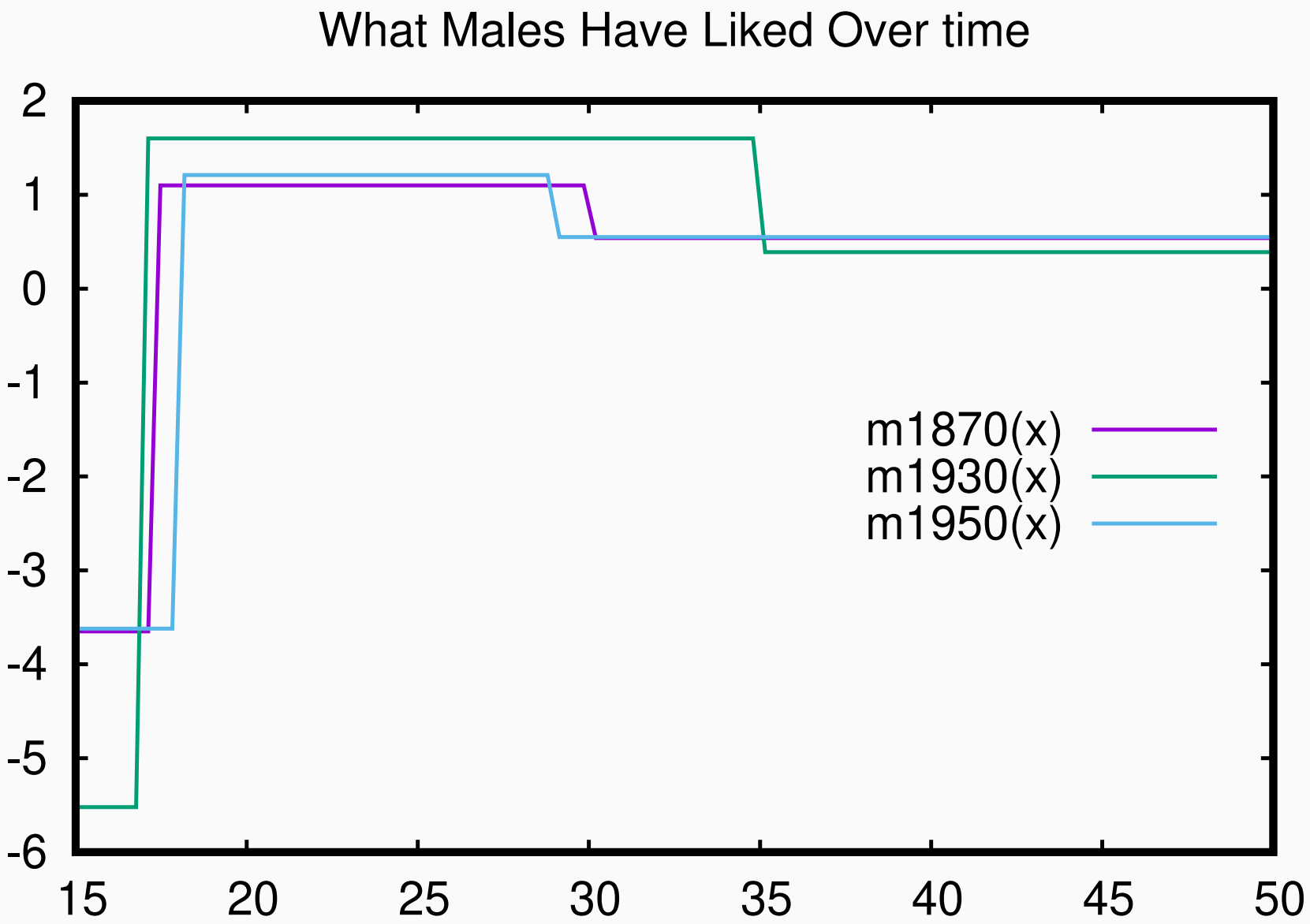


Baby Boom Generation Was Special; We are like our Greatgrandparents

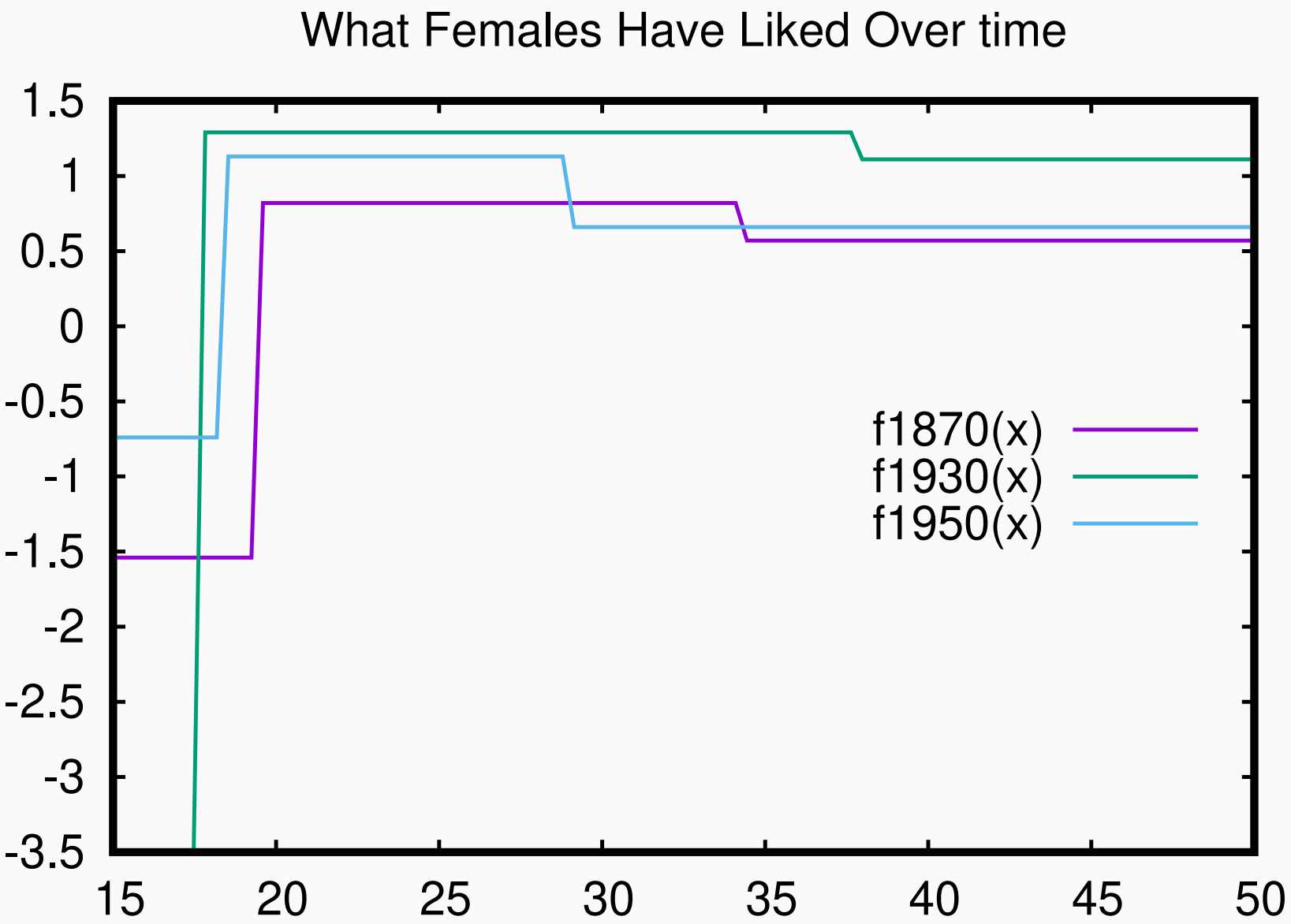
Version			
Differ x Cohorts		(All)	
Cohort	1870	1930	1950
(A) Demgrph			
(B) Divorce cost	6.66	5.05	3.20
(C) Preferences			
α_a^f	-2.67	-4.76	-2.00
α_y^f	-0.31	0.66	-0.13
α_o^f	-0.56	-0.15	-0.60
α_a^m	-4.78	-6.52	-4.88
α_y^m	-0.03	0.34	-0.05
α_o^m	-0.59	-0.87	-0.71
(D) Aging process			
Female			
Adults at	17.25	17.03	17.98
Old at	29.91	35.01	28.87
Male			
Adults at	19.51	17.65	18.45
Old at	34.12	37.68	28.93
(E) Love Vagaries			
(θ)	1.13	1.26	1.26
P_{HH}	1.00	1.00	1.00
P_{MH}	0.48	0.56	0.48
P_{HL}	0.18	0.18	0.18
P_{LL}	0.73	0.76	0.73
(F) Marriage cost	2.98	2.93	2.92
WSSE: E_i		0.028	
Measure of Fit: $1-(E_i/E_1)$		0.825	

- People from the 1930's liked a lot to be married with Adults
- Prime age (adulthood) was very long for them (especially for women)
- For the 30's generation adulthood lasts much longer
- For the 30's generation partner's outlook is better
- Divorce Costs came down slowly
- Much larger improvement of fit

Different Preferences: How Women are Perceived



Different Preferences: How Men are Perceived



Summary: How do we assess the findings?

- Marrying the right person is valuable.
- Gains decrease with age but too young is not good
- Women are liked more, earlier, shorter, and more intensively
- But not by much (less than our prior based on biological notions)
- The generation that made the baby boom (not the boomers) was special: they were into each other more than the rest
- Stefania (Albanesi and Olivetti (2010)) links it to the reduction in maternal mortality

Conclusion

- We asked a question: Do preferences over spouses differ by sex?
- We really did not care about the answer (no vested interests in what the answer may be one way or another.
- We used theory and data to answer it.
- Data has enough variation to be informative
- It matters how to confront theory and data

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Appendices

- We didn't use an identity matrix, which tends to overemphasize targets that are larger in absolute value.

- We set the weight for each of marriage rates equal to 1, the one for each of divorce rates equal to 10, the one for each of age at first marriage equal to 10^{-2}, and the one for each of the fraction of the never-married by age 50 equal to 10. Our way of weighting takes into account the size of their absolute values as in Altonji and Segal (1996)

Different Divorce Cost (Third look)

		1870			1930			1950		
		Partner's Age								
	Age	Adolescent	Young	Old	Adolescent	Young	Old	Adolescent	Young	Old
Female	Adolescent	0.006	0.622	0.051	0.009	0.676	0.062	0.028	0.784	0.118
	Young	0.014	0.750	0.083	0.020	0.794	0.100	0.049	0.862	0.173
1*	Old	0.014	0.743	0.266	0.025	0.809	0.391	0.024	0.753	0.186
Male	Adolescent	0.000	0.905	0.014	0.000	0.931	0.020	0.000	0.900	0.050
	Young	0.000	0.935	0.015	0.000	0.956	0.019	0.000	0.962	0.068
	Old	0.000	0.977	0.096	0.001	0.985	0.153	0.000	0.909	0.130