What Accounts for the Increase in Single Households?

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Summary

- We document some important changes in family composition in the last 40 years.
- We construct and estimate a *m*odel that is consistent with family composition 40 years ago.
- We measure some changes in the structure of wages in the last 40 years that we treat as exogenous.
- We ask our model how would people react to the new wage structure, and how would be the equilibrium that ensues.
- We use those answers as a measurement of the contribution of changes in wages to changes in family composition.

The Data

Big increase in share of single (18–49) women	1974	2011
	20%	36

Larger increase among "non-college" women	1974	2011
Non College	19%	39%
College	24%	35%

	1973	2007
Marriage rate	.144	.074
Divorce rate	.026	.027

Also, large changes in wages	1974	2011	Δ
Men's Average Wages	1.39	1.49	7%
Gender Wage Gap	1.59	1.30	-18%
College Premium (Females)	1.53	1.73	13%
College Premium (Males)	1.42	1.71	20%

2011 wage structure is computed using the 1974 distribution.

The Model

- Agents differ in sex, age, and education/earnings potential.
- Agents search for partners and choose whether to be single or married, whether to have another child, and how much time and resources to invest in the children's education.
- Agents care about the utility of their consumption, and their love life as well as their children's.
- Agents live and age exponentially $i \in$, child, young adult, adult, retirement.
- Agents live in one (single) or two (married) adult households. Also,
  - Children are attached either to single females or to couples.
  - Utility is not transferable.
  - Women choose fertility unilaterally and have at most one child per period.
  - Parents do not know the sex of their children.
  - All the family ages together and investments only pay upon aging.
  - Fathers forget their children and hate instantaneously the children of others.
  - Divorce is free and there is no child support or alimony.

Formally, agents are indexed by $z = \{w, n, q, w^*, \eta, \epsilon\}$

1. Wage/Education/(Sub-age) type $w \in \{w_1^g, \cdots, w_4^g\}$. $\Gamma_{w,w}$

2. Number of children $n \in \{0, 1, \cdots\}$.

3. Whether married $q = 1$ or not $q = 0$.

4. Wage type of spouse (or prospective spouse) $w^* \in \{w_1^{*g}, \cdots, w_4^{*g}\}$, $\Gamma_{w,w}$

5. Permanent (Markovian) Fixture of Love $\eta \in \{\eta_1^g, \eta_2^g\}$, $\Gamma_{\eta,\eta'}$

6. Temporary Fixture of Love ϵ is $N(\mu^q, \sigma^q)$.

All variables except ϵ take finitely many values.

A period is subdivided in three subperiods,

1. People choose their marriage status. They get married or stay single or stay married or get divorced. Both of them have to want to be married in order for it to happen.
2. Women chooses how much effort to place to have an additional child or not to have it.
3. The investments decisions on children in terms of time and resources are made.

At the end of the period exogenous variables get updated (i.e. wages/age, love from the spouse if married, or from a date if single.

This timing has a very important advantage: it gets rid of the possibilities of disagreement between spouses on investment. No issue of bargaining or Pareto weights.

3. The investment stage of a single mother $q' = 0, \; n > 0$

$$\widehat{G}_f(z,0,n') = \max_{c,y,\ell>0} u_f\left(c,0,n',0\right) + \pi(w)\,\beta\, E\left\{V_f\left(w',0,n',w^{*\prime},\eta'\right)|w\right\}$$
$$+\left[1-\pi(w)\right]\beta\left\{\Omega_f(w,0,0) + b(n^{'})E\left\{V(\bar{z}')|y,\ell,n',x\right\}\right\}$$

S.t. $$c + y = \left(1 - \ell - \bar{h}\cdot n'\cdot w\right) w.$$

And where the conditional probabilities are given by

$$E\left\{V_f\left(w',0,n',w^{*\prime},\eta',\epsilon'\right)|w\right\} =$$
$$\int_{W\times W^{*}\times H\times E} V_f\left(w',0,n',w^{*\prime},\eta',\epsilon'\right)\ \frac{x_m(dw^{*\prime},0,0,.,.)}{x_m(.,0,0,.,.)}\ \gamma_\eta[d\eta']\ \Gamma_w[dw'|w]$$

3. Other household types investment choices.

- Single males choose nothing.

- Married couples differ in the fact that the male both consumes and provides income and that the love situation is different and marriage is likely to persist.

- However, married males and married females (and single females) agree in how much to invest. The results of the investment will not become state variables.

2. The fertility decision

- Fertility is stochastic, but females can engage in costly activities in term of utility to shape the probability of having a child

$$G_f(w,q,n,w^*,\eta,q') = \underset{e}{\text{argmax}}\{\widehat{G}_f(w,q,n,w^*,\eta,\epsilon,q',n)\ p(e) + \widehat{G}_f(w,q,n,w^*,\eta,\epsilon,q',n+1)\ [1-p(e)]\}$$

with solution $e^*(w,q,n,w^*,\eta,\epsilon,q')$.

1. The marriage decision

Given $G_g(z, q')$ agents choose whether to be married or to be single by evaluating,

$$\max \quad \{G_f(w, q, n, w^*, \eta, \epsilon, 0), G_m(w, q, n, w^*, \eta, \epsilon, 1)\}.$$
$$\max \quad \{G_m(w^*, q, n, w, \eta, \epsilon, 0), G_m(w^*, q, n, w, \eta, \epsilon, 1)\}.$$

It takes both to agree to marry, so

$$V_g(w, q, n, w^*, \eta, \epsilon) \equiv \begin{cases} G_g(z, 1), & \text{if } \begin{cases} G_f(z,1) > G_f(z,0) \\ \text{and} \\ G_m(z,1) > G_m(z,0) \end{cases} \\ \\ G_g(z, 0), & \text{otherwise.} \end{cases}$$

Solving this problems amounts to finding the thresholds ϵ_m and ϵ_f of indifference. Outcome is $q'_g(z)$.

Population Dynamics

- Repeated substitution yield $\{y_g(z), c_g(z), \ell_g(z)\}$.

- Note that decision rules and shocks processes can be used to update the distribution of agents types $x' = F(x|y_g, c_g, \ell_g, \Gamma)$

- Implicitly we have imposed Rational expectations since agents need to know the distribution to know who they can meet.

Stationary Equilibrium: the prediction of the model

A distribution $\{x_m, x_f\}$, (a description of the number of people of each possible type) as well as agents' choices and values $\{V_m, V_f\}$ are an equilibrium if

1. **Agents maximize** When the agents assume that the distribution of types is given by $\{x_m, x_f\}$ and is constant over time, then their decisions solve their maximization problem, and their values are given by $\{V_m, V_f\}$. *This is important because for agents to choose an option (stay, go) they have to have an idea of who else can they meet.*

2. **The distribution is stationary** If today's state is $\{x_m, x_f\}$, then the optimal decisions of households and the evolution of the shocks generate $\{x_m, x_f\}$ as the state of the economy tomorrow.

Recall the Plan

1. Calibrate a baseline model economy to match the 1974 statistics.

2. Then we change wages to match the changes observed in the data in this order:
   - Level of wages
   - Sex wage premium alone
   - Male wage premium alone
   - Female wage premium alone
   - All changes

3. Compare the recent data with the model statistics obtained from the new equilibrium allocations.

Thresholds ϵ_m and ϵ_f

$$\epsilon_f^*(w_f, n, q, w_m, \eta_f) = G^f(w_f, n, q = 0, w_m, \eta_f) - G^f(w_f, n, q = 1, w_m, \eta_f)$$

The probability of marriage is then

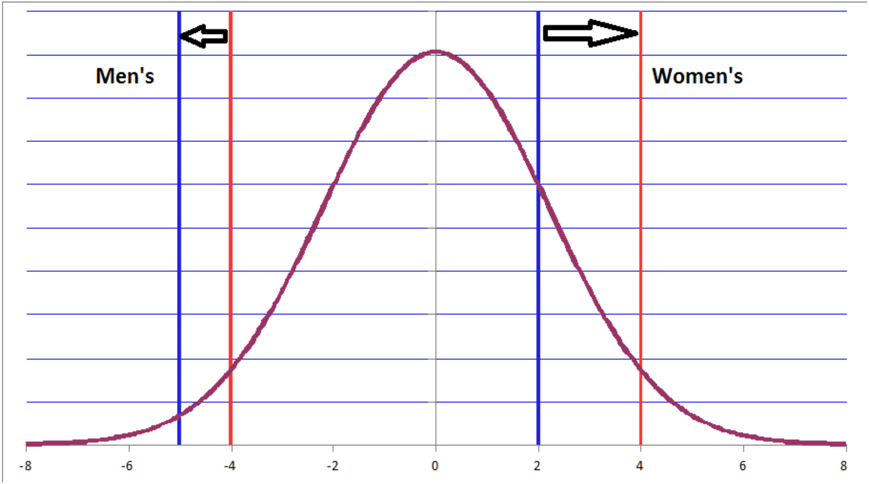
$$p[q = 1|\epsilon_f^*, \epsilon_m^*] = (1 - F(\epsilon_f^*)) \cdot (1 - F(\epsilon_m^*))$$

The cutoff rules have the following properties:

1. $\epsilon_f^*(w_f, n, q, w_m, \eta_f)$ is increasing in w_f, i.e. the gains from marriage decrease as w_f increases.
2. $\epsilon_f^*(w_f, n, q, w_m, \eta_f)$ is decreasing in w_m.
3. $\epsilon_m^*(w_f, n, q, w_m, \eta_f)$ is increasing in w_m
4. $\epsilon_m^*(w_f, n, q, w_m, \eta_f)$ is decreasing in w_f.

1 and 4 imply $p[q = 1|\epsilon_f^*, \epsilon_m^*]$ may rise or fall when wages change.

Thresholds ϵ_m and ϵ_f



Source of Identification

- College women are more likely to be single than college men in 1974.
- Non college women are more likely to be married than non-college men in 1974.
- The "quality" of single women is higher than married women, the opposite is true for men.

		Women	Men
relative (married/single) mean income	(18-29 yrs)	0.82	1.37
	(30-49 yrs)	0.81	1.36

Estimation procedure

- Find the set of parameters that induce the stationary equilibrium of the model to have the same statistics as the data.
- Minimum distance via global search (calibration or indirect estimation). Perhaps over-identified.
- Enormous non-linear problem. We have 32 parameters of which 20 have to be obtained by solving and estimation the model. The others are independent of the model's equilibrium.

Fixed Parameters

- Demographics:
  - π: average life is 32 periods
  - $\Gamma_{w,w'}$: ages are 18-29, 30-49
- Wages:
  - 8 wages: 2 sexes, ages and education levels (PSID)

Fixed Parameters

- Preferences: $u_f(c, q, n, \eta) = \frac{\left[\frac{c}{1+\phi_1 n+\phi_2 q}\right]^{1-\sigma}}{1-\sigma} + [\eta^f + \epsilon] \cdot q$
  - CRRA: $\sigma = 2.0$
  - Discounting: $\beta = .96$
  - Temporary Love: $\mu_\epsilon = 0$
  - Economies of Scale: $\phi_1 = 0.5$, $\phi_2 = 0.7$ (OECD)

Calibrated Parameters (20)

- Fertility:
  - $Prob.[n' = n|age]$ $(\kappa_{yng}, \kappa_{old})$: $p_{age}(e) = \frac{\exp(e)}{\exp(e)+\kappa_{age}\exp(-e)}$
  - Time Cost $(\bar{h})$
- Wages:
  - Education Tech $(\gamma_1, \gamma_2, \mu, \rho_m)$:
    $\bar{P}_g(w'|y,\ell) = \left[\exp\left(\gamma_1 (\ell)^{\mu} + \gamma_2 \left(\frac{y}{n}\right)^{\mu} + \rho_g\right)\right]^{-1}$, prob. that the child will be non-college; does not depend on education of parents and $\rho_f = 0$.
- Preferences: $u_f(c,q,n,\eta) = \frac{\left[\frac{c}{1+\phi_1 n+\phi_2 q}\right]^{1-\sigma}}{1-\sigma} + [\eta^f + \epsilon] \cdot q$
  - Match Quality: Approx. an AR(1) with common persistence, $\rho < 1$
    - gender specific, $\mu_{\eta,g}, \sigma^2_{\eta,g}$
  - Temporary Love (σ_ϵ): $\epsilon \sim N(0, \sigma_\epsilon)$
  - Retirement (Ω)
  - Discounting $(\beta_c, \delta, \omega)$: $b(n) = \beta_c \cdot n^{1-\delta_{wf}}$ and ω is weight on college educated children.
  - Dis-utility of Step-Children (χ)
  - Utility Cost of Effort for Achieve Desired Fertility (ζ)

Estimation:

Demographics

-* indicates that the moment was not targeted in the estimation	Data	Model
Fraction of Single Women - Cond. on College	0.2381	0.2417
*Fraction of Single Women with kids - Cond. on College	0.0806	0.1156
*Fraction of Single Women w/o kids - Cond. on College	0.1575	0.1274
Fraction of Single Women - Cond. on Non-Coll	0.1904	0.1853
*Fraction of Single Women with kids - Cond. on Non-Coll	0.1274	0.0878
*Fraction of Single Women w/o kids - Cond. on Non-Coll	0.0630	0.0979
Fraction of Women without Kids	0.2960	0.2250
*Fraction of Women w/o kids - Cond. on College	0.4689	0.2311
*Fraction of Women w/o kids - Cond. on Non-Coll	0.2329	0.2224
Fraction of Single Mothers	0.1150	0.0954

	Data	Model
Marriage Rate	0.1442	0.2090
Average Age at 1st Marriage - Women	21.1000	21.5000
Divorce Rate	0.0276	0.0228
*Divorce Rate - College	0.0289	0.0268
*Divorce Rate - Non-College	0.0394	0.0214
*Divorce Rate - No Kids	0.0452	0.0298
*Divorce Rate - With Kids	0.0302	0.0216
Difference in Remarriage Probability		
- with and without kids	0.0781	0.0437

Estimation:

Marriage Sorting

	Data	Model
Fraction of Married College Women Married to College Men	0.743	0.560
Fraction of Married Non-Col Women Married to Non-Col Men	0.771	0.557

Fertility

	Data	Model
Average # Children per Mother - College	2.1963	2.1598
Average # Children per Mother - Non-College	2.4448	2.3942
Average # Children per Woman - Single	1.4675	1.4346
Average # Children per Woman - Married	1.9045	1.8842
Birth Rate of Women Aged 18-29 years	0.1265	0.0844
Birth Rate of Women Aged 30-49 years	0.0272	0.0399

Education

	Data	Model
Fraction of College Men	0.3850	0.4655
Fraction of College Women	0.2730	0.2857
Relative Hours Worked of Women - $[\frac{kids}{nokids}]$	0.6895	0.7060
Relative Hours Worked of Mothers - $[\frac{college}{non-college}]$	1.0806	1.0026
Relative Hours Worked of Non-College - $[\frac{\text{married to college}}{\text{married to non-college}}]$	0.7035	0.7415

All Changes

	Baseline	New	Model Change	74-11 Data
Females' college wage premium	1.531	1.733	13 %	13%
Males' college wage premium	1.419	1.699	20 %	20%
Gender wage gap	1.580	1.300	-18 %	-18%
Males absolute average wage	1.420	1.521	7 %	7%
Frac. of Single Women	0.2014	0.2520	25 %	77%
Frac. of Singles among College	0.2417	0.2913	21 %	46%
Frac. of Singles among Non-Coll	0.1853	0.2345	27 %	105%
Frac. of Single Mothers	0.0954	0.1110	16 %	27%
Frac. of Single Mothers among College	0.1146	0.1419	24 %	33%
Frac. of Single Mothers among Non-Coll	0.0877	0.0973	11 %	72%
Marriage rate	0.209	0.176	-16 %	-48%
Divorce rate	0.023	0.028	21 %	5%
Assortative mating				
Col married Females married to Col Men	0.560	0.619	10.5 %	2%
Non-Col married Females married to Non-Col Men	0.557	0.507	-9.0 %	-4%

Increase in all wages of 7%

	Baseline	New	Model Change	74-11 Data
Males absolute average wage	1.420	1.523	7 %	7%
Frac. of Single Women	0.2014	0.2031	1 %	77%
Frac. of Singles among College	0.2417	0.2480	3 %	46%
Frac. of Singles among Non-Coll	0.1853	0.1826	-2 %	105%
Frac. of Single Mothers	0.0954	0.0925	-3 %	27%
Frac. of Single Mothers among College	0.1146	0.1180	3 %	33%
Frac. of Single Mothers among Non-Coll	0.0877	0.0808	-8 %	72%
Marriage rate	0.209	0.216	4 %	-48%
Divorce rate	0.023	0.024	4 %	5%
Assortative mating				
Col married Females married to Col Men	0.560	0.592	6 %	2%
Non-Col married Females married to Non-Col Men	0.557	0.544	-2 %	-4%

Decrease in the gender gap of 18%

	Baseline	New	Model Change	74-11 Data
Gender wage gap	1.580	1.290	-18.3 %	-18%
Frac. of Single Women	0.2014	0.2094	4 %	77%
Frac. of Singles among College	0.2417	0.2744	14 %	46%
Frac. of Singles among Non-Coll	0.1853	0.1905	3 %	105%
Frac. of Single Mothers	0.0954	0.0928	-3 %	27%
Frac. of Single Mothers among College	0.1146	0.1308	14 %	33%
Frac. of Single Mothers among Non-Coll	0.0877	0.0818	-7 %	72%
Marriage rate	0.209	0.204	-3 %	-48%
Divorce rate	0.023	0.024	4 %	5%
Assortative mating				
Col married Females married to Col Men	0.560	0.581	4 %	2%
Non-Col married Females married to Non-Col Men	0.557	0.604	9 %	-4%

Increase in males' college premium of 20%

	Baseline	New	Model Change	74-11 Data
Males college wage premium	1.419	1.707	20.3 %	20%
Frac. of Single Women	0.2014	0.2149	7 %	77%
Frac. of Singles among College	0.2417	0.2715	12 %	46%
Frac. of Singles among Non-Coll	0.1853	0.1928	4 %	105%
Frac. of Single Mothers	0.0954	0.0930	-3 %	27%
Frac. of Single Mothers among College	0.1146	0.1257	10 %	33%
Frac. of Single Mothers among Non-Coll	0.0877	0.0801	-8 %	72%
Marriage rate	0.209	0.198	-5 %	-48%
Divorce rate	0.023	0.024	6 %	5%
Assortative mating				
Col married Females married to Col Men	0.560	0.611	9 %	2%
Non-Col married Females married to Non-Col Men	0.557	0.563	1 %	-4%

Increase in females' college premium of 13%

	Baseline	New	Model Change	74-11 Data
Females college wage premium	1.531	1.732	13 %	13%
Frac. of Single Women	0.2014	0.2060	3 %	77%
Frac. of Singles among College	0.2417	0.2598	8 %	46%
Frac. of Singles among Non-Coll	0.1853	0.1837	-1 %	105%
Frac. of Single Mothers	0.0954	0.0978	3 %	27%
Frac. of Single Mothers among College	0.1146	0.1274	11 %	33%
Frac. of Single Mothers among Non-Coll	0.0877	0.0856	3 %	72%
Marriage rate	0.209	0.201	-4 %	-48%
Divorce rate	0.023	0.022	-2 %	5%
Assortative mating				
Col married Females married to Col Men	0.560	0.613	10 %	2%
Non-Col married Females married to Non-Col Men	0.557	0.566	2 %	-4%

Let's summarize

- We have documented some large changes in how people organize their lives in the last 30 years. More singles, similar children. Differential patterns among educated and non educated.

- We have posed a model of simultaneous choice of marriage, fertility and education. We have mapped it to the data with as much discipline as we can think of. Still trouble with the extent to which uneducated females are single mothers.

- We ask how much of the changes in family arrangements can be traced to changes in wages. About two fifths. Mostly through wage increases (what Jeremy and partners claim) and the sex premia. The college premia does not matter for the number of singles and children.